ENGLISH CYCLOPÆDIA.

DEDICATED, BY PERMISSION, TO HER MAJESTY.

NATURAL HISTORY

OR

Second Division of "The English Cyclopædia,"

CONDUCTED BY

CHARLES KNIGHT.

VOLUME I.

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NOTICE.

SINCE the publication of the "NATURAL HISTORY" Division of the ENGLISH CYCLOPÆDIA, our knowledge of the laws which regulate the various phenomena of life has been largely increased. In the Supplement which is being prepared, the principal discoveries and the results of recent investigations—embracing the many facts which have accumulated, the hypotheses that have been started, and the various theories that have been established—will be carefully set forth, so far as they serve to illustrate the progress of this great department of Science.

In the current numbers of the Re-issue, a reference (*See* SUPPLEMENT) is made at the end of those articles to which it is intended to add further information.

NATURAL HISTORY.

VOLUME I.

AARD-VARK (*Orycteropus*, Geoffroy), in Zoology, a genus of animals belonging to the class *Mammalia*, and order *Edentata*.

The *Orycteropus* is now separated from the *Myrmecophaga*, or Ant-Eaters of Linnæus, with which it had been formerly associated. In its anatomical structure it bears a much closer relation to the armadillos than to any other quadrupeds, not even excepting the ant-eaters, with which it was formerly associated. Like these animals, the *Orycteropus* is provided with large and powerful claws, for digging up roots and insects, and for forming subterraneous burrows; and, like them, has neither incisors nor canine teeth. Its molar teeth, however, are altogether peculiar, both in form and structure, and have no resemblance to the teeth of any other known animal. Of these there are five large ones on each side (both in the upper and under jaws), which are always permanent; and a variable number of from one to three smaller ones, placed in front of the others, and apparently representing the false molars of ordinary quadrupeds. The first of the large molars is smaller than any of the other four, and of a cylindrical form, somewhat compressed or flattened on the sides; the second is rounder; the third and fourth are each composed of two similar cylinders, as it were, soldered together; and the last is a simple cylinder, like the first and second. Immediately in front of these are the small or false molars, which, falling annually, vary in number according to the individual. Properly speaking, the teeth of these animals are destitute of real roots, and are therefore, like the tusks of the elephant, and the incisors of the rodentia, capable of being indefinitely increased, by the deposit of new matter on the under extremity, to counterbalance the continual wear of the upper surface.

In the form of the extremities the *Orycteropus* resembles the armadillos still more nearly than in the nature of its dental system. The legs are remarkably short and stout; the feet plantigrade (that is to say, the animal walks upon the whole sole of the foot, as in man and the bear, instead of bringing the point of the toe only in contact with the ground, as may be observed in the dog, horse, &c.); and the toes, of which there are four on the fore feet and five on the hind, are armed with extremely large and powerful claws, flattened horizontally, and scooped or hollowed out on the under surface, so as to form a most efficient instrument for digging and burrowing beneath the surface of the earth. This process is still further facilitated by the oblique form of the anterior extremities, arising from the unequal length of the toes; the two interior being considerably longer than the others, and the whole diminishing gradually from the index (or toe corresponding with the fore-finger) outwards. In other parts of its anatomy the *Orycteropus* resembles both the armadillos and the ant-eaters, and particularly in the form and structure of the stomach and alimentary canal. The reader who is desirous of further information upon these subjects may consult Cuvier's 'Leçons d' Anatomie Comparée,' and his great work, 'Sur les Ossemens Fossiles,' from which the details here given are for the most part abridged.

The only species of this curious genus with which zoologists are at present acquainted is the Aard-Vark (*Orycteropus Capensis*). It is an animal extremely common in some parts of Southern Africa, though, from its nocturnal habits and extreme timidity, it is not so frequently seen as many others which are in reality scarcer. Its colonial name of aard-vark, or earth-pig, by which it is known among the Dutch inhabitants of the Cape of Good Hope, is derived as well from its habit of burrowing as from the general appearance which it bears, at first sight, to a small, short-legged pig. This animal, when full grown, measures about three feet five inches from the snout to the origin of the tail; the head is eleven inches long; the ears six inches; and the tail one foot nine inches. The head is long and attenuated; the upper jaw projects beyond the lower, and ends, as in the common hog, in a truncated callous snout, having the nostrils pierced in the end of it; the mouth is small for the size of the animal, and the tongue flat and slender, not cylindrical as in the true ant-eaters, nor capable of being protruded to such an extent as in these animals: it is, however,

Aard-Vark (*Orycteropus Capensis*).

covered in like manner with a glutinous saliva, which firmly retains the ants, upon which the animal lives, and prevents those which once come in contact with it from escaping afterwards. The ears are large, erect, and pointed; and the eyes, which are of moderate size, are situated between them and the snout, about two-thirds of the distance from the extremity of the latter. The body of the aard-vark is thick and corpulent; the limbs short and remarkably strong; the hide thick, tough, and nearly naked, having only a few stiff hairs, of a pale reddish-brown colour, thinly scattered over it, excepting on the hips and thighs, where they are more numerous than elsewhere. The tail is about half the length of the body and head together, and, like the body, is nearly naked; it is extremely thick and cylindrical at the base, but decreases gradually towards the extremity, and ends in a sharp point.

Thus formed, the aard-vark is in all respects admirably fitted for the station which nature has assigned to it in the grand economy of the animal kingdom. It feeds entirely upon ants, and in this respect fulfils the same purposes in Southern Africa which is executed by the *Pangolins* in Asia, the *Myrmecophaga* in America, and the *Echidna* in Australia.

These insects raise mounds of an elliptical figure, to the height of three or four feet above the surface of the ground; and so numerous are these gigantic ant-hills in some parts of Southern Africa, that they are frequently seen extending over the plains as far as the eye can reach, and so close together that the traveller's waggon can with difficulty pass between them. They abound more especially in the Zeurevelden, or sour districts, so called from producing a kind of sour grass; are seldom found on the karroos or downs, and never in very dry or woody districts. By constant exposure to the rays of a powerful tropical sun they become so hard and indurated on the outer surface that they easily support the weight of three or four men, and even a loaded waggon will sometimes pass over without crushing them. Internally these mounds are of a spongy structure, something resembling a honeycomb, and are so completely saturated with animal oil that they inflame without difficulty, and are an excellent substitute for wood or coal.

Wherever ant-hills abound the aard-vark is sure to be found at no great distance. He constructs a deep burrow in the immediate vicinity of his food, and changes his residence only after he has exhausted his resources. The facility with which he burrows beneath the surface of the earth is said to be almost inconceivable. We have already seen how admirably his feet and claws are adapted to this purpose; and travellers inform us that it is quite impracticable to dig him out, as he can in a few minutes bury himself at a depth far beyond the reach of his pursuers; and, further, that his strength is so great as to require the united efforts of two or three men to drag him from his hole. When fairly caught, however, he is by no means retentive of life, but is easily dispatched by a slight blow over the snout. The aard-vark is an extremely timid, harmless animal, seldom removes to any great distance from his burrow, being slow of foot and a bad runner, and is never by any chance found abroad during the day-time. On the approach of night he sallies forth in search of food, and, repairing to the nearest inhabited ant-hill, scratches a hole in the side of it just sufficient to admit his long snout. Here, after having previously ascertained that there is no danger of interruption, he lies down, and, inserting his long slender tongue into the breach, entraps the ants, which fly to defend their dwellings upon the first alarm, and, mounting upon the tongue of the aard-vark, get entangled in the glutinous saliva, and are swallowed by whole scores at a time. If uninterrupted, he continues this process till he has satisfied his appetite; but on the slightest alarm he makes a precipitate retreat, and seeks security at the bottom of his subterranean dwelling. Hence it is that these animals are seldom seen even in those parts of the country in which they are most numerous. Like other nocturnal animals, which pass the greater part of their lives in sleeping and eating, they become exceedingly fat, and their flesh is considered to be a wholesome and palatable food. The hind-quarters, particularly when cut into hams and dried, are held in great esteem.

AARD-WOLF (*Proteles*, Is. Geof.), in Zoology, a genus of digitigrade carnivorous mammals, founded by M. Isidore Geoffroy St. Hilaire, for the purpose of giving a place to a new and singular quadruped brought some years ago from Caffraria by the traveller Delalande. This genus is interesting to the zoologist, as forming the intermediate link which connects the civets with the dogs and hyænas—three genera which have hitherto stood, as it were, insulated from surrounding groups, and widely separated from one another. The dogs and hyænas, indeed, had been united a short time previous, by the discovery of an intermediate species in the same locality which has since produced the *Proteles;* but it is this latter species alone, which, uniting the characters of all these three genera, enables us to trace their natural affinities, and to assign to them their proper position in the scale of existence.

To the external appearance and osteological structure of an hyæna this truly singular animal unites the head and feet of a fox, and the intestines of a civet. Its teeth are remarkable: the permanent canines are tolerably large, but the molars are small, and separated by intervals. It has five toes on the fore feet, and four only on the hind; the innermost toe of the fore foot is placed, as in the dogs, at some distance above the others, and therefore never touches the ground when the animal stands or walks. The legs also are completely digitigrade; that is to say, the heel is elevated, and does not come into contact with the surface, as in man and other similarly formed animals, which walk upon the whole sole of the foot, and are thence said to be plantigrade. It is of great importance to remark the difference between these two modifications of the locomotive organs, because they have a very decided and extraordinary influence upon the habits and economy of animal life. Digitigrade animals, which tread only upon the toes, and carry the heel considerably elevated above the ground, have much longer legs than plantigrade animals, and are, therefore, especially fitted for leaping and running with great ease and rapidity. Accordingly, it will be observed that the horse, the stag, the antelope, the dog, and other animals remarkable for rapidity of course, partake strongly of this formation; and even their degree of swiftness is accurately measured by the comparative elevation of the heel. Inattentive observers sometimes misapprehend the nature of this peculiar conformation of the extremities of digitigrade animals, and are apt to confound the hough with the ankle, and to mistake for the knee what is really the heel of the animal. Thus we have heard it said that, in the hind legs of the horse, the knee was bent in a contrary direction to that of man. This is by no means true: a little attention to the succession of the different joints and articulations, will show that what is called the cannon-bone in the horse, and other digitigrade animals, in reality corresponds to the instep in man; and that what is generally mistaken for the knee really represents the heel.

In the particular case of the *Proteles* the natural effect of the digitigrade formation is, in some degree, lessened by the peculiar structure of the fore legs, which, contrary to the general rule observable in most other animals, are considerably longer than the hind. In this respect, also, the *Proteles* resembles the hyænas; and in both genera this singular disproportion between the anterior and posterior extremities abridges the velocity properly due to their digitigrade conformation. This genus contains but a single species.

Aard-Wolf (*Proteles Lalandii*).

The *Aard-Wolf*, or Earth-Wolf (*Proteles Lalandii*, Is. Geof.; *Viverra cristata*, Sparr.), is so called by the European colonists in the neighbourhood of Algoa Bay, in South Africa, the locality in which M. Delalande procured his specimens of this animal. The size of the aard-wolf is about that of a full-grown fox, which it further resembles in its pointed muzzle; but it stands higher upon its legs, its ears are considerably larger and more naked, and its tail shorter and not so bushy. At first sight it might be easily mistaken for a young striped hyæna, so closely does it resemble that animal in the colours and peculiar markings of its fur, and in the mane of long stiff hair which runs along the neck and back; indeed, it is only to be distinguished by its more pointed head, and by the additional fifth toe of the fore feet. The fur is of a woolly texture on the sides and belly, but a mane of coarse stiff hair, six or seven inches in length, passes along the nape of the neck and back, from the occiput to the origin of the tail, and is capable of being erected or bristled up, like that of the hyæna, when the animal is irritated or provoked. The general colour of the fur is pale cinereous (ash-coloured), with a slight shade of yellowish brown; the muzzle is black and almost naked, or covered only with a few long stiff moustaches. Around the eyes, and on each side of the neck, are dark brown marks; eight or ten bands of the same colour pass over the body in a transverse direction, exactly as in the common striped hyæna; and the arms and thighs are likewise marked with similar transverse stripes. The legs and feet are of an uniform dark brown in front, and gray behind. The long hairs of the mane are gray, with two broad rings of black, the second of which occupies the point; those of the tail are similarly marked, and equally long and stiff; whence it appears as if the mane and tail were clouded with an alternate mixture of black and gray. The ears are gray on the interior surface, and dark brown on the outer.

In its habits and manners the aard-wolf resembles the fox: like that animal, it is nocturnal, and constructs a subterraneous burrow, at the bottom of which it lies concealed during the daytime, and only ventures abroad on the approach of night, to search for food and satisfy the other calls of nature. It is fond of the society of its own species; at least, many individuals have been found residing together in the same burrow; and, as they are of a timid and wary character, they have generally three or four different entrances to their holes; so that, if attacked on one side, they may secure a retreat in an opposite direction. Notwithstanding the disproportionate length of their fore legs, they are said to run very fast; and so strong is their propensity to burrow, that one of M. Delalande's specimens, perceiving itself about to be run down and captured, immediately ceased its flight, and began to scratch up the ground, as if with the intention of making a new earth.

M. Isidore Geoffroy St. Hilaire has bestowed upon this species the name of *Proteles Lalandii*, but Sparrman and Levaillant mentioned the aard-wolf long before the date of M. Delalande's journey; and the former has not only described it with tolerable accuracy, but has even ascertained its true generic characters. (Sparrman's 'Travels,' vol. ii., p. 177.)

In the 'Second Voyage' of Levaillant, vol. ii., p. 360, mention is likewise made of this animal under the appellation of 'Loup de Terre, which is a simple translation of its colonial name, aard-wolf.

Sparrman mentions having found ants in the stomach of the *Proteles*, and these insects, it may be observed, are also a favourite food of the bear.

ABDOMEN, the *Belly*, from *abdo*, to hide, because it conceals or hides its contents. The last syllable is only a termination. The *Lower Belly, Imus Venter, Alvus, Gaster*, &c. &c., are synonymous.

The human body is divided by anatomists into three portions—the head, the trunk, and the extremities. The head and trunk enclose cavities which contain the organs or the instruments by which the most important functions of the living body are performed. The trunk forms two cavities, the superior of which is termed the Thorax or Chest, and the lower constitutes the Abdomen.

In the artificial skeleton nothing is shown, because nothing remains except the mere framework of the body, or the bones; but in the natural state, when the soft parts remain as well as the bones, there is a complete partition between the cavity of the chest and that of the abdomen (*fig.* I., 1, 2). This partition is effected by means of an organ which is termed the Diaphragm (*fig.* I., 1, 2), a name derived from a Greek word signifying to divide. The diaphragm is composed partly of membrane, but chiefly of muscle (*Fig.* II.) It is placed transversely across the trunk at about its middle portion, dividing it into two pretty nearly equal halves (*Fig.* I.) But the diaphragm is a moveable body; it is, in fact, one of the main organs of respiration: its chief function consists in alternately increasing and diminishing the capacity of the thorax and abdomen, for the purpose of respiration. But since the very partition which separates these two cavities from each other is perpetually changing its relative position—now encroaching upon the one, and now upon the other—it is obvious that their natural capacity must be constantly varying.

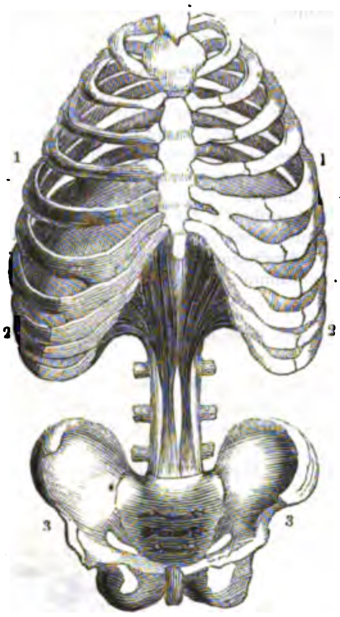


Fig. I.

The cavity of the abdomen is bounded above by the diaphragm (*Fig.* I., 1, 2), below by the bones of the Pelvis or basin (*Fig.* I., 3, 3), which may be considered as belonging to the bones of the lower extremities, before and at the sides by the abdominal muscles, behind partly by the muscles of the loins, and partly by the bone of the spine. The Spine is composed of a number of separate bones, each of which is termed a Vertebra. The vertebræ are firmly united together, and by their union form what is commonly called the back-bone, termed by anatomists the Spinal Column, or the Vertebral Column.

The cavity of the abdomen is lined throughout by a thin, but dense, firm, and strong membrane, termed the Peritoneum, from a Greek word signifying to extend around.

We have thus spoken of the abdomen as a cavity, but without explanation this mode of expression may occasion misconception. During the state of life there is no cavity. The abdomen is always completely full. It has been stated that the diaphragm alternately enlarges and diminishes the space proper to the abdomen; but the abdominal and lumbar muscles, which form so large a part of the boundaries of the abdomen in front, at the sides and behind, in like manner, alternately contract and relax. The consequence is, that a firm and uniform pressure is at all times maintained upon the whole contents of the abdomen, so that there is always the most exact adaptation of the containing to the contained parts, and of the viscera one to the other, not the slightest space or cavity ever intervening, either between the walls of the abdomen and its viscera, or between one viscus and another. By the cavity of the abdomen, therefore, is not meant what the expression might at first view seem to denote, namely, a void or empty space; but the term is merely employed to mark the extent of the boundary within which the abdominal viscera are enclosed.

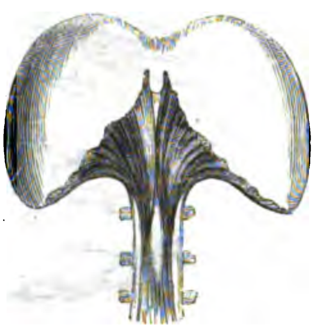


Fig. II.—Diaphragm, removed from its natural situation between the Chest and Abdomen.

The abdomen, for practical purposes, is artificially mapped out into the following regions.

Two imaginary lines are drawn across the abdomen, one of which is supposed to extend from about the seventh rib on one side to the same point on the opposite side (*Fig.* III., 1, 1). The second line is supposed to extend from the fore part of the large bone of the pelvis to the same projecting point on the other side (2, 2). These lines mark out three large and distinct spaces (3, 4, 5). The space above the upper line is termed the Epigastric Region (3). The space below the lower line is termed the Hypogastric Region (5). The space included between the two lines is termed the Umbilical Region (4).

Two lines are next supposed to extend vertically, one on each side, from between the seventh rib to the prominence formed by the large bone of the pelvis (*Fig.* III., 6, 6). By these vertical lines the three first regions are still further subdivided in the following manner:—The right and left parts of the Epigastric Region form two distinct regions (7, 7); these are termed the right and left Hypochondriac Regions (7, 7); while the central part retains the name of the Epigastric Region (3). In like manner the right and left parts of the Umbilical Region form two distinct regions (8, 8), which are termed the Lumbar Regions (8, 8), while the central part retains the name of the Umbilical Region (4). Moreover, the right and left parts of the Hypogastric Region are at the same time each divided into two, which are termed the Iliac Regions (9, 9), while the central part is termed the Region of the Pubis (5).

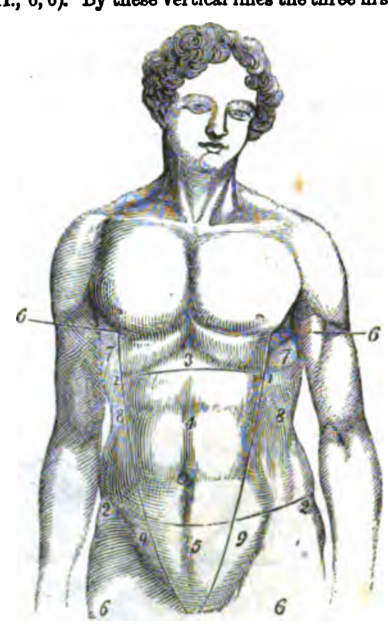
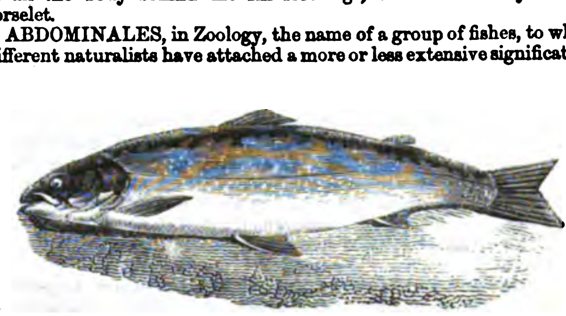


Fig III.

The term *Abdomen*, as applied by entomologists to Insects, has a somewhat different signification from the same term when applied to other animals, being used for the whole portion of the body of an insect behind the corselet (*thorax*), and including the back as well as the belly. It consists, in most cases, of a number of rings without any jointed members for locomotion, and uniformly encloses a portion of the intestines, though sometimes but a very small one. These rings, or very short hollow cylinders, are severally united with each other by a joint, by a membrane, or sometimes by an intimate junction, the exact line of which is not very apparent. The rings in some cases, as in the grub of the chameleon-fly, slide into one another like the tubes of an opera-glass. Each ring is technically termed a segment (*segmentum*), virtually composed of two principal pieces, which, when distinct, are termed arches; the upper the arch of the back, the under the arch of the belly. In some cases these two portions are not distinct, but, when they are so, the two borders usually come into contact. When they do not, but remain free, one usually, more or less overlaps the other, as in bees. In caterpillars, grubs, and wingless insects, such as the flea, where the joining of the corselet with the abdomen is not apparent, the abdomen may always be known by the legs never being jointed with it; and in caterpillars it usually consists of all the body behind the six fore legs, which are always on the corselet.

ABDOMINALES, in Zoology, the name of a group of fishes, to which different naturalists have attached a more or less extensive signification,



Salmon, given as a specimen of the family of Abdominales.

according to the particular principles of their several systems. The classification of fishes given by Linnæus is founded upon the presence and position of the ventral fins (those of the belly) in relation to the pectoral (those of the breast); and these he regards as analogous to the fore and hind members of quadrupeds, and to the wings and feet of birds. Linnæus includes, in his order *Abdominales*, all those species which have the ventral fins placed behind the pectoral, or upon the abdomen, the cartilaginous fishes alone excepted; which, after the example of Ray, Willoughby, and Artedi, he very properly considers as forming an order apart. This arrangement is not now generally adopted, but the term *Abdominales* denotes a family, or subdivision, of malacopterygious (or soft-finned) fishes, only; and, in this restricted sense, includes the greater number of the fresh-water species, as well as those which, like the salmon, periodically migrate from the ocean to deposit their spawn in fresh-water lakes and rivers. M. Cuvier subdivides this family into five subordinate groups, all of which he has defined by appropriate and unequivocal characters. He denominates these sub-families, *Cyprinoïdes*, *Siluroïdes*, *Salmonoïdes*, *Clupeoïdes*, and *Lucioïdes* respectively, from the carps, silures, salmons, herrings, and pikes, the typical genera from which their characters are severally taken.

ABELE TREE, in Botany, the English name of the *Populus alba*. [POPULUS.]

ABELMOSCHUS, in Botany, a genus of the Mallow tribe, usually referred to *Hibiscus*. [HIBISCUS.]

ABERDEVINE (*Carduelis spinus*, Cuvier; *Fringilla ligurina*, Ranzani), sometimes called the Siskin, a well-known song-bird, which has some resemblance to the green variety of the canary-bird, but there is considerable difference in individual birds with respect to the brightness of colouring. The colours of the male in full plumage are as follows: top of the head, black; ear coverts,

Aberdevine, or Siskin (*Carduelis spinus*).

dusky; a line above the eyes; sides of neck, throat, and chest, lemon yellow; back and shoulders, dark olive green, with obscure dusky dashes; quills, brown, with an oblique yellow bar and another above, produced by the yellow edging of the greater coverts; flanks, dusky, with a few brown dashes; rump, yellow, slightly washed with green; two middle tail feathers, dark brown, the rest yellow, tipped with brown; bill and legs, brown colour. Length, 4¾ inches. Tail, short and forked. The plumage of the female is less bright and decidedly marked.

Sepp has delineated the nest of the aberdevine in the cleft of an oak, built with dry bent mixed with leaves, and profusely lined with feathers; the base neatly rounded, and the feathers projecting above the rim, and concealing the eggs, which are blueish-white, speckled with purplish red, like those of the goldfinch. Temminck, again, says it builds in the highest branches of the pine.

It breeds in the north of Europe, and only visits Britain, Germany, and France in the autumn and winter. It is represented in some books as very irregular in its migration, particularly to this country; but we suspect that this opinion has arisen from irregular observation, for, since our attention has been directed to the subject, we have remarked its arrival about Lee, in Kent, to be almost as regular as the departure of the swallows, which takes place about the same time. During its winter stay with us, the aberdevine feeds chiefly on the seeds of the birch and alder.

As a cage-bird it is frequently paired with the canary, to produce what are termed mule-birds; but it is, besides, a lively and persevering songster.

ABIES, in Botany (the *Fir*), a genus of trees of the Coniferous tribe, well-known for the valuable timber which is produced by many of the species. It was formerly considered a part of the genus *Pinus*; but modern botanists have made it a distinct genus. The English appellation is the Saxon *furh-wudu*, fir-wood.

Generic Character.

Flowers monœcious.

Males. Catkins simple, solitary, terminal, or axillary. Stamens obtuse, and often callous at the apex, terminated by a jagged membrane.

Females. Catkins somewhat cylindrical; their scales two-flowered, imbricated, and having frequently at their base externally a bractea, which is either very short or lengthened beyond the scales themselves, and terminated by a taper point.

Cones more or less cylindrical; the scales imbricated and woody, but not thickened at the extremity; seeds ending in a membranous wing.

Embryo about the length of the seed, with several closely-packed cotyledons.

Trees of various sizes, usually with a straight, conical, undivided trunk, from which proceed spreading, horizontal, or drooping branches, arranged in a pyramidal manner. Leaves either solitary, or collected in little fascicles, deciduous or evergreen.

From *Pinus* (the Pine-Tree) *Abies* (the Fir-Tree) is obviously distinguished by its more pyramidal form, and by its leaves arising singly from around the stem, not by twos or threes, or a greater number, from out of a membranous shrivelling sheath, as well as by the characters in the fructification above described. Its species form four very natural tribes, of the first of which, the *Silver Fir* may be taken as the representative; of the second, the *Norway Spruce*; of the third, the *Larch*; and of the fourth, the *Cedar of Lebanon*. As most of these are interesting, either for the excellence of their wood or as objects of ornament, we shall briefly notice those that are at present best known. Those who wish for further information should consult Mr. Lambert's 'Monograph of the Genus Pinus,' L. C. Richard's 'Mémoire sur les Conifères,' Michaux's 'Histoire des Arbres Forestiers de l'Amérique Septentrionale,' Loudon's 'Arboretum et Fruticetum Britannicum.'

SECT. I.—SILVER FIRS.

Leaves growing singly round the branches, and all turned towards one side.

Abies Picea, the Silver Fir (*Abies pectinata*, De Candolle; *Pinus Picea*, Linnæus). Leaves arranged like the teeth of a comb, somewhat emarginate, of a whitish colour underneath. Cones erect, with very blunt closely-pressed scales, which are much shorter than the taper-pointed inflexed bracts. It is a native of the mountains of

Silver Fir (*Abies Picea*).

the middle and south of Europe, in stony, dry, exposed situations. Its favourite district seems to be on the Pollino and in the forest of Rubia, in the kingdom of Naples, where it is found in all its grandeur, often growing from 130 to 150 feet in height, and richly meriting the name *pulcherrima* (most beautiful), applied to it by Virgil. This tree is readily known by its leaves having their points all turned towards the sky, and being mealy underneath, as well as by its long, erect, stalkless cones, of a greenish-purple colour, bristling with reflexed taper points of the bracts that subtend the scales. It is the *Sapin* of the French. Planks of indifferent quality, on account of their softness, are sawn from its trunk, which also yields Burgundy pitch and Strasburg turpentine. For its successful cultivation in this country it requires strong land, such as will suit the oak, and a sheltered situation; it will then become a very large tree. From a communication to Mr. Lambert, it appears that trees have been felled which, at 100 years of age, contained six loads, or 240 cubic feet, of timber. It is said by some to grow slowly for the first fifteen years, but afterwards with great rapidity. A plant in Woburn Park is recorded to have grown for 110 years at the rate of one foot in height and nearly three and a half cubic feet per annum. Its trunk sometimes arrives at 150 feet in height, and six feet in diameter.

Antiquarians, not considering that this plant is the real *Abies pulcherrima* of Virgil, and of the Roman authors, have lost themselves in vain attempts to reconcile the declaration of Cæsar ('De Bel. Gal.,' v. 12), that he found in Britain all the trees of Gaul, except the beech and abies, with the well-known fact that fir-wood is abundant in our ancient mosses, and has been met with even beneath the foundations of Roman roads. What Cæsar meant was, no doubt, that he did not meet with the silver fir in Britain. Of the pine he says nothing, and therefore it is to be presumed that he found it.

Abies Sibirica, the Siberian Silver Fir (*Pinus Sibirica* and *Pinus Pichta* of the gardens). Scarcely anything certain has been published of this tree, which, according to Linnæus, Mr. Lambert, and others, is the same as the *Abies picea*. Gmelin describes it as a native of all parts of Siberia as far as 58° N. lat. in mountainous regions, especially in the upper country lying between the Irtish and the Ob, where it forms dense woods.

Abies grandis, Great Californian Fir (*Pinus grandis*, Douglas and Lambert). Leaves long, narrow, very blunt, whitish beneath, all turned one way. Cones oblong, erect, rather curved, with very broad, uneven, downy scales, which are longer than the bracteæ. Found, by Mr. Douglas, in low moist valleys in northern California, where it attains the height of 200 feet. The wood is soft, white, and of inferior quality. Cones from three to four inches long; bracts very short, jagged, two-lobed, with a short intermediate point.

Abies balsamea, the Balm of Gilead Fir (*Abies balsamifera*, Michaux; *Pinus balsamea*, Lambert). Leaves flat, silvery-white beneath, either emarginate or entire at the point, all curved towards the upper side. Cones cylindrical, oblong, erect, purple, with rounded, even, undivided scales. Found, along with *Abies nigra* and *Abies alba*, in the coldest parts of North America, but always in detached individuals, never in large masses. It extends also along the ridge of the Alleghanies as far as the crests of the mountains of North Carolina. It forms a small slender tree, rarely more than 40 feet high, with a diameter of from 12 to 15 inches. The cones are four to five inches long, and about an inch in diameter. Its wood is light, of a pale yellow colour, and but slightly resinous; it is of little value, and is chiefly split up into staves for fish-barrels. The English name has been given in consequence of a resemblance between the clear transparent greenish-yellow turpentine, which is obtained from numerous cysts in its bark, and the Balm of Gilead of the shops. The turpentine is commonly known under the name of Canadian Balsam. In England this is a small tree of very ornamental appearance when young, on the skirts of plantations, but it rarely acquires any considerable size.

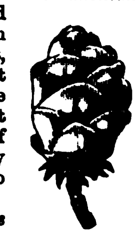
Abies nobilis, Large-Bracted Fir (*Pinus nobilis*, Douglas and Lambert). Leaves very numerous, falcate, all turned one way, of nearly the same colour on both sides. Cones oblong, erect, with rounded broad scales concealed by the long wedge-shaped two-lobed jagged scales, which are bent back, and terminate abruptly in a rigid elongated point. It is a majestic tree, forming vast forests upon the mountains of northern California, where it was found by Mr. Douglas. The timber is said to be of excellent quality. The cones are about six inches long.

Abies Frazeri, the Double Balsam Fir (*Pinus Frazeri*, Pursh and Lambert). Leaves linear, emarginate, silvery-white beneath. Cones oblong, squarrose. Bracts somewhat leafy, inversely cordate, mucronate, reflexed. A native of the mountains of Carolina and Pennsylvania.

Abies Webbiana, Webb's Fir (*Pinus Webbiana*, Wallich and Lambert; *Pinus spectabilis*, Lambert). Leaves linear, solitary, flat, all-spreading, and turned one way, silvery-white beneath, with a deep notch at the extremity. Cones oblong, erect, obtuse, with very broad, rounded, even scales. According to the account of Captain Webb, who first discovered it, this remarkable species attains the height of 80 or 90 feet, with a diameter near the ground of 3 or 4 feet. Its wood seems to be valuable. From what has been reported of its general appearance, it is probably one of the most interesting species that has yet been discovered. Inhabiting the colder regions of northern India, and found among plants which are more Siberian in their character than Indian, there can be no reasonable doubt of its being well able to withstand the rigour of the winters of this country.

Abies Canadensis, the Hemlock Spruce Fir (Michaux; *Pinus Canadensis*, Lambert). Leaves flat, arranged irregularly in two rows; when young downy, as well as the young slender branches. Cones very small, ovate, sharp-pointed, with rather acute, even, entire scales: seeds very small.—The most northerly situation in which this tree is found is about Hudson's Bay, in lat. 51°. Near Quebec it forms extensive forests; in Nova Scotia, New Brunswick, Vermont, and the upper part of New Hampshire, it is extremely common; but in the middle and southern states of North America it is confined to the Alleghanies and their dependent ridges, where it inhabits the sides of torrents and the bleakest situations. It is a noble species, rising to the height of 70 or 80 feet, and measuring from 2 to 3 feet in diameter. It appears to be of slow growth, not arriving at its full dimensions in less than 200 years. When from 25 to 30 feet high its form is exceedingly elegant, but when old its huge limbs are apt to be rent and broken by winds and snow; and their naked stumps, sticking out beyond the young and verdant foliage, give the trees an air of decrepitude and decay. The wood is of little value, being neither sound nor durable. The bark is valuable for tanning; mixed with oak-bark, it is said to be much better than oak-bark alone.

Abies Brunoniana, the Deciduous Silver Fir (*Pinus Brunoniana*, Wallich; *P. dumosa*, Lambert). Leaves flat, all turned one way, serrulate towards the points, covered beneath with a milk-white bloom. Cones terminal, erect, ovate, blunt, very small, with lax, ovate, very blunt scales.—Found in the northern parts of India in the provinces of Nepaul, Bootan, and Gossain Than. It is a tree 70 or 80 feet high, with a clear trunk of from 15 to 20 feet, and a spreading very branchy head. The wood is of bad quality, being liable to warp.



Cone of *A. Brunoniana*.

Abies religiosa, the Sacred Mexican Fir (*Pinus religiosa*, Humboldt and Kunth). Young branches quite smooth. Leaves arranged in two rows, sharp-pointed, covered beneath with a glaucous bloom. Found by Humboldt, on the lower hills of Mexico, at an elevation of 4000 feet. Deppe and Schiede found it upon the cold mountains of Orizaba, at the highest limit of arborescent vegetation. It is described as a lofty tree, resembling *Abies picea* and *Abies balsamea*, from which it is distinguished by its sharp-pointed leaves. The flowers are unknown. The branches are used for adorning the churches in Mexico. According to Mr. Lambert, the cones are like those of the cedar of Lebanon, but smaller, and almost black.

Abies hirtella, the Hairy Fir (*Pinus hirtella*, Humboldt and Kunth). Young branches covered with hairs. Leaves arranged in two rows, flat, acute, covered with glaucous bloom beneath. Known only from the incomplete account of Humboldt, who found it on the mountains of Mexico, growing at an elevation of between 8000 and 9000 feet. He describes it as a small tree, three or four times as high as a man.

Abies Smithiana, the Indian Silver Fir (*Pinus Smithiana*, Wallich). Leaves slender, four-cornered, whitish beneath, a little turned towards one side, dark green, from one inch to one and a half long. Cones from four to six inches in length, erect, ovate-oblong, with obovate, rounded, even scales. A native of the slopes of the Himalaya Mountains. It is a tree of enormous size, with nearly opposite branches, covered with short down, and so arranged as to form generally two rows.

Sect. II.—Spruce Firs.

Leaves growing singly round the branches, and all spreading equally.

Abies excelsa, the Norway Spruce Fir (De Candolle; *Pinus abies*, Linnæus). Leaves scattered, somewhat four-cornered, mucronate. Cones cylindrical, pendulous, with blunt, wavy, slightly-toothed scales. It is a native of the mountainous parts of the north of Europe, where it sometimes constitutes, as in Norway, the principal timber. It is found all over Siberia as high as 70° N. lat., in which region it is a certain sign of the presence of springs of fresh water, for it is only seen in moist and springy places. When growing singly in rich soil, separated from other trees, this forms one of the most beautiful objects that can be imagined, with its long drooping branches touching the very ground, and its regularly pyramidal figure: but in other situations, in plantations where the trees are crowded and deprived of their lower branches by want of light and air, it becomes, after nine or ten years, an inelegant plant of little value except to be cut for poles. When in perfection (and occasionally it arrives at its greatest perfection in this country), it acquires a stature of 150 feet. Its wood is of a white colour, of a fine even

Cone of the Indian Silver Fir.

grain, and very durable: in the market it is known under the name of White Deal or Christiania Deal. In Norway it arrives at maturity in 70 or 80 years. Trees of such an age are what are usually cut down for exportation, and each yields on an average three pieces of

Norway Spruce Fir (*Abies excelsa*).

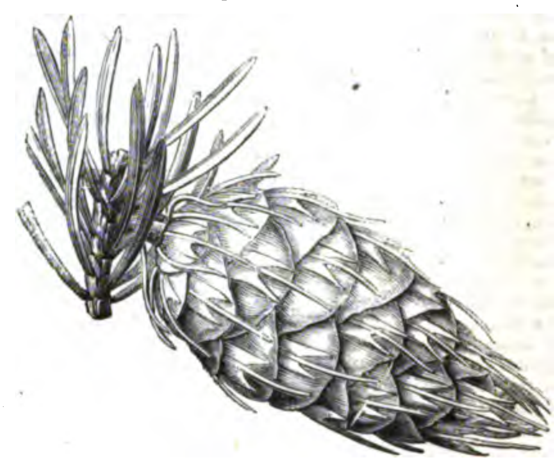
timber, eleven or twelve feet long. The Spruce is readily known by its leaves of one uniform dull green colour, spread equally round the branches, and by its long pendant cones.

Abies orientalis, the Oriental Fir (*Pinus orientalis*, Linnæus and Lambert). Leaves very short, uniformly imbricated, quadrangular, with a callous point. Cones ovate, cylindrical, pendulous, their scales somewhat rhomboid. To botanists this is known chiefly by a figure published by Mr. Lambert after a drawing by Aubriet, the draughtsman who accompanied Tournefort in his journey to the Levant. It was found by that traveller in the mountains south-east of Trebisond, above the convent of St. John. It has been subsequently met with by Russian botanists in the woods of Mingrelia, and was seen near Teflis by Sir Gore Ouseley; but little has been added to our knowledge of the species. The young branches are said to be hairy. The leaves are very short and dense. The cones are small and pendulous, of an ovate, tapering figure.

Abies alba, the White Spruce Fir (Michaux; *Pinus alba*, Lambert). Leaves rather glaucous, spreading equally round the branches, four-cornered, somewhat pungent. Cones narrow, oval, tapering towards the point, with even undivided scales. Found along with *Abies nigra* in the colder regions of North America. According to Michaux it does not advance so far to the northward as that species, from which it is known not only by its smaller size, the trunks rarely exceeding 40 or 50 feet in height, but also by the bluish cast which characterises the foliage, and which gives it a much lighter appearance than the sombre *Abies nigra*. Dr. Richardson, however, states that it was the most northerly tree observed in Franklin's first Polar Journey. The timber is of inferior quality. From the fibres of the root, macerated in water, the Canadian Indians prepare the thread with which they sew together the birch-bark that forms their canoes. Its resin is also used to render the seams water-tight. The bark is said to be occasionally used for tanning.

Abies nigra, the Black Spruce Fir (Michaux; *Pinus nigra* and *rubra*, Lambert). Leaves spreading equally round the stem, short, four-cornered. Cones ovate-oblong, obtuse, with ragged rounded scales. It is a native of the most inclement regions of North America, especially in swampy situations and in the valleys between ridges of low hills, where the soil is deep, black, and humid. In such situations are found the finest forests of this species, and there, although the trees are so crowded together as often not to be more than four or five feet apart, the timber arrives at the height of 70 or 80 feet, with a diameter of from 15 to 20 inches. The firs in the landscapes of northern scenery illustrating Franklin's first 'Polar Expedition' are of this species, which, however, Dr. Richardson did not observe higher than 65° N. lat. The trunk is remarkable for the perfect regularity with which it diminishes from the base upwards. The head is of a regularly pyramidal figure, the branches spreading almost horizontally, and not inclining towards the earth, as in the Norway Spruce. The timber is of great value, on account of its strength, lightness, and elasticity. It is employed for the yards of ships; and in America, in districts where the oak is scarce, also for their knees; floors are occasionally laid with it, but it is not well adapted for this usage, as the planks are apt to split. From its young branches is extracted the Essence of Spruce, so well known as a useful antiscorbutic in long voyages. According to Mr. Lambert, the curious Dwarf Spruce, called *Pinus clanbrasiliana*, is probably a variety of *Abies nigra*.

Abies Douglasii, the Douglas Fir (*Pinus taxifolia*, Lambert; *Pinus Douglasii*). Leaves spreading equally, deep green, whitish beneath, obtuse. Cones cernuous, ovate-oblong, with rather uneven cartilaginous scales, much shorter than the bracts, which are three-toothed, the lateral teeth being membranous, with the intermediate ones much longer and more rigid. According to Mr. Douglas, the discoverer of this gigantic species, it is found in immense forests in North-West America from 43° to 52° N. lat. The trunks vary from two to ten feet in diameter, and from 100 to 180 feet in height. Occasionally it arrives at still greater dimensions. It is an evergreen tree, with an erect taper trunk, which when old is covered with a rugged bark from six to nine inches thick, abounding in a clear yellow resin, and making excellent fuel. The young branches have their bark filled with receptacles of resin, as in the Balm of Gilead.



Cone of Douglas Fir.

The timber is heavy, firm, of as deep a colour as yew, with very few knots, and not in the least liable to warp. The growth is exceedingly rapid.

A considerable number of plants of this important species are now scattered among the parks and woods of this country, some hundreds having been raised and distributed by the Horticultural Society; it appears to suit this climate perfectly, and to be likely to prove more valuable than even the larch itself, being evergreen, and fully as hardy.

Abies Mensiesii, the Menzies Fir (*Pinus Mensiesii*, Douglas and Lambert). Leaves very short, rigid, rather sharp-pointed, whitish beneath, spreading regularly round the stem, very deciduous. Cones oblong, composed of very lax, ragged, retuse, ovate, thin scales, much longer than the narrow, serrated, concealed bractess. Buds ovate, acute, covered with resin. It is a native of Northern California, where it was found by Mr. Douglas, who describes the wood as being of excellent quality.

Sect. III.—Larches.

Leaves growing in clusters; deciduous.

By some botanists this section is considered essentially different from *Abies*; but the want of any clear distinctive characters, either in the mode of growth or the organs of fructification, induces us to concur with Linnæus, Jussieu, and Richard, in considering the Larch as belonging to the same genus as the Spruce. The leaves of the former are clustered or fasciculated, merely in consequence of the universal non-development of lateral branches; so that the leaves themselves make their appearance without a perceptible central axis. This is proved not only in the Cedar of Lebanon, but even in the Larch itself, by numerous cases where the branches being less abortive than usual, lengthen enough to display their real nature.

Abies Larix, Richard; the Common Larch Fir (*Pinus Larix*, Linnæus; *Larix Europæa*, De Candolle). Leaves clustered, deciduous. Cones ovate-oblong, blunt. It is a native of the mountains of the middle of Europe, of Russia, and of Siberia. In the latter country it is the commonest of all trees, delighting in dry elevated situations, where it forms vast forests, sparingly intermixed with pines. Its trunk grows very erect, with graceful drooping branches, gradually diminishing from the base to the apex, and giving it a regularly pyramidal form. In the spring, when its young leaves have just burst into life, it has a peculiar bright yellowish-green tint, which is possessed by no other tree of our forests. The Larch has been now for many years extensively cultivated upon barren exposed land, both in England and Scotland, and it has been found one of the most profitable of all trees to the planter, provided the land be well drained; but it will not succeed in swampy situations. It grows with great rapidity, is subject to very few accidents, transplants with but little risk, and produces timber of great excellence and value, not only for domestic but for naval purposes. In mountainous districts in Scotland the

The Larch (*Abies Larix*).

Duke of Athol has planted it in immense quantities; and it appears, from a report of that nobleman to the Horticultural Society, that in situations 1500 to 1600 feet above the level of the sea, he has felled trees, eighty years old, which have each yielded six loads of the finest timber.

From the boiled inner bark, mixed with rye-flour and afterwards buried for a few hours in the snow, the hardy Siberian hunters prepare a sort of leaven, with which they supply the place of common leaven when the latter is destroyed, as it frequently is, by the intense cold to which hunters are exposed in the pursuit of game.

The bark of the Larch is nearly as valuable to the tanner as oak-bark; it also produces the substance called Venice turpentine, which flows in abundance when the lower part of the trunk of old trees is wounded. A sort of manna, called Briançon Manna, is exuded from its leaves in the form of a white flocculent substance, which finally becomes concreted into small lumps.

It is believed that this species was the *πίτυς* of the ancient Greeks. The origin of the more modern word *larix* is uncertain.

Abies microcarpa, the Red Larch Fir (*Pinus microcarpa*, Lambert). Leaves clustered, deciduous. Cones oblong, small; their scales erect, close-pressed, the upper ones much smaller than the lower. This is a graceful tree, with much of the habit of the common Larch, from which its very small cones, of a bright purple in the summer, readily distinguish it. It is a native of North America. This tree is by no means so well adapted to the planter's purposes as the common Larch, growing very much smaller. The wood is so heavy that it will scarcely swim in water.

Abies pendula, the Black Larch Fir (*Pinus pendula*, Lambert). Leaves clustered, deciduous. Cones oblong, with numerous spreading scales, which gradually diminish from the base to the apex of the cones. Branches weak and drooping. It is a native of North America, where it is found growing in a rich clay soil, mixed with sand, in cold mountainous districts. When cultivated in this country it is an elegant tree, having a good deal of resemblance to the common Larch, but being of a brighter green colour, and much more graceful. The leading shoot will often begin to droop at the height of 15 or 20 feet from the ground, and, after gradually acquiring a horizontal direction, will bend towards the earth so as to form a natural arch of great beauty. The wood is less valuable than that of the common Larch.

Sect. IV.—Cedars.

Leaves growing in clusters; evergreen.

Abies Cedrus, the Cedar of Lebanon Fir (*Pinus Cedrus*, Linnæus and Lambert). Leaves clustered, evergreen. Cones oblong, very obtuse, erect, with broad closely-packed scales, which are a little thickened at the margin. Mount Lebanon and the range of Taurus are the native spots of this most stately and magnificent tree, which compensates for its want of height by its huge wide-spreading arms, each of which is almost a tree in itself. According to Labillardière, a French traveller in Syria, the largest of those now remaining on Lebanon is at least nine feet in diameter. The trees are held in great veneration, and a holiday is set apart for the Feast of Cedars. Its growth is far from being so slow as some imagine; on the contrary, the observations of those who have cultivated it with care prove that it will vie in rapidity of growth with almost any forest tree. Cedar-wood has the reputation of being indestructible; instances have been named of its having been taken from buildings uninjured after a lapse of two thousand years. But it appears highly probable, from some interesting observations made at Tangier by Mr. Drummond

The Cedar of Lebanon (*Abies Cedrus*).

Hay, that the indestructible cedar-wood was the beautiful, hard, deep-brown timber of *Thuja articulata*, the Sandarac Tree. The wood of *Abies cedrus* produces deal of very indifferent quality.

Abies Deodara, the Sacred Indian Fir (*Pinus Deodara*, Lambert). Leaves evergreen, in clusters, acute, triangular, stiff. Cones growing in pairs, stalked, oval, obtuse, erect; the scales closely packed, very broad, and nearly even at the margin. It is a native of the mountains of Hindustan, near the town of Rohilcund, on the mountains of Nepaul and Tibet, at a height of 10,000 or 12,000 feet, and also in the woods of Almora. It is a large tree, with a trunk about four feet in diameter, resembling the Cedar of Lebanon, from which it differs in having its cones upon stalks, and its leaves longer and more distinctly three-sided, and also in the quality of its timber. The Hindoos are said to call it the Devadara, or God Tree, and hold it in a sort of veneration. Its wood is extremely durable, and so resinous that laths made of it are used for candles. Spars of it have been taken out of Indian temples, known to have been erected from 200 to 400 years, uninjured except in those parts which originally were sap-wood. This tree has been extensively cultivated in England, and seems to be realising the favourable anticipations which were formed on its first introduction.

To the species now enumerated, the following almost unknown kinds have to be added:—

Abies Kæmpferi (*Pinus Kæmpferi*, Lambert). A native of Japan, found wild upon the mountains of Fako.

Abies Thunbergii (*Pinus Thunbergii*, Lambert). A scarce plant in Japan.

Abies Momi (Siebold). Found in Japan, as well as the two following. Its wood is in great estimation for its whiteness and fine grain.

Abies Torano (Siebold).

Abies Araragi (Siebold). Wood brown; used for various domestic purposes.

Cultivation.

The genus of resinous plants called *Abies*, which we have thus described, comprehend many forest trees of great importance; and it will be, therefore, proper to add a few remarks on their cultivation. Some of them, such as the Larch, the Norway Spruce, the Silver Fir, and the Balm of Gilead, are raised in the nurseries annually in the open ground, in large quantities, for the supply of our plantations; others, such as the Cedar of Lebanon and the Douglas Fir, are procured in much less abundance, and are treated with more care, being usually kept in pots until they are finally committed to the earth in the situation they may be subsequently destined to occupy.

All the species are propagated by seeds; they may also be propagated both by inarching and by cuttings; but it is found that plants so obtained are either very shortlived or stunted, unhealthy, and incapable of becoming vigorous trees. In some of the species, such as the Balm of Gilead and the Silver Fir, the scales of the cones readily separate from their axis, so as to render the extraction of the seeds a simple and easy operation; but in others, such as the Larch and the Spruce Fir, the scales will neither separate nor open: in such cases it is necessary to dry the cones as much as possible, then to split them by means of an instrument passed up their axis, and afterwards to thresh the portions so separated till the seeds can be sifted out.

Like other resinous seeds, these are perishable unless sown within a few months after the cones have been gathered; they will, however, keep much longer in the cone than if separated; wherefore, they should always be imported in that state.

It is usual in the nurseries to sow them in the spring in beds of light soil, in which no recent manure has been mixed; they are buried at various depths, according to the force of the vital energy of the species. This has been found by experience, as it is said, to be one inch deep for the Silver Fir; half an inch for the Spruce, Balm of Gilead, and Cedar of Lebanon; a quarter of an inch for the Larch; and less for the American Spruce; it is, however, probable that these depths are of very little importance. In order to protect the surface of the beds from being dried while the young seeds are sprouting, it is generally overspread with a thin layer of long straw, which is removed as soon as the crop begins generally to appear. During the first season the seedlings remain undisturbed; the only attention they receive being to keep them from weeds. In the following spring the young plants are taken up carefully, and their roots, being a little shortened, are imbedded in rows about six inches apart, where they remain for one or two years. After this they are transplanted into quarters, in rows a foot or nine inches apart, the plants being about six inches from each other. Having remained in this situation for a year, they are fit to be transferred to the plantation, or they may stand two years in the nursery quarters, and then be taken up and replaced in a situation of the same kind, if circumstances should render such a proceeding desirable. On no account, however, should they be allowed to remain in the quarters more than two years at a time without being taken out of the ground, because they are apt to form long and strong shoots, which are destroyed in the process of transplantation, so that the life of many must be either materially injured or wholly sacrificed.

None of the firs should be transplanted at a height exceeding three feet, for the reason last mentioned; and the Larch is the only kind that will remove advantageously even at this size. The Spruce and its allied species may be removed more successfully when from a foot and a half to two feet high. To this there is no other exception than that of plants that have been constantly reared in pots, as the Cedar of Lebanon; these may be safely removed at any size, if the transplantation is carefully attended to, because their roots are uninjured in the operation. It should however be remembered, in finally planting out large firs which have been always kept in pots, that it is absolutely necessary that their roots should be spread out among the earth as much as may be practicable without straining or breaking them; because, while in pots, they necessarily acquire a spiral direction, which they will not afterwards lose unless it is destroyed at the period of final transplantation; and, if they do not lose it, they are apt to be blown over by high winds, on account of their roots not having penetrated into the earth far enough in a horizontal direction to form the requisite stay to support the trunk and head.

Where great importance is attached to the raising the seeds of rare species of fir, it has been found a very beneficial practice to place them between two turfs placed root to root, the one upon the other, and to watch them till the seeds begin to sprout; they are then to be sown in the usual way, when every seed will usually succeed.

No trees are more impatient of pruning than these. They exude, when wounded, so large a quantity of their resinous sap as to become weakened even by a few incisions; and, if they have suffered many, they are long before they recover from the effects. So great is their symmetry, and so uniformly will their branches form under favourable circumstances, that it will rarely happen that a necessity for the use of the pruning-knife can arise. The great rule to be observed in their management is to allow them ample room for the extension of their branches; if this is attended to, their beauty is not only ensured, but the rate at which they will form their timber will be a full recompense for the space they may occupy.

ABIETINEÆ. [CONIFERÆ].

ABOMA, a large species of serpent, which inhabits the fens and morasses of South America, the *Boa cenchria* of Linnæus. [BOIDÆ.]

ABORTION, a term used in botany and horticulture. In Botany, abortion is employed to express the absence of an organ in relation to an ideal type. Thus the flowers of *Scrophulariaceæ* and *Lamiaceæ* have their sepals and petals arranged with the number five. According to a very general law the stamens equal in number the petals and sepals, but in this case they do not. In the majority of instances the stamens are but four: hence it is said that one stamen is aborted or there is an abortion of one stamen. The want of harmony between the parts of the flower generally is thus spoken of. In other instances, where the ovules are numerous and the seeds only one, two, or three, the remaining ovules are aborted.

In Horticulture, the premature development of the fruit, or any defect in it, is called abortion.

ABOU-HANNES (*Numenius Ibis*, Cuvier; *Tantalus Æthiopicus*, Latham), an African bird, which has occasioned much discussion among the learned as to its identity with the ancient Ibis. The attention of Bruce was attracted, during his stay in Upper Egypt, by some birds called by the natives Abou-Hannes, whose forms reminded him of the ibis, as represented on Egyptian monuments, and repeated observation confirmed him in the opinion of their identity with the ibis of the ancients. This identity was subsequently corroborated by the distinguished naturalists, Geoffroy and Savigny, who accompanied the French expedition into Egypt, and procured a number of specimens. M. Savigny published his observations in a small work ('L'Histoire Nat. et Mythol. de l'Ibis'), now very scarce, and Baron Cuvier also gave a memoir on the Egyptian ibis in the 'Annales du Muséum' for 1804, in which he has clearly proved, from the comparison of a mummy ibis with a stuffed specimen, that the true ibis is not the *Tantalus Ibis* of Linnæus, that being a much larger bird, but is really a species of curlew. This bird appears to be also a native of regions very remote from Egypt.

Herodotus attributes the veneration of the Egyptians for the ibis, to supposed services rendered them by the bird in freeing their country from winged serpents. That the ibis, however, could not feed

True White Ibis (*Numenius Ibis*).

upon serpents appears nearly certain from anatomical inspection. The bill, for example, being long, slender, considerably curved, blunt on the edges, and expanded and roundish at the point, could neither divide nor pierce serpents; and indicates rather an aptitude to dabble in marshy and moist grounds.

On the other hand, Baron Cuvier found, in the mummy of the ibis, remains of the skin and scales of serpents, and hence it has been inferred that the birds might have been serpent-eaters. This inference, however, is at variance with the observations made in Egypt by M. Savigny on a great number of individuals, in the crops of which he uniformly found land and fresh-water shells (*Cyclostomata*, *Ampullariæ*, *Planorbis*, *&c.*), and these shells were always entire when their inhabitants had not been previously digested.

It does not appear that the ibis breeds in Egypt; but, on the testimony of the inhabitants, it arrives as soon as the waters of the Nile begin to rise, augmenting in numbers as the waters increase, and diminishing as they subside, and disappearing when the inundation terminates. These birds, on their arrival, repair to the low lands, which are first covered with water; but when the waters become deeper and spread wider, the birds betake themselves to the higher lands. They afterwards approach the river, where they establish themselves by the sides of the canals and on the small dykes, with which the greater part of the cultivated grounds are surrounded.

The bird in question sometimes lives solitary, sometimes in small troops of from eight to ten. Its flight is lofty and powerful, and it utters at intervals hoarse cries. When it alights on a fresh piece of land, it remains for hours together occupied in tapping the mud with its bill, in search of worms, &c. It walks leisurely step by step, and has not been observed to run, like our curlew (*Numenius arquata*, Latham), to which it otherwise bears some resemblance.

The Egyptians call the bird *Abou-Mensel*, which literally means

'Father Sickle-Bill,' the bill being curved like a sickle. The Æthiopian name, *Abou-Hannes*, means 'Father-John,' because, as M. Dumont supposes, the birds arrive about St. John's day.

The following is the earliest account that we have of the ibis, from an eye-witness (Herodotus, ii. 76):—"The ibis is all over very black: it has the legs of a crane, and a beak considerably curved: its size is about that of a *crex*. Such is the appearance of the black ibis, which fights against the serpents. But the other ibis, which is more of a domestic bird (for there are two kinds), has the head and all the neck bare of feathers: it is of a white colour, except the head, neck, and the extremities of the wings and tail, all which parts are very black. As to its legs and beak, it resembles the other kind of ibis." The black ibis, according to Herodotus, devoured the winged serpents which yearly attempted to make their entry into Egypt from Arabia. It is needless to add that these winged serpents are a fable. Strabo, who himself was some time in Egypt, gives the following account:—"The ibis is the tamest bird of all: in form and size it is like the stork. But there are two varieties of colour, one of which is that of the stork, and the other is all black. Every street in Alexandria is filled with them, partly to the benefit of the citizens, and partly not. The bird is useful so far as it devours all kinds of vermin, with the garbage of the shambles, and the refuse of the eating-houses, &c." Here Strabo makes no distinction between the two, except in colour, and he describes both species as living on all kinds of garbage. He has probably confounded the real ibis and the stork.

ABOU SCHOM, the Arabic name of a species of fox (*Canis variegatus*.)

ABRAMIS. [BREAM.]

ABRAXAS, a genus of nocturnal *Lepidoptera*, to which belongs the common Magpie Moth, *A. grossulariata*. The caterpillar of this moth attacks the leaves of gooseberry and currant bushes at the beginning of the summer. It is of a yellowish white colour, with an orange stripe on each side, and covered with black spots. The chrysalis is black, relieved at its pointed end with orange circles. The expanded fore-wings of the perfect insect measure about one inch and a half across. The wings are of a yellowish white colour, variously spotted with black. The fore-wings have a band of pale orange. The body is orange, spotted with black. The eggs are deposited on currant or gooseberry leaves in July or August, and the caterpillars are hatched in September. To get rid of the attacks of these creatures, they may be picked off, or dusted with the powder of white hellebore, or the leaves of the plants attacked may be burned.

ABRAZITE (*Zeagonite, Gismondine*), a mineral belonging to the group of aluminous hydrated silicates, with alkaline and lime bases. It contains, besides silica and water, about 26 per cent. of alumina, with 14 per cent. of lime and potash.

ABROCOMA. [HABROCOMA.]

ABROMA (from α and βρῶμα, 'not fit for food,' in opposition to *Theobroma*, 'food for gods'), a genus of plants belonging to the natural order *Byttneriaceæ*. The species consist of small trees, with hairy lobed leaves and extra-axillary or terminal few-flowered peduncles at the tops of the branches.

Abroma augusta is a handsome tree, with drooping purple flowers, seated on peduncles opposite the leaves. It is a native of the East Indies. The fibrous tissue of the bark of this plant is manufactured into cordage.

ABRUS (from ἁβρός, soft), a genus of plants belonging to the papilionaceous division of the order *Leguminosæ*. The calyx is bluntly 4-lobed, with the upper lobe broadest. The legume is oblong, compressed, and 4-6-seeded. There is but one species, *A. precatorius*, which is a delicate twining shrub, with abruptly pinnate leaves, bearing many pairs of leaflets. It is a native of the East Indies, but is also found in the tropical parts of Africa and America, where perhaps it has been introduced. The seeds of the commoner variety are red, with a black spot, whilst other varieties produce various coloured seeds. These seeds are in much request as ornaments amongst the inhabitants of the countries where they grow. They are strung as beads, with shells, and other hard seeds. They are brought to Europe from Guinea and the East and West Indies. They are used frequently as beads for rosaries; hence the name *precatorius* given to this species. The leaves and roots of this plant secrete the sweet substance which characterises the liquorice plant (*Glycyrhiza glabra*). In the West Indies it is called Wild Liquorice, and used for the same purposes as the common liquorice. The seeds have been accused of possessing narcotic properties, but this is an error. When swallowed they are very indigestible.

ABSORBENT SYSTEM. The delicate vessels which in the bodies of vertebrate animals are engaged in carrying the food and other matters into the circulation, have this name. It consists of two principal divisions, which may be regarded as two different sets, given off from a common stem. One of these takes its origin in the walls of the alimentary canal, more especially the small intestines, and is called the 'lacteal' system, from the white colour of the liquid it takes up; whilst the other commences in the substance of the body, more especially the skin and neighbouring parts, and is called the 'lymphatic' system, from the colourless fluid, called lymph, which it carries.

The *Lacteals* are the small system of vessels by which the chyle, or nutritive part of the food, is conveyed from the intestines to the left subclavian vein, in which it is mixed with the blood. They have their origin in the villi of the small intestines, which are short hair-like processes, each consisting of a fine net-work of lacteal vessels surrounded by capillary arteries and veins. On the outside the villi are covered with cells, which absorb the chyle before it is conveyed to the loops of the lacteals in the interior of the villus. From the villi the chyle is carried, between the layers of the mesentery, through numberless converging branches, to the thoracic duct, the main trunk of the absorbent system, which, at the part where the chief lacteal branches join it, is dilated into what is called the Receptaculum Chyli. The villi have no visible apertures for the entrance of the chyle, but the walls of the lacteal vessels themselves are extremely thin and permeable, and their canals are furnished with numerous and delicate valves, like those of the veins [CIRCULATION OF THE BLOOD], to prevent the fluid which they contain from descending again to their absorbing extremities. In their passage through the mesentery the lacteals traverse numerous mesenteric absorbent glands, where they communicate with veins, and the fluid contained in them is exposed to the influence of the blood, from which it acquires colouring matter and fibrine.

The *Lymphatics* consist of minute branched tubes of extremely delicate membrane, whose extremities are arranged in a more or less dense net-work in every part of the body. From this net-work they gradually converge into a succession of branches of increasing size, and terminate in two main trunks, called the right and left great Lymphatic Veins, through which the lymph is poured with the chyle from the thoracic duct into the right and left subclavian veins. The lymphatics also communicate with the veins at some other parts of their course, chiefly near their minute extremities, and more rarely by larger branches. They have in their interior numerous delicate valves formed of crescentic folds of the lining membrane, like those of the veins and of the lacteals [CIRCULATION OF THE BLOOD], and, like them, preventing the retrograde course of the contained fluid. The valves of the lymphatics, however, are much more closely set than those of the veins, so that, when full of fluid, the spaces between them being most distended, they give those vessels a knotted or beaded appearance, by which they are easily distinguished from veins of the same size. In the course of the larger lymphatics there are numerous glands of the same nature as those found in the course of the lacteals. They are called Lymphatic Glands. To each of these there pass two or more lymphatic vessels, which on entering them become extremely tortuous, and after varied convolutions and anastomoses, terminate in nearly the same number of branches, which again pass from the gland, and pursue their course towards the main trunk. These glands attain their fullest development in man and the mammalia. They are far less numerous in birds, and are entirely wanting in the fish and amphibia. The function performed by these glands is somewhat obscure, but it has been recently suggested by Professor Bennett, of Edinburgh, that their function is to prepare or produce the colourless corpuscles of the blood. [BLOOD.] He arrives at this conclusion from having observed that in cases where these glands or the spleen are inflamed, or in a condition of increased action, that the colourless corpuscles of the blood can be seen under the microscope to be in larger quantity than is normal. (Bennett, *On Leucocythemia*.)

ABSORPTION, one of the first and most essential of the functions of animal and vegetable tissues. Both animals and plants grow and perform other vital functions through the agency of materials derived from without. The passage of all substances from the exterior to the interior of their bodies is effected by the function of absorption. This function is performed in all cases by the aid of animal or vegetable membrane. This membrane is always in the form of the walls of cells or the walls of vessels formed out of cells. Whether the function of absorption be performed in animals or plants, there are certain general conditions of the membrane or cells through which it takes place, that are necessary in all cases. In the first place, as liquids are found to pass through the walls of cells and membranes, it is necessary that they should be permeable. This is found to be the case in all organised bodies, and in proportion to the permeability of the tissue is the activity with which absorption is performed. In certain parts of plants, as well as animals, the cells become almost impermeable, and these are the parts which cease to grow or to perform active functions. Such are the duramen or heart-wood of trees, and the nails, hairs, horns, and teeth of animal bodies.

During the performance of the various functions in which absorption is required, both liquids and gases pass through the cell-membrane or cell-wall. Liquids containing salts in solution pass into the plant and animal in the supply of food for nutrition. Gases, including the vapour of water, are also absorbed by the cells of plants as a nutritive process, and by those of animals during the performance of the respiratory function. This transmission of fluids through organic membranes is sometimes referred to as a peculiar vital property of animal and vegetable tissues; but it seems to depend considerably on the physical properties of the fluids and tissues. Organic membranes, when separated from the living structure, have the power of absorbing fluids, and if two fluids of different densities are separated by a membrane, the flow through the membrane will be greater from the thinner fluid to the thicker than the contrary. This action, which has been called *Endosmosis* [ENDOSMOSIS], seems to be a modification of that very general law of attraction by which solids are attracted towards each other, as well as liquids and gases, and which lies at the foundation of those phenomena attributed to capillary attraction. Although it would appear as the result of this law that there must be two currents, the one passing out and the other in, this does not always take place, as the perpetual removal, for the purposes of the system either of the plant or of the animal, of the matter absorbed, prevents the action of the outgoing current, which has been called *Exosmosis*.

The cells and surfaces which carry on absorption in the *Vegetable Kingdom* vary according to the circumstances of the plant. In the simpler plants, such as the lower forms of *Algæ*, which consist of one or only a few cells, the whole of the cells are equally employed in absorbing. But as we ascend to plants where the vegetative and reproductive organs are distinct, there we find absorption performed more abundantly by the former. In the higher forms of phanerogamic plants the active duties of absorption are performed by the roots; the loose tissue at the ends of the fibrils of these organs being remarkably adapted for the performance of this function. The same power is also possessed by the recently formed tissues in the stems of these plants, and thus the food—the sap—is carried from the soil to the branches of the plant, which are covered with leaves. The cells of the leaves are adapted to the exhalation of the fluid which has been absorbed below, and thus a perpetual demand for new supplies is created. Not that the leaves are always exhaling; in moist states of the atmosphere and at night they probably also absorb. This function is also undoubtedly performed by the stems of the leafless *Euphorbiaceæ* and by the *Cactaceæ*, which possess very small roots, and will even grow without them.

Absorption in the *Animal Kingdom*, although performed upon the same general principles, and being adapted to attain the same general ends, presents more various modifications of form and greater complication than in the vegetable kingdom. In the first place, the nature of the fluids taken up differs, more especially in the class of cases where that function is adapted to nutrition. Plants derive their food from the mineral kingdom. Animals obtain their food from plants. Plants live on carbonic acid, ammonia, water, and various salts. Animals live on substances elaborated out of these compounds in the cells of plants. In the next place, animals receive their food into an interior sac or bag called a stomach, whilst plants plunge their absorbent cells into the soil from which they derive their nutriment. In the higher forms of animals, a system of vessels called absorbents [ABSORBENT SYSTEM] is made subservient to the ends of the function of absorption—an arrangement which is found nowhere to exist in the vegetable kingdom. In the lower animals, as in the sponges and some of the infusoria, the function of absorption is performed by contiguous cells almost as simply as in plants. In certain parts also of the higher animals, we have absorption carried on in the same way as in the cells of cartilage, and in the contiguous cells of the mucous and cutaneous membranes. In none of the invertebrate animals have we any special absorbent system at all. In the animal kingdom the circulating system has the power of absorption in even a greater degree than the absorbents themselves. From the structure of the walls of the veins, arteries, and capillaries, and the knowledge of the fact that there is constantly passing through them a dense liquid—the blood—we should expect that these organs would offer the necessary conditions for absorption. This has been proved by direct experiment. M.M. Tiedemann and Gmelin found that when such substances as gamboge, madder, camphor, musk, and assafœtida, which are easily detected by their colour and odour, were introduced with the food into the stomach, they were seldom found in the chyle in the time that they had found their way into the blood, and some of them even into the urine. It was also found that if poisonous substances were introduced into the intestines, and secured in one place by two ligatures, and every other part cut away but the artery and vein, they exerted the same influence on the system, and in the same time as usual; whilst if the intestine was treated in the same manner, and all parts cut away but the lacteals, the evidences of absorption were deferred for a much longer period than usual. From these experiments and others it would appear that the lacteals are adapted for receiving only a certain class of compounds, more especially of an oleaginous and albuminous kind.

That part of the absorbent system called Lymphatics were at one time supposed to be engaged in conveying to the blood the used-up matters from all parts of the body preparatory to their final expulsion from the system. The nature, however, of the clear fluid lymph which is contained in them does not support this opinion, and as this lymph has a composition very like to the blood without its red corpuscles, it is inferred that the office of the lymphatics is to assist in the preparation of materials for the blood. These materials being scattered all over those parts of the system on which the lymphatics are distributed, it is to the blood-vessels that the office must be assigned of taking up effete matter, and carrying it into the blood.

That the general cutaneous and mucous surfaces of the body will both exhale and absorb, are well-known facts. The skin, through its perspiriferous glands, which perform their function through the agency of cells, exhales moisture, whilst it is also a powerful absorbent surface. It is proved by direct experiment, that the human hand is capable of imbibing, in a quarter of an hour, an ounce and a half of warm water, which, for the whole body, is at the rate of six or seven pounds per hour. An interesting narrative is on record of a ship's crew who were exposed at sea for several days in an open boat; they had consumed all their water; they had no fluid of any kind which they could drink; they soon began to suffer from thirst; the feeling at length became intolerable, and the drinking of sea-water was found only to increase its intensity. When nearly exhausted, they were exposed, during several hours, to a heavy shower of rain. As soon as their clothes became thoroughly wet their thirst began to abate, and before the rain had ceased their thirst was gone. They did not fail to profit by this experience. From this time each man, as soon as he began to feel thirsty, dipped his shirt in the sea-water and wore it next his skin, which had invariably the effect of removing his thirst, the absorbents taking up the particles of water, but rejecting the saline matter dissolved in it. The mucous surface of the lungs is constantly engaged in throwing off the vapour of water and carbonic acid, and absorbing oxygen gas. It is also through the pulmonary surface that poisons are introduced into the blood, which result in the production of disease, as small-pox, measles, scarlet fever, and others. The different relations of absorbing surfaces to poisonous substances is an interesting subject. Thus, poisons which may be introduced with impunity into the stomach will destroy life when applied to the minutest wound in the skin, as in the case of the poison of venomous serpents, and the Woorara poison. This has been proved not to depend on any decomposition taking place upon the surface of particular membranes, as the Woorara has been introduced into the stomach and bladder, and when rejected has been found to retain its primitive destructive power.

ABUTILON (αβυτιλον, the Greek for mulberry-tree, which the species of this genus resemble), a genus of handsome plants, belonging to the natural order *Malvaceæ*. The species of this genus, amounting to about 80, have been removed from *Sida*. They have a naked five-cleft calyx, with a multifid style, capsular one-celled carpels, 5-30 in a whorl. Several of the species are cultivated in this country. *A. striatum* blossoms freely nearly all the year round, when turned out under a wall in Hampshire. *A. vitifolium*, *A. venosum*, *A. rufinerve*, and *A. pæoniflorum*, are also tolerably hardy species. The plant known as Bencao de Deos, in the province of Rio Janeiro, in Brazil, is the *A. esculentum*. It has large purple solitary axillary flowers, which are dressed and eaten with their viands by the inhabitants of Rio. In cultivation the species require a light rich loam and peat-soil, and should be propagated by striking cuttings in sand in a close frame or under a glass in summer.

ACA'CIA, the name of a plant belonging to the order *Leguminosæ*, mentioned by Dioscorides, as a useful astringent thorn, yielding a white transparent gum. The account given by this Greek author, meagre as it is, accords so well with the gum-arabic trees of modern Egypt, that we can scarcely doubt their identity. Accordingly it is to these, and to others closely related to them, that the classical name is still applied.

Amongst modern botanists the Acacia is a very extensive genus of trees or shrubby plants, inhabiting the tropical parts of both the Old and New World, and, in a very few instances only, extending into temperate latitudes; although over the whole of Australia, and its dependent islands, the species are spread in much abundance. There are nearly 300 species.

Generic Character.—Flowers polygamous. Calyx, with either four or five teeth. Petals, either four or five; sometimes distinct from each other, sometimes adhering in a monopetalous corolla. Stamens varying in number from 10 to 200. Pod not separating into many joints; juiceless, two valved. The species are extremely variable in the structure of their leaves and flowers. Some of them have true leaves that are twice or thrice pinnate, with a multitude of minute, shining, or at least even, leaflets; others have in a perfect state no leaves properly so called, but in their stead the leaf-stalks enlarge, and assume the appearance, and no doubt also the functions, of true leaves: species of the latter description are known by their spurious leaves being expanded vertically, instead of horizontally as in leaves of the ordinary construction. By these very remarkable points of difference in structure the species may be conveniently separated into two great subdivisions.

I. *Leaves pinnated in various degrees.* About 200 species known.

Acacia Catechu (Willdenow), the Catechu Acacia (*Mimosa catechu*, Linnæus). Spines growing in the place of the stipules; when young, straight, but afterwards becoming hooked. Leaves in ten divisions; leaflets in from 40 to 50 couples, linear, downy; with one depressed gland at the base of the leaf-stalk, and from two to three between the upper divisions. Flowers arranged in cylindrical spikes, which grow two or three together. It is a tree with a tolerably high and stout stem; and is found in mountainous places in the East Indies, especially in Bengal and Coromandel. It is most common in Canara and Bahar. Its unripe pods and wood yield, by decoction, one of the sorts of catechu, or terra-japonica. [CATECHU.]

Acacia Arabica (Roxburgh), the Gum-Arabic Tree. Spines growing in pairs. Branches and leaf-stalks downy. Leaves in from four to six divisions; leaflets in from ten to twenty couples, oblong-linear, with a gland between the lowest, and often between the outermost divisions. Heads of flowers growing in threes upon stalks. Pod necklace-shaped. It is an inhabitant of the East Indies, Arabia, and

Acacia Catechu.

Abyssinia, where it forms a tree 13 or 14 feet high, of inelegant appearance; easily recognised by its long curved pods, which are divided into a number of round compressed joints, by means of con-

Acacia Arabica.

tractions between the seeds. This is one of the plants that yield the useful substance called Gum-Arabic, which is procured by wounding the bark; after which the sap runs out, and hardens into transparent lumps, of various figures, very similar to the concretions found upon the bark of the cherry-tree in this country. Gum-Arabic is also produced abundantly by some of the species nearly related to this, such as *A. Nilotica*, or *vera*, found in Egypt; *A. Ehrenbergii*, a native of Dongola; *A. tortilis*, a common plant in the west of Nubia, Kordofan, and Arabia, especially upon Mount Sinai; and *A. Seyal*, an inhabitant of Upper Egypt, Nubia, and western Arabia. It is supposed that Gum-Arabic is collected indifferently from all these, and that the gums of Jidda and Bassorah, Gum-Thur, and East India Gum, are only picked samples. Gum-Senegal is the produce of a distinct species, called *A. Senegal*, found in Arabia and the interior of Africa.

Acacia discolor (De Candolle), the Purple-Stemmed Acacia (*Mimosa discolor*, 'Bot. Repository'), has no spines; the leaves have five pairs of pinnæ. It is a middle-sized tree, found in the southern parts of Australia and in Van Diemen's Land, where it, in common with many others of the same genus, is called Wattle. It appears better adapted than most other Australian species to support our winters. Near London it succeeds perfectly well, all winter long, in the open air, if wrapped round with mats, and it is to be presumed that there is no obstacle to its being almost naturalised in Devonshire and Cornwall and the west of Ireland. It is readily known by its bluish stems and leaves, which are slightly stained with dull purple, and form a strong contrast with its long erect bunches of yellow blossoms.

Acacia pubescens ('Hortus Kewensis'), Downy Acacia. No spines. Leaves with from three to ten pairs of pinnæ. It is a native of the east coast of Australia. In this country it is one of the most beautiful of green-house plants. If allowed to grow freely in the border of a good conservatory, it attains the height of 10 or 12 feet; and in January and February produces a vast abundance of yellow blossoms, which weigh down the slender graceful branches, and perfume the air with a weak but pleasant odour.

Acacia Julibrissin (Willdenow), Silk-Tassel Acacia (*Mimosa Julibrissin*, Scopoli). No spines. Leaves with from eight to twelve pairs of pinnæ. It is a native of Persia and of the Levant. Its specific name is Latinised from two Persian words—*gul*, a rose; and *ebruschim*, silk. In the countries where it grows wild it becomes a small tree, remarkable for its light airy foliage, and for the great beauty of the clusters of lilac flowers, the long and slender stamens of which stream in the wind and glitter in the sun, like a number of silken tassels artificially fastened to the boughs. This species is now commonly cultivated in the warmer parts of Europe.

Acacia acanthocarpa (Willdenow), Prickly-Fruited Acacia. Spines, from the place of the stipulæ, growing in pairs, and hooked. Leaves in from six to eight principal divisions. It is a native of Mexico, where it forms a small tree, with flesh-coloured flowers.

The Black Wood of Van Diemen's Land is the timber of *Acacia melanoxylon*; and the astringent Jurema Bark of Brazil is the produce of *Acacia jurema*.

II. *Leaves pinnated in the young plant; in the old, consisting of nothing but the vertically distended leaf-stalks, called Phyllodia.* About 100 species.

Acacia decipiens ('Hortus Kewensis'), Paradoxical Acacia. Stipules spiny, deciduous. Phyllodia either triangular or trapezoidal; their midrib nearest the lowest side, and lengthened into a spine; a single glandular tooth on the upper edge. Flowers in nearly solitary compound heads. This species is remarkable for the blunders to which it has given rise. When botany was only a science of names, its flowerless branches were taken for the leaves of a kind of fern; and, at a later period, when botanical geography was as yet unheard of, it was believed to be a native of the north-west coast of North America. It is an inhabitant of the south-west coast of Australia, where it forms a bush of singular aspect. In this country it is cultivated in the green-house, and it flowers in March, April, and May.

Acacia Sophoræ ('Hortus Kewensis'), Fragrant Acacia. Phyllodia narrow. Heads of flowers in dense slender racemes. Pods long, curved, taper-pointed, a little contracted between the seeds. It is a native of the south side of Australia and of Van Diemen's Land. In this country it is a very ornamental greenhouse plant, which, if planted in the open border, will grow as high as eight feet. Few plants are more worthy of a permanent station in a good conservatory.

Acacia longifolia (Willdenow), Long-Leaved Acacia. Phyllodia of a narrow lanceolate form, tapering to each end. Spikes of flowers axillary, growing in pairs, on short stalks. It is found very commonly on the eastern coast of Australia, especially in the neighbourhood of Port Jackson, whence it was introduced into Great Britain, among the first of the natural productions of that remarkable country.

Fragrant Acacia.

Cultivation.—The species of this genus are increased artificially in two different ways. Most of them may be multiplied by cuttings struck in silver sand, placed under a bell-glass, and kept in a warm place, to which no direct solar light has access. Such of them, however, as do not increase with sufficient certainty by this method, *A. Julibrissin* for instance, have the power of producing shoots from pieces of their root placed in earth in a hot-bed; and by these the nurserymen generally propagate them. Their seeds also are very often received, and from these they can, of course, be multiplied in all cases.

ACACIA, FALSE, or *Locust Tree.* [ROBINIA.]

ACADIOLITE, one of a group of minerals of doubtful identity, composed of nearly 50 per cent. of silica, with alumina, lime, soda, potash, and water.

ACALEPHÆ (from ἀκαλήφη, a nettle), *Sea-Nettles*, a class of marine invertebrate animals, belonging to the sub-kingdom *Radiata*. It is now made to include a large number of animals, of which the genus *Medusa* of Linnæus may be taken as a type.

The genus *Medusa* was placed by Linnæus in the second section of his *Vermes*, viz. *Mollusca*. The *Mollusca* were divided into six sections in the 'Systema Naturæ;' and in the last of these, consisting of those molluscous forms which had a central mouth below, *Medusa* stood as the first genus, followed by *Asterias* and *Echinus*. The third section of *Vermes* (*Testacea*), with *Chiton* at its head, immediately followed. In this arrangement *Medusa* came between *Nereis* and *Asterias;* but in the body of the work it stands between *Sepia* and *Asterias*.

The following is the Linnæan definition of the genus *Medusa*:— Body gelatinous, orbiculate, depressed. Mouth beneath, central.

The genus contained 12 species, and these consisted not only of true *Medusæ*, but of such genera as *Porpita* and *Velella*.

The *Acalephæ* of Cuvier (his third class of *Zoophytes*) comprehend, to use his own terms, Zoophytes which swim in the sea, and in whose organization may be perceived vessels, which in truth are most frequently nothing but productions of the intestines, hollowed in the parenchyma of the body.

Cuvier's first order of *Acalephæ*, or *Sea-Nettles*, consists of the *Simple Acalephæ*, which he characterises as floating and swimming in the sea by means of the contractions and dilatations of their body, their substance being gelatinous, without apparent fibres. The sort of vessels which are seen in some are hollowed in the gelatinous substance; they often visibly come from the stomach, and do not give place to a true circulation.

The genera contained in this order are the great genus *Medusa*, Linn., with its subgenera *Porpita* and *Velella*.

The great genus *Medusa* is characterised as having a disk more or less convex above, similar to that of a mushroom, and called the *umbrella*. Its contractions and dilatations concur to the motivity of the animal. The edges of this umbrella, as well as the mouth, or the suckers, more or less prolonged into pedicles, which take its place, in the middle of the lower surface, are furnished with tentacles of very different form and size. These different degrees of complication have given rise to very numerous divisions.

The *Arachnodermata* form the second class of M. de Blainville's *Actinozoaria*. He observes that this class corresponds exactly to the genus *Medusa* of Linnæus.

The following is M. de Blainville's definition of this genus:—

Body free, regularly oval or circular, subgelatinous, covered with an extremely fine skin, which is but little or not at all distinct, sustained or not by a solid subcartilaginous part, and provided with very diversiform radiated appendages.

Intestinal canal limited to the stomach, and provided with a single orifice.

Ovaries multiplied, radiated, and opening in the interior of the stomach.

M. de Blainville goes on to state that their form, which is regular, is nearly always circular (the *Velellæ* alone being oval), sometimes discoid or spheroidal, but most frequently hemispherical, which causes them to resemble our umbrellas, and has given rise to the distinction of their body by that name. This body is sometimes furnished in addition, in its circumference, with more or less long cirrhi, to which the name of tentacles, or better, of tentaculiform cirrhi, has been given.

The lower surface of the umbrella, he observes, is sometimes entirely naked, but in other cases is provided with numerous and dispersed tentaculiform suckers, as in the *Porpitæ* and. *Velellæ*, or else with very diversiform appendages, capillaceous at least at their extremity, which zoologists have termed arms, whence the denomination of *Brachideous* which they have given to some species. These appendages or arms are sometimes free from their base, but in other cases are united, which unity produces a sort of peduncle, which has originated the designation of *Pedunculated* for those species that are so provided. In the middle of the lower surface of the umbrella of these *Medusæ* is sometimes a species of peduncle formed by a proboscidiform prolongation of the buccal orifice, and they are then called *Proboscideous;* but in the greater number of cases, the middle of the lower part of the umbrella is occupied by a more or less considerable mass, attaching itself to the body by four roots, in the form of a cross, so as to divide the buccal orifice into four semilunar parts. This peduncle, terminated by more or less numerous capillaceous divisions, has caused the name of *Pedunculated*, or *Polystomatous*, to be applied to those *Medusæ* which are provided with it.

The first subdivisions of the *Arachnodermata* established by M. de Blainville depends on the existence or absence of a solid piece for the support of the umbrella or body of the animal, and consists of the *Cirrhigrada*, which are provided with that support, and of the *Pulmograda*, which are without any such support. These orders, observes M. de Blainville, are further distinguished by the very different nature of the appendages with which the umbrella is furnished on the buccal surface.

The difficulty of examining the *Acalephæ* is, from the very nature of their texture, considerable, and that of preserving them in spirit great. It is not, then, to be wondered at that a great portion of their organization remained for a long time in obscurity, and that much relating to it still remains to be cleared up. To observe them with anything like a satisfactory result, they must be studied on the spot, and while they are alive; and thus it is that several points relative to their organization and habits, and their generation especially, have only lately been cleared up. The possibility of fairly preserving them in spirit is shown in the museum of the Royal College of Surgeons in London, where, in the department comprehending the first division of the Preparations of Nat. Hist., in spirit, several of the Acalephans, (No. 64 to 73 A, both inclusive) are to be seen so preserved. In the following remarks the structure of the typical *Medusæ* will be more especially referred to.

The disk presents a uniform cellular appearance internally, and the cellular substance is very soft. In its mass no fibre has hitherto, we believe, been traced, and indeed the quantity of solid matter in the whole animal must be very small. Those who have taken *Medusæ* out of the sea, and laid them upon a dry board or dry stone, must have observed how soon they sink into a sort of deliquescence. Spallanzani came to the conclusion that the sea-water penetrating the organic texture constitutes the greater part of the volume in the *Medusæ*, some of which when newly taken out of the sea weighed 50 ounces, though their dried remains gave a weight of little more than 5 or 6 grains. A fine muscular membrane appearing, when examined with a magnifying glass, to be composed of numerous fleshy fibres disposed in small bundles, radiating as regards the axis of the *Medusa*, and adhering closely to the gelatinous substance of the disk, may be seen in some species stretching over a given extent of the lower surface of the umbrella, a little within its outer margin. Portions of the disk, or umbrella, have been cut from these animals whilst they were alive: those portions which had no part of this muscular membrane attached to them exhibited no signs of motion; in those, on the other hand, whose connection with the muscular membrane was preserved, the reciprocal contraction and dilatation were continued for some time. Those *Pulmograda* which have cilia around their margins have also circular vessels running along their bases, and most of the projectile and extensile tentacles and filaments have sacs and canals with contained fluids at their roots. If these cilia may be regarded, and they doubtless may be, as one of the causes, and a principal one, of locomotion, the pensile tentacles of the *Medusæ* may be viewed as ancillary at least to that faculty, though they probably are principally employed as nutrient organs. They are hollow and simple, and appear to increase in their extensibility in proportion to their connexion with the appendages of the digestive cavities, or when furnished with a vesicle at their base. Suckers are found at the extremities and along the sides of these tentacles in several of the genera, so as to enable them more securely to catch the floating destined prey, or to assist in anchoring the *Medusa* when it would rest, as we have reason to believe it occasionally does.

Nervous System and Senses.—We are not aware of any quite satisfactory demonstration of a nervous system in the Acalephans. Dr. Grant indeed ('Zool. Trans.,' vol. i.) notices a structure in *Cydippe* which in his opinion can only belong to that system; but Eschscholtz, whose labours in investigating the organization of this class were not small, failed to discover nerves in the largest which he examined. That they enjoy sight has been a question. Ehrenberg has endeavoured to show that *Medusa aurita* possesses eyes in the form of small red points visible on the surface of the eight brown masses which are round the circumference of the umbrella; and he has compared these so-called eyes to those of certain *Rotifera* and *Entomostraca*. He considers the glandular body at the base of the pedicle to be an optic ganglion, and notices its connection with two filaments that decussate about the middle of their course; and he views these as constituting part of a nervous circle, situated, for the greater part of its extent, directly along the bases of the row of tentacles surrounding the umbrella, and so forming a sort of outer wall of the circular vessel or appendage of the intestinal cavity which runs round the margin of the umbrella. He also describes another nervous circle, formed of four ganglion-like masses. These he states to be disposed round the mouth, and to be each connected with a corresponding group of tentacles.

But the general opinion seems to be that touch is the only sense possessed by the Acalephans, as far as proof has hitherto gone. That they are sensible to light, though the evidence in favour of their possessing sight properly so called may not be deemed conclusive, will be generally admitted. It is said that some of the smaller tribes have been known to shun a bright light, and to sink into deep water to avoid it.

The chief seat of the touch appears to be in the tentacula and cirrhi with which the majority of Acalephans are furnished. Many of them, as we have ourselves observed, make no sign when wounded extensively in the umbrella or disk.

Muscular System.—In most of the species of *Pulmograde Medusæ* distinct muscular fibres exist, which present the peculiar markings observed on the fibres of voluntary muscles. Where these cannot be seen, tissue consisting of a granular substance exists which possesses the peculiar power of contraction. Professor E. Forbes says, that he has "paralysed one side of a *Rhizostoma Aldrovandi*, whose disk measured more than a foot across, by removing with a scalpel the bands of that half, whilst the other side contracted and expanded as

Rhizostoma cerulea (Cuvier).

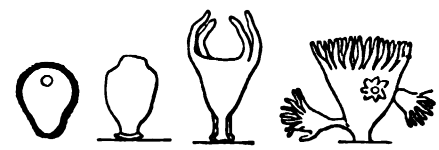
usual though with more rapidity, as if the animal were alarmed or suffering." The tentacles of most species are capable of wonderful extension and retraction, movements which must be effected by means of muscular tissue.

Food and Digestion.—The food, small fishes and marine animals, both living and dead, is probably conveyed to the mouth not only by the tentacles and cirrhi with which the greater part of the *Medusæ* are furnished, but also by contractions in the umbrella or disk itself. Fishes of some size have been found dead and entangled in the tentacles of *Medusæ*, killed most probably by that benumbing or stinging quality which has obtained for them the name of Sea-Nettles. Professor E. Forbes, speaking of the habits of *Sarsia tubulosa*, says, "being kept in a jar of salt water with small crustacea they devoured these animals, so much more highly organised than themselves, voraciously, apparently enjoying the destruction of the unfortunate members of the upper classes with a truly democratic relish. One of them even attacked and commenced the swallowing of a *Lizzia octopunctata*, quite as good a Medusa as itself. An animal which can pout out its mouth twice the length of its body, and stretch its stomach to corresponding dimensions, must indeed be 'a triton among the minnows,' and a very terrific one too."

By the investigations of M. Milne-Edwards principally, we now know that all the *Pulmograda* have gastric cavities, but all have not mouths in the ordinary acceptation of the word. In *Rhizostoma*, for instance, the only communication between the stomach and the outer surface is carried on through numerous branching canals in the pensile arms. In most cases a system of vessels is observed proceeding directly from the stomach, partly nutritive and partly respiratory, but there does not appear to be any distinct blood-vessels. From the recent researches of Frey, Leuckart, and E. Forbes, it does not appear that any special blood-fluid exists amongst the species they have examined.

Reproductive System and Development.—The majority of the Acalephæ have very distinct reproductive glands. In the *Pulmograda* they are placed either on the surface of the sub-umbrella, or on the inner and upper part of the cavity of the peduncle. In most cases these animals appear to be bisexual, though the two sexes are often united in the same individual; but Milne-Edwards, Wagner, and Will have observed individuals with sperm-cells only, and with germ-cells only. Although probably in all cases reproduction takes place by conjunction of these cells, the *Medusæ*, like some other lower animals, have the power of producing their offspring by germination. This fact was first made known by Sars in 1836. Professor E. Forbes, in his great work on the British Naked-Eyed Medusæ, says, "I have observed four modes of propagation by germination among the Medusæ. 1. Germination from the ovaries, as observed by Sars. 2. Germination from the peduncular stomach. 3. Germination from the walls of a tubular proboscis. 4. Germination from the bases or tubercles of the four marginal tentacles in *Sarsia prolifera*." In order to suggest the nature of this mode of reproduction, Forbes has the following passage:—"What strange and wondrous changes! Fancy an elephant with a number of little elephants sprouting from his shoulders and thighs, bunches of tusked monsters hanging epaulette-fashion from his flanks in every stage of advancement. Here a young pachyderm almost amorphous, there one more advanced, but all ears and eyes; on the right shoulder a youthful Chuny, with head, trunk, toes, no legs, and a shapeless body; on the left, an infant better grown, and struggling to get away, but his tail not sufficiently organised as yet to permit of liberty and free action! The comparison seems grotesque and absurd, but it really expresses what we have been describing as actually occurring among our Naked-Eyed Medusæ!"

The history of the development of the ova is not less interesting. When first produced they are retained in the interior of the creature until they are covered with cilia, when they pass out, and are found in the water resembling *fig.* 1. In the course of a little time it attaches itself to some fixed object, and then puts out four arms. In the first stage we have an infusorial animalcule; in the next, *fig.* 2, we have a rotifer or hydroid polype. Not only have we the resemblance to, but some of these forms have been shewn by Steenstrup ('Alternation of Generations') to have been mistaken for permanent states of other animals. The first four arms are succeeded by four more, *fig.* 3: at this stage germs or buds frequently grow from its side, *fig.* 4: the polypiform body then lengthens, and at last becomes wrinkled, *fig.* 5: depressions appear, and the elongated body is cut up into a series of



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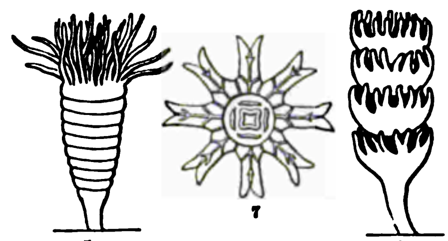

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5 6

horizontal slices, from the edges of which tentacles grow, *fig.* 6: each layer escapes, and presents itself in the form of a young Medusa, *fig.* 7. Such is the history given by Steenstrup, in one of the common forms of Pulmograde Medusæ, and such with modifications appear to be the changes which each ovum of the Medusa passes through before it becomes a fully developed animal.

Power of Stinging.—The name *Acalephæ*, Sea-Nettles, suggests this property. It is not, however, improbable that this function is possessed only by a few species. Some possess this property in a remarkable degree, as the *Cyanea capillata*, which is a terror to bathers in our seas. At most two or three others possess it in relation to the human skin. It is probable they exert greater power over their prey or their enemies amongst the lower classes. The stinging power is supposed to reside in small capsular hairs, which are found in the tissues of the *Acalephæ* as well as in *Actiniæ* and other polypes.

Phosphorescence.—On whatever property this phenomenon depends, there is no doubt that it is possessed in a high degree by almost every species of *Medusæ*. The circumstances, however, on which it depends seem to be little known. On some occasions the *Acalephæ* with other marine creatures will give out abundance of light, whilst at other times not a glimmer can be observed.

The *Acalephæ* have been divided into four families: the *Pulmograda*, the *Ciliograda*, the *Cirrhigrada*, and the *Physograda*. The following is the arrangement of the *Pulmograda* given by M. de Blainville, who, by intercalating the genera of Péron and Lesueur, and of Eschscholtz, the existence of which he is far from guaranteeing, gives us the following synoptic table:—

PULMOGRADA, OR MEDUSARIA.

SECT. I.—*Simple.*

Genera: *Eudora, Ephyra, Phorcynia, Eulymene, Charybdæa.*

SECT. II.—*Tentaculated.*

Genera: *Berenice, Æquorea, Mesonema, Polixena, Ægina, Cunina, Foveolia, Eurybia, Pegasia, Obelia.*

SECT. III.—*Sub-Proboscidean.*

Genera: *Oceania, Aglaura, Melicerte, Cytacis, Thaumantias, Tima, Campanella.*

SECT. IV.—*Proboscidean.*

Genera: *Orithyia, Geryonia, Saphenia, Dianæa, Linuche, Favonia, Lymnorea, Sthenonia.*

SECT. V.—*Brachideous* and *Pedunculated.*

Genera: *Ocyröe, Cassiopea, Aurelia, Melitæa, Evagora, Cephæa, Rhizostoma, Chrysaora, Pelagia.*

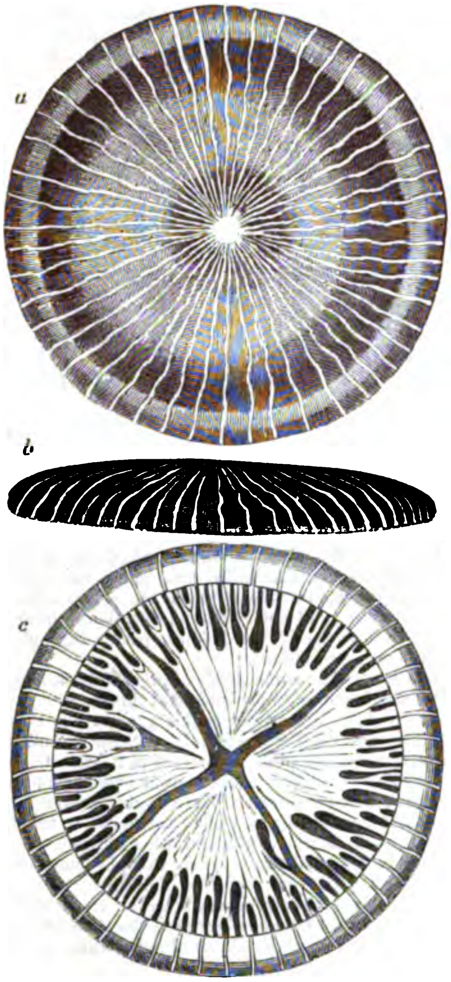
We now proceed to lay before the reader examples of these several sections.

Section I.

Eudora.

Generic Character.—Body very much depressed, discoïd, simple, without tentacular cirrhi, without either peduncles or appendages, and offering within only ramified canals opening (s'abouchant) by four large trunks, in the form of a cross, into a small central cavity without external aperture.

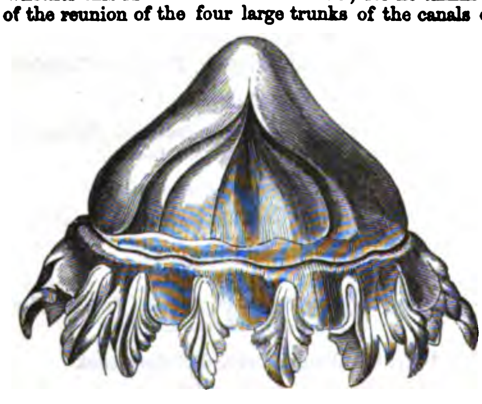
Example, *Eudora undulosa* (Péron and Lesueur).



Eudora undulosa.

a, view of the upper side; *b*, in profile, or with the edge of its disk towards the spectator; *c*, view of the lower side.

M. de Blainville remarks that he only knows this genus from the characteristic and short description given by Péron and Lesueur. He doubts whether this Medusa has not a mouth; for he thinks that the centre of the reunion of the four large trunks of the canals ought to



Charybdæa periphylla.

be regarded as a stomach. He further inquires whether the individual figured was complete. He says that M. Lesueur informed him that there was a membrane on the lower surface, and he inquires whether this was not perhaps some remains of the stomachal cavity.

Cuvier united this genus with the *Geryonia*. Eschscholtz places it in his family *Berenicidæ*, and unites *Euryale* with it.

Charybdæa.

Generic Character.—Body hemispherical, sub-conical, or even semi-elliptical, furnished on its circumference with foliaceous subtentacular lobes, hollowed below by a great stomachal excavation with an aperture as large as itself.

Example, *Charybdæa periphylla* (Pér. and Les.).

Section II.

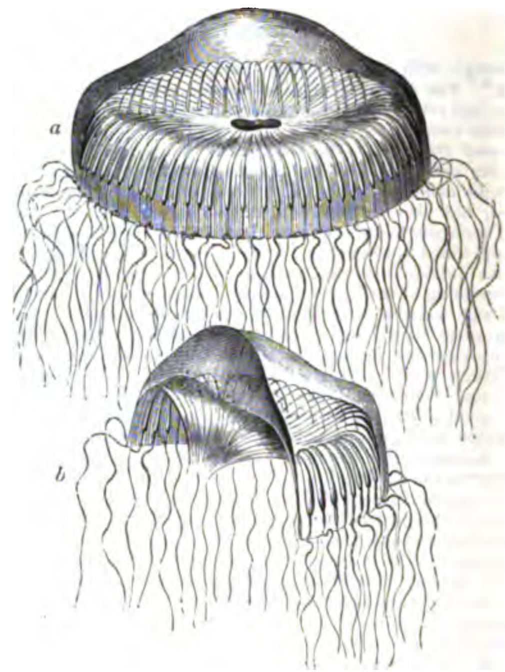
Æquorea.

Generic Character.—Body slightly diversiform, furnished at its circumference with a circle of filamentous tentacular cirrhi, often very long, and more or less numerous, a good deal excavated below, with a median orifice often at the extremity of a sort of circular lip, which is more or less projecting or provided with tentacular fringes.

Stomachal appendages linear, numerous, or sacciform and not numerous.

Example, *Æquorea cyanea* (Pér. and Les.).

Habitat.—South Seas.



Æquorea cyanea.

a, the animal complete; *b*, a portion thereof.

M. de Blainville divides this genus into the following sections:—

*

Marginal cirrhi very numerous; stomachal appendages equally numerous and linear.

A. Lip simple.
Genus *Æquorea*.
B. Lip fringed.
Genus *Mesonema*. (Esch.)

* *

Marginal cirrhi as well as the stomachal appendages sufficiently numerous, or not numerous.

C. Cirrhi sufficiently numerous, originating opposite to the triangular stomachal appendages.
Genus *Polyxena*. (Esch.)

D. Cirrhi and sacciform stomachal appendages few.
Genus *Ægina*. (Esch.)

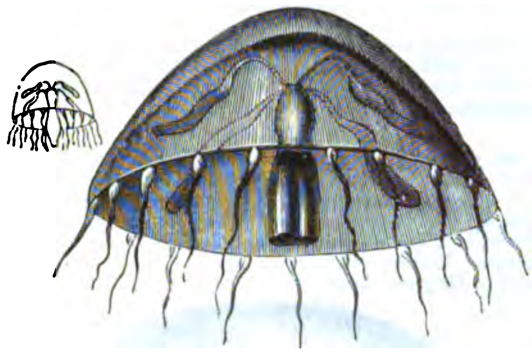
We have selected a genus of the first subdivision for illustration.

Section III.

Thaumantias.

Generic Character.—Body hemispherical, provided at its circumference with tentaculiform cirrhi which are bulbous at the root; very much excavated beneath, and having in its middle a free pedunculiform stomachal cavity dividing itself into claviform canals, and terminated by a simple buccal orifice.

Example, *Thaumantias cymbaloïdea.* (*Med. cym.* Slabber.; *Dianæa, cymb.*, Lam.)



Thaumantias cymbaloïdea.

Placed by Péron among his *Oceaniæ.*
Habitat.—Coasts of Europe; Holland.

Tima.

Generic Character.—Body hemispherical, depressed, furnished on its circumference with a circle of tentaculiform cirrhi, which are short and numerous; not much excavated beneath, and prolonged into a very thick conic peduncle, which is entirely exserted, and terminated

Tima flavilabris.

by a plicated enlargement; buccal orifice at the centre of four labial appendages; stomachal cavity in the enlargement of the peduncle, and giving origin to four ascending canals, and communicating with a marginal canal.
Example, *Tima flavilabris.*
Habitat.—The Azores.

SECTION IV.

Dianæa (Quoy and Gaim.)

Generic Character.—Body hemispherical, furnished on its circumference with a small number of tentaculiform cirrhi; excavated beneath

Favonia octonema.

and provided at its middle with a strong exserted proboscidiform appendage, with four brachideous appendages at its extremity.

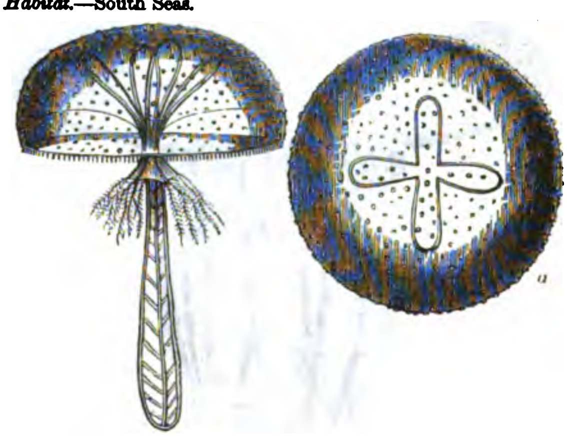
Favonia.

Generic Character.—Body subhemispherical, with neither cirrhi nor tentaculiform marginal cilia; rather deeply excavated beneath, with a long, median, proboscidiform prolongation, having at its root six or eight brachideous appendages, furnished with radiciform suckers. Four ovaries.
Example, *Favonia Octonema.* (*Orithyia Octonema*, Lam.)
Habitat.—South Seas.

Dianæa.

Lymnorea.

Generic Character.—Body subhemispherical, furnished on its circumference with very fine, short, and numerous tentacular cilia; rather deeply excavated beneath, and provided with a long proboscidiform prolongation, having at its base eight bifid and finely divided appendages. Four ovaries, in the form of a cross.
Example, *Lymnorea triedra.* (*Dianæa triedra*, Lam.)
Habitat.—South Seas.



Lymnorea triedra.
a, the disk seen from above.

SECTION V.

Pelagia.

Generic Character.—Body subhemispherical, lobated, auriculated, furnished on its circumference with a few tentaculiform cirrhi; eight inferior apertures at the extremity of a fistulous peduncle provided with four very strong and foliaceous arms. Four ovaries. Stomach with cæciform appendages.

Example, *Pelagia Labiche*, Esch. (*Cyanea Labiche*, Quoy and Gaim.)

Pelagia Labiche.

Rhizostoma.

Generic Character.—Body circular, hemispherical, provided on its circumference with lobes or festoons intermingled with auricles, largely excavated below, with four semilunar orifices, produced by four roots of insertion of a considerable pedunculated mass, afterwards divided into eight very complex brachideous appendages furnished with fibrillary suckers, without a median prolongation. Four ovaries, in the

Rhizostoma Cuvieri.

shape of a cross. Stomachal cavity very large and vascular at its circumference.

Example, *Rhizostoma Cuvieri.*

Habitat.—European Seas.

M. de Blainville separates the genus into two divisions.

A.

Species having a peduncle of insertion for the root, with radical appendages, besides those of the arms.

B.

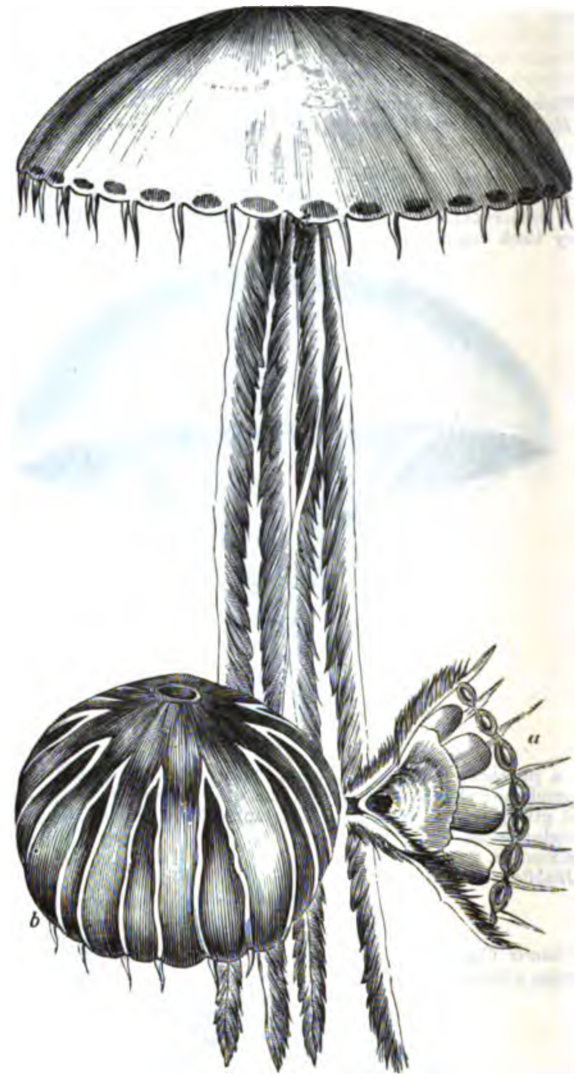
Species having a very short peduncle of insertion, without radical appendages, besides the four bifid arms. (*Evagora*, Pér.)

We have given an illustration of the first. The species grows to a very large size.

Chrysaora.

Generic Character.—Body circular, hemispherical, festooned, and provided with at least twenty-four tentaculiform cirrhi on its circumference; excavated internally into a considerable cavity with sacciform appendages; communicating externally by a single orifice, pierced in the centre of a median peduncle, provided with distinct brachideous appendages. Four ovaries.

Example, *Chrysaora lutea.*



Chrysaora lutea.

a, one-fourth of the disk or umbrella, seen from below; *b*, disk without its appendages.

The Pulmograde Medusæ have been recently studied with great care by Professor E. Forbes, and he proposes to divide them into two groups according as their eyes or ocelli are covered or destitute of this protection. When any of the more common forms of *Medusæ* are examined, as the species of *Rhizostoma* or *Pelagia*, it will be found that the margins of the ocelli are protected by more or less complicated membranes, hoods, or lobed coverings. This character accompanies another of great importance, that is, the possession of a complicated anastomosis and ramification of the vessels. In the case of *Thaumantias* and other genera it will be found that the ocelli are either absent or entirely naked, and this condition is accompanied with a very simple vascular system. Hence Professor Forbes proposes the following classification.

I. Steganopthalmata (στεγανός, *covered*).

Genera. *Aurelia*, Péron; *Medusa*, Eschscholtz; *Pelagia*, Péron and

Lesueur; *Chrysaora*, Péron; *Rhizostoma*, Cuvier; *Cassiopea*, Péron; *Cyanea*, Péron.

II. Gymnophthalmata (γυμνός, *naked*).

1. Vessels branched (*Willsiadæ*).

Genus. *Willsia*, Forbes.

2. Vessels simple. Ovaries convoluted, and lining the pedunculated stomach (*Oceanidæ*).

Genera. *Turris*, Lesson; *Saphenia*, Eschscholtz; *Oceania*, Péron.

3. Vessels simple, eight or more. Ovaries linear, in the course of the vessels on the sub-umbrella (*Æquoreadæ*).

Genera. *Stomobrachium*, Brandt; *Polyxenia*, Eschscholtz.

4. Vessels simple, eight. Ovaries as many as the vessels, small, in the course of the sub-umbrella (*Circeadæ*).

Genus. *Circe*, Mertens.

5. Vessels simple, four. Ovaries four, in the course of the vessels on the sub-umbrella (*Geryoniadæ*).

Genera. *Geryonia*, Péron; *Tima*, Eschscholtz; *Geryonopsis*, Forbes; *Thaumantias*, Eschscholtz; *Slabberia*, Forbes.

6. Vessels simple, four. Ovaries in the substance of the peduncle (*Sarsiadæ*).

Genera. *Sarsia*, Lesson; *Bougainvillea*, Lesson; *Lizzia*, Forbes; *Modeeria*, Forbes; *Euphysa*, Forbes; *Steenstrupia*, Forbes.

This arrangement applies to the British genera only, the species of which, with figures, are described in Professor Forbes's 'Monograph of the British Naked-Eyed Medusæ,' published by the Ray Society.

The second order of the *Acalephæ* are the Ciliograda, of which De Blainville gives the following definition:—

Body gelatinous, very contractile, free, diversiform, evidently binary or bilateral, sometimes appearing subradiated, provided with a kind of straight ambulacra, formed by the approximation of two series of vibratory cilia.

Intestinal canal complete, or provided with two orifices, a mouth and a vent.

The term *Ciliograde* has been given to these *Medusæ* on account of the minute organs called Vibratile Cilia, with which they are covered.

Arrangement.

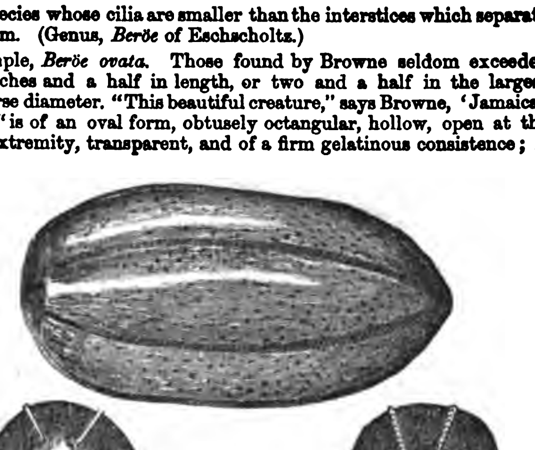
De Blainville, whose amended arrangement we take, observes that systematists have hitherto agreed to imitate Gmelin more or less on the subject of the place of the *Ciliograda* in the animal series, that is to say, in making them a genus approximating to the *Medusæ*; and he instances Lamarck, Cuvier, Latreille, and Oken, as not having expressed any doubts on the subject.

Genera.

1. *Beröe.*

α. Species whose cilia are smaller than the interstices which separate them. (Genus, *Beröe* of Eschscholtz.)

Example, *Beröe ovata*. Those found by Browne seldom exceeded three inches and a half in length, or two and a half in the largest transverse diameter. "This beautiful creature," says Browne, 'Jamaica,' p. 384, "is of an oval form, obtusely octangular, hollow, open at the larger extremity, transparent, and of a firm gelatinous consistence; it



Beröe ovata.

contracts and widens with great facility, but is always open and expanded when it swims or moves. The longitudinal radii are strongest at the crown or smaller extremity, where they rise from a very beautiful oblong star, and diminish gradually from thence to the margin: but each of them is furnished with a single series of short, delicate, slender appendices or limbs (the cilia) that move with great celerity either the one way or the other, as the creature pleases to direct its flexions, and in a regular accelerated succession from the top to the margin. It is impossible to express the liveliness of the motions of those delicate organs, or the beautiful variety of colours that rise from them while they play to and fro in the rays of the sun; nor is it more easy to express the speed and regularity with which the motions succeed each other from the one end of the rays to the other." Dr. Browne frequently met with these animals to the north of the western islands (West Indies).

β. Species whose cilia are twice as long as the interstices.
(Genus, *Medea*, Eschscholtz.)

Example, *Beröe rufescens*.

γ. Species whose cilia are situated in two ambulacral ridges.
(Genus, *Pandora*, Eschscholtz.)

Example, *Beröe Flemingii*.

2. *Cydippe.*

Body regular, free, gelatinous, divided into eight sections, more or less distinct, by as many double longitudinal rows of vibratory cilia. An internal cavity, with a large buccal (?) aperture, whence issue, and are prolonged more or less below, a pair of long appendages, which are retractile, and also furnished with vibratory cilia.

Example, *Cydippe pileus*; *Medusa pileus*, Gmelin; *Beröe pileus*, Lamarck; *Pleurobrachia*, Fleming; *Eucharis*, Péron, who really established the genus; but Eschscholtz having transferred the last name to a genus of Ciliobranchians, De Blainville prefers following him, to avoid greater confusion. [Beröe.]

Beröe (Cydippe) pileus.

3. *Callianira.* [Callianira.]

4. *Mnemia.*

Body smooth, oval, elongated vertically, very much compressed on one side, and as if lobated on the other. Buccal opening between the prolongation of the sides; conical appendages, on which the rows of vibratory cilia are ranged.

Example, *Mnemia heteroptera*, *Callianyra heteroptera* of Chamisso, thus described by Chamisso and Eisenhardt:—Body hyaline, cylindrico-tubular, dilated at one extremity, with a transverse mouth, into which it was impossible to penetrate. A large cestoid wing on each side, with vibratory cilia on its edges; six intermediate smaller wings, of which the four inferior (buccal) are lanceolated, ciliated on the edges, and attached to the base of the body; two superior cestoid wings uniting themselves to the two large lateral ones, which Péron, according to the describers, erroneously regarded as branchiæ.

5. *Calymma.* [Calymma.]

6. *Axiotima.*

Body a little elevated, a little compressed, or subcircular, prolonged to the right and left into a sort of appendages, bearing the series of cilia towards their terminal half only, and up to their end. Mouth small, entirely deprived of labial appendages.

Example, *Axiotima Gaëdis*, Eschscholtz. Locality, South Seas, near the equator.

7. *Eucharis* (Eschscholtz).

Body oval, sufficiently elevated, slightly compressed, or subcircular, covered with papillæ, with the ambulacra of natatory cilia extended from the summit to the base. Mouth small, provided with two rather long pairs of appendages.

Example, *Eucharis Tiedmanni*, Eschscholtz. Locality, seas of Japan. This name had been employed, as we have seen, by Péron, to distinguish another genus of Ciliograda, and should not have been transferred: for in all such cases confusion must be the consequence. The student must now remember that the *Eucharis* of Péron and that of Eschscholtz represent two different generic forms.

8. *Ocyröe.*

Body gelatinous, transparent, vertical, cylindrical, provided above with two lateral musculo-membranous, bifid, thick, wide lobes, and with two fleshy ciliated rib-like elevations, with two other ciliated ribs upon the edges between the lobes: aperture provided with four ciliated arms.

Example, *Ocyröe crystallina*, Rang, who founded the genus. De

Blainville thinks that it bears much resemblance to the last species of *Callianira*—*Callianira hexagona?*

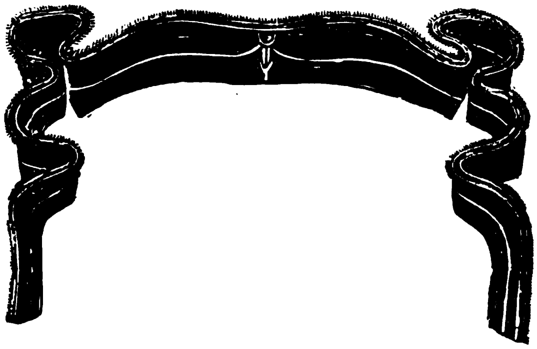
9. *Alcynöe.*

Body gelatinous, transparent, vertical, cylindrical, with eight ciliated ribs, hidden in part under the vertical natatory lobes. Aperture provided with four ciliated appendages.

Example. *Alcynöe vermiculata*, Rang, who established the genus. Locality, coasts of Brasil.

10. *Cestum.*

Body gelatinous, free, regular, very short, but extended or prolonged on each side into a long riband-like appendage, bordered on each angle with a series of vibratory cilia, thus forming four ambulacra,



Cestum Veneris.

two on each side. Mouth inferior and mesial, accompanied by a pair of long, ciliferous, retractile and simple appendages.

Example, *Cestum Veneris*, Lesueur.

Velella lata.

a, upper side; *b*, lower side.

Although there is not much resemblance between this singular genus and the typical forms of Ciliograda, yet they are connected by a succession of intermediate links. If we refer to the genus *Callianira*, we shall find that its globular body is so extended laterally as to have a wing-like appendage on either side. In other genera these lateral appendages are still more extended, until the globular body in the centre is entirely lost. The alimentary canal of *Cestum* runs across the middle of its length, and from it extends, as from the stomach of the *Medusæ*, a series of gastric canals which carry the nutriment to all parts of the body.

The third order is the Cirrhigrada. They are thus called from the cirrhi which are attached to the disk upon which their organs are disposed. These cirrhi are, some of them, tubular, and are furnished with suckers. The cæcal appendages are attached to their base, in which are produced the ova, which pass out at the mouth of the cirrhi. The following is De Blainville's definition of the order:—

Body, oval or circular, gelatinous, sustained in the interior of the dorsal disk by a solid subcartilaginous part, and provided on the lower surface of the disk with tentaculiform cirrhi, which are very extensible.

Genera.

1. *Velella.*

Body membranous, oval, very much depressed, convex, swollen, sustained above by a transparent oval subcartilaginous piece, marked with concentric striæ, and surmounted by a vertical and oblique crest, concave below, with a sort of mesial nucleus, offering a central mouth at the extremity of a proboscidiform prolongation, surrounded by tentacular cirrhi of two kinds, the external being much longer than the internal ones.

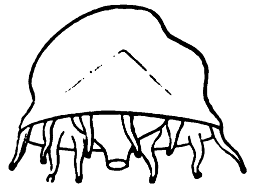
De Blainville observes that Imperato and Columna would appear to be the authors who first noticed the animals which constitute this genus, established, at first, under the name of *Phyllidoce*, by Patrick Browne, and figured by him in his 'History of Jamaica,' tab. 48, *fig.* 1. Forskahl, who gave a very good description of it, arranged it under his genus *Holothuria*. Lœfling made it a *Medusa*, denominating the species known to him *Medusa Velella*, a name adopted by Linnæus in the 'Systema Naturæ.' Dana ('Soc. Roy. de Turin,' 1766) proposed the name of *Armenistarus* for it; and Lamarck published it under the generic appellation of *Velella*, by which it is now generally known to naturalists.

This form is widely diffused, and has been found in the seas of Europe, America, Asia, and Australasia. One of the species, *V. limbosa*, is often taken on the southern coasts of England. The animals are met with far at sea, and often huddled together, young and old, in considerable masses. Sailors are said to fry and eat them.

The *Phyllidoce labris cæruleis*, the *Sally-Man* of Browne, appears to be the *Velella cyanea*, of Lesson and Garnot, and one at least of the species which gave rise to the *Medusa Velella* of Linnæus and Gmelin (Lamarck quotes the last name as well as Browne's *Phyllidoce*, as synonyms of his *Velella mutica*).

2. *Rataria.*

Body oval or circular, sustained by a subcartilaginous, compressed, elevated piece, with a muscular, moveable, longitudinal crest above, concave below, and provided in the middle with a free proboscidiform stomach, and with a single row of marginal tentaculiform suckers.

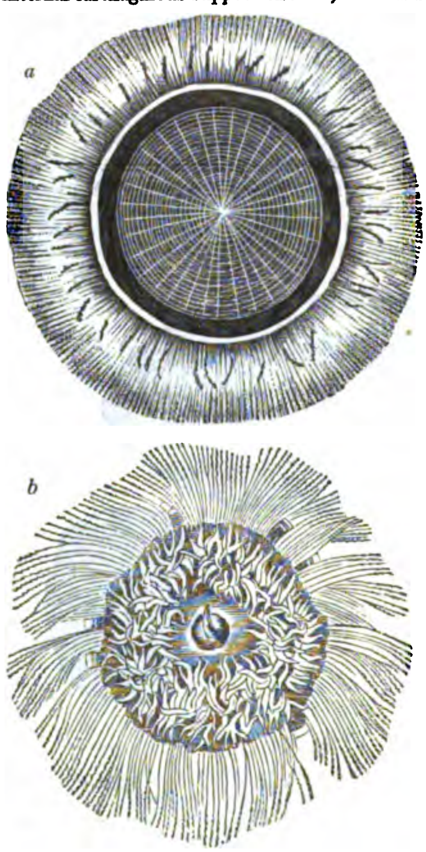


Rataria mitrata, highly magnified.

Eschscholtz established this genus for some very small cirrhigrade animals, whose back is sustained by a subcartilaginous piece, not elevating itself in the dorsal cavity, and which only offer marginal cirrhi on the central surface. De Blainville, after observing that Forskahl has figured with his *Holothuria spirans* (*Velella limbosa* of Lamarck) some very small animals, which M. Eschscholtz himself regards as closely approximating to his *Rataria cordata*, says that it seems possible that the *Rataria* may be only degrees of development of *Velella*. Example, *Rataria mitrata*.

3. *Porpita.*

Body membranous, regular, circular, depressed, slightly convex above; internal cartilaginous support circular, with its surface marked by concentric striæ crossing radiated striæ, covered on its upper surface by a delicate membrane merely. The body is concave below, and the inferior surface is furnished with a great number of tentacula, of which the exterior ones are the longest, and furnished with small cilia, each terminated by a globule: they sometimes contain air; and the internal ones are the shortest, the most simple, and the most fleshy. In the centre of these tentacula is the mouth, in form of a small proboscis, which leads to a simple stomach, surrounded by a somewhat glandular substance.



Porpita gigantea.

a, upper side; *b*, lower side.

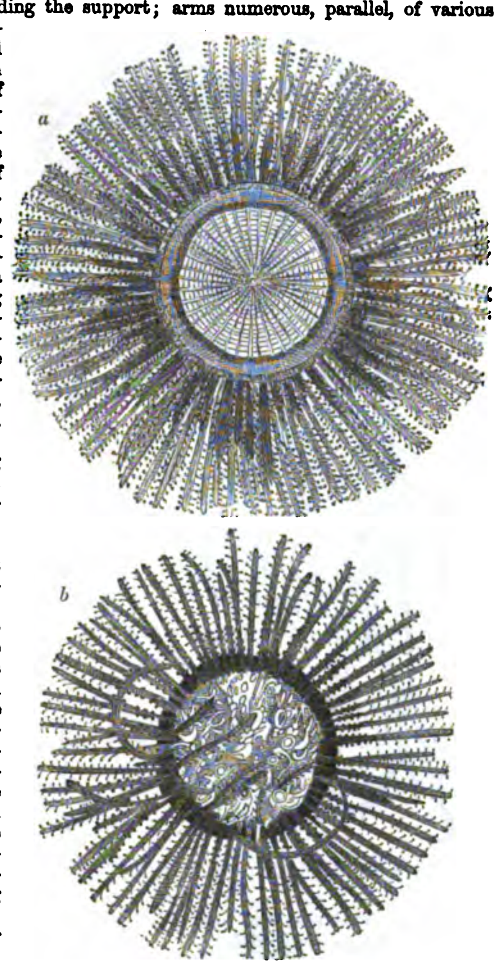
Cuvier, from whom a great portion of the above description is taken, says, in the last edition of the 'Règne Animal,' that there is but one species (*Porpita gigantea*) of a beautiful blue colour, from the Mediterranean, and other warmer seas. Lamarck, who established the genus for an animal which had been placed among the *Medusæ* by Linnæus, gives four species but De Blainville and MM. Chamisso and Eisenhardt coincide with Cuvier in believing that they are all referable to one, though the former admits that the fact is still somewhat doubtful. He observes that Bosc's species, *Holothuria appendiculata*, (*Porpita appendiculata*, Lam.) was evidently established on an impaired animal. Eschscholtz, under the name of *Porpita Mediterranea*, conjoins three of Lamarck's species, and describes three new ones, taking for his character the proportion of the cartilaginous disk, and especially that of the marginal cirrhi.


Profile of *Porpita glandifera*.

Geographical Distribution.—Like that of *Velella*, very wide. Bosc, who met with them at sea, says the animal has the appearance of a 24-sous piece borne along by the waves. Examples, *Porpita gigantea*, and *P. glandifera*.

4. *Polybrachionia.* (Guilding).

Dorsal support (sustentaculum) cartilaginous, naked, flattened, rounded, radiated, concentrically striated; mantle (pallium) narrow, free, surrounding the support; arms numerous, parallel, of various lengths, elongated, affixed beneath, with a power of taking a declining position for the purpose of taking prey. Mouth below, central, purse-shaped, extensile. Tentacula many, varying in form, suctorial, covering the whole ventral surface. Eggs, very small, innumerable, nestled among the tentacula. Example, *Polybrachionia Linnæana.*



Polybrachionia Linnæana, enlarged
a, upper side; *b*, lower side.

This genus has been established by Mr. Guilding, who describes the support as broad and vitreous, the body as cerulean, the tentacula as pallid, and the arms, which are in a triple series, glandulous, the glandules being pedunculated. The diameter of the mantle, exclusive of the arms, is stated to be eleven and a half lines. Mr. Guilding states that the animal is wonderfully beautiful, swimming, or rather floating on the serene surface of the Caribean Sea in calm weather, and embracing its prey by the sudden downward application of some or all of its arms, which are easily broken by attrition.

We think there is hardly enough to warrant a generic separation in this case; the species bears a strong resemblance to the *Porpita cærulea* of Eschscholtz. Mr. Guilding observes that the *Medusa porpita* of the 'Amænitates Academicæ' seems nothing more than the central disk of some species deprived of all the organs of the body.

The fourth order is the PHYSOGRADA. The structure of the creatures belonging to this order were but little known till the publication of Mr. Huxley's researches, in 'Philosophical Transactions' for 1849. They are allied to the preceding order both in the conformation of the gastric organs and in their means of locomotion. The principal difference between this and the preceding families is, that we here lose the radiate form, and observe in the creatures which belong to it a lateral symmetry. This order is now made to include the genus *Physalia* and its allies, which are possessed of an air-bag, by means of which they float through the ocean, and also the various forms of *Diphydæ*. These two forms were included by Cuvier in his division of *Hydrostatic Acalephæ*. Before referring to their arrangement, we shall give the principal results of Mr. Huxley's researches into the anatomy of these creatures, as given by him in the 'Report of the Twenty-First Meeting of the British Association for the Advancement of Science.' We shall speak first of the *Diphydæ*. If one of these creatures is examined, it will be found to consist of two transparent crystalline pieces, which look, when taken out of the water, like morsels of cut-glass. One or both of these pieces contains a wide cavity, lined with a muscular membrane, by the contraction of which the animal is propelled through the water. The attachment of the posterior piece to the anterior is very slight, and when detached it will swim about independently for hours together. It was this circumstance which led Cuvier to suppose that the two pieces were two independent animals, and in this he has been followed by the majority of zoologists. He describes the two individuals as always together, one including itself in a hollow of the other (l'un s'emboîtant dans un creux de l'autre), an arrangement which nevertheless permits their separation without the destruction of life. They are, he observes, gelatinous, transparent, and move very nearly like the *Medusæ*. The including individual (l'emboîtant) produces from the bottom of its hollow a chaplet (chapelet) which traverses a demi-canal of the included individual (l'emboîté), and would seem to be composed of ovaries and of tentacula and suckers like those of the preceding genera. Cuvier then goes on to state the divisions established by MM. Quoy and Gaimard, according to the relative forms and proportions of the two individuals. Thus in the *Diphyes*, properly so called, the two individuals are nearly alike, pyramidal, and with some points round their opening, which is at the base of the pyramid. In the *Calpes*, the included individual has still the pyramidal form, but the including individual is very small and square. In the *Abyles*, the included individual is oblong or oval, and the including rather smaller and bell-shaped. In the *Cuboïdes*, it is the included individual which is small and bell-shaped; the including individual is much larger and square. In the *Navicules*, the included individual is bell-shaped; the including individual large also, but slipper-shaped (en forme de sabot). Cuvier concludes by remarking that there are many other combinations. There are two prominent forms of *Diphydæ*, the *Monogastric* and the *Polygastric*. In the former a single polype is developed in a special cavity of the anterior piece. In the polygastric a long chain of such polypes, each enveloped in a little transparent bract, occupies a similar position. These polypes have no oral tentacles; but a long thread-like tentacle, bearing lateral branches, which are terminated by small sacs, is developed from the base of every polype. The small prehensile sac has a peculiar form, but is only a dilatation of its pedicle. It is much thickened on one side, and contains a great number of the stinging hairs to which we have before alluded. The reproductive organs are medusiform bodies, which are developed by gemmation from the pedicle of the polype.

In the *Polygastric Diphydæ* new polypes are continually being produced by gemmation at the attached extremity of the polype-chain, and in all the species the same gemmation is continually going on among the prehensile and reproductive organs.

The structure of the other forms of *Physograda* are modifications of a common type, in the main identical with that of the *Diphydæ*. The great difference is in the absence of the air-organ, or float. The same continual multiplication of parts by germination goes on among the *Physsophoridæ* as among the *Diphydæ*, and the structure and mode of development of the young organs are the same. Great variety is presented by the reproductive organs, from the form of mere sacs to that of free-swimming bodies precisely resembling *Medusæ*, and developing the generative elements only subsequently to their liberation. In *Physalia* the female organs are free-swimming medusiform bodies, while the male organs are simply pyriform sacs.

As a general conclusion it may be stated that the *Physograda* are essentially composed of two membranes, an outer and an inner, which are called by Mr. Huxley 'foundation membranes,' since every organ is formed by the modelling into shape of one or other or both of these; commencing as a simple process, or diverticulum, and assuming its perfect form by a gradual change of development. The stomach has no walls distinct from those of the general varieties. The reproductive organs are always developed externally. The stinging hairs, or thread-cells, are found in all the species in the greatest abundance.

The following is the arrangement of these creatures according to M. de Blainville:—

PHYSOGRADA.

*

Natatory organ simple and lamellar.

1. *Physalia.*

Generic Character.—Body oval, rather elongated, more narrow and proboscidiform anteriorly, hydatiform in the middle, attenuated and obtuse posteriorly; mouth star-shaped and terminal; anus lateral; a foot in form of a crest or oblique lamina, directed from before backwards; branchiæ very anomalous, and composed of a great number of diversiform cirrhous productions; organs of generation terminating at the anterior third of the right side by two closely approximated orifices.

Example, *Physalia Arethusa.*

This is the *Arethusa* of Browne; *Medusa Caravella* of Müller and Eschscholtz; *Physalus Pelagicus* of Lamarck; the Portuguese Man-of-War of English voyagers. This *Physalus* is an inhabitant of the warm seas, but a shoal of them are sometimes driven into our bays, particularly on the south-west coast.

Physalus Pelagicus; the crest not expanded.

* *

Locomotive organs complex and vesicular.

2. *Physsophora.*

Generic Character.—Body more or less elongated, cylindroid, hydatiform in its anterior part, provided below with two series of vesicular diversiform bodies, with a regular aperture, and behind with a variable number of very diverse cirrhiform productions, two of which are longer and more complex than the others; mouth at the extremity of the hydatiform part; anus terminal.

Example, *Physsophora Muzonema.*

M. de Blainville states that the *Physsophoræ* differ from the *Physaliæ* in swimming or floating in a vertical position, the air-bag being above and the cirrhiferous productions below. The distinction of the species appears to him to depend especially on the number and form of the natatory organs.

3. *Diphysa.*

Generic Character.—Body cylindrical, elongated, contractile, muscular, composed of three parts, the anterior part vesicular, the middle part bearing on its lower part two hollow natatory organs, placed one before the other, and the third part (which is the longest) provided above with a fibrillo-capillaceous plate, and below with cirrhiform productions; mouth terminal.

Example, *Diphysa singularis* (Quoy and Gaimard; 'Astrolabe, Zoologie').

4. *Rhizophysa.*

Generic Character.—Body free, transparent, very contractile, very much elongated, swollen at one extremity into a sort of aëriferous bladder with a terminal orifice, provided throughout its length with scattered tentaculiform productions mingled with cirrhiform filaments.

This genus is divided by M. de Blainville into two sections.

a.

Species with simple tentaculiform productions. Natatory organs hollow. (Genus *Rhizophysa.*)

Example, *Rhizophysa planostoma*, Péron. (*Rhizophysa Péronii*, Esch., 'Acaleph.,' p. 148, No. ii., t. 13, *fig.* 3.)

β.

Species whose tentaculiform productions are covered with cirrhiform filaments. Natatory organs unknown. (Genus *Epibulia*, Esch.)

Example, *Rhizophysa filiformis.* (*Physsophora filiformis*, Forsk.)

1. *Rhizophysa filiformis*; 2. *Physsophora Muzonema.*

* * *

Species provided with two sorts of locomotive organs, the anterior ones hollow, the posterior solid.

5. *Apolemia.*

Generic Character.—Body very much elongated, cylindrical, vermiform, provided anteriorly with many hollow natatory organs in two rows, and behind with solid squamous organs, between which come forth tentaculiform cirrhi, furnished with vermiform suckers.

Example, *Apolemia Urania.*

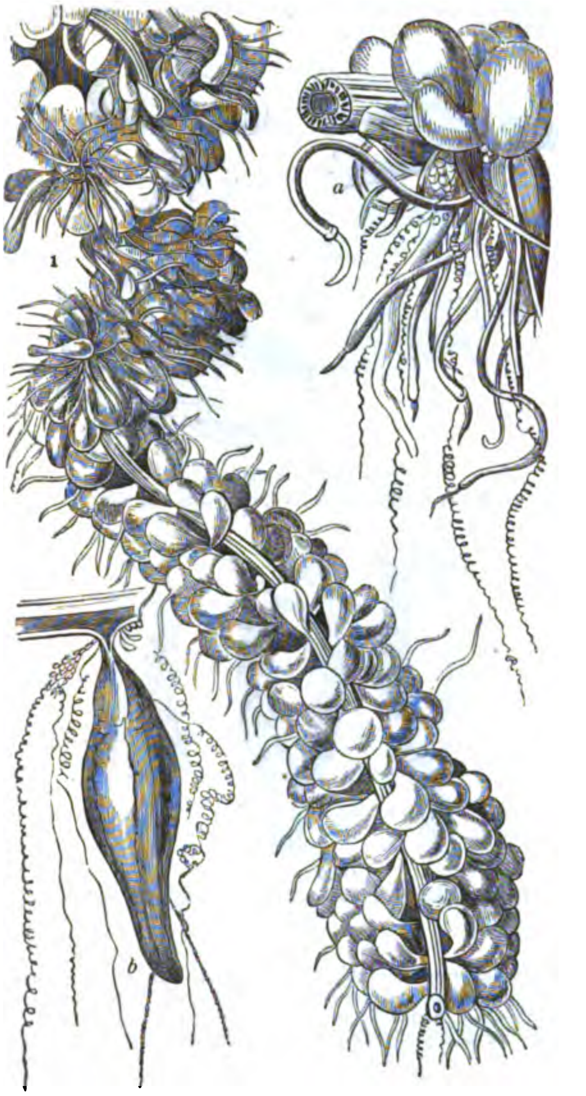
6. *Stephanomia.*

Generic Character.—Body in general very much elongated, cylindrical, vermiform, covered throughout its extent, except in the lower median line, with squamous natatory organs, full and dispersed in transverse bands, between which come forth, and especially inferiorly, long, very much diversified cirrhiform productions, mingled with the ovaries. Orifices of the intestinal canal terminal.

Example, *Stephanomia Amphitrides*, Péron et Lesueur ('Voyage aux Terres Austr.,' p. 45, pl. 29, *fig.* 5).

7. *Protomedea.*

Generic Character.—Body free, floating, cylindrical, fistulous, very long, provided above with an imbricated assemblage of gelatinous bodies (in two alternate rows) which are full and hippopodiform, and throughout the rest of its length with filamentous, cirrhous,



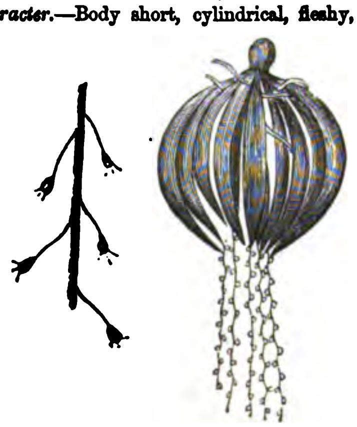
1, a portion of *Apolemia Urania*.
a, a part still more highly magnified; *b*, a single sucker.

diversiform productions. Mouth proboscidiform, at the extremity of a sort of vesicular stomach.

Example, *Protomedea lutea*.

8. *Rhodophysa*.

Generic Character.—Body short, cylindrical, fleshy, swollen above

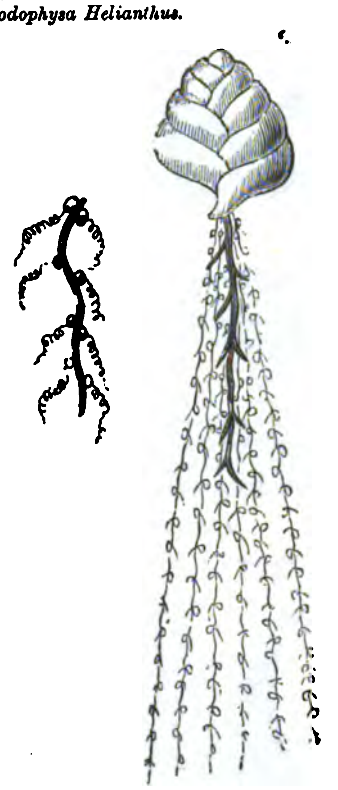


Rhodophysa Helianthus.

into an aëriferous bladder, and provided below with a variable number of gelatinous bodies, which are full, costiform, forming a single

transverse series, and with a variable number of filamentous diversiform productions. Mouth and anus terminal.

Example, *Rhodophysa Helianthus*.



Protomedea lutea.

DIPHYDÆ.

a.

Diphydæ whose anterior part has but a single cavity (Monogastric).

Genera.

1. *Cucubalus*.

Body provided with a large proboscidiform exsertile sucker, with a bunch (grappe) of ovaries at its base, lodged in a large single excavation of a natatory anterior cordiform organ, receiving also the posterior, which is also cordiform and hollowed into a cavity with a posterior and sub-oval orifice.

Cucubalus cordiformis.

Example, *Cucubalus cordiformis*, the only species cited of the genus established by MM. Quoy and Gaimard. Length, two lines. Differs from the other *Diphydæ*, first, in having the nucleus much less hidden and sunk in the anterior natatory body, which has moreover only one large cavity in which it is plunged; secondly, in having the oviferous production very short; and, lastly, in the mode of locomotion, for the animal always swims vertically.

2. *Cucullus*.

Body furnished with a great exsertile proboscidiform sucker, with a bunch of ovaries at its base, lodged in a deep excavation, the only one in the anterior natatory organ, in form of a hood, in which the posterior is inserted (s'emboîte); the latter is tetragonal, and pierced behind with a rounded terminal orifice.

Cucullus Doreyanus.

Example, *Cucullus Doreyanus* (Quoy and Gaimard). Locality, New Guinea.

3. *Cymba* (*Nacelle*).

Body furnished with a large exsertile and proboscidiform sucker, having at its base a mass of ovariform organs, lodged in the single and rather deep cavity of a naviform natatory organ, receiving and partially hiding the posterior natatory organ, which is sagittiform, pierced behind with a rounded orifice crowned with points, and hollowed on its free border by a longitudinal gutter.

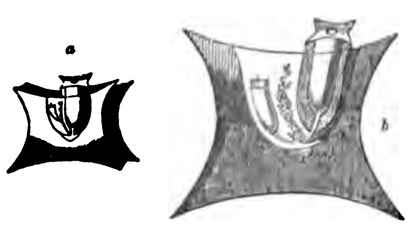
Example, *Cymba sagittata* (Quoy and Gaimard); *Nacelle sagittata* (De Blainville). Locality, Straits of Gibraltar.

Cymba sagittata.

M. de Blainville remarks that he ought to observe that M. Eschscholtz says that this genus, to which he unites the two following genera, possesses an anterior natatory organ with two cavities, and of these the natatory cavity projects in the form of a tube. M. de Blainville further observes that this genus does not differ from the *Cucullì*, except in the form of the natatory organs; in fact, the disposition of the nucleus in the bottom of the single cavity into which the anterior organ is hollowed, and the penetration of the posterior organ into this same cavity are absolutely the same as in the two preceding genera, as M. de Blainville has been able to satisfy himself from the examination of many individuals preserved in spirit.

4. *Cuboïdes.*

Body nucleiform, provided with a large proboscidiform sucker, surrounded by an hepatic mass, having at its base an ovary, whence proceeds a filiform ovigerous production, contained in a large, single, hemispherical excavation of an anterior, cuboïd, natatory organ, much larger than the posterior one, which is tetragonal, and nearly entirely hidden in the first.



Cuboïdes vitreus.

a, natural size; *b*, magnified.

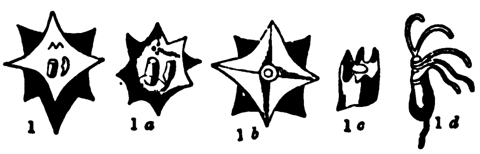
Example, *Cuboïdes vitreus* (Quoy and Gaimard). Locality, Straits of Gibraltar.

This again, according to M. de Blainville, is a genus scarcely distinguishable from the preceding genera, and only by the form and proportion of the natatory organs.

5. *Enneagona.*

Body nucleiform, provided with a large exsertile sucker, having at its base an assemblage of ovaries, whence proceeds an oviferous production. Anterior natatory organ enneagonal, containing with the nucleus in a single (?) excavation the posterior organ, which is much smaller, with five points, and canaliculated below.

Example, *Enneagona hyalina* (Quoy and Gaimard).



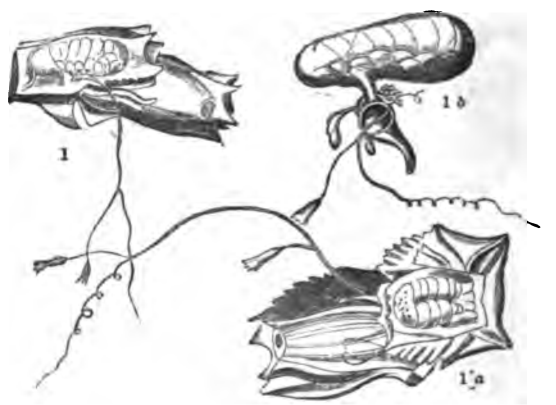
Enneagona hyalina.

1, 1 *a*, 1 *b*, *Enneagona hyalina* under different aspects; 1 *c*, visceral part; 1 *d*, nucleus.

6. *Amphiroa.*

Body nucleiform, of considerable volume, furnished with a proboscidiform stomach, having at its base a bunch of ovaries, prolonged into a long filament, contained in an anterior, polygonal, short, natatory organ, cut squarely, with a single cavity in which the posterior organ, which is equally short, polygonal, and truncated, is inserted.

Example, *Amphiroa alata* (Lesueur). Locality, Seas of Bahama.



Amphiroa alata.

1, 1 *a*, *Amphiroa alata*; 1 *b*, its nucleus extracted.

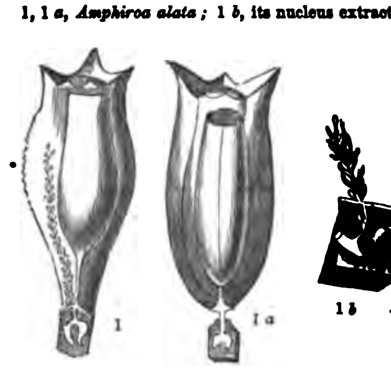
β.

Diphydæ whose anterior part is furnished with two distinct cavities.

1. *Calpe.*

Body nucleiform, without an exsertile proboscis, having a sort of aëriferous vesicle, and at its base an ovary (?) prolonged into a long cirrhigerous and oviferous production. Anterior natatory organ short, cuboïd, having a distinct locomotive cavity; posterior natatory organ very long, truncated at the two extremities, not penetrating into the anterior organ, and provided with a round terminal aperture.

Example, *Calpe pentagona* (Quoy and Gaimard). Locality, Straits of Gibraltar?



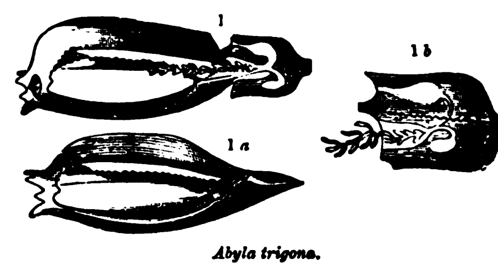
Calpe pentagona.

1, *Calpe pentagona* (profile); 1 *a* (under side); 1 *b*, nucleus.

2. *Abyla.*

Body nucleiform, inconsiderable, with a very long cirrhigerous and oviferous production. Anterior natatory body much shorter than the other, subcuboïd, with a distinct cavity for the reception of the anterior extremity of the posterior natatory body, which is polygonal and very long.

Example, *Abyla trigona* (Quoy and Gaimard). Locality, Straits of Gibraltar.



Abyla trigona.

1, *Abyla trigona*; 1 *a*, posterior part; 1 *b*, anterior or visceral part.

3. *Diphyes.*

Body nucleiform, indistinct, situated in the bottom of a deep cavity, whence proceeds a long tubular production, furnished throughout its extent with proboscidiform suckers, having at their root granular corpuscles and a cirrhiferous filament. Natatory bodies nearly equal and similar; the anterior with two distinct cavities, the posterior with a single one, with a round aperture provided with teeth.

Example, *Diphyes Bory* (Quoy and Gaimard); *Diphyes campanulifera* (Eschscholtz).

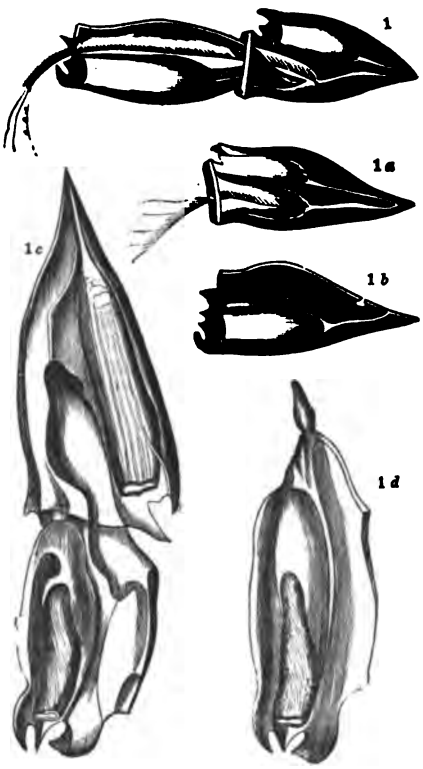
γ.

Doubtful species, or those with one part only.

1. *Pyramis.*

Body free, gelatinous, crystalline, rather solid, pyramidal, tetragonal, with four unequal angles, pointed at the summit, truncated at its base,

with a single rounded aperture communicating with a single deep cavity, towards the end of which is a granular corpuscle.
Example, *Pyramis tetragona* (Otto).



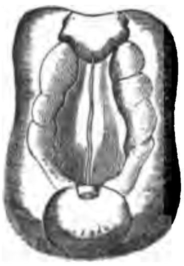
Diphyes Bory.
1, the entire animal (profile); 1 *a*, anterior part of the same; 1 *b*, posterior part; 1 *c*, animal magnified; 1 *d*, posterior part of the same.

M. Eschscholtz makes this organised body a species of his genus *Eudoxia*, which comprehends *Cucubalus* and *Cucullus* of Quoy and Gaimard, admitting that the two natatory organs are intimately united so as to form, apparently, but one.

Pyramis tetragona.

2. *Praia.*

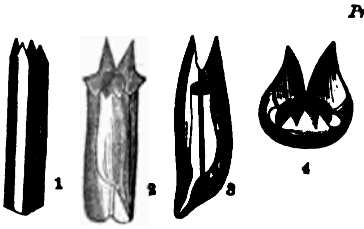
Body subgelatinous, rather soft, transparent, binary, depressed, obtuse, and truncated obliquely at the two extremities, hollowed into a cavity of little depth, with a round aperture nearly as large as the cavity, and provided with a large canal or furrow above.
Example, *Praia dubia* (Quoy and Gaimard).



Praia dubia.

3. *Tetragona.*

Body gelatinous, transparent, rather solid, binary, of an elongated, parallelopiped, tetragonal form canaliculated below, truncated obliquely anteriorly, pierced behind by a gaping orifice furnished with symmetrical points, and leading into a long blind cavity.
Example, *Tetragona hispidum* (Quoy and Gaimard).

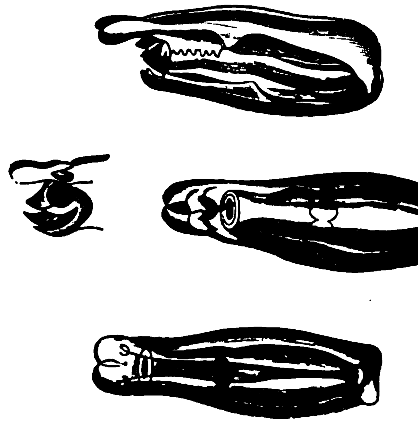


Tetragona hispidum.
1, *Tetragona hispidum*; 2, 3, 4, details of the same.

4. *Sulculeolaria.*

Body subcartilaginous, transparent, elongated, cylindroïd, traversed throughout its length by a very large furrow, bordered with two

membranes, truncated at the two extremities, with a posterior aperture, with appendicular lobes on its circumference, and leading into a very long and blind cavity.
Example, *Sulculeolaria quadrivalvis* (Lesueur). Locality, Mediterranean (Nice).



Sulculeolaria quadrivalvis.

A genus characterised by De Blainville, who found it established in the figures of Lesueur, from those figures; but the former is strongly inclined to believe that the genus is founded on the part of an animal, and not on an entire one.

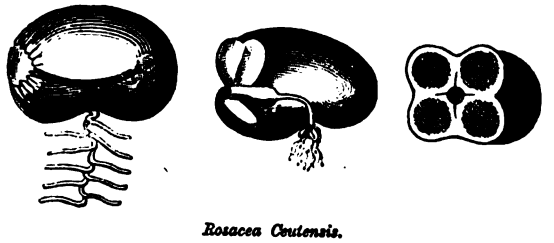
5. *Galeolaria.*

Body gelatinous, rather firm, perfectly regular, symmetrical, subpolygonal or oval, compressed on the sides and furnished with two lateral rows of extremely fine cirrhi. A large posterior aperture pierced in a sort of diaphragm with appendicular lobes, binary above, leading into a large cavity with muscular walls. An ovary at the anterior superior surface, coming out by a mesial and bilabiated orifice.
Example, *Galeolaria australis*, *Beroïdes australis* (Quoy and Gaimard).

Galeolaria australis.

6. *Rosacea.*

Body free, gelatinous, very soft, transparent, suborbicular, with a single terminal aperture at one of the poles leading into an oval cavity which communicates with a depression, whence proceeds a cirrhigerous and oviferous production.
Example, *Rosacea Ceutensis* (Quoy and Gaimard).



Rosacea Ceutensis.

7. *Noctiluca.*

Body free, gelatinous, transparent, spheroïdal, reniform, with a sort of infundibuliform cavity, whence proceeds a proboscidiform contractile production.
Example, *Noctiluca miliaris* (Lamarck).
M. Surriray, a doctor of medicine, while investigating the cause of the phosphorescence of the sea-water at Hâvre, appears to have been the first who observed and called attention to the genus *Noctiluca*, which he described and figured in the memoir that he communicated to the class of sciences of the French Institute. Its size hardly equals that of a small pin's head, and it is as transparent as crystal; he found it very common in the basins at Hâvre, sometimes in such abundance as to form a considerably thick crust (croûte assez épaisse) on the

Noctiluca miliaris.

surface of the water. It has also been observed in England as the cause of phosphorescence in the ocean.

8. *Doliolum.*

Body gelatinous, hyaline, cylindrical, truncated, and equally attenuated at the two extremities, which are largely opened and without apparent organs.

Example, *Doliolum Mediterraneum* (Otto).

M. Otto describes the organism on which he has established this genus as swimming by ejecting and absorbing the water by means of the alternate dilatation and contraction of its two orifices. M. Delle Chiaje ('Mem.,' tom. iii.) seems inclined to believe that the *Doliolum* of Otto is merely a fragment of a species of *Holothuria*, which he names *Holothuria inhærens*. De Blainville observes that if Otto's description of the motion, &c., above stated, be correct, it is probable that the animal is a true *Biphore*.

"Among the genera," says De Blainville, "*incertæ sedis*, which, wrong or right, have been connected with *Physsophora* or *Diphyes*, without even being very certain that they are animals, we shall cite the following genera intentionally omitted in our work."

Cupulites (Quoy and Gaimard), placed among the *Physsophoræ*, whose capsules are disposed on each side of a very long axis, established on an organised body, figured pl. 87, fig. 4—16 in the zoological part of the 'Voyage of the Uranie.' Not having met with this animal in their second voyage, MM. Quoy and Gaimard doubt ('Astrolabe, Zoolog.,' t. iv. p. 53 n.) whether it is an incomplete *Physsophora* or a *Stéphomoniæ* (*Stephanomia ?*) with hollow natatory organs. Cuvier places the genus between *Hippopus* and *Racemis*.

Polytoma (Quoy and Gaimard, 'Zool. of the Uranie,' pl. 87, fig. 12, 13), which may be defined to be an oval mass of globular trivalvular corpuscles (corpuscules globuleux comme trivalves), and which MM. Quoy and Gaimard conceive to be rather a *Biphore* than a *Physograde*.

Tetragona (p. 10), (Quoy and Gaimard, 'Zool. of the Uranie,' pl. 86, fig. 11). This the authors themselves ('Astrolabe,' iv. p. 103) have recognised as being nothing more than the posterior point of *Diphyes hispida*.

Racemis (Delle Chiaje, Cuvier), figured by Delle Chiaje, 'Mem.' tab. 50, f. 11, 12, and described as a globose vesicle endowed with a very quick motion, and disposed towards an ovate shape; but, observes De Blainville, the figures and description are too incomplete to afford a supposition of what it is; in fact, Delle Chiaje confines himself to stating that his *Racemis ovata* executes all the rotatory and rapid motions at the surface of the water, and that those of each vesicle are so lively that it has been absolutely impossible to perceive the aperture with which, according to Delle Chiaje, they are provided. Cuvier only adds to the description of Delle Chiaje, who also places *Racemis* near the *Physsophoræ*, a small membrane with which each vesicle is furnished. M. De Blainville concludes by observing that he had seen a drawing, by M. Laurillard, which had been taken at Nice from one of these organised bodies while alive, and that he supposed that it might well be a mass of eggs of *Mollusca*.

Relations of the Acalephæ to the other Invertebrata.—Mr. Huxley, in his memoir before referred to, proposes to consider the *Acalephæ* in some new relations. The presence of stinging hairs in these animals, in common with the *Hydroid*, *Sertularian*, and *Anthozoic Polypes*, he regards as a fact of primary importance. He endeavours to show that this fact, combined with the radiate polype form, and the composition of the body of two distinct membranes, forms a very good positive character for a group embracing the *Hydroid* and *Anthozoic Polypes*, and the *Acalephæ*. He proposes to give the name of *Nematophora* ('thread-bearers') to this group, in allusion to the characteristic presence of the 'thread-cell.' Frey and Leuckart had, however, applied the term *Cœlenterata* to the same group. It will admit of subdivision into two equivalent subclasses: one including the *Hydroid Polypes*, the *Diphydæ*, *Physsophoridæ*, and *Medusidæ*, in which the stomach is not distinct from the common parietes, and the reproductive organs are external; the other, embracing the *Anthozoic Polypes* and *Beroidæ* in which the stomach is distinct from the common parietes, and the reproductive organs are internal. The author proposes the terms *Anæcioa* and *Æcioa* for these two divisions. These groups mutually represent each other as follows:—

Anæcioa.	Æcioa.
Hydroidæ.	*Actiniadæ.*
Corynidæ.	*Zoanthidæ.*
Pennatulidæ.	*Physsophoridæ.*
Beroidæ.	*Medusidæ.*

On these grounds Mr. Huxley proposes to break up the class *Radiata* of Cuvier into four groups. Supposing the *Cœlenterata* to form a sort of central group, we have, on the one hand, the *Ascidians* and the *Bryozoa* leading to the *Mollusca*; on the other, the *Echinoderms* and the *Entozoa* leading to the *Annulosa*; whilst the *Polygastria*, *Sponges*, and *Gregarinadæ* conduct us towards the lowest plants. These relations may be thus represented:—

Mollusca. Annulosa.

Ascidians. Bryozoa. Echinodermata. Entozoa.

RADIATA.

Cœlenterata.

Anæcioa. Æcioa.

Protozoa.

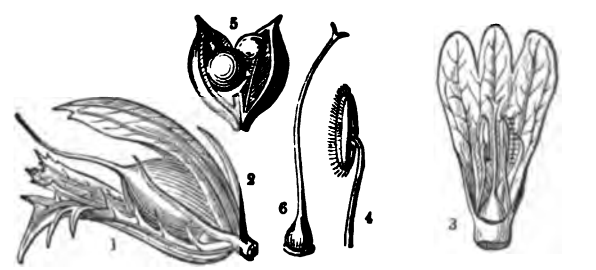
Polygastrica. Spongiadæ. Gregarinadæ.

Fossil Impressions of Medusæ?

Mr. Babbage, in his paper 'On Impressions in Sandstone resembling those of Horses' Feet,' December, 1836, in which he noticed those in the channel of a stream on the extensive moor called Pwll-y-Duon, about seven miles from Merthyr Tydvil, to which his attention was drawn by Mr. Guest of Dowlais, and the analogous casts in the old red-sandstone of Forfarshire, there called Kelpies' Feet, described some observations made by Sir C. Lyell, on impressions left by *Medusæ* on the rippled sand near Dundee. On removing the gelatinous body of the animal, a circular space was exposed, not rippled, but having around half the border a depression of a horse-shoe form. These marks, however, were not considered by Sir C. Lyell as identical with those called Kelpies' Feet, but merely so far analogous as to invite further observations, and to make it desirable to possess drawings of the impressions which different species of *Medusæ* leave when thrown by the tide upon a beach of soft mud or sand. ('Geol. Proc.,' vol. ii.) [*See* Supplement.]

ACANTHA'CEÆ, an order of plants belonging to the Monopetalous division of *Dicotyledons*. Its type is the genus *Acanthus*. The species are herbaceous or shrubby; they are extremely common in every tropical country. Many of the species are mere weeds; others bear handsome flowers with gaudy colours, but seldom with any odour; a very small number have been occasionally employed medicinally as emollients or diuretics.

The roots of *Acanthaceæ* are either annual or perennial. The stems are usually four-cornered when young, but afterwards become nearly round; their inside is occupied by a large proportion of pith,



Analysis of *Acanthaceæ*.

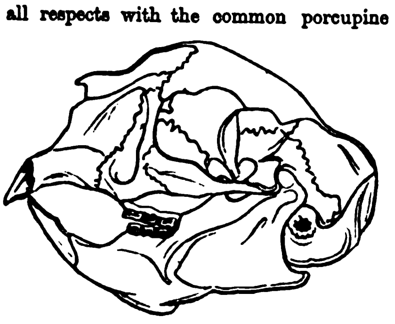
which is enclosed in a thin layer of imperfectly formed wood; and at each joint there is a slight tumour with an articulation, by which they are readily known from both *Scrophulariaceæ* and *Verbenaceæ*. Their flowers are often enclosed within large, leafy, imbricated bracts (1). The calyx (2) is usually composed of either four or five parts, which overlap each other, and occasionally grow together at the base. The corolla (3) is monopetalous and irregular. The stamens (4) are either two or four, but in the latter case are of unequal lengths. The pistillum (6) is superior and turcilled. The seed-vessel (5) contains two cells, which burst when ripe, often with elasticity, and expose a few roundish seeds hanging to the cells by curious-hooked processes.

The stems of all the species emit roots very readily from their tumid articulations; on which account gardeners universally increase them by cuttings of the full-grown branches. They are always easy to cultivate, provided they are not kept in too cold or too dry a situation. The annual kinds freely produce seeds, by which they are readily multiplied.

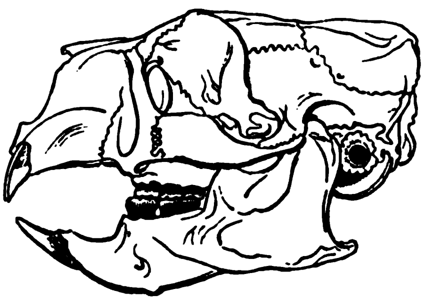
The most common genera are *Justicia*, *Acanthus*, *Ruellia*, *Thunbergia*, *Barleria*, *Eranthemum*, *Lankesteria*, and *Henfreya*.

(Brown's *Prodromus Floræ Novæ Hollandiæ*; Bartling's *Ordines Naturales*; Lindley's *Introduction to the Natural System*; and Nees von Esenbeck's *Exposition*, in the third volume of Dr. Wallich's *Plantæ Asiaticæ Rariores*.)

ACA'NTHION, in Zoology, a genus of *Rodentia*, established by M. F. Cuvier, and embracing two species, which are only known, at present, by their osteology. In the number and form of their teeth, these animals agree in all respects with the common porcupine from which, indeed, they only differ in the general form or outline of the cranium, and the comparative development of the bones of the face and skull; characters which have no very assignable influence upon the habits and economy of animal life. There has been some difference among zoologists as to the use of this term. Thus, *Acanthion* of F. Cuvier is *Acantherium* of J. E. Gray, whilst the *Acanthion* of Gray includes



Skull of Acanthion.



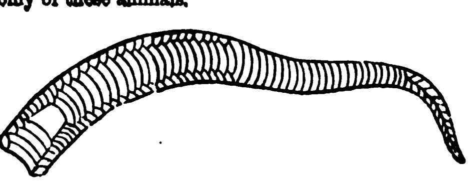
Skull of Porcupine.

both the genera *Hystrix* (Porcupine) and *Acanthion* of F. Cuvier. (Waterhouse, *Rodentia*.)

ACANTHODE'RMA, a fossil genus of fishes, from Glaris. (Agassiz).

ACANTHO'DES, a genus of fossil Ganoid fishes, established by M. Agassiz. The species occur in the carboniferous strata near Edinburgh. (Agassiz.)

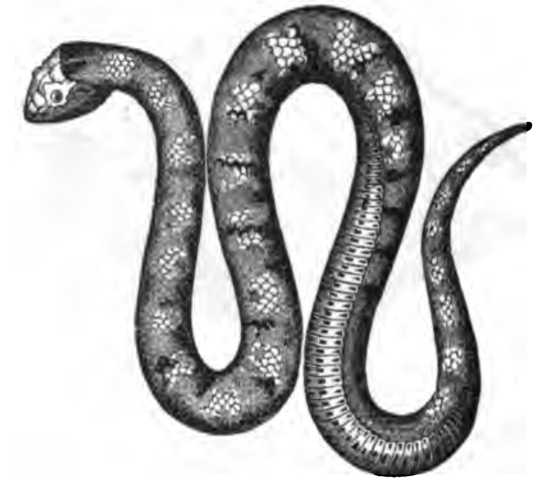
ACA'NTHOPHIS (from ἄκανθα, a thorn, and ὄφις, a snake), in Zoology, a genus of venomous serpents, allied to the vipers, but distinguished by having a single series of plates beneath the tail, except towards the very extremity, where they are, in some cases, separated into two small rows. The bodies and tails of these animals are elongated and cylindrical; their heads round, obtuse, rather prominent over the eyes, and covered in front with nine or ten polygonal plates. The back and upper surface of the tail are covered with reticulated scales of a rhomboidal form; the breast and belly are covered with single transverse plates, as is likewise the tail, excepting towards the very extremity, which is sometimes furnished with a double row of plates, as in the common viper. The tail is terminated by a little spur, or horny excrescence, which has suggested the name of *Acanthophis* (that is 'thorn-snake') for this genus. It springs out of the very end of the tail, and does not appear to be of the same utility as the two horny spurs which grow upon each side of the anus in the Pythons and Boas, and which, being retractile, or capable of being erected and depressed at will, execute important functions in the economy of these animals.



Tail of *Acanthophis*.

The head of the *Acanthophis* is broad and compressed, the mouth capable of great distension, and furnished on each side, besides the retractile poison-fangs common to all the family of truly venomous serpents, with a double row of sharp curved teeth. The species of this genus are of small size, reside on the surface of the dry land, and feed upon frogs, lizards, and small mammals. They are viviparous, and secrete themselves in rat-holes, or beneath the roots of trees. They never strangle or crush their prey by coiling themselves round its body, but expect a more speedy and certain victory from the deadly effects of their poison. The species best known are—

The *Acanthophis cerastinus*, first described by Merrem, and so named from the general similarity which it bears, at first sight, to the *Cerastes*, or Horned Viper, in its short body, large flat head, and eyes surmounted by prominent scales. The length of this species is about fifteen inches, of which the tail measures rather more than a fifth part; the body is thick in proportion to its length, having a circumference of two inches and a half in the middle, from whence it gradually tapers towards either extremity. The native country of this species is unknown.



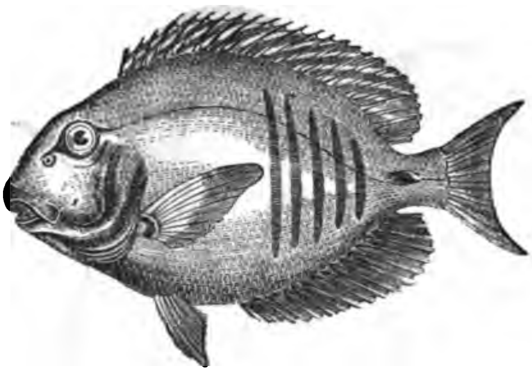
Acanthophis cerastinus.

The *Acanthophis Brownii* is briefly described by Dr. Leach, and figured in the first volume of the 'Naturalist's Miscellany.' The specific name is given out of compliment to Mr. Robert Brown, the celebrated botanist, from whose manuscripts the brief description of Dr. Leach was taken. The body is said to be of a uniform dark brown, the under lip whitish, the upper with a transverse groove in front, the tail small and rather abruptly contracted at its junction with the body, and the apex compressed laterally. This is probably the Death Adder, or Tammem, referred to by Mr. G. Bennett, in his 'Wanderings in New South Wales.' It is a hideous and exceedingly venomous reptile.

ACANTHOPTERY'GII (from ἄκανθα, a thorn, and πτέρυξ, a wing), in Zoology, one of the three primary divisions, or natural orders, of fishes. The fishes are divided into three orders—the *Chondropterygii* (from χόνδρος, cartilage, and πτέρυξ, a wing or fin), or cartilaginous fishes, without a solid bony skeleton; *Acanthopterygii*, fishes having bony skeletons with prickly spinous processes in the dorsal fins; and *Malacopterygii* (μαλακός, soft, and πτέρυξ, a wing), fishes with bony skeletons indeed, but with soft articulated radii in the dorsal fins. These divisions were first employed by Willughby and Ray. Cuvier divides the Acanthopterygious Fishes into fifteen natural families, which he calls after the names of their typical or most common genera.

1. *Percidæ*, including the common Perch, the Sea-Perch, the Barber of the Mediterranean, the Weevers, the Stargazers, and the Sea-Pike.
2. *Triglidæ*, which include the Gurnards, the Flying-Fishes, the Bull-Heads, the Miller's-Thumb, and the Sticklebacks.
3. *Sciænidæ*, which include the Maigres, the Stone-Perch, the Drum-heads, the Red-Throats, and a number of other fishes less known.
4. *Sparidæ*, including the Sea-Breams, the Spanish Bream, the Gilt-Head, and Black Bream.
5. *Menidæ*, a small family whose species are not much known.
6. *Squamipennes*, including the Chætodons and other curious fishes, as the Coachmen, the Horsemen, and others.
7. *Scomberidæ* include the Mackerel, the Tunnies, the Sword-Fishes, the Pilot-Fishes, the John-Dory, and the King-Fish.
8. *Tænidæ*, including the Scabbard-Fish, the Hair-Tail, Red-Band-Fish, and others.
9. *Theutyes*, including the Lancet-Fishes, and some other genera remarkable for their powerful cutting spines.
10. *Anabadæ* include the Climbing Perch and other allied fresh-water fishes.
11. *Mugilidæ* include the Gray Mullet, the Ramando of Nice, and some others.
12. *Gobiodæ* include the Blennies, the Gobies, or Sea-Gudgeons, and the Dragonet.
13. *Lophiadæ* include the Anglers, the Fishing-Frog, or Sea-Devil, and the Frog-Fishes.
14. *Labridæ* include the Wrasses, or Rock-Fishes, the 'Old Wives of the Sea,' the Captains, and the Scarus.
15. *Fistularidæ*, include the Pipe-Mouths, the Snipe-Fish, the Sea-Trumpet, or Bellows-Fish.

ACANTHU'RUS (from ἄκανθα, a thorn, and οὐρά, a tail), a genus of Acanthopterygious Fishes. It contains a great number of species, many of which are remarkable for the beauty of their external forms, and the variety of their colours. They are distinguished from proximate genera by the form of the body and tail, which are exceedingly compressed; by their trenchant teeth, denticulated like a very fine comb; but above all by the moveable spines, edged and sharp like a lancet, with which they are armed on each side of the tail, and with which they inflict dangerous wounds upon the hands of those who touch them incautiously. It is this circumstance that has acquired



Chætodon Chirurgiens. (Bloch.)

for the *Acanthuri* the names of Doctors and Lancet-Fishes, by which they are well known to the English sailors and colonists. These animals have the mouth small, and the muzzle rather advanced. They are among the small number of fishes which live entirely upon vegetable substances, feeding only upon *Fuci*, and other marine plants; their intestinal canal is consequently longer and more complicated than in other species, and their flesh has a peculiar flavour, very different from that of fishes in general. The dangerous weapons with which nature has provided these otherwise harmless fishes are well calculated to defend them from the attacks of their enemies. They abound in all the tropical seas, both of the East and West Indies, and are never known to advance beyond the tropics; consequently they are unknown in the more temperate latitudes.

ACAN'THUS. Under this classical name have been described, by ancient authors, at least three totally different plants. Firstly, a prickly tree with smooth evergreen leaves, and small round saffron-coloured berries, frequently alluded to by Virgil; this is conjectured to have been the Holly. Secondly, a prickly Egyptian tree, described by Theophrastus as having pods like those of a bean; it is probable that this was the *Acacia Arabica*. Thirdly, a herb, mentioned by Dioscorides, with broad prickly leaves, which perish at the approach of winter, and again sprout forth with the return of spring. It is said that the idea of the Corinthian capital of Greek columns was taken from some of the leaves of this *Acanthus*. To this latter plant the name is now applied. The word, in all cases, alludes to the prickly nature of the leaves or stems.

In modern botany *Acanthus* is a genus of herbaceous plants found in the south of Europe, Asia Minor, and India, belonging to the natural order *Acanthaceæ*.

The commonest species is *Acanthus mollis*, or Brankursine, a native of many parts of the South of Europe, growing in shady moist places, among bushes. Its stem is about two feet high, and is covered from

Acanthus spinosus.

the middle to the top with fine large white flowers, slightly tinged with yellow. The leaves are large, soft, deeply cut, hairy, and shining, and surround the lower part only of the stem. Both the leaves and the roots, which are perennial, abound in mucilage, which has caused them to be substituted in domestic medicine for the marsh-mallow. It is this species which is usually supposed to have given rise to the notion of the Grecian capital. But it appears, from the investigation of Dr. Sibthorp, that it is nowhere to be found, either in the Greek islands, or in any part of the Peloponnesus; and that the plant which Dioscorides must have meant was the *Acanthus spinosus*, still called ἄκανθα, which is found, as he describes it, on the borders of cultivated grounds, or of gardens, and is frequent in rocky moist situations. This species differs from *A. mollis* in having a dwarfer stem, flowers tinged with pink instead of yellow, and spiny leaves, much more deeply cut. Both the one and the other are half-hardy perennials, increased by division of the summit of the root. They have been long cultivated in the gardens of Great Britain, but perish if not protected from severe frost.

A'CANUS, a fossil genus of fishes, from Glaris. (Agassiz.)

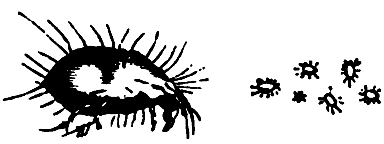
ACA'RIDÆ, a division of *Arachnida* [ARACHNIDA], which comprehends the small spider-like animals popularly termed Mites (*Acari*), as well as Water-Mites and Ticks. Some of these are wanderers on land or in water; others are fixed upon various animals, whose blood or humours they suck, and even insinuate themselves beneath the skin, and often multiply prodigiously.

These minute animals are not considered by modern naturalists to rank among insects, on account of their structure being very different, and from their having, in most cases, like spiders, eight feet, while no insect has more than six feet. Their mouths, in some, are furnished with jaws (*mandibulæ*), either having pincers or claws, but concealed in a projection of the breast-plate (*sternum*) in form of a lip; in others it is in the form of a syphon or sucker; and in others it presents a simple cavity. M. Latreille makes four divisions of the *Acaridæ*:—1, Mites (*Trombidites*); 2, Ticks (*Ricinites*); 3, Water-Mites (*Hydrachnellæ*); and 4, Flesh-Worms (*Microphthira*).

All the creatures now embraced in this family were included by Linnæus under his genus *Acarus*, and the whole of the species are popularly called Mites, or *Acari*. They are all very minute, some being almost microscopical. They are very generally distributed. Some are parasitic, whilst others are free. The itch is now well known to owe its existence to a creature of this tribe. Others live naturally in the human skin, whilst beetles and other insects are very liable to be attacked by them. They are found on the leaves, fruit, flowers, and bark of plants; and on all kinds of provisions, as flour, dried meat, dried cheese, and putrid animal matters.

Amongst the true Mites (*Trombidites*, Latreille), the following common forms are placed:—

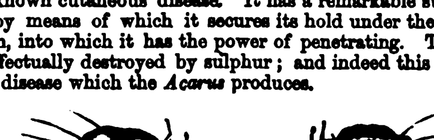
The Domestic Mite (*Acarus domesticus*, De Geer), is very commonly found in collections of insects and stuffed birds, and is exceedingly destructive to cabinets. Camphor has some effect in destroying this pest, but is not powerful enough to prevent it altogether. Moistening



Domestic Mite (*Acarus domesticus.*)

the specimens with a weak solution of corrosive sublimate, is said to prove an effectual preventative. The species found in flour and on food is called *A. Farinæ*.

The Itch Mite (*Acarus Scabiei*, Fabricius, *Sarcoptes Galei*, L.) is a microscopic animal, found under the human skin in the pustules of a well-known cutaneous disease. It has a remarkable suctorial apparatus, by means of which it secures its hold under the epidermis of the skin, into which it has the power of penetrating. This animal is most effectually destroyed by sulphur; and indeed this is a specific for the disease which the *Acarus* produces.



Itch Mite (*Acarus Scabiei.*)

The Sugar Mite (*Acarus saccharinum*) is found in the brown sugar of commerce. Thirty-five out of thirty-six specimens examined by the analytical commissioners of 'The Lancet,' bought in the shops of London, in 1850, were found to contain these creatures.

The Red Spider of the hot-houses is the *Acarus tellarius*. It is the pest of hot-houses and green-houses. Though so small as scarcely to be seen by the naked eye, its effects on plants are very obvious. These creatures live upon the juices of the plant which they attack, and also prevent the function of the leaves from being properly performed. They are best destroyed by sulphur. The mode of applying it is to sprinkle the sulphur on the hot pipes or on plates; afterwards, the plants should be syringed. Other species, as *A. hortensis*, *A. holosericeus*, *A. geniculatus*, attack various plants, and the best way of treating them is the same as the above.

Sparrow Mite.

The Sparrow Mite (*Acarus passerinus*, Fabricius) is distinguished by the remarkable size of its third pair of legs. Geoffroy called it the Bat Tick, and Latreille formerly placed it in his genus *Sarcoptes*.

A very interesting form of these creatures is that first described by Dr. Simon, of Berlin, as inhabiting the sebaceous sacs and hair-follicles of the human skin. He called it an *Acarus*, but Professor Owen regards it as a lower form of one of the higher divisions of *Arachnida*. He names it *Demodex Folliculorum*. It has also been described in this country by Mr. Erasmus Wilson, under the name of *Entozoon Folliculorum*. It has an elongated body, with eight short legs, and is found very commonly in the sebaceous follicles of the nose. In its parasitical habit it resembles some of the lower forms of the *Crustacea*, as the *Cymothoe* and *Bopyrus*; and, perhaps, through the *Tardigrada*, it has a relation with the *Rotifera*.

The Ticks (*Ricinites*, Latreille) are, some of them free, some parasitic. The latter have no eyes. They embrace the genus *Ixodes*, which are well known from attacking cows, horses, dogs, and even tortoises. They bury their suckers so deeply in the skin, that they frequently cannot be taken away without tearing the flesh. They deposit a prodigious quantity of eggs, which are discharged from the mouth. The genus *Argas* is found on pigeons and other birds. The *A. Persicus* is the venomous bug of Miana.

The Water Mites (*Hydrachnellæ*) live only in the water. They are often parasitic on aquatic insects. Dugès has recently made some important observations on the development of these mites, in which he shows that in their earlier stages of growth they have but six legs. If this be correct, it will probably lead to the rejection of Latreille's fourth division, the *Microphthira*, which are characterised by possessing six legs, as they are probably only earlier stages of some of the higher forms.

ACARUS. [ACARIDÆ.]

ACCIPENSER. [STURIONIDÆ.]

ACEPHALOCYST, one of the simplest forms of *Entozoa*, also called *Hydatid*. [ENTOZOA.]

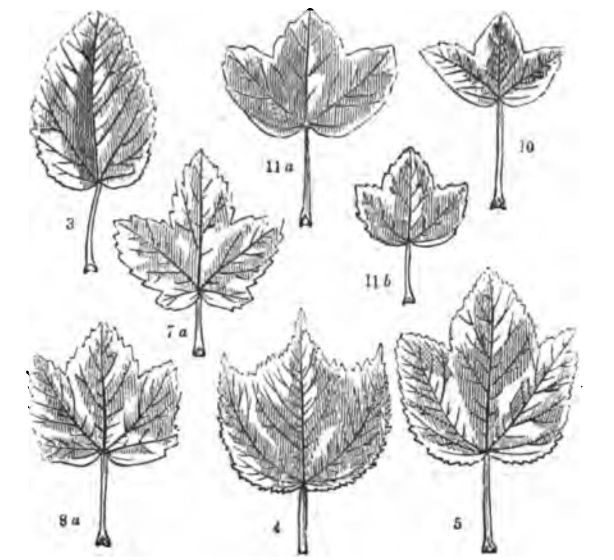
ACER, a name given by the Romans to a tree called *Maple* by the English. It is now applied to a genus of arborescent or shrubby plants, many of which are extremely valuable for the sake either of their timber or of their ornamental appearance. It is the type of the natural order *Aceraceæ*. It has the following characters:—Flowers green and inconspicuous, either containing stamens only, or pistils only, or both united, upon the same individual. Calyx divided into five lobes, of uncertain length. Stamens occasionally five; more frequently varying from seven to nine. Leaves in all cases simple. Fruit double; each division containing one single-seeded cavity, and extended at the back into a kind of wing, called *Key* in English, or *Samara* by botanists.

1. *Acer oblongum*, Oval-Leafed Maple, an evergreen tree, of rapid growth, native of the northern parts of India, both in Nepaul and Kumaon. It is probably confined to the hot valleys of those regions, for it has been found incapable of supporting the climate of England.

2. *Acer lævigatum* (Wallich), the Polished Maple. Leaves oblong, taper-pointed, slightly serrated, shining, green beneath. Flowers white, in branched erect thyrses. Keys broad, short, smooth. It is found in the woods of the higher mountains of Nepaul, and also in the Alps of Sirmoor, where it acquires a trunk thirty or forty feet high, and from three to four feet thick. Its growth is slow; its timber is said by Dr. Wallich to be used by the inhabitants of Nepaul for rafters, beams, and similar building purposes.

3. *Acer Tataricum* (Linnæus), the Tartarian Maple. Leaves heart-shaped, oblong, unequally serrated, usually undivided. It forms an ornamental tree, or rather large bush, from fifteen to twenty feet high, often met with in gardens and plantations. Its native countries are the southern provinces of Russia in Asia, whence it extends as far as Hungary, there finding its most western limit. From its keys, deprived of their wings, the Calmucs form, by the aid of boiling water, an astringent beverage, which, mixed with an abundance of milk and butter, forms a favourite article of their diet. The wood is hard and white, mixed with brownish veins.

4. *Acer striatum*, the Striped-Bark Maple (*A. Pennsylvanicum*, Linnæus). Leaves roundish, finely serrated, divided at the upper end into three nearly equal tapering lobes; when young, covered with a mealiness, which is gradually thrown off as they increase in size. It is a native of North America, from Canada to the high lands in Georgia. In those countries it forms a considerable part of the undergrowth of the woods, among sugar-maples, beeches, birches, and hemlock-spruce firs. It rarely exceeds eight or ten feet in height, except in a very few favourable situations, when it will occasionally grow double that height. Its wood is very white, and is used by the North Americans for inlaying cabinet-work; its shoots afford food to various animals, especially to the moose-deer, in winter and spring, whence it has acquired the name of Moose-Wood. In Europe it is occasionally seen in plantations, where it is remarkable for the bright rosy tint of its young leaves in spring. When cultivated, it frequently grows to thrice its native size, in consequence of being grafted upon the Sycamore Maple.



Forms of the leaves of Species of Maple.

3. *A. Tataricum*. 11 *a* and *b*. *A. Creticum*.
10. *A. monspessulanum*. 7 *a*. *A. opulus*. 8 *a*. *A. obtusatum*.
4. *A. striatum*. 5. *A. barbatum*.

5. *Acer barbatum* (Michaux), the Bearded Maple. Leaves heart-shaped, three-lobed, nearly equally serrated; the lobes of nearly equal size, or the lateral ones much the smallest; nearly smooth beneath. It is a native of deep pine and cedar swamps in Jersey and Carolina, where it forms a small tree.

6. *Acer spicatum*, the Spike-Flowered Maple (*A. montanum*, Aiton). Leaves heart-shaped, smooth above, downy and glaucous beneath, of an oblong figure, with about five unequal, tapering, coarsely and unequally serrated divisions. It is a native of the United States and Canada. The red colour of its keys in the autumn forms its principal beauty.

7. *Acer opulus* (Aiton), the Gueldres-Rose-Leaved Maple. Leaves more or less heart-shaped, roundish, five-lobed, smooth beneath. It is a small tree, ten or twelve feet high, found in France, especially in Dauphiny.

8. *Acer obtusatum* (Willdenow), the Neapolitan Maple. Leaves heart-shaped, roundish, five-lobed, woolly beneath; the lobes either obtuse or pointed, and coarsely serrated. Flowers in drooping corymbs. Hungary, Croatia, and many parts of Italy, produce this beautiful species. On all the hills and lower mountains of the kingdom of Naples, in Camaldoni, Castellamare, and the Abruzzi, it is found abundantly, growing usually to the height of forty feet; it is extremely striking, with its reddish-purple branches, in the wood of Lucania, between Rotonda and Rubia; and in the Basilicata and Calabria it is said, by Tenore, to acquire colossal dimensions. It is certainly very singular that so fine a tree as this, occupying so large a tract of country, frequently visited by English tourists, should be almost unknown in this country; and yet, although it is perfectly hardy, and very easily multiplied, it is scarcely ever met with in any but botanical collections. There are two forms of the leaf—one with blunt, and the other with pointed lobes.

9. *Acer campestre* (Linnæus), the Common Maple. Leaves heart-shaped, with three or five deep segments which are not serrated, but generally two-lobed or three-lobed, and narrow at their base; downy beneath—at least, when young. Branches covered, when old, with a corky bark. Flowers in erect, branched, downy corymbs. Keys short, smooth, with nearly parallel edges, diverging at right angles. Found in every hedge-row in England, and spread over the greater part of Europe. It is said not to be indigenous in Scotland, and on the continent it does not approach the north nearer than the southern provinces of Sweden. It advances as far to the eastward as the range of the Caucasus, where it disappears. In England this is either a bush or a small tree, of inelegant appearance, and its wood is of little value, except for the use of the turner, who makes it into cups, bowls, &c. The Common Maple is sometimes planted by farmers upon bad land, for the purpose of fencing; for which, however, it is ill adapted.

10. *Acer Monspessulanum* (Linnæus), the Montpellier Maple. Leaves deciduous, very slightly cordate, and downy at the base, with three perfectly entire, nearly equal, diverging lobes, slightly hairy beneath.

It is found in dry stony situations in Languedoc, Dauphiny, Provence, and Piedmont; it even occurs as far north as the departments of the Rhine.

22. *A. Lobelii.* 20. *A. saccharinum.* 24. *A. rubrum.*
23. *A. eriocarpon.* 18*a*. *A. caudatum.* 6. *A. spicatum.*

7*b*. *A. opulus.* 15. *A. sterculiaceum.* 8*b*. *A. obtusatum.*

11. *Acer Creticum* (Linnæus), the Candian Maple. Leaves evergreen, variable in form, wedge-shaped at the base, leathery, glossy, smooth, with three entire or serrated lobes, of which the side ones are the shortest, sometimes undivided. It is a native of the mountains of Candia and the Grecian Archipelago; it is frequently cultivated in the South of Europe.

12. *Acer heterophyllum* (Willdenow), the Variable Maple. Leaves evergreen, ovate, unequally-serrated, entire or occasionally three-lobed, very glossy. This is the plant sold in the English nurseries under the name of *A. Creticum.* It is rather delicate, and is a native of the Levant.

13. *Acer pseudo-platanus* (Linnæus), the Sycamore Maple. Leaves heart-shaped, coarsely and unequally serrated, glaucous and downy on the veins beneath; with five lobes, of which the lower ones are generally the smallest. This noble tree is scarcely met with in a truly wild state beyond the limits of middle and southern Europe: it is occasionally seen on the lower ridges of the Caucasus, and does not appear to extend much farther eastward. In Italy it is said to arrive at its greatest degree of perfection, acquiring the height of 50 and 60 feet. Its English name has originated in an erroneous notion that this is the sycamore of Scripture—a totally different tree, the *Ficus Sycamorus.* It flourishes in many parts of England: many varieties are known to gardeners.

14. *Acer macrophyllum* (Pursh), the Broad-Leaved Maple. Leaves deeply heart-shaped, not serrated, divided into five deep, spreading, slightly-lobed segments, the middle one of which is often narrow at its base, and the lower ones generally smaller than the others; when young slightly downy, when old shining and perfectly smooth: is a native of the north-west coast of North America, where its timber is used.

15. *Acer sterculiaceum* (Wallich), the Shady Maple, is a large tree, with a trunk often three feet in diameter; found in Nepaul.

16. *Acer villosum* (Wallich), the Shaggy Maple, is a very large tree, found on the Himalaya Mountains, approaching the limits of perpetual snow in Sirmoor and Kumaon.

17. *Acer cultratum* (Wallich), the Curve-Keyed Maple, is a large tree, native of the regions towards the Himalayas, in Kumaon and Srinaghur.

18. *Acer caudatum* (Wallich), the Long-Pointed Maple. It is a native of the highest regions of Nepaul, of Sirmoor, Kumaon, and Srinaghur.

19. *Acer Platanoides* (Linnæus), the Norway Maple. Leaves heart-shaped, very smooth, except at the axils of the veins; five-lobed, the lobes taper-pointed and diverging, with a few taper-pointed diverging teeth. This is a fine tree, with very handsome glossy deep-green leaves, for the sake of which it is a great deal cultivated. The northern and midland parts of Europe, and the north of Asia, as far as the Ural Mountains, produce this species. In the Russian Empire it passes from the state of a shrub, in the northern provinces, to that of a handsome tree with a trunk two feet thick, in the more southern districts. Its wood is valued for turners' work. From its ascending sap a kind of coarse sugar has been procured, in the same way as from the *A. saccharinum,* in America. Two varieties are known to gardeners; one, the Silver-Striped, in which the leaves are slightly stained with white; and the other, the Cut-Leaved, in which the leaves are deeply and irregularly jagged. When the foot-stalks of the leaves are broken they exude a milky fluid.

20. *Acer saccharinum* (Linnæus), the Sugar Maple. Leaves heart-shaped, glaucous beneath, very smooth, except at the axils of the veins; five-lobed, the lobes taper-pointed, and very coarsely toothed. Flowers in nodding corymbs. Keys not much diverging. From a little to the north of the Saint John, in Canada, to the woods of Upper Virginia, and probably still farther south, this species prevails; and it forms a large portion of the vegetation of New Brunswick, Nova Scotia, Vermont, and New Hampshire, sometimes becoming as much as 80 feet high. In the autumn the woods of those countries are dyed of a crimson hue by the changing leaves of the Sugar Maple. The wood is hard, and has a satiny lustre, but it is readily attacked by insects, and is not of much value, except when its grain is accidentally waved, and then it is in request for the cabinet-makers. The younger Michaux states, that it may be at all times known from that of the Red Maple by a very simple test. If you pour a drop or two of solution of sulphate of iron upon the wood of the Sugar Maple, in a minute it becomes of a greenish cast, while that of the Red Maple becomes deep blue. The saccharine matter contained in its ascending sap is the principal cause of this species being in so much request. From this, obtained by tapping the trunk in the spring during the space of six weeks, a very considerable quantity of a fine brown sugar is procured; as much, it is said, as 33 lbs. per tree. The Sugar Maple does not generally succeed very well in England, where it is rarely seen; and even when in health does not attain a height of more than fifteen or sixteen feet.

21. *Acer nigrum* (Michaux), the Black Sugar Maple. This plant is a native of similar situations with the last, of which perhaps it is only a variety.

22. *Acer Lobelii* (Tenore), Lobel's Maple, is found among the mountains in the north of the kingdom of Naples.

23. *Acer eriocarpon* (Michaux; *A. dasycarpum,* Willdenow), Sir Charles Wager's Maple is found in most parts of North America on the eastern side, where it is commonly called White Maple. It grows with great rapidity, and is extremely common in the plantations of all Europe, where it is remarkable for the deep crimson hue of its leaves in autumn. Its wood is light, and of little or no value except to the

turner. It is said to make excellent charcoal for gunpowder. The nurserymen usually call this species the Cut-Leaved Scarlet Maple.

24. *Acer rubrum* (Linnæus), the Red or Scarlet Maple. The deep-red colour of the flowers in the spring, and of the keys and leaves in autumn, have given rise to the name of this species, which is found, from Canada to Florida, growing in swamps along with alders. Its wood is used by the Americans for articles of furniture, and is also in request for the stocks of rifles—for which, when it is what they call 'curled,' its toughness renders it well adapted. Two varieties of this species are cultivated in this country, under the names of *A. coccineum* and *A. intermedium*.

25. *Acer circinatum* (Pursh), the Curled Maple, grows on the north-west coast of North America, and is a small, scrubby, worthless tree.

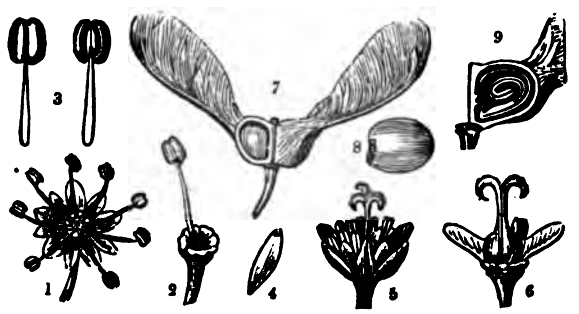
Cultivation.—The hardy maples, which are the only kinds of any importance in this country, are all increased either by seeds or layers. The European species readily yield their keys, which should be gathered when fully ripe, and immediately buried in heaps of river sand, where they may remain till the following February; they may then be sown in beds, rather thinly, and, when one year old, should be transplanted, and treated like other forest trees. They ought never to be headed back, as oaks and Spanish chestnuts are. From layers they all make excellent plants very rapidly. They are occasionally budded upon the common sycamore, but this mode is little practised in England.

ACERAS, a genus of Orchidaceous plants, of which one species, the *A. anthropophora*, is found growing in Great Britain. It is a small plant, from 8 to 12 inches in height. It has a long lax spike of greenish yellow flowers, the parts of which are so arranged as to give them the appearance of the small figure of a man: hence this plant has been called the Man-Orchis.

ACERATHE'RIUM. Some Fossil *Rhinocerata* have been thus named by Kaup.

ACERDESE, in mineralogy, a hydrous sesquioxide of Manganese, called also *Manganite*. Varieties of it have been called *Newkirkite* and *Varoacite*.

ACERACEÆ, an order of Polypetalous Dicotyledons. Their flowers are unsymmetrical, their stamens hypogynous, their fruit is winged, and their petals have no appendages upon them. The species are all trees or shrubs, with opposite stalked exstipulate leaves, and are found exclusively in the north of Europe, Asia, America, and India. A sweet mucilaginous sap is common in these plants, from which sugar can be manufactured.



1. Unisexual Flower. 2. Stamen on Disk. 3. Stamens separate. 4. Petal. 5. Bisexual Flower. 6. Pistil. 7. Fruit. 8. Seed. 9. Embryo.

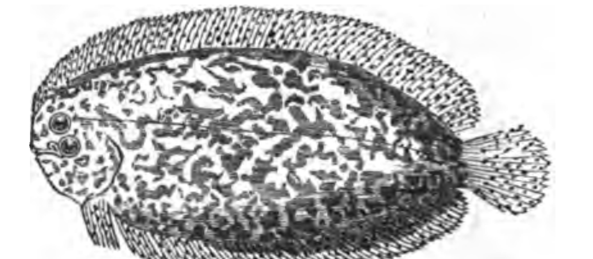
ACERVULA'RIA, a genus of Fossil *Madrephylliæa*.

ACHILLEA, a genus of plants belonging to the natural order *Compositæ*, consisting of 60 or 70 species, found exclusively in the colder climates of the northern hemisphere. This genus is found in the suborder *Corymbiferæ*, and is distinguished by the florets of the disk being hermaphrodite and tubular, and the tube being plane, compressed, and two-winged. The fruit is compressed, and has no pappus. There are five British species. *A. Ptarmica* is an abundant plant, and on account of its strong odour is called Sneezewort. *A. millefolium* has got its specific name from the segmented character of its leaves. It is called in English Millefoil and Yarrow. This plant has the tonic and stimulant properties of the sub-order to which it belongs in a slight degree, and on that account has been employed as a remedy in some diseases, but its medical properties are very feeble.

ACHILLE'UM, a genus of Fossil *Spongiadæ*, of which two species occur in the cretaceous strata of England. (Goldfuss.)

ACHIME'NES (from *a*, prefix, and χεῖμα, winter), a genus of plants belonging to the order *Gesneraceæ*. The species of this genus are very numerous, and, although not useful, they are many of them extensively cultivated, on account of the beauty of their flowers. In consequence of their general culture, a great many varieties of the species are becoming known. After flowering, the stems die down; and the tubers should be dug up, and kept free from frost and wet till January, when, by planting them in succession, flowers may be obtained till the summer. They may be planted in a mixture of loam and leaf-mould, with a little silver sand. They can be placed out in the summer, but require shading on hot days.

ACHI'RUS, a genus of flat-fish, belonging to the sub-branchiate division of *Malacopterygii*. In external form these fishes resemble the common sole. Like the *Pleuronectes* in general, they have the body and tail very much compressed, and the eyes both on the same side of the head; but they are easily distinguished from all other genera of flat-fish by the total want of pectoral fins.



Achirus marmoratus.

The species of *Achirus* have no air-bladder, and consequently remain, for the most part, at the bottom of the sea; being, in fact, ungifted with the faculty of increasing or diminishing their specific gravity, which the possession of this important organ bestows upon ordinary fishes. Their power of locomotion in other directions is however considerable; and, notwithstanding the disadvantages of their form, and the oblique direction in which this necessarily compels them to move, their motions are frequently very rapid. Their habits, as far as at present known, are similar to those of the *Pleuronectes*. They are found in the warmer regions both of the East and West Indies, but not in deep water, or in situations far removed from land; they abound along the shores, and furnish a plentiful and wholesome food to the inhabitants.

Various species of *Achirus* have been enumerated by zoologists, the most remarkable of which appears to be the *Achirus marmoratus* of Lacépède. The flesh is of a delicate flavour, and highly esteemed: it inhabits the coasts of the Isle of France. The *Achirus pavonicus* is distinguished by the beauty of the spots, which, like the eyes on the peacock's tail, cover its body; and the *A. fasciculatus* and *A. bilineatus* are easily recognised by the characters from which they respectively derive their names. The former is found on all the coasts of America and the West Indies: the latter inhabits the shores of China, and feeds upon small crustacea and mollusca.

ACHLYA, a genus of Cryptogamous plants, belonging to the order *Confervaceæ*. It is composed of a single tubiform cell, which expands at the end into a large cell, which is cut off from the lower portion of the tube by the formation of a partition. In this enlarged cell a circulation of granular particles has been observed. In the course of time cells are formed in this enlarged cavity, and fill it up. The parent cell eventually bursts at some spot, and allows of the escape of the enclosed cells; but before this takes place the cells in the interior move about, and, after their escape, exhibit for a considerable time an active movement. They are good examples of the *Zoospore*. They soon attach themselves to some fitting object, and grow into little plants, like their parent. A similar process goes on in most of the *Algæ*, but is not so easily observed as in this case.

The only species of *Achlya* which has been described is the *A. prolifera*, which is found parasitic upon fish and other aquatic animals. This plant is more especially developed on fish and aquatic reptiles kept in confinement. It was first observed on gold fish, but several writers have described it as existing on other animals, as the Stickle-back, Water Salamander, Frog, and Newt.

(*Reports on Botany*, Ray Society, 1845; Lindley's *Vegetable Kingdom*.)

ACHMITE. [EUCHYSIDERITE.]

ACHRAS, a genus of tropical plants belonging to the natural order *Sapotaceæ*. It has a calyx divided into six parts; a corolla monopetalous, divided into six lobes; stamens twelve, of which six are sterile and six fertile; and an ovarium, with from six to twelve cells. The fruit resembles an apple, with from one to twelve seeds, contained in hard bony nuts, which have a shining coat, and a long hard scar over the whole of their inner angle.

The genus contains only one species, which yields a copious milky fluid when wounded. Its leaves are entire, leathery, undivided, shining, of a lanceolate form, without stipules. The flowers are large, white, bell-shaped, and grow singly from the axils of the leaves. This is called, in the West Indies, the Sapodilla Plum. The fruit in size and shape resembles a bergamot pear; like the medlar, it is only eaten in a state of decay; before that period it is austere and uneatable, but in the proper state it is so rich and sweet as by some to be considered only inferior to the orange.

ACHYRA'NTHES, a genus of plants belonging to the order *Amarantaceæ*. *A. aspera* and *A. fruticosa* are used in India as remedies in dropsy. *A. globulifera* is used in Madagascar as a remedy in syphilis.

ACIDA'SPIS, a genus of fossil *Crustacea*, of the group of *Trilobites*; found in the Wenlock limestone. (Murchison.)

ACONITE, WINTER. [ERANTHIS.]

ACONI'TUM, a genus of plants belonging to the natural order *Ranunculaceæ*. From very early times it has borne the same name, and has been known for the dangerous properties of many of its species. They are all hardy herbaceous plants, many of them of great beauty; and are so easily cultivated, that one of them, *A. Napellus*, is found in every cottager's garden. The English call them Wolf's Bane. From all other ranunculaceous plants *Aconitum* is at once known by its having the very large uppermost segment of its calyx overhanging the petals and other parts in the form of a helmet.

Aconitum Napellus.

The common species, *A. Napellus*, is one of those in which the greatest degree of virulence has been found to reside. It is a native of alpine pastures in Switzerland and other mountainous parts of Europe. Its leaves are very dark green, deeply cut into from five to seven long segments. The stem is about three feet high. The flowers are in long, stiff spikes, and of a deep blue colour; they appear from May to July. All the parts of this plant are extremely acrid, especially the roots, which are scraped and mixed with food to form a bait for wolves and other savage animals. Poisonous properties are probably found in all the species of the genus. *A. cammarum*, *A. lycoctonum*, and *A. anthora* are certainly equally dangerous. None of them however, not *A. Napellus* itself, can be compared for fatal energy with the dreadful Bikh of Nepaul, the *Aconitum ferox*, which seems to possess the concentrated power of all the European species.

ACO'NTIAS (from ἄκων, a javelin), the name of a genus of serpents established by Cuvier, for the purpose of distinguishing certain species hitherto placed with the genus *Anguis*, or common snake. This genus is characterised by the absence of all the bones which represent the extremities in the genus *Anguis*, while it retains the structure of the head common to these animals and to the lizards, and has the body similarly covered with small scales only, without the horny plates which guard its under surface in the common serpents, and protect them from injury in the various rapid motions which they perform. The species of *Acontias* seem thus to afford a link between the common snakes and true serpents.

Acontias Meleagris.

As might naturally be expected from this conformation, the progressive movements of the species of *Acontias* are very different from those of common serpents. They do not glide along the surface like these animals, but boldly carry their heads and breasts erect; and if closely pursued defend themselves courageously, and dart with the velocity of an arrow against their assailant. Though dreaded in their native countries, because confounded with their venomous congeners, these animals are perfectly harmless, and neither possess the means nor have the desire of being injurious. They have no poison fangs, and their cheek-teeth are so small as, in some species, to be barely perceptible. Their habits are gentle; and they are so timid that they generally fly at the least noise, or, upon the slightest appearance of danger, conceal themselves under some shrub or tuft of grass, or even bury themselves under-ground when no other refuge is at hand.

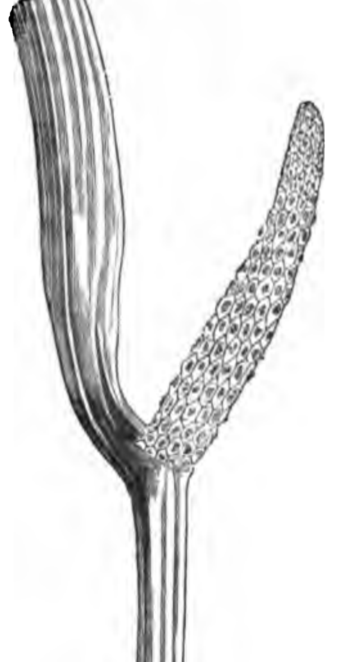
They are, generally speaking, of a small size; and, as their mouths are not susceptible of the enormous dilatation possessed by the true serpents, they are incapable of swallowing any animal approaching to their own dimensions, and feed upon worms and insects. Different species of *Acontias* are found in almost every part of the old world. The arid plains of Syria and Palestine produce a species which has been mentioned by the prophet Isaiah (xxxiv., 15), under the Hebrew denomination *Kippos*, improperly translated 'the great owl' in our common version of the Sacred Scriptures, but which the learned Bochart ('Hierozoicon,' pars post. lib. iii. cap. xi.) has shown to refer more properly to the *Acontias*, or *Anguis jaculus*, the Dart Snake of the Greeks and Romans. Other species inhabit Asia Minor, Egypt, and Persia; India and China have also their *Acontias*; and the Cape of Good Hope produces a species without eyes.

Of the common Egyptian Acontias many fables are recorded by ancient authors, principally arising from confounding this really harmless species with the more deadly and venomous serpents of the same localities.

ACORI'NÆ, ACORI'DEÆ, or ACORA'CEÆ, a small natural order of Endogens, with the following essential character:—The flowers are hermaphrodite, surrounded with scales. The spathe is leaf-like, but not rolled up. The stamens are complete, placed opposite the scales, and have two-celled anthers which are turned inwards. The ovaries are distinct. The fruit is baccate, juicy at first, but finally juiceless. The seeds have the embryo seated in the axis of a copious albumen. The rootstock is jointed; the leaves sword-shaped, and embracing each other in the bud. Such is the character given this order, which was first separated from *Araceæ* by Agardh, and the separation was afterwards adopted by Schott, Link, and Lindley. The genera assigned to this order by Lindley were *Acorus*, *Gymnostachys*, *Tupistra*, and *Aspidistra*. The two last genera are now assigned by the same author to the order Liliaceæ. This small group of plants in its geographical distribution is confined to the eastern hemisphere. None of them have the acrid properties of some of the *Araceæ*. The *Acorus Calamus* is a British plant, and has slightly aromatic properties.—(Lindley, *Vegetable Kingdom*.)

ACORN, the English name of the fruit of the oak. [QUERCUS.]

A'CORUS, the botanical name of the plant that produces the drug called in the shops *Calamus aromaticus*. It is the type of the natural order *Acoraceæ*. It is found abundantly in the fresh-water marshes of many parts of England. It has a perennial, creeping, horizontal stem, as thick as the finger, the whole of the under side of which sends down roots into the mud or earth, in which the plant uniformly grows. From this spring many deep-green sword-shaped leaves, about three feet long. In the midst of all is a leaf-like stem, from below the point of which protrudes a cylindrical or rather conical spadix of greenish flowers, which are so closely packed together that the stalk is not to be seen. The leaves when bruised are fragrant; for which reason they were formerly employed to strew the floors of rooms, or of churches, under the name of rushes. This practice is still maintained in some places, where the plant is common, as at Norwich, the cathedral of which city is strewed with sweet rushes upon certain high festivals. The flowers are so seldom produced, that it is a common belief that they never are borne. *Calamus aromaticus* is slightly aromatic, and is occasionally used as a stimulant; but is of very little importance. The part employed is the dried creeping stem, or, as it is improperly called, root.



Acorus Calamus.

ACOTYLE'DONES, or ACOTYLEDONEÆ, the name of the first class in Jussieu's 'Natural System of Botany.' It is derived from the circumstance of all the plants which it comprehends vegetating without the aid of the seed-lobes called cotyledons. Such plants are also in all cases destitute of flowers, and are in fact the same as what Linnæus called *Cryptogamia*. They are also called *Cellulares*.

ACOUCHY, a small species of Cavy. [AGOUTI.]

ACRITA (from ἄκριτος, indistinct), a division of the class *Radiata*, adopted by Owen, and applied to the *Acalephæ*, the *Polypifera*, except the *Bryozoa*, the *Polygastrica*, and certain forms of *Entozoa*, in none of which are the indications of a nervous system decided, and they constitute the lowest forms of the radiate group of animals.

ACROCHO'RDUS (from ἀκροχορδὼν, a wart), a genus of serpents discovered in Java by the traveller Hornstedt. It is easily distinguished from others of the innoxious family of serpents by the innumerable small scales which cover every part of the head and body both above and below, and which in preserved specimens, or when the live animal distends the lungs and body with air, assume the appearance of so many granulated warts or tubercles. This circumstance has suggested the name of *Acrochordus*. The head of the acrochord is flat, the mouth is provided with a double row of small sharp teeth, but without poison-fangs, and the throat is capable of enormous dilatation. The tongue is short and thick, the vent simple and without the horny spurs which are common to many other genera of serpents. The only species of which much is known is the *Acrochordus Javanicus* of Lacépède and others. This animal averages from six to ten feet in length, and the body grows gradually thicker from the head to the vent, and there suddenly contracts, so as to form a very short slender tail. In the thickest part of the body, immediately above its junction with the tail, the individual procured by Homstedt, of which the entire length was eight feet three inches, measured three inches in diameter, whilst the greatest breadth of the tail did not exceed half an inch, and its length was scarcely a ninth part of that of the whole body. This individual was a female, and, when opened, was found to contain five young ones perfectly formed, and about nine inches in length. It was caught in a plantation of pepper-trees, and the Chinese, who accompanied Homstedt, cooked and ate its flesh, and reported it to be of a most delicious flavour. The stomach contained a quantity of half-digested fruit, from which it has been inferred that this serpent is frugivorous. Cuvier, however, doubts on this point.

Acrochordus Javanicus.

ACROCU'LIA, a fossil genus of *Gasteropoda*, allied to the *Neritidæ*. It occurs in Palæozoic strata. (Phillips.)

A'CRODUS, a genus of fossil Placoid fishes, established by M. Agassiz. The species occurs almost exclusively in the lias and oolite. One British species (*A. minimus*) is referred to the keüper series by M. Agassiz. It occurs at Aust Cliff in the bone-bed. The others abound at Lyme Regis, Bath, and Stonesfield.

ACRO'GASTER, a genus of fossil fishes. (Agassiz.)

ACROGENS (from ἄκρος, the topmost, and γεννάω, to produce), in Botany, one of the primary classes of the Vegetable Kingdom, according to the Natural System. This class, with identical limits, is also known by the following designations:—

Acotyledons (Jussieu), so named from the fact of the absence of cotyledons amongst this class of plants.

Exembryonatæ (Richard), designating the absence of any regular embryo in the reproductive cells, or spores.

Cellulares (De Candolle), denoting the general absence of vascular tissue and the prevalence of cellular tissue in these plants.

Agamæ, of various authors, implying the absence of the necessity of the union of two cells in order to reproduce a new individual.

Cryptogamia (Linnæus), intended to convey the idea that if two cells were necessary to the reproduction of the new plant in this class, it was not obvious, as in the Phænogamous plants.

The *Acrogens*, as equivalent to the above expressions for the same class, embrace all those plants which are included in the above definitions. This term itself is, however, only applicable literally to those plants which, destitute of flowers, possess a stem growing in a manner distinctive from those called *Exogens* [EXOGENS] and *Endogens* [ENDOGENS]. It has been thus restricted by Lindley in his 'Vegetable Kingdom,' and he places the stemless flowerless plants in another class, called *Thallogens*. The structure of the stem, however, is at best an artificial character, and the adoption of the terms for the classes expressive of its characters, has rather been accidental than necessary. On this account it is perhaps better to regard the *Thallogens* as a section of *Acrogens* than an independent and equal group.

The stems of *Acrogens* differ much in appearance from those of Exogens and Endogens. The wood is not secreted from layers of tissue, which have the power of reproducing regular zones of wood, as in Exogens, or a regular arrangement of vascular and cellular tissue, as in Endogens. There is generally but a single ring of vascular bundles even in the Ferns. These vascular bundles do not go on

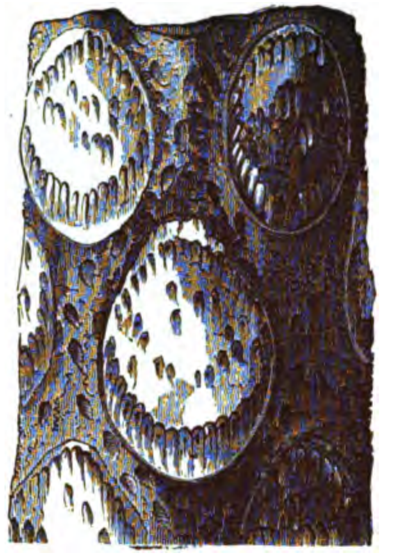
Chnoophora excelsa, an acrogenous stem.

increasing in size, but are all developed together. The lower part of the stem does not continue to increase in size, and its growth is deter-

Portion of outside of stem of *Chnoophora excelsa*.

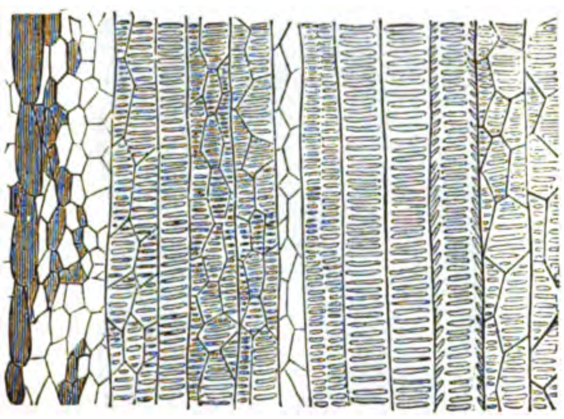
mined by the development of new vascular bundles in connection with the leaves of the point or upper part of the stem: hence their name. In the Liverworts and Mosses there is only a simple vascular bundle in the centre of the stem. In *Isoetes* too there is a ring of vascular bundles. Science is very deficient in good observations on the structure of the stems of these plants.

The reproduction of the Acrogens is not so simple as was at one time believed. The recent researches of Suminki, Hoffmeister, and others, show that in the Ferns and many other Acrogens the spore is but a transitionary condition, which results in the production of two sets of cells, by the union of which alone can a new individual be produced. [PLANTS, REPRODUCTION IN.]



External portion of an Acrogenous stem.

Section of stem of *Alsophila vestita*.



Tissue of an Acrogenous stem.

The following is an analysis of the alliances and orders found in the class of Acrogens, according to the system adopted by Lindley in his 'Vegetable Kingdom.' Thus

Asexual (?) or flowerless plants,	ACROGENS.
Stem and leaves distinguishable,	TRUE ACROGENS.
Stem and leaves indistinguishable.	THALLOGENS.

Alliances of THALLOGENS.

Algales.—Cellular flowerless plants, nourished through their whole surface by the medium in which they vegetate; living in water, or very damp places; propagated by zoospores, coloured spores, or tetraspores.

Fungales.—Cellular flowerless plants, nourished through their thallus (spawn or mycelium); living in air; propagated by spores colourless or brown, and sometimes enclosed in asci; destitute of green gonidia.

Lichenales.—Cellular flowerless plants, nourished through their whole surface by the medium in which they vegetate; living in air; propagated by spores usually enclosed in asci, and always having green gonidia in their thallus.

Natural Orders of Algales.

1. *Diatomaceæ.*—Crystalline angular fragmentary bodies, brittle, and multiplying by spontaneous separation.

2. *Confervaceæ.*—Vesicular filamentary or membranous bodies, multiplied by zoospores generated in the interior, at the expense of their green matter.

3. *Fucaceæ.*—Cellular or tubular unsymmetrical bodies, multiplied by simple spores formed externally.

4. *Ceramiaceæ.*—Cellular or tubular unsymmetrical bodies multiplied by tetraspores.

5. *Characeæ.*—Tubular symmetrically-branched bodies, multiplied by spiral-coated nucules filled with starch.

Natural Orders of Fungales.

6. *Hymenomycetes*, or *Agaricaceæ.*—Spores generally quaternate on distinct sporophores; hymenium naked.

7. *Gasteromycetes*, or *Lycoperdaceæ.*—Spores generally quaternate on distinct sporophores; hymenium enclosed in a peridium.

8. *Coniomycetes*, or *Uredinaceæ.*—Spores single, often septate on more or less distinct sporophores; flocci of the fruit obsolete, or mere peduncles.

9. *Hyphomycetes*, or *Botrytaceæ.*—Spores naked, often septate; thallus floccose.

10. *Ascomycetes*, or *Helvelaceæ.*—Sporidia contained (generally eight together) in asci.

11. *Physomycetes*, or *Mucoraceæ.*—Spores surrounded by a vesicular veil or sporangium; thallus floccose.

Natural Orders of Lichenales.

12. *Graphidaceæ.*—Nucleus breaking up into naked spores.

13. *Collemaceæ.*—Nucleus bearing asci; thallus homogeneous, gelatinous, or cartilaginous.

14. *Parmeliaceæ.*—Nucleus bearing asci; thallus heterogeneous, pulverulent, or cellular.

Alliances of ACROGENS.

Muscales.—Cellular (or vascular) spore-cases immersed or calyp trate, *i. e.* either plunged in the substance of the frond, or enclosed within a hood, having the same relation to the spores as an involucre to a seed vessel.

Lycopodales.—Vascular; spore-cases axillary or radical, one- or many-celled; spores of two sorts.

Filicales.—Vascular; spore-cases marginal or dorsal, one-celled, usually surrounded by an elastic ring; spores of but one sort.

Natural Orders of Muscales.

1. *Hepaticæ.*

15. *Ricciaceæ.*—Spore-cases valveless, without operculum or elaters.

16. *Marchantiaceæ.*—Spore-cases valveless, or bursting irregularly, without operculum, but with elaters.

17. *Jungermanniaceæ.*—Spore-cases opening by a definite number of equal valves, without operculum, but with elaters.

18. *Equisetaceæ.*—Spore-cases peltate, splitting on one side, without operculum, and with an elater to every spore.

2. *Musci.*

19. *Andræaceæ.*—Spore-cases opening by valves, with an operculum, without elaters.

20. *Bryaceæ.*—Spore-cases valveless, with an operculum, without elaters.

Natural Orders of Lycopodales.

21. *Lycopodiaceæ.*—Spore-cases one- to three-celled, axillary, reproductive bodies similar.

22. *Marsileaceæ.*—Spore-cases many-celled, radical (or axillary), reproductive bodies dissimilar.

Natural Orders of Filicales.

23. *Ophioglossaceæ.*—Spore-cases ringless, distinct, two-valved; formed on the margin of a contracted leaf.

24. *Polypodiaceæ.*—Spore-cases ringed, dorsal or marginal, distinct, splitting irregularly.

25. *Danæaceæ.*—Spore-cases ringless, dorsal, connate, splitting irregularly by a ventral cleft.

(Lindley's *Vegetable Kingdom*; Schleiden's *Principles of Scientific Botany*, translated by Dr. Lankester; Henfrey's *Report on the Higher Cryptogamous Plants*, at the Twenty-first Meeting of the British Association.)

ACRO'GNATHUS, a genus of fossil Cycloid fishes, found in the chalk of Sussex. (Agassiz.)

ACRO'LEPIS, a genus of fossil Ganoid fishes, found in the magnesian limestone of Durham. (Agassiz.)

ACRO'PTERIS (from ἄκρος, a point, and πτέρις, a fern), a genus of Ferns allied to *Asplenium*.

ACROSALE'NIA, a genus of Fossil *Echinodermata*. (Agassiz.) It occurs in the Isle of Sheppy.

ACROSTICHON (from ἄκρος, a point, and στίχος, a row), a genus of Ferns, most of which require stove heat in cultivation. The whole of the species now referred to this genus are extra-European, being inhabitants of the West and East Indies, and Australia.

ACROTE'MNUS, a genus of Fossil Ganoid Fishes. *A. Faba* is found in the chalk of Sussex. (Agassiz.)

ACT'ÆA. Under the name of ἀκτῆ, the Greeks described a medicinal plant, which the moderns have ascertained to be what is now called *Sambucus Ebulus*. [SAMBUCUS.] Linnæus applied the name to a genus of perennial herbaceous plants found in various parts of Europe, and the north of Asia, and America, belonging to the natural order *Ranunculaceæ*, and only in a slight degree resembling the species intended by classical authors. The genus thus understood is known from all others of the Ranunculus tribe by its anthers being turned inwards, so that when they burst the pollen may immediately fall upon the stigma, while its flowers have only four sepals and four petals. The properties of all the species are nauseous and deleterious, as might be expected from their affinity to the poisonous Aconite.

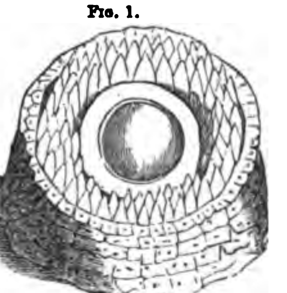
One species, *Actæa spicata*, a common European plant, is found occasionally in the north of Yorkshire among bushes; it is popularly called Black Baneberries and also Herb Christopher. It has purplish-black juicy fruits, which would be dangerous from their tempting appearance, if the fetid odour of the leaves did not prevent their being touched.

Another species, the *A. cimicifuga*, a North American plant, derives its name from the belief that its fetid leaves have the power of driving away bugs.

ACTINIA. [ACTINIADÆ.]

ACTINI'ADÆ, a family of Helianthoid Polypes, having for its type the old genus *Actinia*, the *Sea Anemonies*. It has the following characters. Animal single, fleshy, elongate or conical, capable of extending or contracting itself, fixed by its base, but with the power of locomotion; mouth in the middle of the upper disk, very dilatable, surrounded by one or more rows of tentacula; oviparous and viviparous; marine.

FIG. 1.

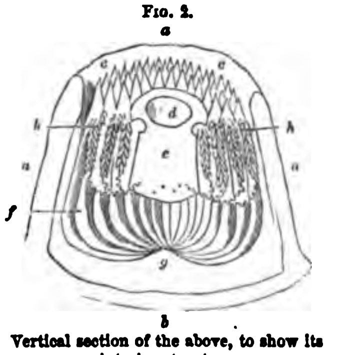


Small Leathery Animal-Flower (*Actinia coriacea*).

The internal structure of the *Actiniæ* has been carefully investigated by Spix, Teale, and others. They possess an alimentary cavity, with a single aperture, very large at the lower end, and so elastic and contractile that it can easily be turned inside out. The cavity is surrounded with flat muscles, running lengthwise and parallel.

The egg organ (*ovarium*), according to Teale's observations in *Actinia coriacea*, forms elongated masses attached along the inner border of a series of organs called leaflets, fig. 2, *h h*. "Each ovary is composed of several folds or plaits, which, when unfolded, show this structure to be about three times the length it assumes when attached to the leaflet. By carefully spreading out these folds, the ovary, with the assistance of a lens, is seen to consist of two very delicate layers of membrane, enveloping a closely compacted layer of ova. After enveloping the ova, the membranous layers are placed in apposition, and form a kind of mesentery, by which the ovary is attached to the internal border of the leaflet." The *Actiniadæ* propagate all the year round, although perhaps in some species the ova are deposited most abundantly in autumn. The ova are roundish, and like those of polypes in general, are moved by means of vibratile cilia, which cover their surface. After being discharged from their parent they move about actively for several days, during which they undergo some change in form. They then relax their activity, the cilia are absorbed, they attach themselves to a spot, and pass through a series of forms, before arriving at maturity.

FIG. 2.



Vertical section of the above, to show its interior structure.

a a a. The skin.
b. The base, by which the animal is fixed to the rocks.
c. The three rows of feelers (tentacula).
d. The mouth.
e. The stomach.
f. Longitudinal muscles.
g. Point in which they unite.
h h. The ovaries, which open by their oviducts into the stomach.

Although Spix has described in *Actinia coriacea* a nervous system, this has not been confirmed by more recent observers.

The habits of the *Actiniæ* have been studied by the Abbé Dicquemare and others. The forms of *Actiniæ* vary according to their contraction or expansion, presenting innumerable varieties. Their expansion is said to be a more certain indicator of fine weather than the rise of the barometer; but this cannot be practically taken advantage of except during summer, as the cold of winter drives the *Actiniæ* from the shore to the deeper waters, where the temperature is more equable and mild. On changing their place of abode, some abandon themselves to the mercy of the waves, others creep along the bottom, turning themselves inside out, and making use of their tentacula as feet. When they find a suitable place, they fix themselves, often so firmly, that they cannot be detached without tearing their bodies.

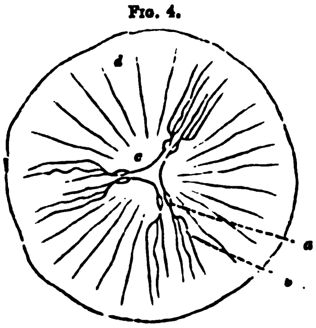
FIG. 3.

a a. The ovaries greatly magnified.
b. The oviduct.
c. Eggs.
d. Ditto, with the first appearance of the embryo.
e. Ditto, farther advanced.
f. Ditto, ditto.

Our distinguished English naturalist, Ellis, has given a very minute and, so far as it goes, an accurate account of these animals in the 'Philosophical Transactions,' vol. lvii., part of which it may be interesting to quote:—

"The lower part," he says, "of these bodies have a communication with a firm, fleshy, wrinkled tube, which sticks fast to the rocks, and sends forth other fleshy tubes, which creep along them in various directions. These are full of different sizes of these remarkable animals, which rise up irregularly in groups near to one another.

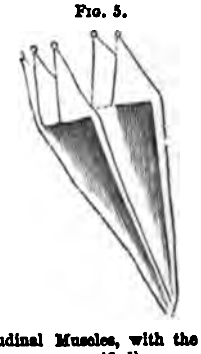
FIG. 4.



Distribution of the nerves at the base of the *Actiniæ*, according to Spix.
a. The nervous ganglions.
b. Nerves.
c. Nerves of communication between the ganglions.
d. The longitudinal muscles.

"This adhering tube, that secures them fast to the rock or shelly bottom, is worthy of our notice. The knobs that we observe are formed in several parts of it by its insinuating itself into the inequalities of the coral rock, or by grasping pieces of shells, part of which still remain in it, with the fleshy substance grown over them. This shows us the instinct of nature, that directs these animals to preserve themselves from the violence of the waves, not unlike the anchoring of mussels, by their fine silken filaments that end in suckers; or rather, like the shelly basis of the *Serpula*, or worm-shell, the tree-oyster, and the slipper-barnacle, &c., whose bases conform to the shape of whatever substance they fix themselves to, grasping it fast with their testaceous claws, to withstand the fury of a storm.

FIG. 5.



Longitudinal Muscles, with the feelers (magnified).

"When we view the inside of this animal dissected lengthwise, we find a little tube leading from the mouth to the stomach, from whence there rise eight wrinkled small guts, in a circular order, with a yellowish soft substance in them; these bend over, in the form of arches, towards the lower parts of the bulb, from whence they may be traced downwards to the narrow part of the upright tube, till they come to the fleshy adhering tube, where some of them may be perceived entering into a papilla, or the beginning of an animal of the like kind, most probably to convey nourishment till it is provided with claws: the remaining part of these slender guts are continued on their fleshy tube, without doubt, for the same purpose of producing and supporting more young ones from the same common parent.

"The many longitudinal fibres that we discover lying parallel to each other, on the inside of the semi-transparent skin, are all inserted in the several claws round the animal's mouth, and are plainly the tendons or muscles for moving and directing the claws at the will of the animal: these may be likewise traced down to the adhering tube."

A strong light incommodes the *Actiniæ*, noise startles them, they are affected by odours, and fresh water causes them to die. These various feelings originate in their great irritability, which appears to increase according to their sufferings. They can support a temperature as low as 45°, and up to 140°, Fahr.; but beyond these extremes they perish. They are often left exposed to the air during spring-tides; but in such cases they always retain a great quantity of water, which they squirt out with force when molested.

These singular creatures have a power of reproduction equal to that so well known in the Fresh-Water Polyp (*Polypus viridis*, Bory., *Hydra viridis*). They may be cut perpendicularly or across, and each cutting will give origin to a new animal. The young *Actinia* are seen issuing, already formed, sometimes from the mouth; and sometimes the base of the old animal is dissevered, a portion remaining attached to the rock, where it continues to live, increasing in size, becoming more and more rounded, while, in a short time, a mouth, stomach, and tentacula are formed, presenting a complete *Actinia*. At length, the side-portions of this base give out globules, which are detached, fix themselves upon adjacent rocks, where they grow, and produce a new colony like the parent animal.

The *Actiniæ* feed upon small crustaceous and molluscous animals and fishes, which they seize with their tentacula, and afterwards disgorge what they cannot digest. They are found in every sea, some suspended from the vaults of sub-marine reefs, others covering the more exposed sides of rocks with a sort of flower-like tapestry, and some confining themselves to the smooth sands, on the surface of which they spread out their tentacula, and even withdraw under the sand when danger threatens. Each species, indeed, generally selects a peculiar haunt. Some of the species have the power of stinging, like the *Acalephæ*, which depends on their possessing in their structure the same organ as the *Acalephæ*, and other forms of polypes, and known under the name of Thread-Cells, or Stinging Hairs.

Many of the species are used as food in tropical countries, on the coasts of which they are more numerous than in colder climates.

The genera comprising the family *Actiniadæ* form several natural groups:

A. Such as have the tentacula reduced to the form of tubercles. A single species, constituting the genus *Discosoma* of Leuckart, belongs to this division, which cannot be regarded as certainly established, the genus referred to having been founded on a specimen preserved in alcohol, which alters materially the forms of sea-anemonies. Ehrenberg asserts that it is his *Actinia brevicirrhata*, which has very small and numerous tentacula. Ex. *Discosoma nummiforme*.

Edwardsia vestita.

B. Such Sea-Anemonies as have simple tentacula. Of these the following are the principal genera:—

1. *Minyas*, Cuvier (*Actiniata*, Blainville), *Free Actiniæ* having more or less globose bodies inflated at one end, and having at the other a disk covered by a great number of very short tentacula. Cuvier placed this genus among the *Echinodermata*, but the observations of Lesueur and Quoy, who have seen the living animal, place it without a question among the true *Actiniadæ*. As many of the usually fixed species are capable of swimming and of inflating their suctorial disks, it is by no means sure that such is always the habit of *Minyas*; indeed, we have observed an allied and undescribed animal which inhabits the Mediterranean, swimming at the surface of the sea in winter, but when confined in a glass of water it adhered to the sides in the manner of an *Actinia* properly so called.

Example, *Minyas cyanea*.

2. *Moschata*, Renieri, vermiform and free, and, according to De Blainville, incrusted with adhering substances. It is said to live floating in the sea. Both Ehrenberg and Dujardin have supposed that there was some mistake regarding this genus, and that it might have been founded on specimens of *Actinia* (*Cribrina*) *bellis*. It is more probably however identical with the *Edwardsia* of M. de Quatrefages ('Annales des Sciences Naturelles,' 1842), founded on some remarkable vermiform *Actiniadæ* which are invested with a sort of tube to which sand and gravel adhere. Three species of *Edwardsia* have been discovered by the author of the genus on the west coast of France, and a fourth in the Grecian Archipelago by Professor E. Forbes, the habits of which are very remarkable. It can move up and down freely in its membranous tube, and when kept for some time in sea-water, the tube having been injured, it came out of it altogether and moved about twisting its body in the manner of some *Annelides*. On being supplied with sand and gravel, it proceeded to construct another tube, rolling itself up in the sand and secreting glutinous matter for the membranous lining. It eats voraciously, and attacks such animals as come within reach of its tentacula. It lives buried in sand, and in places a few inches below sea-level.

3. *Iluanthus*, Forbes ('Annals of Natural History,' vol. v., 1840.) A single species only is known. The body is free, and tapers posteriorly to a point, which is probably buried in the soft mud among which it lives. The mouth is round, and surrounded by numerous long filiform tentacula. The *Iluanthus Scoticus* was found in four fathoms of water in Loch Ryan.

Iluanthus Scoticus.

4. *Actinia*, Linnæus, now restricted to such species as have simple tubular retractile tentacula, and adhere by a broad base. Ehrenberg has separated such *Actiniæ* as have a glandular epidermis, under the name of *Cribrina*. From the glands protrude long filaments, the uses of which are unknown. The tentacula of all the species are (contrary to the supposition of Ehrenberg) perforated at their extremities. The subgenus *Adamsia* has been constituted, by Professor E. Forbes, for the reception of the curious parasitical *Actinia maculata*, which envelopes the mouths of dead shells, generally selecting such as have been previously invested by the *Alcyonidium echinatum*. As such shells are frequently inhabited at the same time by the Hermit Crab, not a few naturalists have mistaken the coincidence for some necessary and mysterious friendship of the zoophyte for the crustacean.

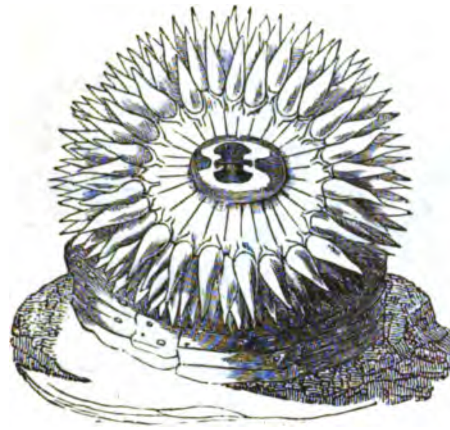
A large number of species of *Actiniæ* have been described, but many of them not with sufficient distinctness, and it is probable many more will be ultimately ascertained. The following are common species on the British coasts:

The Stout-Armed Animal-Flower (*Actinia crassicornis*, Müller) is three inches broad, with a leathery unequal envelope of an orange colour; the tentacula in two ranges, usually marked with a rose-coloured ring. Its abode is commonly in the sand.

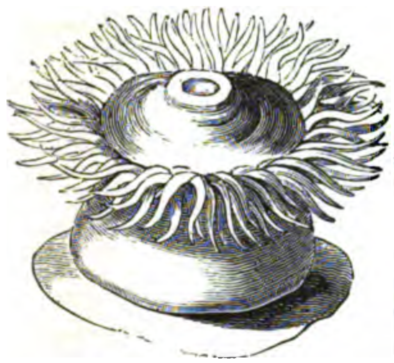
The Purple Animal-Flower (*Actinia Mesembryanthemum*) has a soft skin, finely striated, usually of a beautiful purple, often clouded with green. The tentacula, to the number of a hundred, vary much in colour. When the tide retires this species may be seen ornamenting the sea-rocks with its beautiful colours—"purple, violet, blue, pink, yellow, and green, like so many flowers," says M. Lamouroux, "in a meadow."

The White Animal-Flower (*Actinia Dianthus*, Ellis) is four or more inches broad, of a white colour; the margins of the mouth are expanded into lobes, all furnished with innumerable tentacula. There is an inner row of these, still larger.

In his 'British Zoophytes,' Dr. Johnstone enumerates twenty species of the genus *Actinia*, as found in the British islands. It is, however, a question whether all these are really different species; as few animals have a greater tendency to assume different forms than the members of this genus.



Stout-Armed Animal-Flower (*A. crassicornis*).



Purple Animal-Flower (*A. mesembryanthemum*).

White Animal-Flower (*A. Dianthus*).

5. *Anthea*, Johnstone, includes such *Actiniæ* as have not the power of retracting their tentacula. Several of the species grow to a large size.

Example, *Anthea Tuediæ*, Johnstone, 'Brit. Zoophytes,' p. 222, fig. 33.

6. *Actinoloba*, Blainville (*Metridium*, Oken), species in which the oral disk is divided at the margin into more or less rounded lobes, which bear short simple tentacula.

Example, *A. dianthus*, 'Phil. Trans.,' vol. lvii., tab. 19, fig. 8.

7. *Capnea*, Forbes, of which one species only is known. The disk is round, with several circles of exceedingly short tubercular retractile tentacula, and the body is in part invested with a peculiar epidermis, which is divided at the margin into eight lobes.

Example, *C. sanguinea.* "Annals of Natural History,' vol. vii., pl. 1, fig. 1.) Irish Sea.

Capnea sanguinosa.

C. Sea-Anemonies having more or less pinnate tentacula.

8. *Actineria*, Quoy and Gaimard. Such as have the entire disk covered by very small villose ramified tentacula.

Example. *A. villosa*, Quoy and Gaimard. ('Voy. Astrolabe, Zooph.,' pl. 49, figs. 1, 2.) Tonga islands.

9. *Actinodendron*, Quoy and Gaimard. Species having very long arborescent tentacula disposed in one or two series on the oral disk.

Example, *A. alcyonoideum.* ('Voy. Ast.,' pl. 48, figs. 1, 2.) This animal is more than a foot in height, and secretes a stinging mucus.

10. *Thalassianthus*, Leuckart. One species only is known, the *T. aster*, an inhabitant of the Red Sea, figured in the plates to Rüppell's 'Voyage.' Its tentacula are numerous, short, and pinnate. It is probably identical with the *Epicladia* of Ehrenberg.

11. *Heterodactyla*, Ehrenberg. The tentacula are of two sorts, some simple and others pinnate.

Example, *H. Hemprichii.* Red Sea.

12. *Megalictis*, Ehrenberg, founded on an animal from the same locality with the last, and characterised by having all the tentacula arborescent, but the internal ones are the larger and more pinnate, and have their extremities hollowed into a sort of socket.

Example, *Megalictis Hemprichii.* [*See* SUPPLEMENT.]

ACTI'NOCAMAX, a division of Belemnites, proposed by the late Mr. Miller of Bristol, upon the supposition that the species which he ranked in it had no true alveolar cavity or phragmacone. The correctness of this view is doubtful. The species belong to the cretaceous strata. [BELEMNITE.]

ACTINOCARPUS (from ἀκτὶν, a ray, and καρπὸς, a fruit), a genus of plants belonging to the order *Alismaceæ*. One of the species of this genus, *A. damasonium*, is a British plant, though rare. Like the order, it is an aquatic plant, and has cordate, oblong, floating leaves, with white flowers. Another species, *A. minor*, is sometimes found cultivated in our gardens.

ACTINO'CERAS, a genus of Fossil *Cephalopoda*, separated from *Orthoceras* by Mr. Stokes. The species belong to the Palæozoic strata. *A. Simmsii* occurs in Ireland.

ACTINOCRINI'TES, a genus of *Crinoidea* [ENCRINITES], containing many species. It occurs in Silurian and Carboniferous strata. (Miller.)

ACTI'NOLITE, a crystallised mineral of a green colour, a variety of hornblende, found in primary stratified rocks, and occasionally in trap-rocks. The name is derived from ἀκτὶν, a ray of light, and λίθος, a stone, from the crystals being arranged in the form of rays. It occurs in masses or asbestiform.

ACU'LEUS, or *Prickle*, in Botany, is a hard, conical, often curved expansion of the bark of some plants, such as the rose, and is intended either for their defence against enemies, or to enable them to hook themselves upon their neighbours, so as to gain a more free access to light and air, or for other purposes unknown to us. The prickle is composed entirely of cellular tissue, which is at first soft and flexible, and only acquires its hardness and rigidity when old. In some respects it may be compared to a hair, from which it chiefly differs in its large size and greater permanence. Care must be taken by the young botanist not to confound the prickle with the spine or thorn, which is of a totally different nature. [SPINE.] They may be distinguished by the prickle breaking readily from the bark, and leaving a clean scar behind; while the spine cannot be torn off without rending through the bark into the wood itself. Leaves are often metamorphosed into spines, but never into *aculei*.

ADAMAN'TINE SPAR, a simple mineral, more commonly denominated *Corundum* by mineralogists, the name given to it in India, from which country it was first brought to Europe. The first specimens of it were sent by Dr. Anderson, of Madras, to Mr. Berry, a lapidary in Edinburgh, as the substance used in India to polish masses of crystal and all other precious stones, except the diamond. It was examined by Dr. Black, who ascertained its peculiar nature, and from its great hardness he called it Adamantine Spar. With the exception of the diamond, it is the hardest substance known. It contains about 90 per cent. of alumina, a little iron, and a little silica, is usually of a pale grey or greenish colour, but is also found of various tints of red and brown. It is usually met with in rough ill-defined crystals, in granite, and sometimes in primary limestone, and is found in China, many parts of India, and occasionally in different parts of Europe. *Emery*, the well-known substance used in the cutting and polishing of glass, in polishing steel, making razor-straps, and similar purposes in the arts, is a granular variety of Corundum, usually very much mixed with iron ore. It is chiefly imported from the Isle of Naxos, in the Grecian Archipelago, but is also found in Saxony. The *Sapphire* is a remarkable instance how the mysterious chemistry of nature in the mineral kingdom produces from the same elements substances the most different in external form; this beautiful precious stone yielded by the analysis of Chenevix 94 per cent. of alumina; and Tennant found in emery, when freed from its admixture of iron, 92 per cent. of the same earth. The sapphire is, after the diamond, the most valuable of gems; it is usually dark blue, but also occasionally colourless, and the precious stones called by lapidaries *Oriental Ruby*, *Oriental Topaz*, *Oriental Amethyst*, and *Oriental Emerald*, are red, yellow, violet, and green Sapphires, distinguishable from the other gems of the same name which have not the prefix Oriental, by their greatly superior hardness and greater specific gravity. Sapphires are found in gravel and sand in the island of Ceylon and in Pegu, but they have never been seen in a matrix. They are also occasionally found in gravel in different parts of Europe, and they have been met with of a clear blue colour and crystallised, in the lava of Nieder Mendig, near Andernach on the Rhine.

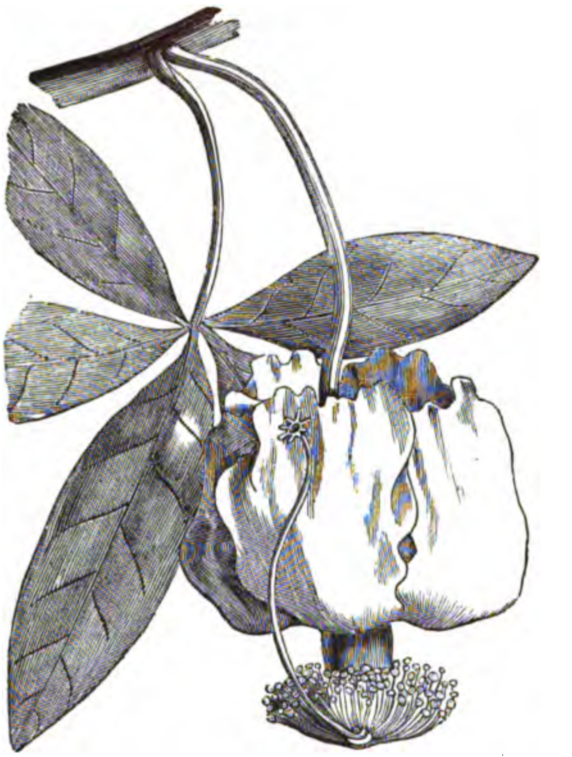
ADANSONIA, so called in honour of Michael Adanson, the French naturalist, is an extraordinary tree found in Africa within the tropics, particularly in Senegal, where it is called *Baobab*.

The celebrated traveller Humboldt considers it as the 'oldest organic monument of our planet,' in consequence of the calculations of Adanson that specimens, still found on the north-west coast of Africa, are probably 5000 years old; these calculations are, however, open to many objections.

In appearance, *Adansonia* is unlike any other known tree: the enormous dimensions of its trunk bear a striking disproportion to the other parts. It is not unusual to find a trunk not more than 12 or 15 feet from the root to the branches, with a circumference of 75 or 78 feet. The lower branches are very long, and at first horizontal, extending perhaps 60 feet; the consequence of which is that they bend down to the ground, entirely hiding the trunk, and giving the tree the appearance of a huge mass of verdure. The wood is very soft, even when in perfection, and is subject to a disease, which may be compared to the very malady of which its celebrated discoverer died—a sort of softening of all the hard parts, so that the least storm is sufficient to overthrow and dismember its enormous bulk. A curious practice prevails among the negroes of hollowing its trunk out into chambers, and therein depositing the bodies of malefactors, or of persons to whom the usual rites of sepulture are denied. In this situation the bodies become dried up, and soon acquire the state of perfect mummies.

Adansonia belongs to the natural order *Bombaceæ*, among which it is at once known by a broad tube of stamens and deciduous calyx, combined with a woody closed fruit, containing a soft pulp.

The only species is *Adansonia digitata*, the Monkey-Bread, Sour Gourd, Lalo Plant, &c., of the African negroes. The leaves are deep



Leaf and flower of *Adansonia digitata*.

green, and divided into five unequal parts, each of which is of a narrow lanceolate figure, and radiates from a common centre, the outermost divisions being the smallest. The flowers grow singly in a pendulous position from the bosom of the leaves, are very large, white, crumpled at the edge, and have the petals very much reflexed. The stamens are very numerous, and are collected into a tube, which spreads at the top into a sort of umbrella-like head, from the midst of which arises a slender curved style, terminated by a rayed stigma. The fruit is an oblong, dull green, downy body, eight or nine inches long, containing several cells, in each of which there is a number of hard shining seeds immersed in a soft pulp, which is scarcely juicy. From this pulp the negroes prepare an acidulous drink, much used in the fevers of the country. The bruised leaves, in a dry state, form a substance called *lalo*, which they mix with their food and imagine is useful in checking, or counteracting, the effects of profuse perspiration. Like the rest of the order, *Adansonia* is emollient and mucilaginous in all its soft parts. [*See* SUPPLEMENT.]

ADAPIS, in Zoology, the name of a genus of Fossil Pachydermatous (thick-skinned) mammals, described by M. Cuvier, in his great work 'Sur les Ossemens Fossiles,' vol. iii. p. 265. The word is found in Gesner, as a synonyme of the common rabbit (not, as stated in the reference to Cuvier just given, of the *Hyrax*), and is appropriated to the present genus, from the presumed similarity in size, organization, and habits, which probably existed between the hedgehog (*Hyrax* and the fossil species.

Skull of the Fossil *Adapis*.

The remains, upon which M. Cuvier has founded this genus Adapis, the only specimen which he was able to procure during a period of twenty-five years devoted to researches after fossil bones, consist of three fragments of skulls, found in the plaster quarries of Montmartre, Paris, celebrated for the enormous quantity and variety of the remains of extinct animals which they have produced, and which, in the hands of M. Cuvier, have effected such improvements in the kindred sciences of zoology and geology. The first of these fragments is a head, nearly perfect on the side, imbedded in the mass of gypsum which contained it; and exhibiting the dentition nearly in a perfect form. The general outline of this skull closely resembled that of the hedgehog, but it was about one-third larger: there were four incisor teeth in each jaw, trenchant or edged and oblique; followed, on each side, by a canine tooth, of a conical form, but in other respects differing little from the molar teeth in length and figure. Of these latter there appear to have been seven in each side of each jaw. Two other fragments procured by M. Cuvier—one a portion of a lower jaw, another of an upper jaw—served to complete his description, by supplying some of the back teeth which were wanting in the more perfect specimens.

ADDA, the Arabic name of a small species of lizard (*Scincus officinalis*) celebrated by the eastern physicians on account of its pretended efficacy in the cure of elephantiasis, leprosy, and other cutaneous diseases, to which the Arabs and inhabitants of Egypt are peculiarly subject; and of which, according to Bruce, they are more afraid than of the plague itself.

The Adda, as described by Bruce, is about six inches and a half in length; the body and tail are cylindrical, the latter thick at the base, and ending in a very sharp point; the head is conical, and the mouth provided with two rows of small feeble teeth; the face is covered with five black lines, which cross one another like a net; the body is of a light straw colour, crossed with eight equidistant bands of black, and the scales are so finely polished that they almost appear as if they had been varnished. The adda is found in Arabia, Egypt, and Nubia; it is particularly abundant in the neighbourhood of the ancient Meroë (near the Nile, about 17° N. lat.); and, in short, throughout every part of the sandy deserts of Asia and Africa, wherever the slightest traces of moisture exist. "It burrows," says Bruce, "in the sand, and performs the operation so quickly, that it is out of sight in an instant, and appears rather to have found a hole than to have made one: yet it often comes out during the heat of the day to bask itself in the sun; and, if not very much frightened, will take refuge behind stones, or in the withered, ragged roots of the absinthium, dried in the sun to nearly its own colour."

ADDAX. [ANTELOPE.]

ADDER, a name of the common viper. [VIPERIDÆ.]

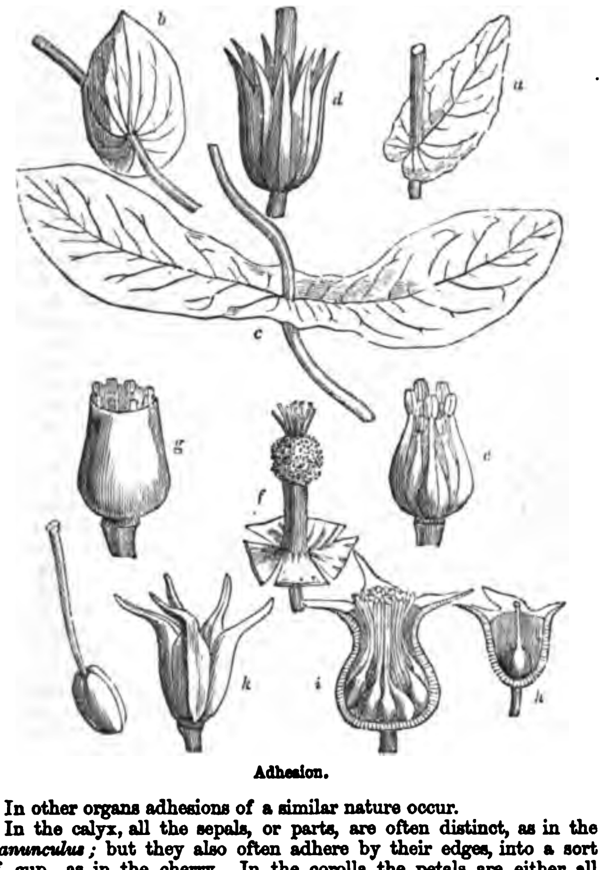
ADELFORSITE, a variety of mineral, included under Heulandite. [HEULANDITE.]

ADELO'CRINUS, a fossil genus of *Crinoidea*, from North Devon. (Phillips.)

ADHESION, in Botany, is applied to the union of parts which are separate in other plants, or in younger states of the same plant. Many of the characters which cause the diversity of appearance in the vegetable kingdom originate in the adhesion of a few very simple organs; and what we are accustomed to consider parts of extremely different nature, only seem so in consequence of the way in which such adhesion occurs. Thus, the stem of a tree is not a homogeneous mass of vegetable matter, perforated by holes, or filled by little cavities caused by the extrication of air in it when in a soft state, but is produced by the adhesion of certain elementary bodies, called Cellular Tissue and Vascular Tissue [TISSUES, VEGETABLE], arranged in a definite manner, which varies in every species; neither is a leaf, or a fruit, or a flower, a mere mass of pulp, or an expansion, like the horn of an animal, but also consists of these same elementary organs in a state of adhesion.

Guided by these facts, modern botanists have made use of this property of adhesion to explain the nature of every organ that plants bear, and there are few anomalies that are not due in a great measure to the union of contiguous parts.

Some leaves are said to be stem-clasping, or amplexicaul, when their base partially surrounds the stem (*fig. a*); while some stems are said to be perfoliate, when they seem as if they pierced through the leaf, as in *Bupleurum rotundifolium* (*fig. b*); but the latter differ from the former only in this, that in the first the lobes at the base of the leaf embrace the stem without adhering, while in the second they not only clasp the stem but grow together where their margins come in contact. Some leaves are hollow, as in the Pitcher Plant, and these were formerly thought to be special organs with which no analogy could be discovered; they are now known to be leaves which have rolled up so that their opposite margins come in contact and adhere. Other leaves, growing from opposite sides of a stem, adhere in consequence of their bases becoming connate (*fig. c*), as in the honeysuckle; and finally there are others, many of which grow in what botanists call a whorl, that is to say, all round a stem upon the same plane, and adhere by their margins into a sheath (*fig. d*), as in *Casuarina*.



Adhesion.

In other organs adhesions of a similar nature occur.

In the calyx, all the sepals, or parts, are often distinct, as in the *Ranunculus*; but they also often adhere by their edges, into a sort of cup, as in the cherry. In the corolla the petals are either all separate, as in the rose, or they adhere by their edges into a cup or bell, as in the different heaths, *Campanula*, and the like.

Similar adhesions take place between the stamens. In the rose they are all distinct from each other; in the geranium they slightly adhere at the base (*fig. e*); in the mallow they adhere into a tube, except near the upper extremity, where they are not united, and have their ordinary appearance (*fig. f*); in other plants they grow together into a solid tube in which no trace of separation can be discovered, as in the genus *Guarea* (*fig. g*).

Finally, in the pistil there are certain parts called carpels, each of which is a hollow body terminated by a style and stigma. These carpels are hollow, because they are formed of a flat organ, doubled up so that its edges come in contact and adhere to each other. Sometimes only one carpel is present in a flower, as in the cherry (*fig. h*); sometimes several, as in the rose (*fig. i*). In the *Nigella*, the styles of the carpels are all distinct (*fig. k*), but in the lily and the myrtle (*fig. l*) the styles of the carpels adhere so completely that there seems to be but one. In the apple, the calyx seems to grow from the top of the fruit; this is caused by the carpels having at a very early period adhered to the inside of the calyx, which afterwards grows with their growth, and, finally, leaves its extremities in a withered state near the top of the carpels: in the cherry, on the contrary, no adhesion ever takes place between the carpel and the calyx; and, consequently, when the fruit is ripe, there is no trace of the latter upon its upper end. In the raspberry, the fruit is enabled to slip like a thimble from off the receptacle, because the carpels all adhere by their sides.

(De Candolle, *Théorie Elémentaire de la Botanique*; Lindley, *Introduction to Botany*; Schleiden, *Principles of Scientific Botany*.)

ADIANTUM (ἀδίαντον), a genus of Ferns, so called by the Greeks because the leaves are of such a nature that water will not readily moisten them. The plant described by Hippocrates and his successors under this name appears to have been the *A. Capillus Veneris*, or the Maiden-Hair Fern—a rare European species, occasionally met with on moist rocks, and old damp walls, even in this country. From other genera of the same tribe it is known by its size, or masses of reproductive particles, being situated upon the margin of the leaves, and covered over by a thin curved scale which separates from the leaf by its inner edge.

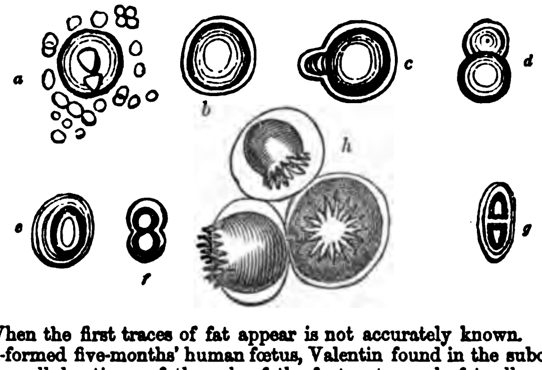
The number of species is very considerable, probably not far from 80 or 90, and, as is the case in all extensive genera of Ferns, comprehends every degree of division of the leaves, from perfect simplicity to the most compound conditions. All those in which the leaves are much divided are remarkable for the very delicate elastic stalks on which the broad leaflets are attached; it is to this circumstance that the name of Maiden's Hair has been given to the European species. The genus is scattered over all the world, from Europe to New Zealand, but is not found in any high latitudes in either hemisphere. By far the greater part of the species inhabit damp tropical woods.

A. Capillus Veneris is a dark-green stemless plant, found in damp, rough rocky places, by the side of water-courses, and on the edge of wells, where the air is keen and dry. Its leaves, which are from six to fifteen inches high, have a blackish-purple highly-polished stalk, divided into a great number of very slender ramifications, from the extremities of which proceed the thin, delicate, wedge-shaped leaflets, which are notched irregularly upon their upper edge, and have the most graceful appearance imaginable when growing a little above the eye, and gently agitated by the wind. Wonderful medicinal properties were once ascribed to this species, but they have long since been discovered to have no existence except in the exaggeration of fanciful practitioners. All that can be discovered in it is a slight but pleasant aromatic flavour; the French occasionally use it in slight coughs. *Capillaire* is prepared by pouring boiling syrup upon the leaves of this species, or of *A. pedatum*, an American plant of larger growth and far less divided leaves; a little flavour is afterwards given with orange-flowers.

ADINOLE, a laminated variety of Felspar, sometimes called Fusible Hornstone, Leelite, and Petro-silex. [FELSPAR.]

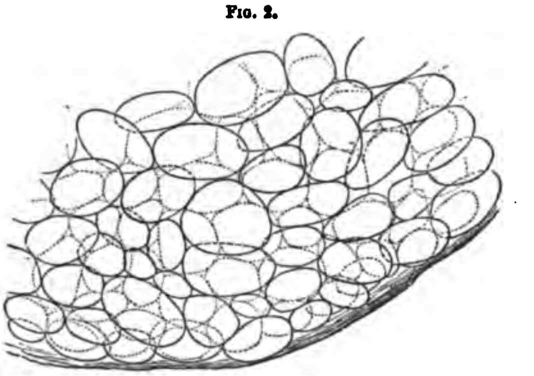
ADIPOSE TISSUE is usually associated with *Areolar Tissue* [AREOLAR TISSUE], the two being generally known collectively as *Cellular Tissue*. It must be distinguished from *Fat* [FAT], adipose tissue being a membrane of extreme tenuity in the form of closed cells or vesicles, while fat is the material contained within them. The membrane of the adipose vesicle does not exceed the 20,000th of an inch in thickness, and is quite transparent; it is moistened by watery fluid, for which it has a greater attraction than for the fat it contains. Each vesicle is a perfect little organ, varying, when fully developed, from the 300th to the 800th of a line; minute capillaries may be observed on their external surface. (*Fig.* 2). When fat-vesicles are deposited together in large numbers, as is usually the case, they assume a more or less regular polyhedric form from their mutual pressure.

FIG. 1.



When the first traces of fat appear is not accurately known. In a well-formed five-months' human fœtus, Valentin found in the subcutaneous cellular tissue of the sole of the foot not merely fat-cells, such as occur in adults, varying from the ordinary size to the 125th or 100th of a line, within and around which were numerous small vesicles (*fig.* 1, *a*), but other forms which threw more light on their structure and development. In some the surrounding cell-membrane was much more distinct than as it occurs in adults (*b*). In others there appeared to be a deposition of fat, not occupying the whole space of the cell (*c*); the remainder of the cell having often a striped or streaky appearance, and forming a lateral projection; this is seen in *c*, and in a more marked degree in *d* and *e*. In other fat-cells there were observed to be two vesicles, separated by a septum, against which they were partially flattened by pressure (*g*), or merely separated by a constriction in the external walls, as in *f*. This form leads us to conclude that

Fig. 2.



fat-cells increase by division. The fat-vesicle of the human subject contains *Margarin*, a solid fat, and *Olein*, a fluid fat. These sometimes separate spontaneously, presenting a very beautiful microscopic appearance. The margarin collects in a spot on the inner surface of the cell-membrane, and presents the appearance of a small star, whilst the olein occupies the remainder of the vesicle, unless when the quantity of fat in it is rather smaller than usual, in which case we may observe a little aqueous fluid between the olein and the cell-membrane. (*Fig.* 1, *h*.)

The chemistry of the substances *Margarin* and *Olein* is somewhat complicated, but the function of the adipose tissue cannot be explained without it. These two substances, with *Stearin*, are the most widely distributed fats in the organic kingdom, but they are not the only ones. They were formerly regarded as salts formed by fatty acids with *Glycerin*. Recent investigations have however shown that this view requires a slight modification. Berzelius thinks that glycerin does not exist ready formed in the neutral fats, but that it is a product of the formation of soap; and he considers the base of the neutral fats to be the oxide of a radical ($C_3 H_2$) which he terms *Lipyle*. Glycerin is then formed from two equivalents of the oxide of lipyle, with three equivalents of water: $2\,C_3 H_2 O + 3\,H O = C_6 H_7 O$. If to this we add one equivalent of water, we obtain the usual formula.

According to this view, which is supported by Redtenbacher, Varrentrap, and Mulder, the base of every neutral fat yielding glycerin is a compound which is represented by $C_3 H_2 O$.

The most important of the fatty acids are :—

Stearic Acid	$C_{68} H_{66} O_5 + H O$
Margaric Acid	$C_{34} H_{34} O_3 + H O$
Oleic Acid	$C_{44} H_{40} O_4 + H O$

These are universally diffused in plants and animals; and, combined with the oxide of lipyle ($C_3 H_2 O$), they form the neutral fats—stearin, margarin, and olein; and this is the form in which they most commonly occur in the organic kingdom. Sometimes, however, a more powerful base (potash, soda, &c.) removes the oxide of lipyle, and there are then formed compounds of the fatty acids with alkalies.

In connection with this subject, Mulder observes that "when salad-oil is conveyed into the stomach, it may pass unchanged into human fat, for both consist of margarin and olein, although in different proportions; and as margarin and olein are found in many vegetables used for food, nothing is more simple than to assume that these substances are directly transferred, without change, into the fats of the animal body.

"But if these same vegetables are eaten by a sheep, the olein and margarin must undergo some change in the body of the animal, since mutton-fat contains a large amount of stearin. In this case the change is easily understood, for 2 eq. margaric acid ($C_{68} H_{68} O_6$) = 1 eq. stearic acid ($C_{68} H_{66} O_5$) + 1 eq. oxygen. Thus, from two equivalents of margaric acid one equivalent of stearic acid is produced, and one equivalent of oxygen is given off. In all probability such a deoxidation of the margaric acid in the food of the sheep is really effected; and on the contrary, when mutton-fat is used for food by man, stearic acid is most probably converted into margaric acid by the absorption of oxygen." It is now believed by our first physiologists, that the neutral fats taken as food do not directly form fatty tissue, but that they enter the blood in a saponified state. In fact the alkaline character of the bile as it enters the duodenum renders it impossible for the fat to enter the blood without undergoing this change. If it be saponified, we readily understand how compounds of fatty acids and soda should exist in the blood and in various parts of the body. When a soda-soap however exists in the blood, it cannot form a neutral fat, such as margarin or olein, without combining with glycerin. This leads to the inquiry, in the first place, whether these soaps meet with glycerin; and secondly if they do, whether the glycerin would combine with the fatty acids and form neutral fats. There is good reason for believing that both these questions may be answered in the negative, for the glycerin set free when the soda-soap is formed, is most probably at once decomposed; and further, glycerin will not remove the soda from the fatty acid and form a neutral fat.

It has been suggested by Mulder, that although glycerin will not enter into this combination, the oxide of lipyle in a nascent state may do so, and that in this manner the fatty acids may be converted into neutral fats, and deposited in the cellular tissue, and other parts of the body. We have already shown that (according to the opinion of Berzelius) glycerin is the oxide of the radical ($C_3 H_2$) lipyle. The second oxide of this radical exists in lactic acid, which is supposed by the great majority of chemists to be present in most parts of the body. When lactic acid ($C_6 H_5 O_5$) is sublimated, we obtain a white sublimate, the composition of which is $C_3 H_2 O_2$; while the composition of the oxide of lipyle is $C_3 H_2 O$.

It may happen that there are causes of deoxidation at work in the system, by which some of the substances usually converted into lactic acid are made to produce oxide of lipyle, which in the nascent state unites with the fatty acids, forming neutral fats.

Hence in all probability the neutral fats are not deposited directly and unchanged in the cellular tissue, but are first saponified, and entering the blood as margarate and oleate of soda, are again reduced to neutral fats by the influence of lactic acid.

The next question for our consideration is *the formation of fat*—a subject which has given rise to much angry and intemperate discussion between the leading chemists of France and Germany. Dumas, who may be regarded as the representative of the French school, maintains that all the fat of animals originates in and is obtained from plants; while Liebig, on the contrary, maintains that a portion of it is formed by the animal itself, from starch, sugar, and gum. The goose was the animal respecting which the dispute originated. When fattened with Indian corn, the starch must, according to Liebig, have been changed into fat, because he had found but a minute quantity (about 1 part in 1000) of fat in that kind of grain. Dumas however extracted 9 per cent. of fat from Indian corn (or ninety times as much as Liebig), and thus he found in the food which the goose had eaten much more fat than had to be accounted for. The actual fact is, that the amount of fat in this grain is so variable that no conclusion can be drawn from the experiment. Liebig quotes many examples of substances which, although they contain little fat, are well known by experience to be especially fit for fattening the animal body. Rice, peas, beans, and potatoes are all known to possess this property; yet rice gives only 0·2 to 0·8 per cent. of matters soluble in ether (the ordinary means of determining the amount of fat); peas 1·20 to 2·1; beans 0·70, and dried potatoes 0·35 per cent. Thus any animal that has eaten 1000 pounds of one of these substances may obtain from them 2 to 8, 12 to 21, 7, or 3½ pounds of fat respectively. He makes the following calculations:—Three pigs to be fattened in thirteen weeks require 1000 pounds of peas, and 6825 pounds of boiled potatoes, the latter being equal to 1638 pounds of dry potatoes. These contain in all 26 pounds of fat, the peas yielding 21 pounds, and the potatoes 5. One fattened pig gives on an average 50 to 55 pounds of fat, the three yielding 150 to 165 pounds. Each pig before fattening contains on an average 18 pounds of fat—that is, 54 pounds for the three. If to these 54 pounds be added 26 pounds contained in the food, we get 80 pounds; and if we subtract these from 150 to 165 pounds, there is a remainder of 70 to 85 pounds of fat produced from the starch, &c., of the food. Liebig's opinion is further strengthened by the circumstance that some fats are undoubtedly produced in the body, as, for instance, the fats peculiar to the brain, *Cholesterin*, *Cetine*, *Phocenine*, &c. To obtain these from other fat requires just as much a new arrangement as if they were produced from starch; hence, in a scientific point of view, there is nothing improbable in the supposition that animals are able to produce fats.

With regard to the formation of fat in plants, it is worthy of observation that all seeds which yield oil on pressure—as the castor-oil seed, hemp-seed, &c.—contain starch in their early stages, this starch disappearing as the oil increases, and when the seed is completely developed not a trace of the starch remaining. This renders it probable that these fatty matters are formed from starch. From their ultimate composition it is obvious that whenever fats are produced from any substance there must be produced at the same time either highly oxidised compounds, or else that oxygen must be itself liberated. Liebig observes that if from the formula for starch, $C_{12} H_{10} O_{10}$, we take nine equivalents of oxygen, there will remain in 100 parts—

C_{12}	79·4
H_{10}	10·8
O	9.8

The empirical formula for fat which comes nearest to this is $C_{11} H_{10} O$, which gives in 100 parts—

C_{11}	78·9
H_{10}	11·6
O	9·5

According to this formula an equivalent of starch, in order to be converted into fat, would lose one equivalent of carbonic acid and seven of oxygen, or (expressed in symbols) $C_{12} H_{10} O_{10} = C_{11} H_{10} O + C O_2 + 7\,O$.

The same point is also clearly shown by contrasting the ultimate composition of starch and fat.

	Starch.	Human Fat. (Chevreul.)
Carbon	44·91	79·00
Hydrogen	6·11	11·42
Oxygen	48·98	9·58

As we are not acquainted with any constituent of plants which can take up the oxygen thus liberated in the formation of fat, we must regard this as one of the sources of the oxygen given off by plants. Mulder has given the following scheme as illustrative of the mode in which starch may possibly be converted into fat or oil in the vegetable kingdom:—

	C	H	O
To 7 equiv. of starch	84	70	70
Add 8 equiv. of water		8	8
And we have	84	78	78
Which are equal to			
1 equiv. of margaric acid	34	34	3
1 equiv. of oleic acid	44	40	4
2 equiv. of oxide of lipyle	6	4	2
69 equiv. of oxygen			69
Making as before	84	78	78

As to the mode in which fat is deposited, there is reason to believe that it is immediately formed out of the blood, without any glandular apparatus for secreting it, by the capillary arteries of the adipose vesicles. By chemical analysis, the materials of fat, like those of all the other secretions, are found to be contained in the blood.

As diffused over the body, the adipose membrane consists of masses which vary considerably in their magnitude and shape. In some places they are rounded, in others pear-shaped, and in the median line of the abdomen, egg-shaped. The distribution of the membrane is exceedingly unequal. There is, in general, a considerable layer immediately beneath the skin; and especially between the skin and the abdominal muscles, where it occasionally accumulates in enormous masses. Between the folds of the membranes which form the omentum and mesentery there is usually a large quantity; also around the heart and the kidneys; on the face, and especially on the cheeks, and in the orbits of the eyes; in the palms of the hands, the soles of the feet; the pulp of the fingers and toes, the flexures of the joints, the fibres of muscles, and the sheath of vessels. In most of these organs it never entirely disappears, whatever be the degree of leanness to which the body may be reduced; while in the cranium, the brain, the eye, the ear, the nose, and several other organs, there is none, whatever be the degree of corpulency.

The functions of the adipose tissue are manifold and apparent. 1. It fills up interstices, and acts as a kind of pad or cushion for the protection of organs which would be otherwise injured by the movements of the body; so essential does it appear in some parts that even where there is great emaciation it does not wholly disappear. 2. By its non-conducting power it assists in maintaining the heat of the body when exposed to external cold. It is found in immense quantities in the animals inhabiting the Arctic Seas, as in the whale tribe, and also in all animals living in the colder parts of the earth. 3. It acts as a storehouse for fuel during times of necessity. Some animals are exposed to a want of combustible food in the winter time, and they accordingly become fat in the autumn, and are thus supplied with material for maintaining their animal heat. It is well known that fats are amongst the most important agents of food by which animal heat is maintained. Animals that hybernate depend solely for their existence upon the fat deposited in their bodies, which is gradually consumed during hybernation. 4. The presence of fat seems to favour the development of protein tissues. It is always found in the ova of animals before the embryo is formed. The administration of oils in certain diseases attended with emaciation, as in phthisis, has been found most beneficial, and appears to act favourably, by assisting the development of protein tissues.

(Lehmann, *Physiological Chemistry*; Kölliker, *Handbuch der Gewebe-Lehre*; Carpenter's *Principles of Physiology*.)

ADJUTANT. [CRANES.]

ADO'NIS, a genus of plants belonging to the natural order *Ranunculaceæ*, and containing many species of very great beauty. The name is merely poetical. *Adonis* is distinguished from *Ranunculus* by the want of a little scale at the base of the petals, and from other genera of the order by the numerous hard, dry, sharp-pointed grains of which its fruit consists.

Botanists divide the genus into two sections, the first of which comprehends all the annual kinds, the second all the perennials. Ten species are spoken of as belonging to the first section, inhabiting corn-fields and similar dry exposed places, chiefly in the south of Europe and north of Africa. Some of them have deep crimson flowers, as *A. autumnalis*, the common Pheasant's-Eye of our gardens; in others the blossoms are yellow: it is not improbable that they are all varieties of the same species.

Of the perennial kinds, *A. vernalis*, which is common in gardens in England, is found in a wild state abundantly on all the mountains of middle Europe. Its flowers have from ten to twelve petals of a yellow colour, and of a brilliancy which is rendered the more dazzling by the deep green tuft of finely-divided leaves among which they expand. It is only a few inches high, and is one of the early harbingers of spring. Three others are described, all mountain plants, resembling *A. vernalis* in general appearance, but perhaps still more beautiful. They seem to have been occasionally brought to this country, but to have been soon lost again.

Nothing has been remarked as to the sensible properties of these plants; they doubtless partake of the acridity so prevalent in their tribe.

ADO'XA, a genus of plants belonging to the natural order *Araliaceæ*. The only species of this genus is the *A. Moschatellina*, which is a little inconspicuous plant found in woods and groves in all parts of Europe. It is common at Charlton and Hampstead, near London, and in many other spots in England.

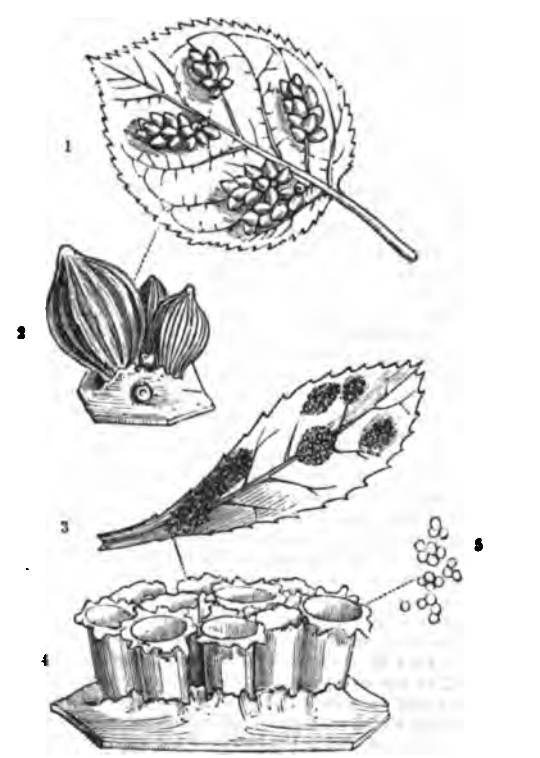
From a granular root, which when dry is white as snow, arise, early every spring, a few leaves about four or five inches high, divided into three principal divisions, each of which is also three-leaved, with every lobe deeply cut into roundish segments. The stem that supports the flowers has two opposite leaves, like those of the root, only they have a short stalk, and consist of but three leaflets. The flowers have a musky smell, are pale green, and are collected in little round heads. Each one consists of a superior calyx of five lobes; there are no petals; the stamens are ten; the styles five; and the ovarium contains five cells. This last changes to a succulent berry, having five compressed seeds.

In English this is called Moschatel; it is a pretty, interesting plant, much sought after by the curious for the sake of its delicate, modest appearance. No known medicinal properties belong to it.

ADULARIA, a synonym of Felspar. [FELSPAR.]

ÆCI'DIUM, a genus of minute parasitic plants belonging to the natural order *Fungi*, found in great abundance in this and other northern countries. By some modern writers it has been combined with *Uredo* and others; but it appears distinctly characterised by its peridium, or enveloping membrane, having a tubular form, and being altogether distinct from the cuticle of the plant on which it grows.

The species are universally parasitic upon the leaves or flowers or bark of living plants, where they are generated beneath the cuticle. Their structure is of the most simple kind; consisting of nothing more than a little mass of excessively minute sporules, or reproductive particles, much smaller than the finest sand, inclosed in a thin bag, of



1. *Æcidium cancellatum*, on a leaf, natural size. 2. Peridia, magnified. 3. *Æcidium Berberidis*, natural size. 4. Peridia, magnified. 5. Sporules.

either a fibrous or reticulated structure, which in time pierces the cuticle under which it lies, gradually assumes a tubular appearance, and finally bursts at the apex for the purpose of enabling the sporules to escape.

A great many species are found upon the weeds and trees of Europe, varying in colour, size, and form. Of these the two following are among the most common:—

Æcidium cancellatum, the Pear Æcidium. This plant is often very common in the latter months of autumn on the back of the leaves of the cultivated pear-tree, to which it gives a singularly warted aspect. It makes its appearance, crowded in little patches of a pale brown colour, which, when examined with a microscope, are seen to consist of numerous oval bodies, about a line long, rather the broadest towards the upper end. These bodies are, when young, slightly furrowed, but at a more advanced period they divide into tough parallel fibres, which open at the sides, but do not separate at the apex. Through the passages thus formed between the fibres fall the sporules, or seed-like particles.

To inaccurate observers this species would appear an aggregation of the nests of some minute insect, for which we know it to be often mistaken. It probably does not produce any injurious effect upon the plants it attacks, for it generally makes its appearance late in the season, when the leaves have nearly completed their office for the year.

Æcidium Berberidis, the Barberry Blight. The bright orange powder that collects upon the leaves and flowers of the common Barberry consists of the sporules of this species, which are discharged from thousands of little tubular apertures, that spread in patches over all the tender parts. These apertures are the open ends of the peridia in a state of maturity, and are bordered at first by a ragged toothed membrane, which finally falls away. There is a popular notion that Barberry bushes blight corn. The rust of corn is a species of *Puccinia* [PUCCINIA], and it is not improbable that the spores of *Æcidium* from the Barberry may produce *Puccinia* on the corn.

(Henslow's *Journal of the Royal Agricultural Society*, 1841.)

ÆGA'GRUS, a wild species of Ibex, called Paseng by the Persians. [GOAT.]

ÆGOPODIUM (from αἴξ, a goat, and ποδίον, a little foot), a genus of plants belonging to the order *Umbelliferæ*. One species, *Æ. podagraria*, is common throughout the whole of Europe, and grows abundantly in Great Britain. It has a stem one or two feet high, with furrows. The leaves are two or three times ternate; the leaflets unequal at the base and acutely serrate. It has a creeping root, and grows in damp places. Although well known, and having the names of Goat-Weed, Ash-Weed, Herb Gerard, and Wild Masterwort, it seems to possess no medicinal properties. Linnæus says that it is boiled when young, and eaten as greens in Sweden.

AE'LODON, the generic title applied by H. von Meyer to the fossil crocodile or gavial of Monheim.

AEROLITES, called also *Meteoric Stones*, are bodies which have fallen on the earth from the atmosphere, and are named from ἀήρ, atmosphere, and λίθος, a stone. We possess historical records from very remote antiquity, and numerous writers in all ages have mentioned instances of the remarkable phenomenon of stony bodies having been seen to fall from the sky; yet, till within the last fifty years, all such accounts were treated as tales of the ignorant and superstitious. The first man of science who directed attention to the subject of aërolites was Chladni, a German philosopher, who, in a tract published at Riga and Leipzig, in 1794, upon the mass of native iron found by Pallas in Siberia, maintained the credibility of the traditions of that and other stony bodies having fallen from the air. His sagacious inductions, although they failed at the time to make any great impression, prepared philosophers for a more willing reception of the evidence as to two instances of the same extraordinary event, which were shortly afterwards brought under their notice. In 1796 a stone was exhibited in London, weighing 56 pounds, which fell at Wold Cottage, in Yorkshire, in December of the preceding year; but, although the fact was attested by several credible witnesses, the possibility of such an occurrence was still doubted. It was remarked, however, by Sir Joseph Banks, that there was a great resemblance between the Yorkshire stone and one in his possession, sent to him from Italy, with an account of its having fallen from the clouds, along with many others of a similar nature, near Sienna, in July, 1794. In the year 1799 Sir Joseph Banks received a circumstantial account, accompanied by specimens, of a fall of stones from the atmosphere, which was said to have taken place near Benares, in Hindustan, in the preceding December; and as these specimens were also nearly identical with the Yorkshire stone, incredulity began to give way. It was not, however, till the appearance of the celebrated paper of Howard, in the 'Philosophical Transactions' for 1802, giving an account of his analysis of the Benares stone, that men of science declared their belief in the phenomenon, supported, as the evidence then was, by the researches and opinion of so cautious and accurate an inquirer; and a fall of stones at L'Aigle, in Normandy, which took place in the following year, at the time the memoir of Howard was in the hands of the public, removed all doubt. The Institute of France deputed the celebrated Biot to examine, on the spot, the whole circumstances attending this remarkable event; and the result of his labours will be found in his report, in the seventh volume of the 'Mémoires de l'Institut.' He satisfied himself of the authenticity of the facts which had been narrated; and the specimens he collected on the ground, being analysed by Vauquelin and Thénard, yielded the same result as the analysis of the Benares stone by Howard.

An account of the circumstances that attended the fall of stones at Benares and at L'Aigle will convey the best idea of the phenomenon, not only as it occurred in these two cases, but in most other instances of which a circumstantial description has been preserved. They are always accompanied by a meteor, which at night appears like a burning fiery ball, surrounded by a brilliant vapour, and with a tail like a comet; in the day, on account of the strong light of the sun, and the smoke and vapour evolved, the meteor looks more like a small cloud of different colours, and of a singular form, which, after a powerful explosion, seems to burst and scatter its contents.

At a short distance from Benares, on the 19th of December, 1798, a very luminous meteor was observed in the heavens, about eight o'clock in the evening, in the form of a large ball of fire; it was accompanied by a loud noise, resembling that of thunder, which was immediately followed by the sound of the fall of heavy bodies. On examining the ground, it was observed to have been newly torn up in many places, and in these stones were found of a peculiar appearance, most of which had buried themselves to the depth of six inches. At the time the meteor appeared the sky was perfectly serene; not the smallest vestige of a cloud had been seen since the 11th of the month, nor were any observed for many days after. It was seen in the western part of the hemisphere, and was only a short time visible. The light from it was so great as to cast strong shadows from the bars of a window upon a dark carpet, and it appeared as luminous as the brightest moonlight. Many of the stones were collected, and some of them weighed two pounds each.

On the 26th of April, 1803, at one o'clock in the afternoon, the sky being clear, with the exception of a few light clouds, a ball of fire was observed in Normandy, in many places far distant from each other—namely, Caen, Falaise, Alençon, Verneuil, and Pont Audemer—which moved rapidly from south-east to north-west; and about the same time, in the district of L'Aigle, loud explosions were heard, which lasted from five to six minutes, resembling the sound of cannon and musketry, and were followed by a long-continued noise, like that of many drums. The meteor from which the noise proceeded appeared not so much like a ball of fire, but rather like a small rectangular cloud, which, during the phenomenon, seemed not to move; but the vapour of which it consisted was sent out, after each explosion, in all directions. It seemed to be about half a league north-west from L'Aigle, and must have been at a very considerable elevation, as it appeared to the inhabitants of two villages, more than a league distant from each other, to be immediately over their heads at the same instant. Throughout the whole district over which the cloud hung there was heard a hissing noise, like that of a stone from a sling, and a vast number of stones fell to the ground. The space on which they fell formed an ellipse of two leagues and a half long by one broad, the larger diameter being from south-east to north-west, the direction in which the meteor moved: the largest stones were found at the south-east end of the ellipse, and the smallest at the opposite extremity. Above 2000 were collected, and they varied in weight from 2 drachms to 17 pounds and a half.

Aërolites, when taken up soon after their fall, are extremely hot. They are generally angular, of prismatic and pyramidal forms, the angles being rounded; their broken irregular surface is coated with a fused black crust, like varnish, seldom exceeding a quarter of a line in thickness. When broken, they differ a little in appearance; but they are, for the most part, composed of a collection of small spherical bodies, of a grey colour, imbedded in a gritty substance, and often interspersed with yellow spots. One of the most remarkable circumstances is the great similarity of composition of all the meteoric stones, on whatever part of the earth they have fallen. Iron is found in all, and in a considerable proportion, partly in a malleable state, partly in that of an oxide, and always in combination with a greater or less proportion of the rare metal called nickel. The earths silica and magnesia and sulphur constitute the other chief ingredients; but the earths alumina and lime, the metals manganese, chrome, and cobalt, together with carbon, soda, and water, have also been found in minute and variable quantities, but not in the same specimens. The variations discovered by analysis are never, however, sufficient to destroy that affinity of external character by which they are instantly recognised. No new substance, nothing with which we are not already acquainted, has ever been discovered in their composition. But, although all the constituent elements are found in different mineral substances, no combination of them, similar to that in meteoric stones, has ever been met with, either among the stratified rocks of any period of formation, or among the unstratified rocks, or among the products of any volcano, extinct or in activity. Their specific gravity is about 3·50, but varies according to the proportion of iron which they contain. They are sometimes very friable, sometimes very hard; and some that are friable when they first fall, become hard afterwards. In size they vary from 2 drachms weight to 300 pounds. One of the stones which fell at L'Aigle yielded by the analysis of Thénard,—

Silica	46	per cent.
Magnesia	10	„ „
Iron	45	„ „
Nickel	2	„ „
Sulphur	5	„ „

and Laugier afterwards discovered the presence of chrome in it. Frequently small detached portions of malleable iron are disseminated through the mass, and the black crust acts powerfully on the magnet.

The appearance of these bodies is not periodical, nor connected with any particular state of the atmosphere, nor of the weather; and they have fallen in all climates, on every part of the earth, at all seasons, in the night and in the day.

Chladni has compiled a very copious catalogue of all recorded instances, from the earliest times: of which twenty-seven are previous to the Christian era; thirty-five from the beginning of the first to the end of the 14th century; eighty-nine from the beginning of the 15th to the date of the fall at L'Aigle at the beginning of the present century. In 1837 M. Quetelet, of Brussels, published a catalogue of remarkable meteors, and again in 1841. Mr. Herrick, in America, and M. Chasles, in France, also published lists in 1841. The latest accounts have been published by Professor Baden Powell, in the 'Transactions of the British Association,' since the year 1847. Numerous as the instances are in which these phenomena have been witnessed they can form but a small proportion of the whole amount, when we compare the small extent of surface occupied by those capable of keeping a record of such events, with the wide expanse of the ocean, the vast uninhabited deserts, mountains, and forests, and the countries possessed by savage nations. Many of those which occur in the night must also escape observation even in civilised countries.

Among the more remarkable instances to be met with in ancient authors, the following may be mentioned. Livy states that, in the reign of Tullus Hostilius (about 654 B.C.), a shower of stones fell on the Alban Mount, not far distant from Rome. Plutarch, in the 'Life of Lysander,' describes a stone that fell at Ægos Potami, in the Hellespont, near the modern Gallipoli, about 405 B.C., which is also mentioned by the elder Pliny (ii.), who says that it was to be seen in his time, that is, five hundred years afterwards, and that it was as large as a waggon, of a burnt colour, and its fall was accompanied by a meteor. It is also recorded in the 'Parian Chronicle.' The mother of the gods was worshipped at Pessinus, in Galatia, under the form of a stone, which was said to have fallen from heaven; and that stone, in consequence of a treaty with Attalus, king of Pergamus, was solemnly brought to Rome by Publius Scipio Nasica, about 204 years B.C., and placed in the temple of Cybele. The sun was worshipped at Emesa, in Syria, under the form of a large, conical, black stone, which, as the people about the temple reported, fell upon the earth. It was afterwards brought with great pomp to Rome by Elagabalus, who had been high-priest of the temple; and the description of it, given by Herodian (v.), accords with the appearance of a meteoric stone. In China records exist of occurrences of this kind during a period of 2400 years. These were translated by M. Biot; and to give an instance of the nature of these records we may state that between the years A.D. 960 to 1270 no less than 1479 meteors are registered. Of course these were not all aërolites. The great stone at Cholula in America was asserted by the Mexicans to have fallen from heaven.

One of the cases of more modern date, most circumstantially described, is that of the stone which fell at Ensisheim, in Alsace, in 1492. The emperor Maximilian being there at the time, ordered an account of the event to be drawn up. It weighed 270 pounds; and was afterwards suspended by a chain in the church at Ensisheim for three centuries. During the French Revolution, it was carried off to Colmar, and many pieces were broken from it. One of these is in the museum at the Jardin des Plantes, in Paris; it is identical in composition with other meteoric stones, and contains native or malleable iron. What remained of the precious relic has since been restored to the good people of Ensisheim, and it now stands near the great altar in their church.

Besides aërolites properly so called, masses of malleable iron, often of vast size, have been found in situations, which, together with their composition, leave no doubt as to their being of meteoric origin. An immense mass, seen by Pallas in Siberia, which forms the subject of Chladni's tract in 1794 above alluded to, was found quite insulated, at a great elevation on a mountain of slate near the river Yenessei, removed from everything that could excite suspicion of its being a production of art, and totally different from any ore of iron seen either before or since that time. The tradition was, that it had fallen from heaven, and, as such, was held in veneration by the Tartars; but it was removed in 1749 to the neighbouring town of Krasnojarsk by the inspector of the iron mines there. The mass, which weighed about 1400 lbs., was of an irregular form, not solid, but cellular like a sponge, the cells containing small granular bodies of a glassy nature, afterwards found to be the simple mineral olivine, so common in basalt. The iron was tough and malleable, and, according to the analysis of Howard, yielded 17 per cent. of nickel; but Klaproth and John found a much smaller proportion of nickel, and Laugier found, by another analysis, silica, magnesia, sulphur, and chrome. The disagreement of such skilful operators shows that the mass was not uniform in its composition. Another vast mass of meteoric iron was found in South America, in the jurisdiction of Santiago del Estero, about 500 miles north-west from Buenos Ayres, and is described in a memoir in the Spanish language, printed in the 'Philosophical Transactions' for 1788, by Don Rubin de Celis, who was sent by the governor of the province to examine it. It lay in a vast plain of above 100 leagues in extent, half sunk in the ground, and the size was such as, estimating it by the specific gravity of iron, would give a weight of more than 13 tons. According to the analysis of Proust and of Howard, it contains 90 per cent. of iron, and 10 of nickel. Specimens of this mass, which were sent to the Royal Society by Don Rubin de Celis, are in the collection of the British Museum. A mass of meteoric iron at the Cape of Good Hope, mentioned by Barrow in his 'Travels in Africa,' as an artificial production, is described by Van Marum in the 'Haarlem Transactions,' a large portion of it having been sent to the public museum there by the governor of the colony. The mass, when found, was equal to about 177 lbs., but much had been carried away. The specific gravity is 7·604. Tennant found it to contain 1·10 per cent. of nickel, and a trace of carbon, and Stromeyer detected cobalt in it, which last metal has also been found by Dr. Turner in some meteoric iron from Buenos Ayres. Another mass was found in Brazil, about 50 leagues from Bahia, the weight of which was estimated at 14,000 lbs.; a fragment of this, analysed by Dr. Wollaston, yielded 4 per cent. of nickel. Many other instances of similar masses of iron might be mentioned, which are evidently of meteoric origin; but the only instance on record of iron having been actually seen to fall from the atmosphere, is that which took place at Agram, in Croatia, in 1751. On the 26th of May, about six o'clock in the evening, the sky being quite clear, there was seen a ball of fire, which shot along with a hollow noise from west to east, and after a loud explosion, accompanied by a great smoke, two masses of iron fell from it, in the form of chains welded together.

Aërolites and meteoric iron are not the only products of meteors which have fallen upon the earth after explosion. Numerous instances are mentioned of black and red dust, which has covered great tracts of land; and it is remarkable that such dust has generally been found to contain small angular grains resembling augite. There have also been cases of the fall of a soft gelatinous matter of a red colour like coagulated blood, which have given rise to the stories of the sky having rained blood. Such appearances have not unfrequently accompanied the fall of stones. On the 15th November, 1775, rain of a red colour fell around Ulm and the Lake of Constance, and on the same day in Russia and Sweden. The red water was of an acid taste, probably from the presence of sulphuric acid; and the precipitate, which was flaky like snow, when dried, was attracted by the magnet. In the night of the 5th March, 1803, a red dust, in some places accompanied by rain, fell in different parts of Italy. In Apulia, there was first a very high wind with much noise, and then a reddish-black cloud appeared coming from the south-east, from which there fell a yellowish-red rain, and afterwards a quantity of red dust. It continued the whole of the following day and part of the succeeding; the dust was examined, and was not found to be volcanic. Fabroni, in the 'Annales de Chimie,' tom. lxxxiii, says, that near Arezzo, in March, 1813, the ground being then covered with snow, there was a shower of fresh snow of a red colour, which continued for many hours, accompanied the whole time with a sound like that of the violent dashing of waves at a distance; the greatest fall was accompanied with two or three explosions like thunder. The red snow being melted, a precipitate was obtained of a nankeen colour, which yielded silica, lime, alumina, iron, and manganese.

The origin of this remarkable class of natural phenomena is involved in great obscurity, and many different theories have been proposed to account for them. By some they have been supposed to be bodies ejected from distant volcanoes belonging to our earth,—a conjecture which is refuted by every circumstance connected with them. No substance in the least resembling aërolites has ever been found in or near any volcano; they fall from a height to which no volcano can be supposed to have projected them, far less to have given them the horizontal direction in which meteors invariably move for a considerable part of their course. Another hypothesis is, that meteoric bodies are formed in the atmosphere, which is equally untenable; for, in the first place, there is no ground for supposing, from any discoveries yet made in chemistry, that the elements of which they are composed exist in the atmosphere; and even if they did, the enormity of the volume of the atmosphere, attenuated as it is at the great height from which the meteors fall, which would be required to produce a solid mass of iron of thirteen tons weight, places the conjecture beyond all credibility. A third hypothesis is, that they are bodies thrown out by the volcanoes which are known to exist in the moon, with such force as to bring them within the sphere of the earth's attraction. This hypothesis was so far entertained by Laplace, that he calculated the degree of lunar volcanic force that would be necessary for this purpose. He calculated that a body projected from the moon with a velocity of 7771 feet in the first second would reach our earth in about two days and a half; but Olbers and other astronomers are of opinion that the velocity of the meteors, which has been estimated in some cases to be at first equal to some miles in a second, is too great to admit of the possibility of their having come from the moon. The theory which is most consistent with all known facts and laws of nature is that proposed by Chladni, namely, that the meteors are bodies moving in space, either accumulations of matter as originally created, or fragments separated from a larger mass of a similar nature. This opinion has also been advanced by Sir Humphrey Davy, at the conclusion of one of his papers in the 'Philosophical Transactions' for 1817, giving an account of his researches on flame. It is also the opinion of Sir John Herschel and Alexander von Humboldt; the latter of whom, in his 'Cosmos,' devotes a large space to the consideration of this highly interesting subject.

Those who wish to investigate this curious subject will find it most ably and copiously treated in Chladni's work, *Ueber Feuer-Meteore, und über die mit denselben herabgefallenen Massen*, Vienna, 1819, which is a second edition of his first treatise. The *Lithologie Atmosphérique* of Izarn may also be consulted; also a good compilation by Bigot de Morogues, entitled *Mémoire Historique et Physique sur les Chûtes des Pierres*, Orleans, 1812; Humboldt's *Cosmos*; and the *Quarterly Review* for December, 1852. [*See* SUPPLEMENT.]

AESCHINITE, a mineral of which the principal salt is a titanate of zirconia. [TITANIUM.]

ÆʹSCULUS, a genus of plants belonging to the natural order *Hippocastaneæ*. It consists of trees found in the temperate parts of America and Asia, remarkable for the beauty of their flowers and leaves, and for their forming in some sort a type of tropical vegetation in northern latitudes. It must not be confounded with the Æsculus of the Romans, which was a kind of oak. [QUERCUS.] The best known species is the Common Horse-Chestnut (*Æsculus Hippocastanum*), a very handsome timber-tree, formerly much used for avenues, and still extensively planted wherever round masses of wood, or gay flowering trees, are required. Its bark and its nuts are also among the more useful products that the hardy trees of this climate afford. It is very singular that the native country of this species should be unknown. One writer says it inhabits the northern parts of Asia; another, that it is found in the cold provinces of India; and a third assigns it to the mountain-chains of Asia Minor; while all the positive information that books really afford is, that it was brought to Vienna from Constantinople in the beginning of the 16th century, and was thence dispersed through all Europe. The popular name of Horse-Chestnut has arisen from the custom among the Turks of grinding the nuts and mixing them with the provender given to horses that are broken-winded. Starch is also yielded in very considerable quantity by the nuts; and, deprived of its bitterness by maceration in weak ley, has been recommended as excellent nutritious food for horses, goats, oxen, and sheep. The general characters of the Horse-Chestnut are too well known to require description. As a forest-tree, it is well adapted to light lands, upon which it will thrive, although they may be very sterile; in tenacious clay, it is always stunted and unhealthy, as in the Regent's Park; in rich alluvial soil, it acquires its greatest beauty. The timber is soft and spongy, and

Horse-Chestnut (*Æsculus Hippocastanum*).

therefore of little value. There are no very old specimens in this country, the species having been introduced, as it is said, only in 1683.

A second species, the *Æsculus Ohiotensis*, is found wild in North America, on the banks of the Ohio, between Pittsburg and Marietta. In stature it varies from 10 to 35 feet; and differs from the common kind in having larger and much more undulated leaves. It has been cultivated for some years in this country, but has never flowered.

Besides these, a third species, *Æsculus carnea*—or, as it is sometimes called, *Æsculus rubicunda*, or *rosea*—is occasionally met with in gardens. Its origin is unknown. For all purposes of ornament, this is much superior to the common kind.

The Buck's-Eye Chestnuts of North America belong to the genus *Pavia*. [PAVIA.]

The first two species of Horse-Chestnut are propagated by sowing their seeds either in the autumn at such a depth below the surface as to be secure from the attacks of mice, or else in the spring; but in the latter case they must be preserved during the winter in heaps of sand. The seeds should not be placed less than six inches apart in the beds, because the leaves are so large as to require more than usual space to expose themselves to light. The last species, and the varieties of the first, not yielding seeds, are multiplied by budding upon the common Horse-Chestnut.

AESHNA. In this recent genus of *Libellulidæ* Mr. Strickland ranks a fossil insect from the Lias of Warwickshire.

AETHOPHYʹLLUM, a fossil genus of plants from the Keuper Sandstone. (Brongniart.)

ÆTHUʹSA is a genus of plants belonging to the natural order *Umbelliferæ*, which includes among its species one of the most poisonous plants known in Europe.

Æthusa Cynapium is a little annual plant, found commonly in gardens and fields, resembling the common parsley so much that it has

Æthusa Cynapium.

acquired the vulgar name of Fool's Parsley. From a taper whitish root arises an erect branchy stem, about a foot high, generally stained with purple near the ground. This is covered by finely-cut shining leaves of a deep green, much resembling those of Garden Parsley, from which they are known thus: in the true Parsley, the leaves are twice pinnated or divided, and the leaflets are broad, and cut into three wedge-shaped toothed lobes; in the Fool's Parsley, on the other hand, the leaves are thrice pinnated, and the leaflets are narrow. sharper, and jagged; besides which, the leaves of Fool's Parsley have a disagreeable nauseous smell, instead of the fine aromatic odour of Common Parsley. When in flower, *Æthusa* has its principal umbels destitute of involucra, while the partial umbels are furnished with an involucrum, consisting of four or five narrow sharp leaves, hanging down from one side only of the common stalk; this last circumstance will distinguish it when in flower, not only from parsley, but from all other British umbelliferous plants.

Many dangerous accidents have occurred from mistaking this plant for parsley. The symptoms attendant upon poisoning by *Æthusa* are, swimming of the head, nausea, cold perspiration, and chilliness at the extremities. To counteract its effects, emetics are recommended, and the immediate use of weak vegetable acids, such as lemon-juice, vinegar, or sour wine.

AETO'BATES, a genus of fossil fishes allied to the Rays. The species are found in the London clay of Sheppey. (Agassiz.)

AGALLOCHUM. [EXCÆCARIA; AQUILARIACEÆ; EAGLE-WOOD.]

AGALMATOLITE (also *Pagodite, Bildstein, Lardite*). This mineral is found in China, and is seldom brought into this country except cut into various figures. Less characteristic varieties have been found in Transylvania and Saxony; it is found also in Wales. Occurs massive. Fracture coarse splintery, imperfectly slaty. Soft. Colour white, with a shade of gray, green, yellow, red, or brown, none of them bright. Streak shining. Unctuous to the touch. Slightly translucent, but in most cases only the edges. Specific gravity 2·815.

Before the blowpipe infusible, but becomes white. Partly soluble in sulphuric acid, leaving a residue, chiefly of silica.

Analysis of the Chinese variety by Vauquelin:—

Silica	56
Alumina	29
Lime	2
Protoxide of Iron	1
Potash	7
Water	5
	100

A'GAMA, in Zoology, a genus of reptiles belonging to the order *Saurians*, and family *Iguanians*, of Baron Cuvier.

In the form of their heads and teeth the species of *Agama* resemble the common lizards, but differ in the imbricated scales which cover their tails. These animals have the body thick, and shorter in proportion than the generality of the saurian family; the skin is lax, and capable of being distended or puffed out with air at the will of the reptile; the whole body, as well as the head, neck, and feet, is covered with minute rhomboidal or hexagonal scales, often prolonged in the form of little spines, and bristling when the body is inflated with air. The head is short, broad, and flat, particularly towards the occiput; the neck also is short, and the tail seldom longer than the body. These proportions give the Agamas much of the hideous and disgusting appearance of toads. In many parts of South America they are called Chameleons, from their power of dilating the skin with air, and imitating, to a certain extent, those animals in the various hues which they are capable of assuming. In other respects the various species of Agamas differ so considerably from one another, as to have induced Baron Cuvier to arrange them in separate subgenera, distinguished by the form of their scales and the presence or absence of pores in the thighs. Generally speaking, the Agamas have no thigh pores; some however are provided, as is the case with many other saurian reptiles, with a row of these pores along the inner surface of each thigh; some species have the toes so short and rigid as to compel them to live entirely on the surface of the earth, where they reside among rocks and heaps of stone, and conceal themselves in the crevices; others again, which have long and flexible toes, ascend trees with great facility, and sport among their branches with the utmost security. All are of a diminutive size, and, like most other reptiles, feed upon insects and other small animals: one or two species however are reported to be herbivorous. Their geographical distribution is very extensive, and embraces all the hot and most of the temperate parts of the known world: Asia, Africa, Australia, and South America have each their appropriate species, which often differ from one another very slightly.

The most remarkable species are, of those without pores on the interior face of the thighs:—The Muricated Agama (*Agama muricata*, Cuvier), first described by the celebrated John Hunter in the zoological part of White's 'Voyage to New South Wales.' It is one of the most common lizards of that colony; measures upwards of a foot in length, comprehending the tail, which is twice as long as the body, and, from the great length and perfect division of its toes, readily ascends trees, and lives entirely in the woods, where it hunts about for insects and caterpillars. Its general colour is a brownish gray, marked with dusky bars, which run in a longitudinal direction on the body, but transversely on the legs and tail. The scales which cover the upper and outer parts of the trunk and extremities are rhomboidal and carinated, or elevated into sharp-pointed ridges, forming parallel lines or rows of spines upon the back and sides, from the shoulders to the very point of the tail. The head is covered with similar scales, all directed backwards and prolonged upon the occiput into a crest of weak spines. The toes of all the feet are well separated, and furnished underneath with small pointed scales; the two middle toes of the hind feet are nearly twice the length of the others.

The *Agama barbata* of Cuvier is another species from the same locality. It is rather larger than the Muricated Agama, but preserves the same relative dimensions, and lives in the forests in the same manner. This species is figured and described in White's 'Voyage,' p. 255, but was considered by Mr. Hunter as a mere variety of the former.

Other species of this division, having pores on the inner surface of the thighs, are the *Leiolepis* (*A. guttata* of M. Cuvier) of Cochin-China, with white rays and spots on a bright blue ground; the *Tropidolepis* (*A. undulata*), of a uniform dark blue colour with a white cross on the throat, and which, as well as the kindred species, *A. nigri-collaris* and *A. cyclurus*, described by Spix, inhabits various

Muricated Agama (*Agama muricata*).

parts of South America; the *Brachylophes* (*A. vittata*), which seems to form the connecting link between this genus and the guanas, from which latter it is distinguished only by the absence of teeth in the palate; it is found in India, and has light blue bands upon a dark blue ground: and lastly the *Physignathes* (*A. cocincinus*), from the Malayan Peninsula, remarkable for its large size, uniform blue colour, but more particularly from being one of the very few species of saurian reptiles which feed upon vegetable substances. Baron Cuvier assures us that it lives entirely upon fruits and nuts.

Of the Agamas without pores in the thighs, the principal species are, the Spinous Agama (*A. aculeata*) of a yellowish gray colour with numerous transverse brown bands. All the upper parts of the body are covered with elevated scales, forming small pointed pyramids of four-sides; the body is short and thick, the tail likewise short, the head broad and flat, and the belly protuberant. Excepting in the length of the tail, and the body being covered with scales, the whole animal has much of the form and appearance of a frog or toad: it is found at the Cape of Good Hope, and is of larger size than the generality of the other species.

Spinous Agama (*Agama aculeata*).

The Tapayaxin (*A. orbicularis*) of South America is very similar to the species last described in its form and proportions, but is still shorter and thicker. The extraordinary figure of this reptile approaching almost to the form of a perfect sphere, its broad flat head, its skin covered with small tubercles or warts interspersed among the scales, and the faculty which it possesses of distending its body with air, and to a certain degree assuming different shades of colour, have caused it to be sometimes compared to a toad, and sometimes to a chameleon; but the truth is, that it has no actual relation or affinity to either of these animals, but is indebted solely to its naturally disgusting aspect for the calumnies which the early Spanish writers have heaped upon it. The Tapayaxin inhabits the mountainous and rocky parts of South America, from the Isthmus of Darien to Patagonia.

Other sub-genera and species belonging to this division of the Agamas are—*Trapelus* (*A. Ægypticus*), remarkable for its change of colour, even more sudden than that of the true chameleon; the *A. calotes*, of a bright blue colour with transverse white marks on the sides, from the Molucca Islands; the *Lophyres* (*A. gigantea*, Kuhl), with a crest of long elevated spines on the neck; and the *Lyriocephalus* (*A. scutata*), which has a similar elevated crest along the back, and the tail keel-shaped. This latter species, in many respects a most singular reptile, inhabits Bengal, and lives upon fruits.

For ample details concerning the specific differences of the Agamas, we refer the reader to the works of Cuvier, Daudin, and Merrem.

A'GAMÆ, in Botany, is a name given by some authors to the large division of the Vegetable Kingdom called Flowerless Plants, and may be considered equivalent to the older term, Cryptogamic. [ACROGENS.]

A'GAMI (*Trophia crepitans*, Latham), an interesting bird, sometimes also termed the Gold-Breasted Trumpeter, classed by Pallas among Cranes, by Brisson among Pheasants, and making the first genus in

Agami.

Temminck's *Alectorides*. It is the size of a pheasant or large fowl, being 22 inches in length, but appears larger from having a long neck, and from standing high on its legs. It bears some slight resemblance to the pheasant in the glossy iridescent green on the breast, and in a space round the eyes naked of feathers; but has a very short tail, consisting of twelve black feathers, over which the long, loose, silky scapulary rump-plumes hang droopingly. Its long greenish legs assimilate it to wading birds (*Grallatores*), but it is said not to have the habits of these, never visiting fens and the margins of water, and living wholly in upland forests and arid mountains. It inhabits the forests of tropical America, and never visits the cleared grounds or the settlements. According to M. Monoucour, it is very gregarious, being found in numerous flocks, which walk and run, but rarely fly, and, when they do, seldom rise more than a few feet above the surface of the ground. Even when pursued they trust most to their speed in running.

Several naturalists have given accounts of the Agami in a domestic state. Its docility and attachment to man are remarkable. "The Agami," says Monoucour, "is not only tamed easily, but becomes attached to its benefactor with all the fondness and fidelity of the dog; and of this disposition it shows the most unequivocal proofs. When bred up in the house, it loads its master with caresses, and follows his motions; and if it conceives a dislike to persons on account of their forbidding figure, their offensive smell, or of injuries received, it will pursue them sometimes to a considerable distance, biting their legs, and testifying every mark of displeasure. It obeys the voice of its master, and even answers to the call of all those to whom it bears no grudge. It is fond of caresses, and offers its head and neck to be stroked; and, if once accustomed to these familiarities, it becomes troublesome, and will not be satisfied without continual fondling. It makes its appearance as often as its master sits down to table, and begins with driving out the dogs and cats, and taking possession of the room; for it is so obstinate and bold, that it never yields, and often, after a tough battle, can put a middle-sized dog to flight. It avoids the bites of its antagonist, by rising in the air, and retaliates with violent blows with its bill and nails, aimed chiefly at the eyes; and after it gains the superiority, it pursues the victory with the utmost rancour, and, if not parted, will destroy the fugitive."

The peculiar noise which these birds make, without opening the bill, is one of their most remarkable characteristics. This noise is no doubt produced by a peculiar conformation of the organ of sound. According to Pallas, the larynx, which is on the outside of the breast, is about as thick as a swan's quill and almost bony, becomes much more slender, loose, and cartilaginous when it enters within the breast, where two semicyrindrical canals of a membranous texture, and capable of being extended, proceed from it. The air-bag on the right side descends to the pelvis, and within the breast it is divided into three or four cells by transverse membranes. The air-bag on the left side is narrower. Vosmaër tells us that the sound is sometimes preceded by a wild cry, interrupted by a call somewhat like 'scherck, scherck,' and then follows the characteristic noise somewhat resembling the cooing of pigeons. It utters, in this way, five, six, or seven times, with precipitation, a hollow noise nearly resembling the syllables 'too too, too, too, too, too,' resting upon the last a very long time, and sinking the sound gradually till it terminates. During this, the breast is seen to heave, as in birds while singing, though the bill remains shut. It is, no doubt, produced by the air pressed up from the lower air-bags on the right and left above described, which, meeting with the transverse membranes in its passage, causes them to vibrate and sound, and this is communicated to the surrounding muscles, and by these to the external air.

The Agami, like the rest of the *Alectorides*, builds no nest, but scratches a shallow place at the root of a tree where it deposits its eggs, from 10 to 16 in number, and of a light green colour. They are somewhat larger than a hen's egg, and of a rounder form. The down remains a long time on the young, and grows into long silky plumes, very close, like fur, and it is not till they are one-fourth the size of the adult birds that the true feathers appear.

Dr. Latham tells us, that "one of the Agamis, a young bird, found its way into a farm-yard in Surrey, and associated with the poultry. It was perfectly tame, and, on one occasion, accompanied the hounds for three miles, and kept up with them. It was last in the possession of Lord Stanley, but died on its way into Lancashire."

AGARIC-MINERAL, an earthy variety of calcareous spar, resembling chalk. It is also called *Rock-Milk*. [CALCAREOUS SPAR.]

AGARI'CIA (Lamouroux), the Mushroom Madrepore, a genus of coral madrepores, so called from its resemblance in form to mushrooms (*Agarici*). The animal inhabitants of *Agaricia* are unknown, with the exception of a single species observed by M. Lesueur on the shore of St.-Thomas in the Antilles. Lamarck enumerates five species, and Parkinson seven.

AGA'RICUS is the generic name by which all the species of Mushrooms properly so called are collectively known. It comprehends such plants of the fungus tribe, as have a cap (or pileus) of a fleshy nature, supported upon a distinct stalk, and a number of parallel unequal vertical plates or gills arising out of the cap, and inclosing the particles by which the species are reproduced; particles which the vulgar call seeds, and botanists sporules. This genus, now divided into a large number of sub-genera, consists of not fewer than 1000 species, inhabiting meadows, and heaths, and rocks, and masses of decaying vegetable matter, in the whole of Europe, and in many other parts of the temperate regions of the earth. Among them a large proportion are poisonous, a few are wholesome, but by far the greater number are altogether unknown in regard to their action upon the human constitution. The species are often extremely similar; there are no means of distinguishing botanically the tribes that are poisonous from such as are wholesome, but in every case practice is requisite to determine that point independently of general structure. It is for this reason that the use of wild mushrooms is so dangerous. Indeed there is this most remarkable fact connected with their qualities—a fact which seems to show that their properties depend upon climate and situation, and accidental circumstances, rather than upon any specific peculiarities—those kinds which are wholesome in one country are not so in another; thus, in Great Britain, the Common Mushroom, *Agaricus campestris* (*fig.* 1), the Fairy-Ring Agaric, *A. pratensis* (*fig.* 2), and the *A. Georgii*, are the only sorts that it is quite safe to eat; while the Fly Agaric, *A. muscarius* (*fig.* 3), and *A. virosus* (*fig.* 4), are extremely poisonous. But in other countries of Europe it is different. In Rome one of the few mushrooms excluded from the markets by the government inspectors is the *A. campestris*. In France, in Italy, and especially in Russia, a usual aliment is afforded by a great variety of species which, although very common in this country, it would be extremely dangerous to eat; and, on the other hand, even the dangerous *A. muscarius* is a species of food in Kamtchatka.

The following characters will serve to distinguish such Agarics as are poisonous or suspicious:—

1. Such as have a cap very thin in proportion to the gills.
2. Such as have the stalk growing from one side of the cap.
3. Those in which the gills are all of equal length.
4. Such as have a milky juice.
5. Such as deliquesce; that is, run speedily into a dark watery liquid.
6. And lastly, every one that has the collar that surrounds the stalk filamentous, or resembling a spider's web.

As to the rest, the eatable kinds that can be safely employed in Great Britain are the following:—

A. campestris, the Common Mushroom (*fig.* 1), the species that is so commonly raised artificially for food. This is readily known in any state by its fragrant odour, by which alone it may be always recognised, and the absence of which is extremely suspicious. When in a very young state it resembles little snow-white balls, which are called Buttons; afterwards it acquires a stalk, separates its cap, and becomes shortly conical, with liver-coloured gills, and a white thick fleshy cap, marked with a few particles of gray. At a more advanced age the cap is concave, the colour gray, and the gills black; in this state it is called a Flap. [FUNGI.]

A. Georgii is like the latter, but its gills are always very pale, and its flavour inferior. It is said occasionally to weigh as much as 14 lbs.

A. pratensis, or *oreades*, the Fairy-Ring Mushroom, is so well known by its popular designation as to require no description. Well may it have gained that name; for, in former times, there would, doubtless, be great difficulty in imagining how such productions could spring up in a few hours in the regular rings they appear in, without the aid of some supernatural agency. The use to which this species is usually applied is that of being powdered and mixed with rich sauces, after having been previously strung upon a line, and dried in the shade. Dr. Badham, in his work on 'The Esculent Funguses of Britain,' shews that a large number of other species may be eaten with impunity. Great caution is however necessary, and no person should venture on the eating of strange species unless practically acquainted with their distinctions. Dr. Badham's work contains drawings of the species which will greatly assist those who may be desirous of distinguishing the edible kinds.

Eatable *Agarici.*

Poisonous *Agarici.*

A'GATE, an ornamental stone used in jewellery, and for some purposes in the arts: it is sometimes called Scotch Pebble. The name is derived from the Greek ἀχάτης, a stone described by Theophrastus, and which, he says, came from the river Achates, in Sicily, now the Drillo, in the Val di Noto. It is one of the numerous modifications of form under which silica presents itself, almost in a state of purity, constituting in the agate 98 per cent. of the mineral. The silicious particles are not so arranged as to produce the transparency of rock crystal, but a translucent, sometimes almost opaque substance, with a resinous or waxy fracture; and a variety of shades of colour are produced by a minute quantity of iron. The same stone sometimes contains parts of different degrees of translucency, and of various shades of colour; and the endless combinations of these produce the beautiful and singular internal forms, for which, together with the high polish they are capable of receiving, agates are prized as ornamental stones. Although occasionally found in other rocks, they are most usually met with in that variety of the trap rocks called Amygdaloid or Mandelstein, forming detached rounded nodules, not cemented to the base or mass of the rock, but easily separable from it, and having generally a thin layer of green earth interposed, and a rough irregular exterior, as if moulded on the asperities of the sides of a pre-existing cavity. The silicious particles have often, but far from constantly, arranged themselves in thin layers parallel to the external surface of the nodule; sometimes the nodule is not solid, but a hollow space is left in it, studded with crystals of quartz; and not unfrequently crystals of carbonate of lime and other minerals, totally distinct in composition from that of the agate, are superimposed on the quartz crystals.

The theory of the formation of agates is a problem of great difficulty, and we must be much further advanced than we are, in our knowledge of the chemical processes of nature in the mineral kingdom, before we can expect to throw any light on this very obscure subject. The great supply of agates is from a class of rocks to which all geologists now assign an igneous origin, analogous to that of lava in existing volcanoes. The theory divides itself into two parts; first, the formation of the cavities in which the agates are found; and, secondly, the filling of these cavities. With regard to the first, we have many analogies from modern lavas, and from processes of art, to guide us to a pretty satisfactory conclusion. Gases are evolved in great quantities by volcanoes, and if produced at the same instant with a flow of lava, they would rise in bubbles in the melted mass; but in proportion as that became more viscid they would rise with greater difficulty to the surface, and when it consolidated would form cavities, the shape of which would be determined by the nature of the pressure of the surrounding viscid lava. To account for the filling up of the cavities three theories have been proposed: one supposes the silicious matter to have been introduced in aqueous solution from without, and to have been gradually deposited in the cavities; another, that, in obedience to some peculiar laws of attraction, it has separated from the rest of the rock, and insinuated itself into the hollows left by the gases; and a third, that these hollows were filled by the sublimation of the silica and other materials from the rest of the mass by the action of heat. Each hypothesis is supported by particular cases, which it satisfactorily explains, but there are probably as many against as in favour of each; all of them imply conditions of chemical action different from anything of which we have had experience. We frequently find, it is true, masses of silicious petrified wood in which hollows of the tree have been filled with agate, not to be distinguished from many nodules found in the trap rocks; and that the matter of the agate must have been introduced into the wood by aqueous infiltrations there can be no doubt: but, in this case, the whole substance of the sustaining mass, the wood, is penetrated by silicious matter; and the difficulty of the theory of infiltration, in the case of the trap rocks, consists in the absence of any trace in the rock of the channel by which the solution of silicious matter could have arrived at the cavity. The following section of an agate is a good example of the filling up of a cavity by infiltration, for it is evident that the silicious matter, in whatever way it may have arrived, was introduced at the point *a*, and that there was a gradual deposition of it. Such examples would be more frequently met with, if there was anything in the external coat to tell us in what direction to slit the stone: this same specimen might have been cut in many directions without throwing any light upon its mode of formation, and the section we now see was an accidental cut in the right direction. An attentive consideration of the products of volcanoes may lead to some satisfactory conclusion; for although agates have not been found in lavas, cavities in them are often partially or entirely filled with minerals distinct from any in the rest of the rock.

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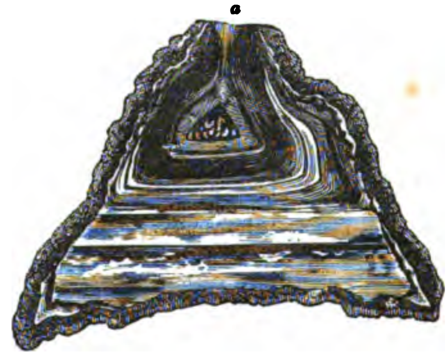


Agate.

Agates are often found as loose pebbles in the beds of rivers, or in gravel, but in these cases they have been derived from the disintegration of Amygdaloids, the base of which is very often subject to decomposition when exposed to air and moisture, and then the silicious nodules fall out. They vary in size from that of millet seed to a foot in diameter; but one, two, and three inches in diameter are the most common.

The stones distinguished by mineralogists and lapidaries by the names of Carnelian, Calcedony, Onyx, Sardonyx, Mocha-Stone, Blood-stone, Chrysoprase, and Plasma, are so closely allied to agate, that they may be conveniently described under this head. In chemical composition they are not distinguishable, except in the case of the chrysoprase by its colouring matter.—*Carnelian*, so called because some kinds are of a flesh colour (*carnis*, Latin for flesh), is that variety of a uniform colour which is of most common occurrence: carnelians are never figured or striped. The colours are shades of red and yellow, the deep clear red being the rarest and most valuable. The great supply of carnelians is from Japan, where they exist in vast quantities, and they are also imported from Bombay, being collected in the province of Guzerat; but the best, according to Niebuhr, come from the Gulf of Cambay. Many of the antique gems are engraved in carnelian, and it is now much used for seals.—*Calcedony*, so called from having been early found at Calchêdon (sometimes incorrectly written Chalcedon) in Bithynia, opposite Constantinople, is also of a uniform colour, generally of a milky white or pale yellow, like turbid jelly, often with an internal wavy structure in the form of stalactites, and very generally with a peculiar. mammillary surface. It is found in great abundance in the Faroe Islands, in Iceland, in Cornwall, and many places of Great Britain, as well as other countries; sometimes in large masses, from which cups and other vessels are formed. Pliny describes it as being found in the neighbourhood of Thebes in Egypt and as brought to Rome from Carthage.—*Chut* is a kind of granular calcedony, and forms a transition to the rock called *Hornstone*.—*Onyx*. In this agate the silicious particles are arranged in alternating horizontal layers of opaque white and translucent blue, gray, or brown; and because these have a resemblance to the marks on the human nail, the stone was called from the Greek word for nail, ὄνυξ. It was known to the ancients, and was employed by them, as it is now, for those beautiful gems called cameos, the figure being cut out of the opaque white, the dark part forming the ground, or the contrary. It is most valuable when the contrast of colours is strong, and when the layer is thick enough to give a high relief to the object to be engraved. In the royal library at Paris, there is an antique cameo cut out of an onyx with four layers, representing the apotheosis of Augustus, eleven inches by nine, which is supposed to be the finest in existence. Agates with an onyx structure are not uncommon, particularly among calcedonies, but the finest are brought from India. Cameos are sold at Rome which are made from a thick shell, having different coloured layers like an onyx.—*Sardonyx* is a variety of onyx which is supposed by some to have received its name from having been brought from Sardes, in Lydia. By others it has been said that the name comes from Sardo, the Greek name of Sardinia, there being some reason for thinking that the Carthaginians brought the stones from that island, and exported them during their occupation of it. In this the opaque white alternates with a rich deep orange brown of considerable translucency, and as this is of rare occurrence the sardonyx is of greater value. The finest are brought from the east, and some antique gems are formed of them.—*Mocha-Stones* and *Moss-Agates* are semitransparent calcedony, including various ramified forms, produced by iron, manganese, bitumen, and chlorite or green earth, but sometimes also, as has been proved by Daubenton and MacCulloch, produced by the presence of real vegetable bodies, such as *Confervæ* and mosses. The first are found in Guzerat, but received their name from having been brought from Mocha, in Arabia.—*Blood-Stone*, or *Heliotrope*, is a green agate coloured by chlorite, with numerous bright red spots like drops of blood. It is also called oriental jasper.—*Chrysoprase* (from χρυσέος, golden or beautiful, and πράσον, a leek) is a rare apple-green calcedony, found in Silesia, which owes its colour to the presence of the metal nickel.—*Plasma* is another scarce green semitransparent calcedony, but of a dark tint, which, in the opinion of MacCulloch, is coloured by chlorite.—*Sard* is a deep reddish-brown variety.

The great supply of the figured agates of commerce is from Oberstein, in the old Palatinate, about 30 miles east of Treves, and 45 miles south of Coblenz. When they were used as buttons, knife-handles, &c., the trade was more extensive than at present. They are found in many parts of Scotland, especially at the Hill of Kinnoul, near Perth, where there is an amygdaloidal trap very full of fine specimens.

A'GATHIS is the generic name given by botanists to the trees, known in common language by the name of Dammar and Kawrie Pines. These plants belong to the natural order *Coniferæ*, from all other species of which they are known, firstly, by their broad, lance-shaped, leathery leaves, the veins in which are numerous and nearly parallel, diverging a little at the base, and converging at the apex; and, secondly, by their seeds having a wing on one side instead of proceeding from the end.

The Dammar Pine (*Agathis loranthifolia*), or the *Pinus Dammara* of Linnæus, is a large tree found on the very summits of the mountains of Amboyna, Ternate, and in many of the Molucca Islands. When young it has something of the aspect of a young cedar, the wood of which it is said to resemble. It is occasionally cultivated in the hot-houses of curious persons; but is of little value except for its resin, which, when pure, is white, clear, and brittle as glass, but in time becomes amber-coloured.

Its timber is represented to be light and of inferior quality, wholly unfit for any situation exposed to wet, but answering tolerably well for in-door purposes.

The Kawrie Pine (*Agathis Australis*) grows only in New Zealand, in the forests of which it attains a considerable height, with a straight clean stem, which from its lightness and toughness, has been found well calculated for the masts of ships. It is distinguished from the Dammar Pine by its narrower and more acute leaves, and by its more rapid mode of growth.

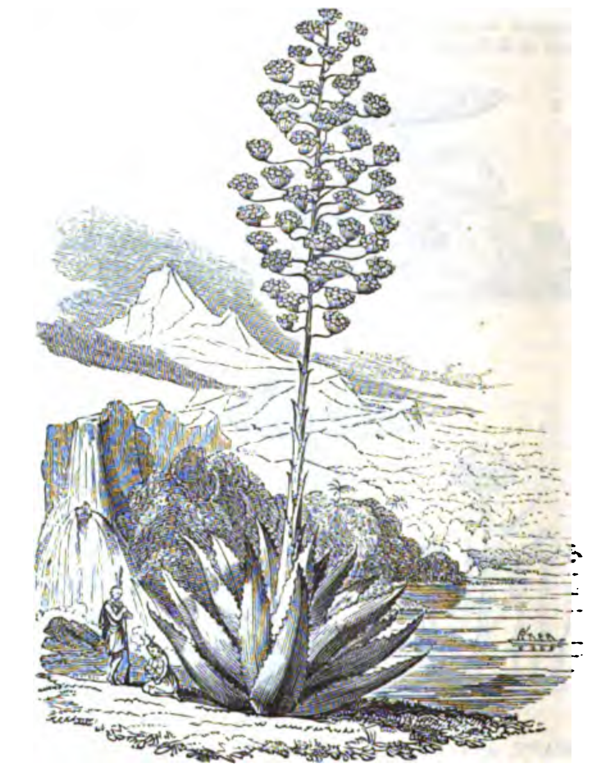
AGATHOPHY'LLUM (from ἀγαθὸς, good, and φύλλον, a leaf), a genus of plants belonging to the natural order *Lauraceæ*, one species of which, the *A. aromaticum*, yields the clove-nutmegs of Madagascar.

AGATHO'TES (from ἀγαθότης, goodness), a genus of plants belonging to the natural order *Gentianaceæ*. It is distinguished by having a rotate 4-parted corolla, with two pores at the base of each segment. *A. chirayta* is a well-known species, a native of Nepaul, Kumaon, and the Himalayas. The specific name is an imitation of the Sanscrit and Bengalee names. This plant has been known for a great length of time as a remedy in India, but has only recently been introduced into European practice. It is an annual plant, about three feet high, flowering in the rainy season. The whole plant is taken up, and the proper time for collecting it is just when the flowers begin to wither. When dried it has an intensely but agreeable bitter taste, and is destitute of aroma. The root is possessed of the greatest bitterness. The bitter principle is readily imparted to water and to alcohol. [CHIRAYTA, ENG. CYC., in ARTS AND SC. DIV.]

AGA'VE, a genus of plants belonging to the natural order, *Amaryllidaceæ*. The species are known by the name of American Aloes, and produce clusters of long stiff fleshy leaves, collected in a circle at the top of a very short stem, and bearing flowers in a long terminal woody scape. With *Doryanthes* and *Yucca* it forms in the natural order *Amaryllidaceæ* an instance of high development both in vegetation and fructification, compared with what is more generally characteristic of that tribe. If a *Crinum* or an *Amaryllis* had the stem elongated into a woody trunk, instead of being contracted into a short disk, lying at the bottom of a scaly bulb, the affinity between them and *Agave* would at once be obvious.

There are many species of this genus, one only of which requires to be mentioned.

Agave Americana, or the American Aloe, is a plant which, when full grown, has a short cylindrical woody stem, which is terminated by



American Aloe (*Agave Americana*).

hard, fleshy, spiny, sharp-pointed, bluish green leaves, about six feet long, and altogether resembling those of the arborescent aloes. Each of these leaves will continue to exist for many years, so that but a small number have withered away by the time the plant has acquired its full maturity. It is commonly supposed that this occurs only at the end of one hundred years; but this, like many other popular opinions, is an error; the period at which the Agave arrives at maturity varying, according to circumstances, from ten to fifty, or even seventy years. In hot or otherwise favourable climates, it grows rapidly, and arrives sooner at the term of its existence; but in colder regions, or under the care of the gardener, where it is frequently impracticable to attend to all the circumstances that accelerate its development, it requires the longest period that has been assigned to it. Having acquired its full growth, it finally produces its gigantic flower-stem, after which it perishes. This stem is sometimes as much as 40 feet high, and is surrounded with a multitude of branches arranged in a pyramidal form, with perfect symmetry, and having on their points clusters of greenish-yellow flowers, which continue to be produced for two or three months in succession. The native country of the American Aloe is the whole of America within the tropics, from the plains nearly on a level with the sea, to stations upon the mountains at an elevation of between 9000 and 10,000 feet. From these regions it has been transferred to almost every other temperate country; and in Italy, Sicily, and Spain, it has already combined with the date and the palmetto to give a tropical appearance to European scenery.

Independently of its beauty and curiosity, this plant is applicable to many useful purposes. Its sap may be made to flow by incisions in the stem, and furnishes a fermented liquor called by the Mexicans Pulque; from this an agreeable ardent spirit, called Vino Mercal is distilled. The fibres of its leaves form a coarse kind of thread, and are brought to this country under the name of Pita Flax; the dried flowering stems are an almost impenetrable thatch; an extract of the leaves is made into balls, which will lather water like soap; the fresh leaves themselves cut into slices are occasionally given to cattle; and, finally, the centre of the flowering stem split longitudinally is by no means a bad substitute for a European razor-strop, owing to minute particles of silica forming one of its constituents.

AGE. The term of human existence is divisible into distinct periods, each of which is distinguished by characters peculiar to itself. These characters, as far as they are external, are obvious to every one; but these external characters depend on internal states which are not obvious, and which have been discovered only by careful and persevering research. And the curious and interesting facts which those researches have disclosed, show that the different epochs into which life is divided are not arbitrary distinctions, but arise naturally out of constitutional differences in the system, dependent on different physiological conditions. The natural epochs of human life are six, namely, the period of infancy, childhood, boyhood or girlhood, adolescence, manhood or womanhood, and old age. The space of time included in the first four of these periods is fixed. In all persons after the lapse of a certain number of years, a definite change in the system uniformly takes place, in consequence of which the peculiarities which distinguish one period give place to those which characterise the succeeding. Thus the period of infancy, commencing at birth, extends to the end of the second year, the point of time at which the first dentition is completed: the period of childhood, commencing at the close of the second year, extends to the termination of the seventh or eighth year, the point of time at which the second dentition is completed: the period of boyhood or girlhood extends from the seventh or eighth year to the commencement of the age of puberty; that is, in general, in this country, in the female, from the twelfth to the fourteenth year, and for the male, from the fourteenth to the sixteenth year: the period of adolescence extends from the commencement of the period of puberty to the twentieth year of the female, and the twenty-fourth of the male: the period of womanhood extends from the twentieth, and of manhood, from the twenty-fourth year, to an age neither determined nor determinable with any degree of exactness; because the point of time at which mature age lapses into old age differs in every individual. It differs in many cases by a considerable number of years; and it differs according to primitive constitution, to the management of early infancy and childhood; according to regimen, exercise, occupation physical and mental, and the several other circumstances included under the general term 'mode of life.'

It is an observation familiar to every one, that some persons are older at fifty than others are at seventy, while instances every now and then occur in which an old man who reaches his hundredth year retains as great a degree of juvenility as the majority of those who attain to eighty. The period extending from the age of thirty or forty to that of extreme old age is then the only variable period in the term of human existence; the only period not fixed by limits which it is beyond the power of man materially to extend or abridge.

The changes which take place in the system at the different epochs of life consist of changes in the physical condition of the body, and are intimately connected with and mainly dependent on the operation of a principle of consolidation, the influence of which, commencing at the first moment of existence, continues, without intermission, until the last moment of life. By this principle the body is changed, first from the state of a fluid into that of a solid; and next, from a soft and tender solid, into a solid which slowly, imperceptibly, but nevertheless uninterruptedly, increases in firmness and hardness.

When first the human embryo becomes distinctly visible, it is almost wholly fluid, consisting only of a soft gelatinous pulp. [FŒTUS.] In this gelatinous pulp solid substances are formed, which gradually increase, and are fashioned into organs. These organs, in their rudimentary state, are soft and tender, but, in the progress of their development, constantly acquiring a greater number of solid particles, the cohesion of which progressively increases, the organs at length become dense and firm. As the soft solids augment in bulk and density, bony particles are deposited, sparingly at first and in detached masses, but accumulating by degrees: these, too, are at length fashioned into distinct osseous structures, which, extending in every direction, until they touch at every point, ultimately form the connected bony frame-work of the system. This bony fabric, like the soft solid, tender and yielding at first, becomes by degrees firm and resisting, fitted, as it is designed, to be the mechanical support of the body, and the defence of all the vital organs.

While the osseous system is thus extending in every direction, and everywhere increasing in compactness, the progressive consolidation of the body is equally manifest in all the tissues which are composed of the cellular membrane as well as in all those which possess a fibrous nature. The membranes, the ligaments, the tendons, the cartilages, gradually increase in firmness and elasticity, and proportionally diminish in flexibility and extensibility; and this change takes place, to a considerable extent, in the muscular fibre also, as is manifest from the toughness of the flesh of animals that are used for food, the degree of which every one knows is in proportion to the age of the animal; and from the conversion in extreme old age, in many parts of the body, of muscle into tendon, a denser material being substituted for the proper muscular fibre.

The steady and increasing operation of the principle of consolidation is still more strikingly manifest in the deposition, as age advances, of bony matter in tissues and organs to which it does not naturally belong, and the functions of which it immediately impairs and ultimately destroys. The textures in which these osseous depositions most commonly take place are membranes, tendons, cartilages, and the coverings of the viscera, but above all the coats of the blood-vessels, in consequence of which these highly flexible, elastic, and moveable organs become firm, rigid, and immoveable. But even when not converted into bone, several of these structures lose their flexibility with advancing age, and acquire an increasing degree of rigidity. This is strikingly manifest in all the parts of the apparatus of locomotion; in the joints, the mechanical contrivances for facilitating motion, and in the muscular fibre, the generator of the power by which motion is produced. The joints in old age are less pliable, less elastic, and more rigid than in youth; first, because the ligamentous and cartilaginous structures of which they are composed are more dense and firm; and, secondly, because the oily matter which lubricates them, and which renders their motions easy and springy, is secreted in less quantity, and of inferior quality. Induration and proportionate deterioration take place then in the muscular fibre, the origin of the motive power, and in the joint, the instrument by which the operation of the motive power is facilitated; and consequently the movements become slower, feebler, less steady, less certain, and less elastic.

But among all the changes induced in the body by the progress of age, none is more remarkable, or has a greater influence in diminishing the energy of the actions of the economy, and in causing the ultimate termination of all those actions in death, than the change that takes place in the minute blood-vessels. The ultimate divisions, or the smallest branches of the arteries and veins, the capillary vessels, as they are termed, are exceedingly abundant in the early periods of life, and are as active as they are numerous. The capillary arteries, the masons and architects of the system, by the agency of which all the structures are built up, and all the parts of the body grow and are developed, are numerous and active in the early stages of life, while they are carrying on and completing the organisation of the frame. But from infancy to childhood, from childhood to youth, from youth to maturity, and from maturity to old age, the number and activity of these vessels progressively diminish. Their coats, like other soft solids, increase in density and rigidity; their diameter contracts, many of them become completely impervious and ultimately disappear. The diameter of the capillary veins, on the contrary, enlarges. The coats of the veins, originally thinner than those of the arteries, instead of thickening and contracting, seem rather to grow thinner and more dilatable: hence their fulness, their prominence, their more tortuous course, and their greater capacity. At the two extreme periods of life the quantity of blood contained in these two sets of vessels is completely inverted. In infancy, the proportion of blood contained in the capillary arteries is greater than that contained in the capillary veins; in youth, this disproportion is diminished; at the period of maturity, the quantity in one set, nearly if not exactly balances that in the other; in advanced age, the preponderance is so great in the veins, that these vessels contain probably two-thirds of the entire mass. This difference in the distribution of the blood, at the different epochs of life, affords an explanation of several important phenomena connected with health and with disease. It shows, for example, why the body grows with so much rapidity at the early periods of life; why it remains stationary at the period of maturity; why it diminishes in bulk as age advances; why a plethoric state of the system affects the arteries in youth, the veins in age; why hæmorrhage, or a flow of blood, is apt to proceed in the young from the arteries, and in the aged from the veins; and so on.

The growth of the heart does not keep pace with the extension of the sanguiferous system, nor does its force increase with the augmenting density and resistance of the solids; hence there is a disturbance of the balance between the forces of propulsion and of extension which increases with advancing age; the diminished energy of the heart being indicated by the languor and slowness of the pulse, often not exceeding fifty pulsations in a minute, and sometimes sinking even lower than this. Hence, not only is less blood sent to the several organs, but that which is sent is less completely acted upon by the air in respiration on account of the diminished quantity which is transmitted through the pulmonary system of vessels; hence, the diminution of all the secretions, and hence, finally, the failure of the function of digestion, the source of the materials from which the blood itself is prepared and its losses replenished.

Upon the whole, then, it is clear that two great changes take place in the physical condition of the body in the progress of age; first, a gradual diminution in the quantity of the fluids, both of the entire mass contained in the system, and of the proportionate quantity contained in each organ; and secondly, a progressive augmentation and induration of the solids. With this change in the physical condition of the body is uniformly combined a no less important change in its vital action. Progressively and proportionally as the solid parts increase in density and rigidity, they decrease in irritability and mobility; that is, they are less sensible to the influence of stimulants, and the power of contraction resident in the muscular fibre is less excitable.

AGE OF ANIMALS. It is often a matter of great practical importance to possess some means of determining the age of animals. The data that exist at present are, however, very inadequate to determine this point. Amongst domestic animals the age may be judged of by the presence, absence, or change of certain organs in the body.

The age of the horse is known principally by the appearance of the incisor teeth, or, as they are technically called, the nippers. Of these there are six in each jaw, broad, thin, and trenchant in the foal, but with flat crowns marked in the centre with a hollow disk in the adult animal. The foal- or milk-teeth appear fifteen days after birth; at the age of two years and a half the middle pair drop and are replaced by the corresponding permanent teeth; at three years and a half the two next, one on each side, fall and are likewise replaced; and at the age of four years and a half the two external incisors of the first set drop and give room to the corresponding pair of permanent teeth. All these permanent nippers, as we have already observed, are flattened on the crown or upper surface, and marked in the centre with a circular pit or hollow, which is gradually defaced in proportion as the tooth wears down to a level with its bottom. By the degree of this detrition, or wearing of the teeth, the age of the animal is determined, till the eighth year, at which period the marks are generally effaced; but it is to be observed that the external incisors, as appearing a year or two after the intermediate, preserve their original form proportionally for a longer period. After the eighth year the age of the horse may be still determined for a few years longer by the appearance and comparative length of the canine teeth or tushes. These, it is true, are sometimes wanting, particularly in the lower jaw, and in mares are rarely developed at all. Those of the under jaw appear at the age of three years and a half, and the upper at four; till six they are sharp-pointed, and at ten they appear blunt and long, because the gums begin about that period to recede from their roots, leaving them naked and exposed; but after this period there are no further means of judging of the horse's age, excepting from the comparative size, bluntness, and discoloured appearance of the tushes. The duration of the horse's life seldom surpasses thirty years, though there have been instances recorded in which it is said to have extended to double that period.

In cattle with horns, the age is indicated more readily by the growth of these instruments than by the detrition and succession of the teeth. The deer kind, which shed their horns annually, and in which, with the single exception of the rein-deer, they are confined to the male sex, have them at first in the form of simple prickets without any branches or antlers; but each succeeding year of their lives adds one or more branches, according to the species, up to a certain fixed period, beyond which the age of the animal can only be guessed at from the size of the horns and the thickness of the burr or knob at their roots which connects them with the skull. In the common stag, the pricket or first horn falls during the second year of the animal's life, and is replaced by one with a single antler, and called, from this circumstance, the fork. This again falls during the third year, and is replaced by the third horn, which, as well as the fourth or following pair, have commonly three or four, and sometimes even five branches. In the same manner the number of antlers goes on increasing till the eighth year of the animal's life, beyond which period they follow no fixed rule, though they still continue to increase in number, particularly towards the summit of the horn, where they are often grouped in the form of a coronet, and in this state they are called royal antlers. The fallow-deer, the roe-buck, and others of this genus, present similar phenomena; the number of the antlers increases according to certain fixed rules up to a certain period, beyond which the age can only be determined, as in the stag, by the comparative size and development of the burr and shaft, or that part of the horn from which the antlers grow. In the former species, the prickets of the second year are replaced by horns bearing two antlers, and already beginning to assume the palmated form which distinguishes them from the antlers of most other deer. Afterwards this palm increases in breadth, and assumes an indented form on the superior and posterior borders: these are the fourth horns, which are shed in the animal's fifth year, and are replaced by others in which the palm is cloven or subdivided irregularly into distinct parts, so that the horns of old animals frequently assume a great diversity and singularity of form. From this period the horns begin to shrink in size, and are even said to end in becoming simple prickets as in the first year.

The horns of oxen, sheep, goats, and antelopes, which are hollow and permanent, are of a very different form, and grow in a different manner, from those of the deer kind. These, as is well known, consist of a hollow sheath of horn, which covers a bony core or process of the skull, and grows from the root, where it receives each year an additional knob or ring, the number of which is a sure indication of the animal's age. The growth of the horns in these animals is by no means uniform through the whole year, but the increase, at least in temperate climates, takes place in spring, after which there is no further addition till the following season. In the cow kind, the horns appear to grow uniformly during the first three years of the animal's life; consequently, up to that age they are perfectly smooth and without wrinkles, but afterwards each succeeding year adds a ring to the root of the horn, so that the age is determined by allowing three years for the point or smooth part of the horn and one for each of the rings. In sheep and goats the smooth or top part counts but for one year, as the horns of these animals show their first knob or ring in the second year of their age; in the antelopes they probably follow the same rule, though we have very little knowledge of their growth and development in these animals.

There are very few instances in which the age of animals belonging to other classes can be determined by any general rules. In birds it may be sometimes done by observing the form and wear of the bill; and some pretend to distinguish the age of fishes by the appearance of their scales, but their methods are founded on mere hypotheses, and entitled to no confidence. The age of the whale is known by the size and number of laminæ of whale-bone, which increase yearly, and, if observation can be relied upon, would sometimes indicate an age of three or four hundred years for these animals.

AGE OF TREES. Plants, like animals, are subject to the laws of mortality, and seem mostly to have a limited period for their existence.

It is chiefly to annual and biennial plants that what may be called a precise period of duration is fixed; a period determined by the production of their fruit, and not capable of being prolonged beyond that event, except by artificial means. Plants that live for a long time belong either to the class of *Endogens* or *Exogens*.

To the first of these classes belongs the *Palm Tribe*, and some other tropical trees. There is scarcely any well-attested evidence of these plants ever acquiring any considerable age. It has indeed been supposed, that certain Brazilian cocoa-nut palms may be from 600 to 700 years old, and that others probably attain to the age of something more than 300 years. But the method of computing the age of palms, which is either by the number of rings externally visible upon their rind between the base and summit of the stem, or by comparing the oldest specimens, the age of which is unknown, with young trees of a known age, is entirely conjectural, and not founded upon sound physiological considerations; besides which, the date-palm which is best known to Europeans, does not at all justify the opinion that palms attain a great age; the Arabs do not assign it a greater longevity than from two to three centuries. Independently of this, the mode of growth of such endogenous trees as palms seems to preclude the possibility of their existing beyond a definite period of no great extent. The diameter to which their trunks finally attain is very nearly gained before they begin to lengthen, and afterwards all the new woody matter, which every successive leaf necessarily produces during its development, is insinuated into the centre. The consequence of this is, that the woody matter previously existing in the centre is displaced and forced outwards towards the circumference. As this action is constantly in progress, the circumference, which in the beginning was soft, becomes gradually harder and harder, by the pressure from within outwards, till at last it is not susceptible of any further compression. After this has occurred, the central parts will gradually solidify by the incessant production of new wood, which thrusts outwards the older wood, till at last the whole stem must become equally hard, and no longer capable of giving way for the reception of new matter; for what has once been formed always remains, and is never absorbed by surrounding parts. It is probable, for this reason, that endogenous trees, such as palms, attain no considerable age, and that the duration of their existence must be absolutely fixed in each species by the power they may respectively have of permitting the descent of woody matter down their centre.

In exogenous trees it is quite the reverse, and to their existence no limited duration can be assigned. In consequence, first, of the new woody matter which is constantly formed beneath the bark near the circumference of their trunk, and, secondly, of the bark itself being capable of indefinite distention, no compression is exercised by the new parts upon those previously formed; on the contrary, the bark is incessantly giving way to make room for the wood beneath it, while the latter is, in consequence, only glued, as it were, to what succeeds it, without its own vital powers being in any degree impaired by compression. It is in the newly-formed wood that the greatest degree of vitality resides: in the old wood near the centre life in time becomes extinct; but as each successive layer possesses an existence in a great degree independent of that which preceded it, the death of the central part of an exogenous tree is by no means connected with any diminution of vitality in the circumference. Hence it is that hollow trees are often so healthy; and that trees in the most vigorous state are often found decayed at the heart without any external sign, as timber-merchants frequently discover to their cost. Of the many remarkable cases upon record of aged trees the following are among the more interesting:—

At Ellerslie, the birth-place of Wallace, three miles to the south-west of Paisley, stands an oak, in the branches of which tradition relates that on one occasion that chieftain concealed himself with three hundred of his followers. However improbable the latter circumstance may be, it is at least certain that the tree may well have been a remarkable object even at the period assigned to it by tradition, namely, in the beginning of the 14th century; and if so, this individual must be at least 700 years old. Its branches are said to have once covered a Scotch acre of ground; but its historical interest has rendered it a prey to the curiosity of the stranger, and its limbs have gradually disappeared till little remains except its trunk.

The Wallace Oak.

Of ancient yews several authentic instances can be named. At Ankerwyke House, near Staines, is a yew older than the meeting of the English barons at Runnymede, when they compelled King John to grant Magna Charta. This tree, at 3 feet from the ground, measures 9 feet 3 inches in diameter; and its branches overshadow a circle of

The Ankerwyke Yew.

207 feet in circumference. The yews of Fountains' Abbey, in Yorkshire, are probably more than 1200 years old, and to others an age of from 2500 to 3000 years has been assigned.

Even this degree of antiquity is, however, much less than that of the Baobab trees of Africa, estimated by Adanson at 5150 years; and the deciduous cypress of Chapultepec in Mexico, which the younger De Candolle considers still older.

The following list of old trees is from Moquin Tandon's 'Tératologie Végétale:'—

There are known—

Palms of	200, 300 years.
Cercis	300 ,,
Chirodendron	327 ,,
Ulmus (Elm)	355 ,,
Cupressus (Cypress) . . .	388 ,,
Hedera (Ivy)	448 ,,
Acer (Maple)	516 ,,
Larix (Larch)	263, 576 ,,
Castanea (Chestnut) . . .	360, 626 ,,
Citrus (Oranges, Lemons, &c.) .	400, 509, 640 ,,
Platanus (Plane)	720 ,,
Cedrus (Cedar)	200, 800 ,,
Juglans (Walnut)	900 ,,
Tilia (Lime)	364, 530, 800, 825, 1076 ,,
Abies (Spruce)	1200 ,,
Quercus (Oak)	600, 800, 860, 1000, 1600 ,,
Olea (Olive)	700, 1000, 2000 ,,
Taxus (Yew)	1214, 1466, 2588, 2880 ,,
Schubertia	3000, 4000 ,,
Leguminosæ	2052, 4104 ,,
Adansonia (Baobab) . . .	6000 ,,
Dracæna (Dragon Tree) . .	6000 ,,

The way in which the age of some of these specimens has been computed is twofold: firstly, by comparing them with other old specimens, the rate of growth of which is known; and secondly, by cutting out a portion of their circumference, and counting the number of concentric rings that are visible. For in exogenous trees the woody cylinder of one year is divided from the succeeding one by a denser substance, which marks distinctly the line of separation of the two years.

In the course of inquiries into the method of computing the age of ancient trees, a discovery has been made of some importance to timber growers, inasmuch as it shows that those who plant for profit alone should not allow their trees to grow beyond a certain number of years, varying according to species: for it has been found that so far are exogenous trees from continuing always to increase in diameter at the same rate, that every kind diminishes in its rate of growth after a certain age:—the oak, for example, between its fortieth and its sixtieth year, the elm after its fiftieth, the spruce-fir after its fortieth, and the yew probably after its sixtieth. With reference to this subject, Professor De Candolle has constructed a table of rate of growth, which we subjoin.

Table of the rate of Increase in Diameter of certain Exogenous Trees, expressed in lines.

Yrs. to Yrs.	Quercus pedunculata, 130 years old.	Quercus sessiliflora, 210 years old.	Quercus sessiliflora, 333 years old.	Larch-Fir, 255 years old.	Elm 335 years old.	Spruce-Fir, 120 years old.	Yew 71 years old.
1 to 10	54	10	18	48	16	41	8
10 . 20	62	16	33	61	44	54	11½
20 . 30	54	22½	39½	58	58½	52	12
30 . 40	60	12	38	72	72	45	10½
40 . 50	48	13½	23	46	88	35½	7
50 . 60	44	14	12½	57	74	36	12½
60 . 70	56	10¾	9	46	78½	18	8
70 . 80	44	11	9½	29	66	17	
80 . 90	32	9½	8½	30	59	18	
90 . 100	32	9¾	8	24	45	13	
100 . 110	30	9½	7½	32	30	22	
110 . 120	36	9	8½	26	30	22	
120 . 130	30	9	8	20½	24		
130 . 140		9½	10	22	24		
140 . 150		10	8	23	18		
150 . 160		8½	8½	21	19		
160 . 170		9	9	20	17½		
170 . 180		10	8	19	23		
180 . 190		9	8	18	30		
190 . 200		9	7	21	34		
200 . 210		9	8	22	34		
210 . 220			7	22½	26		
220 . 230			6	21	36		
230 . 240			8	22	28		
240 . 250			8	20½	26		
250 . 260			7½		24		
260 . 270			8		17½		
270 . 280			8		26		
280 . 290			8½		28		
290 . 300			8½		29		
300 . 310			9		16		
310 . 320			8		16½		
320 . 330			8		21		

AGENEIOSES, in Ichthyology, a genus of Abdominal Malacopterygious fishes, separated from the *Silures* by Lacépède, and containing two species, both from the fresh-water lakes and rivers of Surinam.

AGGERZEEN. [Antilopeæ, *Strepsiceros*.]

AGILA-WOOD. [Aquilariaceæ.]

AGNO'STUS, the remarkable fossil genus of *Crustacea* usually found with *Asaphus Buchii* and other trilobites in the lower Palæozoic strata. (Brongniart.) Called *Battus* by Dalman. It abounds near Llandeilo and Christiania.

AGNOTHE'RIUM, a fossil genus of *Mammalia*. (Kaup.)

A'GONUS, in Ichthyology, a genus of Acanthopterygious fishes, first separated from the *Cotti* by Bloch, and afterwards adopted, by Lacépède and Pallas, under the different names of *Aspidophorus* and *Phalangistes*. The greater number of the species belonging to the genus *Agonus* are found in the northern Pacific Ocean, particularly along the coast of Japan, and northward as far as Behring's Straits. They are all of diminutive size, never exceeding nine or ten inches in length, and are nowhere used as an article of human food. One species only, the

Agonus Accipenserinus.

Pogge (*A. Europæus*), inhabits our own coast, as well as the coasts of France, Holland, Iceland, and even Greenland; it is also found in the Baltic, but, according to Baron Cuvier, never in the Mediterranean, though Brunnich expressly affirms the contrary. (*Histoire Naturelle de Poissons*, of Baron Cuvier and M. Valenciennes.)

AGOUTI (*Dasyprocta*, Illiger; *Chloromys*, F. Cuvier), in Zoology, a genus of animals belonging to the class *Mammalia* and order *Rodentia*.

The most prominent zoological characters of the Agoutis are found in the nature and conformation of the feet and toes. The toes are provided with large powerful claws, and yet the animals make no use of them in digging or burrowing; they are pretty long and perfectly separate from one another, enabling them to hold their food between their fore-paws, and in this manner to convey it to their mouth. Like all other animals which are thus accustomed to use the fore-paws as hands, they have a habit of sitting upright upon their hind-quarters to eat, and frequently also assume the same position when they would look around them, or are surprised by any unusual sound or occurrence. Their food is exclusively of a vegetable nature, and consists most commonly of wild yams, potatoes, and other tuberous roots: in the islands of the different West India groups they are particularly destructive to the sugar-cane, of the roots of which they are extremely fond. The planters employ every artifice for destroying them, so that at present they have become comparatively rare in the sugar islands, though on the first settlement of the Antilles and Bahamas they are said to have swarmed in such countless multitudes as to have constituted the principal article of food for the Indians. They were the largest quadrupeds indigenous in these islands upon their first discovery. The same rule of geographical distribution holds good generally in other cases, namely, that where groups of islands are detached at some distance from the mainland of a particular continent, the smaller species of inhabitants are usually found spread over both, whilst the larger and more bulky are confined to the mainland alone, and are never found to be indigenous in the small insulated lands.

Though the Agoutis use their fore-paws as hands to hold their food whilst they eat, yet their toes are nevertheless rigid and inflexible, and their claws large, blunt, and nearly straight. They are consequently deprived of the power of ascending trees; and as they also do not construct burrows, they wander at large among the woods, sheltering themselves beneath fallen timber, or in the hollow of some decayed tree. Here they produce and nurture their young, bringing forth, according to some accounts, three or four times in the year; according to others, never having more than a single litter in the same season, and even that consisting of not more than two or three individuals. It is probable, however, from the amazing numbers of these animals found in all the hotter parts of South America, notwithstanding the destruction made among them by small carnivorous animals, as well as by the Indians, and likewise from the close affinity which they bear to the hare and rabbit of our own country, that the Agoutis are tolerably prolific. The young are brought forth with their eyes closed, as in the case of most of the *Rodentia* and *Carnivora*; but they are covered with hair, or rather small bristles of the same colour as the mother: they soon acquire the use of their limbs, and learn to shift for themselves.

The hind legs of the Agoutis are considerably longer than the fore, and their pace is tolerably rapid for a short distance. But they seldom trust to speed of foot for their safety, but seek for shelter and security in the first hollow tree, or under the first rock they meet with. Here they allow themselves to be captured, without any other complaint or resistance than the emission of a sharp plaintive note. The head of the Agouti is large, the forehead and face convex, the nose swollen and tuberous, the ears round, short, and nearly naked, and the eyes large and black. The hair is annulated in different degrees with black, yellow, and green; it is generally coarse and bristly, like the weak spines of a hedgehog, though in one species it approaches in fineness to the fur of the rabbit; the tail is most commonly a mere naked stump or tubercle, which in the Acouchy alone attains any apparent length, and is covered with a few short scattered hairs. The teeth are twenty in all; namely, two incisors and eight molars, four on each side, in each jaw. The latter are all nearly of the same size, oval in figure, and with flat crowns, which exhibit the different convolutions of the enamel as it penetrates the softer materials of which the body of the tooth is composed. It is impossible from mere description to convey an idea of the intricate figures which these convolutions assume; and we, therefore, refer to the annexed figure, where *a* and *b* in the diagram represent respectively the upper and lower jaws, and the figures 1, 2, and 3, the appearances of the teeth at different ages, or after different degrees of trituration: No. 3, representing the teeth

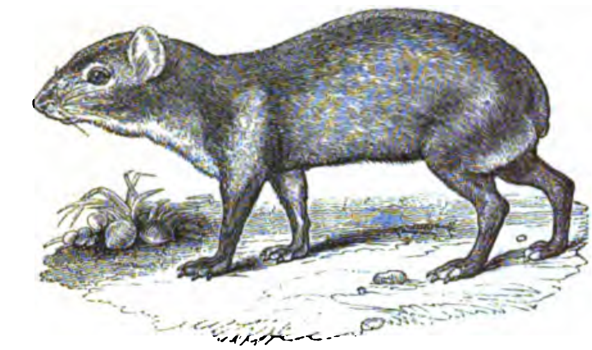
Teeth of the Agouti, from Cuvier's 'Dents des Mammifères.'

shortly after they begin to wear; No. 2, their intermediate state; and No. 1, when very much worn. The teeth are exclusively adapted for vegetable food; they are essentially formed for grinding and bruising, not for cutting and tearing. The stomach and intestines therefore, which are always in harmony with the organs of mastication, are fitted only for the digestion of vegetable substances. The flesh of these animals is white and tender; it is a very common and favourite article of food in South America, and is dressed like hare or rabbit. The following species are distinctly known:—

1. The Common Agouti (*Dasyprocta Aguti*), sometimes called the Long-Nosed or Yellow-Rumped Cavy, from its long nose and the prevalent colour of its back and shoulders, is the size of a middling hare, being one foot eight inches in length, and about eleven or twelve inches high at the croup. The head resembles that of the rabbit, the nose is thick and swollen, the face arched, the upper lip divided, the ears round and naked, the eyes large, the upper jaw considerably longer than the lower, and the tail a naked flesh-coloured stump. The hairs of the upper and fore parts of the body are annulated with brown, yellow, and black, which give the animal a speckled yellow and green appearance on the neck, head, back, and sides; on the croup however they are of a uniform golden yellow, much longer than on any other part of the body, and directed backwards; the breast, belly, and inner side of the fore-arms and thighs are light straw colour, and the moustaches and feet black. The general length of the hair on the upper and anterior parts of the body is about an inch, that of the croup is upwards of four inches long, and all, excepting the short coarse fur of the legs and feet, and that on the breast and belly, is of a stiff harsh nature, partaking more of the quality of bristles than of simple hair.

2. The Black or Crested Agouti (*Dasyprocta cristata*), is rather improperly called the Crested Agouti by M. Geoffroy St. Hilaire, since the hairs of its head and neck do not exceed those of the shoulders and back in length. It is considerably smaller than the Common Agouti, being about the size of a rabbit, whilst that species approaches the dimensions of the hare. Its general proportions and form, however, are the same; but the hairs of the back and sides, instead of being annulated with various-coloured rings as in that species, are nearly uniform black, whilst the long hairs of the croup are perfectly so: the belly and legs are equally covered with short dark hair. There is

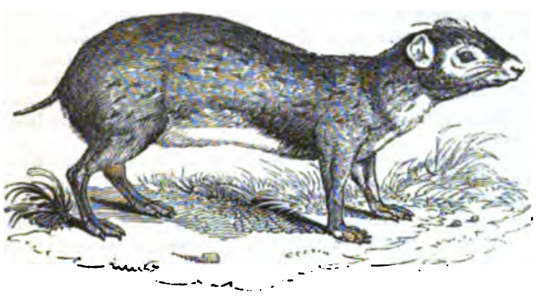
not any appearance of crest, and the tail is still shorter than in the Common Agouti. Both this species and the former seem to inhabit the same climates—Surinam Guiana, and Brazil; the Common Agouti,



Black or Crested Agouti (*Dasyprocta cristata*).

however, appearing to have a rather more extensive range, and to be likewise found in the West India Islands, and even as far south as Paraguay.

3. The Acouchy, or Olive Agouti (*Dasyprocta Acuchi*), is considerably smaller than either of the foregoing species, and is at once distinguished by the greater length of its tail, which is upwards of two inches in length, not much thicker than a crow's quill, and covered with short scattered hairs like those on the tail of a rat. In other respects it is



The Acouchy (*Dasyprocta Acuchi*).

of the same form as the Agoutis; has the same naked round ears, the same large black eyes, and the same olive-green colour mixed with yellow and black. The hairs of the croup are not so long as in the Agoutis, but are perfectly black; and all the under-parts of the body, the breast, belly, and interior of the arms and thighs, straw-coloured with a tinge of red. The hair of the legs and feet is short and black, and that of the body much finer in quality than the hair of the Agoutis. It inhabits some of the West India Islands, Guiana, and the northern parts of Brazil.

4. White-Toothed Agouti (*Dasyprocta croconata*, Wagler) is a species founded by Wagler upon a specimen brought by Spix from the river Amazonas. It is about the same size as the Common Agouti, but it differs in its incisor teeth being entirely white, in having the tarsi shorter, the nails shorter, and the general hue of its fur much richer.

5. *Dasyprocta prymnolopha* is a species described by Wagler, which inhabits Guiana. It is one of the most beautiful of the species, and is readily distinguished by the broad black band which runs along the hinder half of the back, and is continued to the tail.

6. The Sooty Agouti (*Dasyprocta fuliginosa*, Wagler). This species is the same as the *D. nigricans* of Natterer and the *D. nigra* of Dr. J. E. Gray. It is readily distinguished by its black colour and large size. It inhabits the northern provinces of Brazil.

7. Azara's Agouti (*Dasyprocta Azaræ*), a species inhabiting Paraguay, Bolivia, and the southern parts of Brazil. Mr. Waterhouse says it is identical with Dr. Gray's *D. punctata*.

AGRIMO'NIA, a genus of plants belonging to the order *Rosaceæ*. It is known from all the other genera of the same tribe by its having only two or three pistils enclosed in the deep tube of its calyx, from 7 to 20 stamens, and small-notched petals.

The common species, *Agrimonia Eupatoria* (Common Agrimony), is an erect, hairy, herbaceous plant, frequent by the side of hedges in fields, on the skirts of woods, and in similar situations all over England. Its lower leaves are interruptedly-pinnated, with the leaflets of an oval form, and coarsely serrated. When bruised, they yield a slight but pleasant aromatic odour. The stem is nearly simple, and a foot and a half or two feet high. The flowers, which are small and yellow, are succeeded by little bur-like fruits.

The leaves, which are astringent and aromatic, have been found useful in the preparation of fever-drinks, and for the cure of slight inflammation in the mouth or throat; on this account Agrimony is always reckoned one of our wild medicinal plants, and is often employed as an ingredient in herb-teas.

Common Agrimony (*Agrimonia Eupatoria*).

AGRIMONY. [AGRIMONIA.]

AGRIOPES (*Agriopus*, Cuvier), in Ichthyology, a genus of Acanthopterygious fishes, belonging to the family which M. Cuvier denominates *Joues Cuirassées*, and which are distinguished from other families of the same order, by having the suborbital plates extending backwards over the cheeks, so as to cover either the whole or the greater part of them, and thus defending them, as it were, with a buckler or cuirass. But what particularly distinguishes the Agriopes from most other genera of fishes is, that they have only nine rays in the pectoral fins, a number very rarely found in this class of animals. Three species are enumerated by Messrs. Cuvier and Valenciennes :—

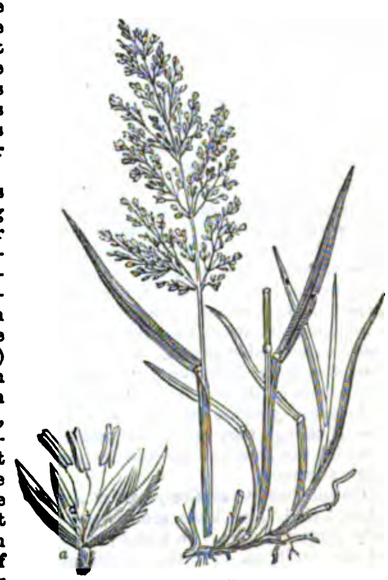
1. The *Agriopus torvus*. This fish inhabits Table Bay and the seas around the Cape of Good Hope, where it is called by the Dutch colonists Zee-Paard (or Sea-Horse). This fish exceeds two feet in length, and is common in the markets of Cape Town.

2. The Warty Agriope (*A. verrucosus*) is so called from having the skin of the head and body entirely covered with prominent conical tubercles, surrounded at the base with small papillæ. It grows to the same size, and inhabits the same localities, as the preceding species.

3. The *Agriopus Peruvianus* is found in the neighbourhood of Lima, and grows to the length of eight or nine inches.

AGROSTEMMA (from ἀγρός, a field, and στέμμα, a crown), a genus of plants belonging to the *Sileneous* division of the order *Caryophyllaceæ*. It has several species, the best known of which is the Corn Cockle, which is now referred to the genus *Lychnis* [LYCHNIS] or *Githago*.

AGRO'STIS, a genus of Grasses, consisting of a considerable number of species with loose-branched capillary panicles of flowers, and a creeping habit. Among British grasses, it is at once known by the glumes (*a*) or outer scales of each flower being two in number, unequal in size, of a membranous texture, and containing but a single floret; while the paleæ, or inner scales, are short, very thin, almost transparent, and two in number, the larger of them occasionally having an awn at its back.



Agrostis alba.

Two species only are natives of this country—one of which, *A. vulgaris*, is found everywhere in dry, exposed, barren situations, and is of very little value to the farmer, except for its earliness; the other, *A. alba*, is equally abundant in marshy places, where it forms a valuable pasture. Under the name of Irish Fiorin Grass, this species has been the object of much attention from experimental agriculturists, some of whom have extolled its qualities very highly as a marsh-fodder; but the experience of others does not confirm their opinion; nor does it appear to thrive in England so well as it is represented to do in Ireland, where its vigour is such as to have led to the belief that the Irish plant is a distinct species, called *A. stolonifera*. In England it is best known, along with *A. vulgaris*, under the name of Quitch, or Quicks, and is generally extirpated as a troublesome weed, in consequence of the rapidity with which, by means of its creeping, rooting, vivacious stems, it spreads and overruns pasture- and garden-ground.

AI. [BRADYPUS.]

AIR-BLADDER, a peculiar organ with which the great majority of fishes are provided, and by which they are enabled to adapt the specific gravity of their bodies to the various pressures of the superincumbent water at different depths. It is composed of a lengthened sac, sometimes simple, as in the common perch, sometimes divided into two or more compartments, by a lateral or transverse ligature, as in the trout and salmon, and, at other times, furnished with appendices, more or less numerous according to the particular species. In all cases, it is composed of a thick internal coat of a fibrous texture, and of a very thin external coat; the whole being enveloped in the general covering of the intestines.

The modifications of this organ are infinitely varied in different genera and species of fishes. In the greater number of instances it has no external opening, and the air with which it is found distended is believed to be produced by the secretion of a certain glandulous organ, with which it is in all these cases provided. This air has been examined, and found to consist of oxygen and nitrogen, but with less oxygen than common air. In fresh-water fishes, the air-bladder communicates sometimes with the œsophagus, and sometimes with the stomach, by means of a small tube; and it is observable, that in the greater number of these instances, in which it has a direct external communication with the intestines, the secreting glands above mentioned do not exist; thus giving us strong reason to believe that its functions and uses are not uniformly the same in all the different classes of fishes. A very limited number of species, among others the common eel, have air-bladders not only opening by an external duct, but likewise provided with secreting glands; and thus occupying an intermediate station between the two larger classes, at least as far as the nature and functions of this organ are concerned.

In general, all fishes which enjoy great powers of locomotion, and have occasion to pass through various degrees of superincumbent pressure in their rapid transitions from the surface to the bottom of the ocean, are provided with this important organ; and so indispensable is it in their economy, that those which, for the sake of experiment, have been deprived of it, have sunk helpless to the bottom, and there remained incapable of moving, or even of maintaining their equilibrium. But to fishes whose habits and organization confine them either to the surface of the water or to the bottom of the sea, and which, therefore, do not require to pass through different depths, or to encounter different degrees of pressure, the possession of an air-bladder is by no means so essentially requisite. Accordingly we find, that all the different species of rays and *Pleuronectes* or flat-fish, such as skates, soles, turbots, brills, etc., which live only upon the coasts and sand-banks at the bottom of the ocean, as well as the mackerel and others which find their food entirely at the surface, have no air-bladder; and so small is the relation of this otherwise important organ to the general conformation of fishes, that we sometimes find it present in one species, and wanting altogether in another of the same genus. Although it does not appear that the air-bladder is connected with the function of respiration in fishes, it occupies the position, and has the same relations, as the lungs in reptiles. It is, in fact, the homologue of these organs. Fishermen are well acquainted with the nature and functions of the air-bladder, or, as they most commonly call it, the *Swim*. They are accustomed to perforate this vessel with a fine needle in cod and other species which require to be brought fresh to market, sometimes from a very great distance. By this operation, the confined air is allowed to escape, and the fish constrained to remain quiet at the bottom of their well-boats, where they live for a very considerable period. Cod-sounds, which are brought in great quantities from Newfoundland, are nothing more than the salted air-bladders of these fishes. The Iceland fishermen, as well as those of America, prepare isinglass of a very excellent quality from cod-sounds, though they are not acquainted with the method of clarifying it, which the Russians practise in preparing isinglass from the sound of the sturgeon.

(Owen, *Lectures on Comparative Anatomy*, vol. ii.)

AIR-CELLS, in plants, are cavities in the leaves or stems, or other parts containing air. In water-plants they have a very definite form, and are built up of little vesicles of cellular tissue, with as much regularity as the walls of a house; they no doubt enable the plant to float. They are well seen in the structure of the *Victoria regia*. In plants which do not float, the form of the air-cells is less definite; they often appear to be mere lacerations of a mass of cellular substance, and their object is unknown; well-known instances of their presence are the chambers in the pith of the walnut-tree, and the tubular cavities in the stem of the bamboo, and other Grasses.

AIR-PLANTS are so called because they possess the power of living for a considerable time suspended in the air. It is however a mistake to suppose that these plants are naturally suspended freely in the air, and that such a situation is that in which they will thrive; they will only exist in air for a shorter or longer period, according to the species and to other circumstances, but in the end they will perish. This arises from the fact that all plants require inorganic as well as organic constituents, and although these latter elements can be supplied from the air in the form of carbonic acid, ammonia, and water, the former cannot.

There are two different tribes to which the name of Air-Plants has been applied; of which one, containing the moss-like *Tillandsia usneoides*, which hangs in festoons from the branches of trees in the hot damp forests of tropical America, and the fragrant *T. xiphioides*, which adorns the balconies of the houses in Buenos Ayres, is called by botanists *Bromeliaceæ;* the other, abounding in species of the most different nature and appearance, is named *Orchidaceæ*.

Till within a few years the cultivation of Air-Plants of the *Orchis* tribe was supposed to be attended with insuperable difficulties; and of the many hundreds of beautiful species that are found in foreign countries, scarcely any were known in Europe, except from drawings, bad descriptions, and imperfect dried specimens.

The native country of these curious plants is wherever a climate is found in which heat and moisture are in excess. Within the tropics in Asia, Africa, and America, in damp and shady forests, by the side of fountains, within reach of the spray of waterfalls, perched upon the branches of trees, or clinging to rocks and stones by means of their long and writhing roots—creeping among moss, rearing their flowers in the midst of brakes and other moisture-loving tribes—in all such situations they are found in abundance. The principal stations for them are the woods of Brazil and Peru, the lower mountains of Mexico, the West Indies, Madagascar, and the adjoining islands, and the whole of the Indian Archipelago; in Java alone nearly 300 species have been discovered.

The conditions under which Air-Plants, of the kind now described, naturally thrive are—1, high temperature; 2, diffused light, like that of a shady grove, and not direct solar light; 3, a great degree of dampness; and, 4, a perfect freedom from stagnant water round their roots: for on the trunks of trees or on stones and rocks no water can lodge, and all the moisture they receive must necessarily be in the form of vapour or of falling rain. And it is to circumstances of this nature that the gardener has chiefly to attend. Damp, shade, heat, and good drainage will be his objects; the three former will cause him no trouble, but the latter will require him to alter entirely his usual mode of cultivation. Instead of considering in what kind of soil his Air-Plants are to be placed, he will endeavour to dispense with soil, and to supply its place with bits of rotten wood, chopped moss in very small quantities, fragments of half-baked pottery, such as garden-pots, and the like.

Another point of great importance in the cultivation of these plants is, securing for them a season of repose. In their native climates, although they have no winter, they have a period of comparative rest from growth, and securing for them this repose whilst under culture is a great secret of success. It is to a knowledge of this, taken in conjunction with the circumstances before explained, that we owe the remarkable improvement that has taken place in the mode of cultivating these plants in Great Britain.

(Lindley, *Observations in the Transactions of the Horticultural Society*, vol. i., New Series, p. 42, and the later volumes of the *Botanical Register*.) [EPIPHYTES; ORCHIDACEÆ.]

AIR-VESSELS, in plants, are what botanists call *Spiral Vessels*. It is supposed by some that these are the only parts through which air is conveyed into the vegetable system, and it has been proved that, in some cases at least, the air that they contain consists of a larger proportion of oxygen than atmospheric air. But it is doubtful whether the action of these vessels is more than local, and it is certain that air has tolerably free access to many parts, as the leaves, for example, by means entirely independent of the spiral vessels.

AIRA, a genus of Grasses belonging to the tribe *Sesleriece*, and distinguished by possessing a lax panicle, two-flowered glumes, the outer pale terete on the back, and a dorsal awn. There are several species, but that which is best known is *A. cæspitosa*, the Tufted Hair-Grass. It has long and flat leaves, with a fibrous perennial root. It flowers in the beginning of August, and reaches a height of four feet. It grows naturally on marshy damp soils, in the form of large tufts. It is a wiry harsh grass, and is rejected by domestic animals. It may, however, be advantageously sown as a cover for game, and also by the side of ponds and marshes for snipe and wild fowl. (Lawson, *Agrostographia*.)

AITONIA (after Mr. W. Aiton, for many years head-gardener at Kew), a genus of plants belonging to the order *Meliaceæ*. The *A. Capensis* is a native of the Cape of Good Hope, and is cultivated in our greenhouses.

AIZOON. [TETRAGONIACEÆ.]

AJOWAMS, or AJWAMS, the Indian name for the fruits of Umbelliferous plants belonging to the genus *Ptychotis*. They are chiefly employed in veterinary medicine.

ALABASTER, a white stone used for ornamental purposes. The name is derived from Alabastron, a town of Egypt, where there appears to have been a manufactory of small vessels or pots, made of a stone found in the mountains near the town. These vessels were employed for containing certain kinds of perfumes used by the ancients in their toilet, and with which it was the custom to anoint the heads of their guests, as a mark of distinction, at their feasts. There are in Horace many allusions to this custom. In like manner, Mary, the sister of Lazarus, poured upon the head of our Saviour, as he sat at supper, "very precious ointment" from an alabaster-box. Vessels of a similar form, although not made of the white stone, bore the same name amongst the Greeks and Romans.

There are two kinds of white stone to which antiquaries and artists give the name of alabaster: the one is a carbonate of lime; the other is gypsum, or sulphate of lime. Many of these ancient perfume-vessels are made of the compact crystalline mass deposited from water holding carbonate of lime in solution, which is found in many places in almost every country. When the deposition takes place on the ground, it forms what mineralogists call a *stalagmite*, from a Greek word signifying a drop, and it is often composed of layers distinguishable by different degrees of translucency, giving the stone the appearance of the striped agates, called onyx. [AGATE.] Hence, according to Pliny, the alabastrites was sometimes called onyx. But it is easy to ascertain of which of the two kinds a vessel is composed, for *carbonate* of lime is hard, and effervesces if it be touched by a strong acid; but *sulphate* of lime does not effervesce, and is so soft that it may be scratched with the nail. The term alabaster is now generally applied to the softer stone. This last, when pure, is a beautiful semi-transparent snow-white substance, easily worked into vases, lamps, and various other ornaments, but it is seldom found in masses large enough for statuary; and, indeed, artists would be unwilling to execute any great work in a material so very liable to injury. The finest quality known is found in the neighbourhood of Volterra in Tuscany, and it is cut into a variety of works of great taste and beauty at Volterra, Florence, Leghorn, and other places in that part of Italy, whence they are sent all over the world, and sold at very reasonable prices.

Alabaster is found in Derbyshire and Staffordshire, and is manufactured at Derby into small ornaments and toys. [GYPSUM.]

ALABAUDINE, a name for Manganese-Blende, a sulphuret of manganese.

ALABES, a genus of fishes belonging to the order *Malacopterygii*, and family *Apodes*. This genus, which consists of a single species of small size, a native of the Indian Ocean, resembles in most respects the common Conger-Eel (*Muræna*) of our own seas.

ALARIA, a genus of sea-weeds. [ALGÆ].

ALAUDA. [ALAUDINÆ].

ALAUDINÆ, a sub-family of birds belonging to the order *Passerinæ*, and the family *Conirostres*, is thus characterised by Mr. Swainson:—

Bill more lengthened than in any of the *Fringillidæ*; the tip entire or obsoletely notched. Tertial quills considerably lengthened, pointed, and generally as long as the quills. Claws very slightly curved; the claw of the outer toe always shorter than that of the inner toe; the hinder claw considerably lengthened, and either nearly straight or very slightly curved.

Alauda. (Linn.)

Bill cylindrical; nostrils concealed. Wings very long; no spurious quill; the first, second, and third quills longest, and nearly equal; the rest considerably graduated; tips of the lesser quills emarginate. Tail forked. Head crested. (Sw.)

The Larks are characterised by their having the hind-claw, which is like the fore-claws, somewhat straight, and longer than in the pipits and the wag-tails. The bill is straight, and rather short and strong, the upper mandible being arched without any notch, and not longer than the under. The nostrils, situated at the base of the bill, are oolong, and protected by small plumes and bristles directed forwards. The feathers on the back part of the head can be raised up at the will of the bird into the form of a crest.

Various species of larks are found in all parts of the globe, and are everywhere distinguished by their vigilance and their singing. They are peculiarly birds of the fields, meadows, and other open places. The conformation of their feet, except in a few instances, such as the woodlark, does not adapt them to perch upon trees. They accordingly always build on the ground, making in general a rather slight though neat nest, and laying about five eggs, usually of a grayish white, with specks of a brown colour. They frequently rear two broods of young during the summer.

They are almost all birds of passage; for even in Britain, where some remain during the winter, the greater number flock together and migrate, either southward or to the sea-coast. During these migrations immense numbers of them are caught in nets for the table, particularly on the continent, where small birds are more sought after for this purpose than in Britain.

Localities.—Europe and America.

Mr. Swainson considers this as the Fissirostral type.

Example:—*Alauda arvensis*. This is the *Alouette*, *Alouette Ordinaire*, and *Alouette des Champs* of the French; *Lodola*, *Lodola Canterina*, *Lodola di Passo*, and *Lodola di Montagna* of the Italians; *Feld Lerche* of the Germans; *Hedydd* and *Uchedydd* of the ancient British; and *Skylark* (in Scotch *Lavrock*) of the modern British.

The Skylark is too well known, from its inexpressibly beautiful song, chanted forth far up in the air when at liberty and in its natural state, to require any description.

Food.—Insects and their larvæ, with many sorts of seeds and grain.

Nest.—On the ground. Eggs four or five, greenish white, spotted with brown.

Localities.—All the parts of Europe; also in Asia and the northern parts of Africa, but not in the south of that vast continent (Temm.); the whole of Europe within the temperate zone, many parts of Asia, and the north of Africa. (Selby.)

Calendula. (Linn.)

Bill thick, much compressed; the culmen curved and convex; the commissure arched; the tip of the upper mandible wide above and inflexed. Wings long or moderate; the first quill very small and spurious; the second nearly equal to the third and fourth; lesser quills short, emarginate. Tail slightly forked. Lateral toes equal. Africa. The Dentirostral type—*C. magnirostris*, 'Ois. d'Afr.,' pl. 193. (Sw.)

Sub-genera:—*Myrafra*, Horsf.—Bill as in *Calendula*. Wings short, rounded; greater quills hardly longer than the secondaries and tertials; the first quills spurious, half the length of the second, which is shorter than the third; the third, fourth, fifth, and sixth equal, and longest. Tail short, even. Legs long.—*M. Javanica*, 'Linn. Tr.,' xiii. 159. (Sw.)

Braconyx, Sw. (*Brachonyx*).—Bill as in *Calendula*. Hinder claw very short. Wings and tarsi much lengthened. Africa. (Sw.)

Agrodroma. (Sw.)

Bill slender, considerably compressed; both mandibles of equal length; the tip of the upper one not reflected over the lower, and with a small notch, almost obsolete. Wings long; the first four quills nearly equal; the rest rapidly diminishing, and emarginate at their tips; tertials lengthened, pointed, as long as the quills. Tail moderate, even. Legs pale, long, slender. Tarsus longer than the middle toe. Lateral toes equal, but the outer claw shorter than the inner. Colour brown, lark-like. Distribution universal. The Insessorial or pre-eminent type—*Agrodroma rufescens*, 'Enl.,' 661, f. 1. (Sw.)

Macronyx. (Sw.)

Bill slender, compressed, thrush-like, entire; nostrils large, naked, the aperture lateral. Wings short; the primaries not longer than the tertials, the first four of equal length; secondaries long, emarginate. Tail moderate, even. Feet enormous. Tarsus and hinder toes very long, and of equal length. Lateral toes unequal, the inner shortest. Africa. The Rasorial type—*M. flavicollis*, 'Ois. d'Afr.,' pl. 195; *M. flavigaster*, Sw., 'Birds of West Africa,' ('Naturalists' Library,' *Ornithology*, vol. vii., p. 215.)

Certhilauda. (Sw.)

Bill slender, lengthened, more or less curved; nostrils round, naked. Wings very long; the first quill spurious; the three next nearly equal. Tail moderate, even. Feet lengthened; the lateral toes equal; length of the hinder claw variable, although typically short and straight. Africa. The Tenuirostral type—*Certhilauda longirostra*, 'Ois. d'Afr.,' 192; *C. bifasciata*, Rüpp., 'Atlas,' plate 5; *C. nivosa*, Sw., 'Birds of West Africa' (vol. vii., p. 215.)

Such are Mr. Swainson's views as to the arrangement of this sub-family. [FRINGILLIDÆ.] The genus *Anthus*, Bechst., is placed by Mr. Swainson at the end of his sub-family *Motacillinæ* (Wagtails), under his family *Sylviadæ* (Warblers).

Fossil Larks.

Dr. Buckland figures a lark (*Alauda*) among the land Mammifers and Birds of the third period of the Tertiary Series, in the first plate of the illustrations of his 'Bridgewater Treatise.' He had previously noticed the remains of the lark in Kirkdale Cave. ('Reliquiæ Diluvianæ,' pp. 15, 34, plate xi., ff. 24, 25.)

ALBATROSS (*Diomedea*), a genus of web-footed birds, comprising three species—the Albatross of China (*D. fuliginosa*, Latham); the Yellow- and Black-Beaked Albatross (*D. chlororynchos*, Latham); and the Common Albatross (*D. exulans*, Linnæus.) The genus is principally distinguished by the following characters:—a very strong, hard, long beak, which is straight to near the extremity, when it suddenly curves. The upper mandible appears composed of many articulated pieces, furrowed on the sides, and crooked at the point; the lower mandible smooth and cut short; the nostrils lateral, and placed like small rolls in the furrow of the mandible; the feet short; the three toes long and completely webbed; the wings very long and narrow. The name Albatross is a word apparently corrupted by Dampier from the Portuguese Alcatraz, which was applied by the early navigators of that nation to cormorants and other large sea-birds.

The Common Albatross is the species which is most frequently met with in the seas of Southern Africa. It is the largest sea-bird known.

The top of the head is a ruddy gray; the rest of the plumage is white with the exception of several transverse black bands on the back, and

Common Albatross (*Diomedea exulans*).

a few of the wing feathers. The feet and membrane are of a deep flesh colour; the bill a pale yellow.

The weight of this bird has been variously stated from 12 to 28 pounds; and a similar difference appears to exist in authors with respect to the distance between the extremity of the extended wings. Forster says above 10 feet; Parkins, 11 feet 7 inches; Cook, 11 feet; another says 12 feet; a specimen in the Leverian Museum measured 13 feet; and Ives (p. 5) mentions one, shot off the Cape of Good Hope, which measured 17½ feet from wing to wing.

We can, from this circumstance, readily understand the extensive range in which the Albatross is found; not being confined, as Buffon imagined, to the Southern Ocean, but being equally abundant in the northern latitudes, though Forster says he never observed it within the tropics. These birds are seen in immense flocks about Behring's Straits and Kamtchatka about the end of June, frequenting chiefly the inner sea, the Kurile Islands, and the Bay of Pentschinensi, whereas scarcely a straggler is to be seen on the eastern or American shore. They seem to be attracted thither by vast shoals of fish, whose migratory movements the albatrosses follow. On their first appearing in those seas they are very lean, but, from finding abundance of food, they soon become fat. Their voracity is so great, that they will often swallow a salmon of four or five pounds weight.

They do not, however, confine themselves to fish, but will prey on any other sea-animal; and Cook's sailors caught them with a line and a hook. The Kamtchatkadales take them by fastening a cord to a large hook, baited with a whole fish, which the birds greedily seize. Their usual food, however, seems rather to be fish-spawn and small shell-fish.

Notwithstanding their strength, they never venture to attack other sea-birds, but are, on the contrary, attacked by the gulls. "Several large gray gulls," says Cook, "that were pursuing a white albatross, afforded us a diverting spectacle: they overtook it, notwithstanding the length of its wings, and they tried to attack it under the belly, that part being probably defenceless: the albatross had now no means of escaping but by dipping its body into the water; its formidable bill seemed to repel them."

Their flesh is tough and dry; but the Kamtchatkadales take them for the sake of their entrails, which they blow up, and use as buoys for their nets. They employ the wing-bones also, which Edwards says are as long as their whole body, for tobacco pipes.

ALBIN, a white variety of *Apophyllite*. [APOPHYLLITE.]

ALBI'NOS, a word of Portuguese origin, by which the Portuguese voyagers denominated the white negroes whom they found on the coast of Africa. These negroes were also termed *Leucæthiopes*—a term signifying white negroes. Both names are now used, but the former popularly, to designate individuals who exhibit characters similar to those observed in the white negroes, among whatever race or in whatever country the variety may arise.

These singular beings are distinguished from other individuals of the human race by remarkable characters, which are invariably the same among whatever people or under whatever external circumstances the variety is found. Their most striking peculiarities consist in the colour of their skin and in that of their hair and eyes.

Their skin is of a pearly whiteness, without any admixture whatever of a pink or a brown tint. In the snow-white skin of the fairest European woman there is always some tint of a pink or brown colour, but in the Albinos the skin is wholly destitute of either tinge, and is of a dull pearly whiteness. It is often not soft and smooth in proportion to its whiteness, as is generally the case with the blonds of the European race; but, on the contrary, is rough, dry, and harsh.

The whiteness of the hair always corresponds to the whiteness of the skin. Not only the hair of the head, but also that of the eyebrows, eyelashes, beard, and even the soft down that covers the external surface of the body, has the same unnatural whiteness.

With this whiteness of the skin and hair is connected a still more striking peculiarity, namely, a redness of the eyes. That part of the eye called the iris is of a pale rose colour, while the pupil is intensely red: in a word, the eye is exactly similar to that of many forms of white animals, as the white rabbit, rat, mouse, &c.

This peculiarity depends upon the absence of certain cells in the body, called pigment-cells, which, wherever present, give a more or less dark colour to the surface on which they are developed. It is the formation of these cells in the skin and hair, and in the interior of the eye, that gives the various colours to these parts of the body; and when these cells are absent they present the appearances observed in Albinos. In the skin the part which secretes these cells is the upper surface of the *cutis*, or true skin. They are mixed, however, with varying proportions of colourless cells. These cells together constitute, when they lie flat upon the surface of the body, the *epidermis*, or scarf-skin. The cells which have not yet become hardened were supposed to form a soft layer, which was called the *rete mucosum*, or mucous layer. It is in the black races of mankind that the pigment-cells most abound, and just in proportion as the skin is fair do we find them deficient in quantity or less dark in colour: but in the fairest races these pigment-cells are found. In the same manner their presence in the hair produces the various shades of colour observed in this appendage of the skin, and they may be very numerous in the hair and not so in the skin generally. The eye requiring for its function a dark chamber, has developed in its interior a large quantity of pigment-cells, constituting the *pigmentum nigrum* of its interior membranes. What is true of man is also true of the lower animals, and the colour of their skin and hair depends on these peculiar cells.

The anatomical condition of Albinism is the absence of the pigment-cells. In the complete Albinos they are everywhere absent from the skin, the hair, and the eyes. It is this which gives the unnatural whiteness to the skin and the hair, and the redness to the eyes; this latter phenomenon resulting from the delicate blood-vessels reflecting the colour of the blood in them, an appearance which is entirely absent when the pigment-cells are deposited as usual.

On the other hand it appears that there is a tendency in some animals which have naturally only a few pigment-cells to develop them in greater number than usual, as we see in the occasional presence of black sheep in a flock. Black varieties and white varieties, with a mixture of the two colours, are not at all uncommon amongst our domesticated animals. Of the causes which produce this peculiar affection of the organs in question we are ignorant; and the speculations of Buffon on this subject afford a striking example of the absurdities into which men, even of acute minds, fall when they substitute conjecture for investigation, or deem it consistent with the spirit of philosophy to place trust in fancy, when they are without knowledge. Thus, assuming that white is the primitive colour of nature, he says, that this colour may be varied by climate, food, and manners, to yellow, brown, or black; that these colours may, under certain circumstances, return to the primitive colour, but so much altered, that it has no resemblance to the original whiteness, because it has been adulterated by the causes that have been assigned. Nature, he tells us, in her most perfect exertions, made men white; and this same Nature, after suffering every possible change, still renders them white; but the natural or specific whiteness is very different from the individual or accidental. It is useful, occasionally, to recur to what was formerly considered, and is still sometimes considered, as an explanation of the phenomena of nature.

Some writers represent the peculiarities which distinguish the Albinos as altogether the result of disease. They found this opinion on the roughness and harshness of the skin, on the tenderness of the eyes, and the comparative physical weakness of these individuals. But the harsh and almost leprous appearance of the skin, though sometimes found, is by no means universal; the tenderness of the eyes arises from the increased sensibility of the organs in consequence of the abstraction of the dark-coloured substance by which, in the natural state, they are defended from the light: and, even admitting it to be a fact, which however does not appear to be fully established, that these persons are physically weaker than other men, it would not follow that this weakness is the result of disease. As far as can be judged from external appearance, and from their accounts of their own feelings, Albinos appear perfectly healthy, and many do not exhibit a single mark of disease whatever. It is also certain that domestic animals which exhibit varieties perfectly analogous to those of the human Albino are free from disease. This peculiarity has been observed in the sheep, pig, horse, cow, dog, cat, mouse, ferret, monkey, squirrel, rat, hamster, guinea-pig, mole, opossum, martin, weasel, roe, fox, rhinoceros, elephant, badger, beaver, bear, camel, buffalo, and ass; and even in the crow, blackbird, canary-bird, partridge, common fowl, and peacock. It is remarkable, however, that it has never been seen in any cold-blooded animal. In all the mammalia and birds just enumerated, the nature and characters of the deviation seem to be perfectly analogous to those of the human Albino. The pure whiteness of their skin and other integuments, and the redness of the iris and pupil, mark the same deficiency of colouring matter. A white mouse, possessed by Blumenbach, exhibited the same inability to bear the light which has been observed almost universally in the human examples; the animal kept its eyelids closed even in the twilight.

The physical, intellectual, and the moral qualities, associated with this singular conformation of the body, have not been stated with distinctness and accuracy. It would seem that the Albino is both physically and mentally somewhat weaker than other men. All accounts agree in representing his physical strength as inferior to that of persons of the ordinary conformation. Saussure, in his 'Voyage dans les Alpes,' expressly states, in relation to two boys whom he examined with much attention at Chamouni, that, when they were of a proper age, they were unable to tend the cattle like the other children; and that one of their uncles maintained them out of charity, at a time of life when others were capable of gaining a subsistence by their labour. Wafer, the old voyager, in his account of the Indian Albinos in the Isthmus of Darien, while he represents them as being as nimble in the moonlight as the other Indians, states that they are not so strong and lusty. But in what degree their intellectual powers are confined, or whether indeed there be any decided inferiority, we have at present no means of forming an accurate judgment.

Some inconvenience certainly arises from the conformation of the eye peculiar to the Albinos. A strong light cannot be borne, and even the full glare of day appears to excite some degree of uneasiness. Hence the eyelids are usually more drawn over the ball of the eye than is common with other persons, and the eyes are generally weak, tender, and watery; while vision is more agreeable and more perfect in twilight. But the inconvenience of an ordinary degree of light, and the advantage of imperfect darkness, have been exaggerated.

It would seem that there is a greater tendency to the formation of this variety in some parts of the world than in others. It is more common among the African and the Indian tribes than among the European people. In the Isthmus of Darien, and in some of the oriental islands, it is so frequent that some writers have conceived that those persons form a distinct and peculiar tribe; but for this opinion there is no foundation. Mr. Bowdich, however, states that the king of Ashantee, who seems to have considered persons of this description as a great curiosity, and to have indulged his taste for collecting them in a truly Oriental manner, had assembled about him nearly a hundred white negroes. Blumenbach states that he has himself seen sixteen Albinos in various parts of Germany; and examples have been not unfrequently found in Denmark, England, Ireland, France, Switzerland, Italy, the Grecian Archipelago, and Hungary. It is common in both sexes, but it would appear to be somewhat more frequent in males than in females.

ALBITE, a mineral of the Felspar group, in which the potash of felspar is exactly replaced by soda. It includes *Pericline*, *Tetartine*, *Carnatite*, and *Cleavlandite*. It occurs massive and crystallised. Primary form a doubly oblique prism. Cleavage parallel to the primary planes. Colour commonly white, sometimes gray, greenish, bluish, or red; streak white. Fracture uneven. Hardness 6·0. Lustre pearly on the cleavage planes, vitreous in other directions. Transparent, translucent. Specific gravity 2·6 to 2·68. The massive varieties have a laminar structure. Found in Norway, Sweden, Dauphiny, St.-Gothard, Scotland, and accompanying felspar in most of its numerous localities; from this it differs chiefly in containing soda instead of potash. Analysis, by Stromeyer: silica, 70·68; alumina, 19·20; soda, 9·06; lime, 0·23.

ALBUCA (*albus*, white), a genus of plants belonging to the natural order *Liliaceæ*. The species are mostly found at the Cape of Good Hope. They are cultivated in this country, and require the treatment of greenhouse bulbs.

ALBU'MEN.—In plants this term has been improperly applied to the substance which in some seeds is interposed between the embryo and their coat. It varies very much in density, and other characters, and is often the most valuable part of a plant. In the cocoa-nut it is the meat, the milk being a fluid uncondensed portion of it; in the coffee-seed it is the part that is roasted; and in corn it is that which is ground into flour. The oil of the castor-oil plant, and of the poppy, the aroma of the nutmeg, and the greasy nutritious substance that forms chocolate are all the produce of albumen. In the ivory-nut it is the hard part from which it has acquired its name.

This substance in the beginning is of a pulpy nature, and is the matter in which the young embryo first makes its appearance; in this state it is present in all plants, but as the embryo, for the nutriment of which it is destined, increases in size, the albumen is gradually absorbed by it, either wholly, as in the turnip, the pea, the bean, and the like; or in part only, the residue being of a consistence varying between softness, as in the poppy, and extreme hardness, as in the date-palm. [SEED.]

Botanists find its presence in abundance, or its total or almost total absence, a character of very great importance in distinguishing the different tribes of plants.

ALBURNUM, in plants, is that part of the stem of trees which timber-merchants call *Sapwood*. It is the newly-formed unchanged wood lying immediately below the bark, and is always of a very light colour. It is the principal channel through which the crude sap is conveyed from the roots into the leaves, and is, therefore, an indispensable part in all exogenous trees. [EXOGENS.] It consists of delicate fibrous tissue; in which respect it differs from *Heartwood*, or *Duramen*, in which the tissue is combined with solid secretions, the nature of which varies with species. It is probably on the latter account that heartwood is so much more durable than sapwood; for simple fibrous tissue is in itself very perishable, and it only ceases to be so in consequence of the presence of secretions of a less destructible character.

While many plants have the alburnum and heartwood distinctly separated, there are others, technically called Whitewooded Trees, which consist of nothing but alburnum. This arises from their not forming any solid secretions which can give durability to the central parts; hence all such trees are quickly perishable, and are generally unfit for any but temporary purposes.

ALCA (Cuvier), the Auk, a genus of Web-Footed sea-birds, which has a singularly-formed bill, being very broad when viewed laterally, straight towards the base, but much curved towards the point. Both the mandibles are half covered by projecting feathers, and furrowed near the point. The upper mandible is crooked, and the under forms a projecting angle. The nostrils are towards the middle of the sides of the upper mandible, being very narrow and almost closed by a membrane covered with feathers. The legs are short, and placed far back, so that the birds when standing have their backs nearly perpendicular. There are only three toes fully webbed, the back toe being wanting. The claws are somewhat pointed. The wings are short, and the first quill is as long as the second, or perhaps a little longer.

Only two species are known, the Great Auk (*Alca impennis*), and the Razor Bill (*Alca Torda*), both natives of the British Isles. [AUK.]

ALCE'DO (Linnæus), Kingfisher, a genus of birds of which the characteristics are:—The bill long, straight, quadrangular, thick, and pointed; the tongue short, fleshy, flat, and slightly arrow-shaped at the point; the nostrils at the side of the base of the bill running obliquely, and nearly closed by a naked membrane; the legs with the shank (*tarsus*) short; the feet with three toes forward, the outer joined to the middle one as far as the second joint; the inner one similarly joined as far as the first joint. The hind toe is broad at the base. The wings have the first and second quills nearly equal, but these are shorter than the third, which is the longest in the wing.

There is only one species of Kingfisher (*Alcedo Ispida*) indigenous to Britain. It is the most beautiful of our native birds. More than sixty species have been described by naturalists, chiefly natives of Asia and Africa, and all distinguished by the splendid colours of their plumage. [HALCYONIDÆ.]

ALCES, the Elk. [DEER.]

ALCYNOE. [ACALEPHÆ.]

ALCYONELLA (diminutive of *Alcyonium*), a genus of animals belonging to the Fresh-Water *Polyzoa*, or *Ascidian Zoophytes*. The species of this genus were originally regarded as plants. They are composed of a fleshy sponge-like mass, which consists of vertical, aggregated, membranaceous tubes, which open on the surface. In these tubes the polypes are seated, which are ascidian; the mouth is encircled with a single series of filiform tentacula, which, like those of the whole family, are depressed or incomplete on one side. The eggs are contained in the tubes, and are coriaceous and smooth.

The most common species is the *A. stagnorum* of Lamouroux, which is commonly found in stagnant waters, especially when they contain iron in solution. The polype-mass of this species is a sponge-like substance, somewhat elastic, of a blackish green colour, and is more or less apparently porous. It is composed of tubes which rise from the base to the surface, and are connected together by a firm transparent gelatinous substance. The walls of the tubes are composed of a thin pellucid colourless membrane, through which the ova in their interior can be easily seen. The ova are very numerous, although the animal itself is comparatively rare, abounding at one season, and almost absent at another, in the same pond.

This animal was originally described by Trembley in 1741, and although he was perfectly aware of its nature at that early period, it has been often described since both as a plant and a sponge. One of the best modern accounts is that of Mr. T. P. Teale, in the first volume of the 'Transactions of the Leeds Philosophical and Literary Society.' (Johnston, *British Zoophytes*.)

ALCYONIDÆ, a family of the Asteroid Polypes, containing the genera *Alcyonium* and *Sarcodictyon*. They are distinguished from the *Pennatulidæ* (Sea-Pens), and the *Gorgoniadæ* (Sea-Fans), by the polype-mass being tough and fleshy, without any distinct axis, but strengthened by the irregular distribution of calcareous spiculæ. The polype-cells are placed in the fleshy mass, and scattered over its surface.

The best known of the species of this family is the *Alcyonium digitatum*, which was described by Ellis under its popular name of Dead Man's Hand, or Dead Man's Fingers. It has been described by naturalists by other names, especially *Lobularia*; but this is inadmissible, as having been previously employed to name a plant. *Alcyonium* is derived from Alcyon, the kingfisher; and this word means sea-foam, of which the kingfishers were supposed to make their nests.

The species in question is one of the most common of our maritime productions, and is found on stones and shells and rocks, and can frequently be collected at the low-water mark during a spring-tide. It sometimes covers the object to which it is attached as a mere crust, at other times it rises up in one or more conical masses. Where there is only one, the fishermen give it the name of the Cow's Paps, from its resemblance to the teat of the cow's udder. The skin is tough, and when examined presents little radiated points, which indicate where the tentacles of the polypes exist. The tentacles are short, obtuse, and ciliated on the margins. The polype-cells are placed just under the skin, at the termination of a series of aquiferous canals which run throughout the polype-mass. These tubes communicate with each other, so that many of the polypes are, as it were, collected together, forming a compound animal. The space between the tubes is occupied by a loose fibrous network, forming lozenge-shaped compartments, with smaller meshes in them. These interstices are filled with gelatinous matter, in which irregular calcareous spiculæ lie embedded. The ova are developed in the polype-tubes, and are about the size of a grain of sand. They are produced in spring and summer, and ultimately discharged from the mouth of the polype.

A second species of *Alcyonium*, *A. glomeratum*, has been described by Dr. A. H. Hassall.

The genus *Sarcodictyon* has been described by Professor Edward Forbes. It differs from *Alcyonium* in the incrusting, creeping, and anastomosing form it assumes. Its polypes also are distant from each other, and placed in uniserial prominent cells. It has eight pinnated tentacula. Only one species has been described, *S. catenata*.

(Johnston, *British Zoophytes*.)

ALCYONIDIUM (from *Alcyonium*, on account of its external resemblance), a genus of animals belonging to the Infundibulate section of the *Polyzoa*, or *Ascidian Zoophytes*. It presents a fleshy variously-lobed mass, containing in it 5-sided cells, which contain ascidian polypes surrounded with a double sheath. The most common species of this genus is the *A. gelatinosum*. It is one of the most common productions of the sea-shore, and few persons can have been at the sea-side without having noticed it. The older botanists described it as a plant. Gerard in his 'Herbal' says:—"This is a very succulent and fungous plant of the thicknesse of one's thumbe; it is of a dark yellowish colour, and buncheth forth on everie side with many unequal tuberosities or knots." He called it the 'Sea Ragged Staffe.' Ray called it a *Fucus;* but Lamouroux, who first classed it amongst plants, has the honour of having discovered that it was studded all over with polypes. We are indebted to Dr. Arthur Farre for a very elaborate account ('Phil. Trans.,' 1839) of this creature. The polype-mass grows naturally in deep water attached to old shells and stones. It is however washed upon most of our coasts after every storm. The mass is clustered or fingered, and rises to the height of from 6 to 12 or 18 inches. It resembles a compact sponge, but is more pellucid and gelatinous. The surface is smooth, but is speckled with dots which indicate the spots where the polypes are contained. The polypes are so closely connected with their cells that it is impossible to separate them without mutilation. The tentacles are 16 in number.

Two other species have been described as frequent on the British coasts, *A. hirsutum* and *A. parasitium*.

(Johnston, *British Zoophytes*.)

ALCYONIUM. [ALCYONIDÆ.]

ALDER. [ALNUS].

ALECTO (one of the Furies of the Greek mythology), a genus of Infundibulate *Polyzoa*, characterised by the creeping and branched character of its polype-mass. There are several species, all of which are found attached to old shells and stones, and are mostly dredged for in deep water.

ALETHO'PTERIS (Sternberg), a genus of Fossil Ferns, mostly from the Coal formation. (*Pecopteris* of Brongniart.)

ALETRIS, a genus of plants belonging to the natural order *Liliaceæ*. One of the species, *A. farinosa*, is the most intense bitter known. It is found in fields and the edges of woods very commonly in the United States, and is used in infusion as a tonic and stomachic. Large doses produce poisonous effects.

ALEURITES, a genus of Euphorbiaceous plants, many of the species of which are now referred to *Croton*. [CROTON.]

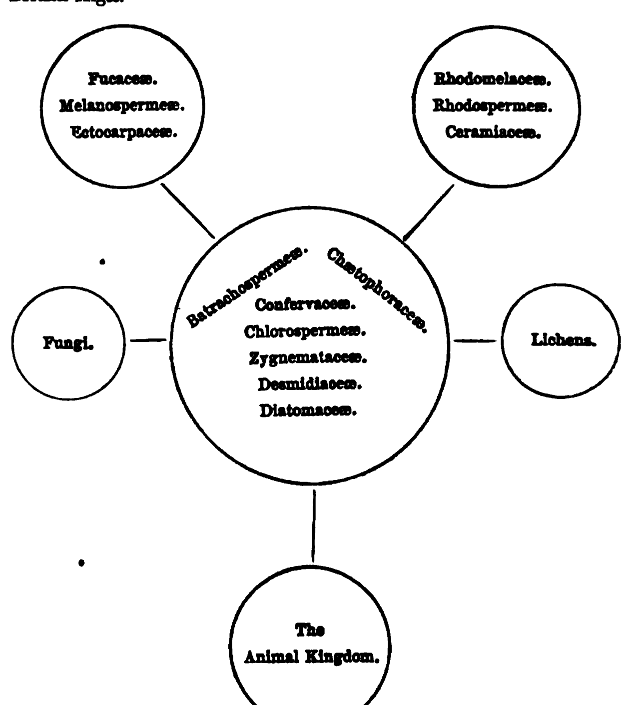
ALEXANDRITE, a name given to specimens of the mineral *Chrysoberyl*, brought from the Ural. [CHRYSOBERYL.]

ALGÆ is the name given by botanists to the tribe of plants which comprehends the Sea-Weeds, Lavers, and fresh-water submersed species of similar habits. In structure they vary through a vast variety of intermediate gradations, from the state of simple microscopic vesicles to branched woody individuals many fathoms in length. Some of them are only visible to the naked eye when they are collected in heaps; of this nature is the green and red slime that we find in damp walks, at the bottom of shaded walls, and in similar situations; others grow together in the bed of the ocean, and when they rise to the surface form floating banks of such extent as to impede the course of ships; of this kind are the *Chorda filum*, or Sea Cat-Gut, of Orkney, meadows of which have been seen in Scalpa Bay; and the Gulf-Weed of navigators, which, according to Humboldt, being carried by the Gulf Stream, forms two banks in the great basin of the Northern Atlantic Ocean, one of which stretches over 11 degrees of latitude, and the other over 4 degrees.

The plants included under this designation are every day becoming better known through the influence which the microscope and better methods of investigation are producing in every department of natural history. Under the term *Algæ* Linnæus included the Lichens and other plants as an order in the class *Cryptogamia*, or *Acrogens*. The Lichens have been long since separated; but the plants that are now ordinarily called *Algæ* present differences quite as wide as any that separate the orders of the class *Exogens*, so that we cannot regard the term *Algæ* as of only ordinal value. Dr. Lindley, in his 'Vegetable Kingdom,' constitutes an alliance which he calls *Algales*, and which he makes to embrace the following natural orders:—

1. *Diatomaceæ*, or Brittleworts.
2. *Confervaceæ*, or Confervas.
3. *Fucaceæ*, or Sea Wracks.
4. *Ceramiaceæ*, or Rose Tangles.
5. *Characeæ*, or Charads.

The first of these orders includes the *Desmideæ*, which are almost entirely microscopic. They are hardly comprehended under the term *Algæ* at all. [DIATOMACEÆ; DESMIDEÆ.] It is only very recently that naturalists have come to the conclusion that they are plants. The Charads, or fifth order, present in many respects a much higher development than the rest, and may be justly regarded as not belonging to *Algæ*. [CHARACEÆ.] The relation of these groups to each other and the animal kingdom may be seen in the following diagram, given by Professor Harvey in his work on the 'British Algæ.'



As Mr. Harvey is the most recent writer on this subject we shall follow him in this article. He divides the *Algæ* into three sub-classes.

1. *Melanospermeæ*, which are marine plants of an olive green, or olive brown colour, having a monœcious or diœcious fructification. The spores are olive-coloured; each enveloped in a pellucid skin, and either simple, or separating into two, four, or eight sporules. They possess *antheridia*, or transparent, orange-coloured, vivacious corpuscles, moving by means of vibratile cilia.

2. *Rhodospermeæ*, which, with one or two exceptions, are marine plants, mostly of a rosy red or purple colour. The fructification is of two kinds: either of spores in external or immersed conceptacles, or densely aggregated together and dispersed throughout masses of the frond; or of tetraspores of a red or purple colour, external, or immersed in the frond, and each enveloped in a pellucid skin which at maturity separates into four sporules. Some possess antheridia which are filled with yellow corpuscles.

3. *Chlorospermeæ*, which are marine or fresh-water plants of a green colour. The fructification is dispersed through all parts of the frond. The spores are green, formed within the cells, and often at maturity having vibratile cilia. They produce also gemmules, or external vesicles, which contain a dense, dark-coloured, granular mass, which finally separates from the frond.

The *Melanospermeæ* include the following orders: — *Fucaceæ, Sporochnaceæ, Laminariaceæ, Dictyotaceæ, Chordariaceæ, Ectocarpaceæ.*

The *Fucaceæ*, which have for their type the genus *Fucus*, are all of them marine plants. They are of an olive brown or greenish colour, and very fine in their texture. The cellular structure of which all the *Algæ* are composed is in these plants in a very condensed state, assuming a leathery and sometimes even a woody character. The base of their stem or stipes forms a dense shield-like root, whilst their upper part is often expanded into a broad foliaceous appendage. The reproductive organs consist of small black or very dark spores, which are collected into sori or are found scattered on various parts of the frond. These spores are enveloped in a thick gelatinous mucus, which seems to be a provision for the purpose of attaching them more securely to the rocks on which they grow in the midst of the restless element to which they are constantly exposed. They are of very rapid growth, and only a few months serve to cover a surface of naked rock with a forest of various species of *Fuci*. Kelp is manufactured from the species of plants belonging to this section of *Algæ*; the one most commonly collected for this purpose is the *Fucus vesiculosus*. Kelp is not now manufactured to any great extent in this country, but a few years since it was a source of great wealth in the Western Islands and the western shores of Scotland. [KELP.] At one time the quantity made in Scotland and its adjacent isles was not less than 20,000 tons annually, which sold at the average price of 10*l.* per ton.

Of all the species, that which is the most common is the *Fucus vesiculosus*, great quantities of which are cast upon our coasts, and which is known by its strap-shaped, olive-green, forked divisions, having little yellowish oval uneven pods at their points, and by the crackling noise it makes when trodden upon; a circumstance which is owing to its stems having a considerable number of air-bladders, by means of which it floats. The structure of the pods is highly curious. Externally they consist of a hard rind, covered with tumours, each of which has a little hole in its centre. Internally they contain a soft mucous substance, in which lie, next the rind and immediately below its tumours, a number of round balls (*a*). These little balls are composed of jointed threads (*b*) which hold together a great many little oval grains (*c*) enveloped in a sort of jelly. These grains are the spores by means of which the plant is propagated, and when ripe they are discharged through the holes in the tumours above described.

Fucus vesiculosus.

Although, from the simple structure of the *Algæ*, we should not expect that they would elaborate many of those secretions which in higher plants are found subservient to the use of man and other animals as food, yet among many of these a gelatinous matter is secreted, which is nutritious. In Gothland, the *F. vesiculosus* is given as provender to hogs, and hence is called Swine-Tang. Many other animals will also eat this plant as food, in times of scarcity. It is also collected in Jersey, and when dried is used as fuel. The fishermen both of our own and the Dutch coasts use this *Fucus* and the *F. serratus* for packing up their fish; the latter is however preferred, as, from containing less mucus, it is less likely to ferment. The *Fuci* were at one time used considerably in medicine, as well as other forms of *Algæ*, but since the discovery of their active principle, iodine [IODINE, ENG. CYC., ARTS AND SC. DIV.], they have been comparatively little used. According to Ecklon, the *Laminaria buccinalis* of the Cape of Good Hope is the sea-weed that produces the greatest quantity of iodine.

The *Sargassum vulgare*, or Tropic Grape, the *Fucus natans* of older writers, is remarkable for the immense quantities in which it occurs in certain portions of the ocean. It only grows within forty degrees of the equator, on each side, although occasionally thrown up by currents on our own shores. In some parts of the ocean it is so constant that it is said to assist pilots in rectifying their longitude. It was the occurrence of immense fields of these weeds that struck the sailors of Columbus with so much awe, and led them to suppose that Providence had determined to frustrate their course, which nearly terminated in the giving up of their great attempt to discover the New World.

Alaria esculenta, when stripped of the thin part, forms a part of the simple fare of the poorer classes of Ireland, Scotland, Iceland, Denmark, and the Faroe Islands.

The *Sporochnaceæ* are a small group, composed of the Scatter-Tuft (*Sporochnus*) and three other genera, which are remarkable for bearing little tufts of fine green filaments on the fronds. They are of an olive or yellowish green colour: they become flaccid on exposure to the air, acquiring a verdigris colour, and possess the property of decomposing other *Algæ* with which they may come in contact.

The *Laminariaceæ*, or Tangles, have a densely fibro-cellular structure and their spores are collected together in sori on the surface of the frond. These plants are coriaceous or membranaceous in structure, and are little changed by exposure to the air. Some of them are used. *Laminaria esculenta* is an edible species. It grows to the length of 20 feet, and the midrib, stripped of its membranaceous covering, is the part that is eaten. *L. saccharina*, or the Sugar Sea-Belt, is said to be eaten by the Icelanders. In Japan it is also considered a great delicacy. *L. digitata*, or Sea-Wand, is eaten in Scotland, and is cried about the streets of Edinburgh as *Tangle*. Many of the sea-weeds belonging to this and other genera have been found to make excellent manure for grass-lands. Kelp has in many instances been used, and it has perfectly succeeded. It has been tried as a top-dressing, and singly or in combination with other manures on corn, pasture, potatoes, turnips, &c., with the best effect.

To this section belongs the *Chorda filum*, Sea-Whiplash, or Sea-Whipcord, which is often found 30 or 40 feet in length. The frond of this plant is hollow within, interrupted at short distances, an arrangement which appears to be for the purpose of enabling the plant to float in the water, and thus securing the same end as the more highly developed vesicles of *Fucus vesiculosus*.

The *Dictyotaceæ*, or Sea-Networks, are a larger section than the last, and are characterised by the beautifully reticulated texture of the tegument. Their fronds are of various forms, but all of them are ribless.

The *Chordariaceæ* and *Ectocarpaceæ* have their fronds formed of jointed filaments, which are either free or united into a compound body

The *Ectocarpaceæ* are olivaceous or green marine plants; their fructification is monœcious, the capsules external, and the globules placed between swollen ramuli. It contains the genus *Ectocarpus* and two others.

The *Rhodospermeæ* include the following orders:—*Rhodomelaceæ Laurenciaceæ, Corallinaceæ, Delesseriaceæ, Rhodymeniaceæ, Cryptonemiaceæ, Ceramiaceæ.* These orders are distinguished by their brilliant and little-fading tints, their leaf-like fronds, and the collection of their spores into sori, or, if scattered, by the spores being arranged on a ternary plan. The *Chondrus crispus*, or Carrageen Moss, belongs to the order *Cryptonemiaceæ*. In Ireland it is used extensively as an article of food, and has lately been sold in London as a substitute for Iceland Moss. It is frequently employed, instead of isinglass, for the manufacture of blanc-mange and jellies. It has a slight bitter flavour, which may be removed by steeping for some time previous to boiling.

Another genus of the same order is *Gelidium*. A species of this genus is said to be the substance collected by the swallows and used in the construction of the edible nests of Java. Strange as it may seem that a taste for birds' nests should exist among any people, yet so strong is this taste in China, that the trade in birds' nests forms a very lucrative and extensive branch of commerce. Burnett, in his 'Outlines of Botany,' observes, "It has been estimated that 242,400 lbs. of birds' nests, worth in China 234,290*l.* and upwards, are annually exported from the Indian Archipelago." The only preparation the birds' nests undergo is that of simple drying, without direct exposure to the sun; after which they are packed in small boxes. They are assorted for the Chinese market into three kinds, according to their qualities; and the common price for birds' nests of the first sort at Canton is no less than 3500 dollars the pecul, or 5*l.* 18*s.* 1½*d.* per lb.; for the second, 2800 Spanish dollars the pecul; and for the third, 1600. The collecting these birds' nests, according to Mr. Crawfurd, is as perilous a toil as our fearful trade of gathering samphire; for he says, "The nests are obtained in deep and damp caves, and are most esteemed if taken before the birds have laid their eggs. The coarsest are those collected after the young have been fledged. The finest nests are the whitest; that is, those taken before they are defiled by the young birds. They are taken twice a year, and if regularly collected, and no unusual injury offered to the caverns, the produce is very equal, and the harvest very little if at all improved by being left unmolested for a year or two. Some of the caverns are extremely difficult of access, and the nests can only be collected by persons accustomed from their youth to the office. In one place the caves are only to be approached by a perpendicular descent of many hundred feet by ladders of bamboo and rattan, over a sea rolling violently against the rocks. When the mouth of the cavern is attained, the perilous office of taking the nests must often be performed by torch-light, by penetrating into the recesses of the rock, where the slightest trip would be instantly fatal to the adventurers, who see nothing below them but the turbulent surf making its way into the chasms of the rock." (Crawfurd's 'Eastern Archipelago.')

Several other species of *Gelidium* are made use of as food, more especially in the East, where they are added to dishes to render the hot and biting condiments more palatable.

The *Iridea edulis*, Edible Dulse, is a favourite food with many of the *Crustacea*, as lobsters, crabs, &c.: it is also eaten by fishermen, both raw and roasted. It is said to resemble in flavour roasted oysters. The *Halymenia palmata* was at one time used as a masticatory, but its use has been supplanted by tobacco. It is still, however, used as a popular remedy in scorbutic and other cutaneous diseases. "To the Icelanders it is a plant of considerable importance. They prepare it by washing it well in fresh water, and exposing it to dry, when it gives out a white powdery substance, which is sweet and palatable, and covers the whole plant. They then pack it in casks to keep it from the air, and thus preserve it ready to be eaten, either in this state with fish and butter, or, according to the practice of wealthier tables, boiled in milk, and mixed with a little flour of rye. The cattle are also very fond of this sea-weed, and sheep are said to seek it with such avidity as often to be lost, by going too far from the land at low-water." ('Quart. Rev.,' vii. 68.) From this latter circumstance it was called *Fucus ovinus*, or Sheep Dulse. In Kamtchatka it is used for making a fermented beverage, which is easily produced on account of the great quantity of sugar this plant contains.

Amongst the *Rhodymeniaceæ* is the genus *Gracillaria*, the species of which are also used as food, and one of them, *G. lichenoides*, is highly valued in Ceylon and other parts of the East, and bears a great resemblance to *G. compressa*, a species of the British coast, and which Dr. Greville says is little inferior to the first, and has been used in this country both as a pickle and a preserve. The *G. tenax*, the *Fucus tenax* of Turner, is invaluable to the Chinese as the basis of an excellent glue and varnish. "Though a small plant," says Dr. Greville, "the quantity annually imported at Canton from the provinces of Fokein and Tchikiang is stated by Mr. Turner to be about 27,000 lbs. It is sold for 6d. or 8d. per pound, and is used for the purposes to which we apply glue and gum arabic. The Chinese employ it chiefly in the manufacture of lanterns, to strengthen or varnish the paper, and sometimes to thicken or give a gloss to silks or gauze." Mr. Neill thinks it probable that the gummy matter called chin-chou, or hai-tsai, in China and Japan, may be composed of this substance. Windows made of slips of bamboo, and crossed diagonally, have frequently their interstices wholly filled with the transparent glue of hai-tsai.

A celebrated vermifuge on the Continent is prepared from the *Helminthocorton*, a genus which grows in the Mediterranean, and goes by the name of the Coralline of Corsica. It has also been recommended as a remedy in cancer, but is seldom used in this country.

The *Plocamium*, or Hair-Flag (*Delesseriaceæ*), is one of the most elegant plants of this section. It was formerly used much in the construction of artificial landscapes on paper, and its collection and preparation gave employment to many of the poor on our coasts.

The order *Ceramiaceæ* contains six genera, one of which is the *Griffithsia*, a plant named after Mrs. Griffiths, who has done much to advance the knowledge of the order *Algæ* in Great Britain. The most extensive genera in this tribe are *Calathamnion* and *Polysiphonia*. Most of the species belonging to these two genera are natives of the sea, and are found attached to rocks, and to shells, stones, and corallines which are thrown up by the waves. Many of them are also found parasitic upon the larger sea-algæ, as the various species of *Fucus* and others.

The *Chlorospermeæ* include the orders *Siphonaceæ*, *Confervaceæ*, *Ulvaceæ*, *Oscillatoriaceæ*, *Nostocaceæ*, and *Palmellaceæ*.

The order *Siphonaceæ* consists of plants which are found in the sea, in fresh water, or on damp ground, of an herbaceous green colour. The frond is either composed of membranaceous, filiform, continuous, simple, or branched tubes, or formed of a combination of similar tubes, forming a spongy or crustaceous, globular, cylindrical, or flat body; the reproductive organs are vesicles produced on the outer surface of the tubes, filled with a dark green granular mass. This tribe contains four genera: *Codium*, *Bryopsis*, *Vaucheria*, and *Botrydium*. The most interesting genus is *Vaucheria*, on account of the remarkable observations that have been made upon its reproductive granules by Unger and other botanists. [VAUCHERIA.]

Codium, the Sea-Purse, is a hollow, sub-globose, dark green plant, composed of an interwoven mass of tubular continuous filaments, the reproductive vesicles being attached to the filaments near the surface of the frond. There are two British species found on submarine rocks. *Bryopsis* has two British species, which are also marine plants. The frond is membranaceous, filiform, tubular, cylindrical, glistening, branched; the branches are imbricated, or distichous and pinnated, and filled with a fluid containing minute granules. Their numerous branches give them the appearance of feathered mosses—hence their name. *Botrydium* (from Βότρυς), a Grape-Bunch, is nothing more than a spherical vesicular receptacle, filled with a watery fluid: it opens at the apex, and has, descending from the lower part, a bunch of radical fibres. In structure this plant resembles *Codium*, but it is much smaller, the receptacle not being bigger than a grain of mustard, and it grows upon the ground in moist shady situations. Granules are contained in the watery fluid within the plant, and when the weather is dry, the upper part of the receptacle collapses, giving the plant a cup-shape.

The *Confervaceæ* are for the most part green plants, but sometimes pink or brown. The fructification consists of a granular, coloured internal mass, which assumes various forms.

The genus *Conferva*, although still containing numerous species, has been much reduced by the formation of new genera. It has however still an indefinite character, on account of the comparatively little attention which the order *Algæ* has received from botanists. The "filaments are articulated, free, distinct, uniform, simple or branched. Fruit (?), an internal, coloured, granular mass (endochrome). Colour green, rarely purple or orange." The species of *Confervæ* are found wherever there is water. In running streams they attach themselves to the stones at the bottom, and are so abundant frequently in stagnant ponds and pools as to conceal everything else. Some few of them are found in sea-water, and some on dry land. Some of the species have been found developing their peculiar forms under the influence of the ingredients of different mineral-springs; and one, the *Conferva thermalis*, is only found in thermal springs. Under favourable circumstances they sometimes go on developing to an immense extent in lakes or ponds in which they grow. They are generally at first green, but as they ascend to the surface of the water, and are exposed to the air, they become whitish. The rapidity of the growth of these plants is sometimes very extraordinary, and lakes, and even the ocean itself, are covered for several miles with floating masses of *Confervæ* several inches in depth. Of the various species of *Confervæ*, the *C. fracta*, the *C. crispata*, and *C. rivularis* are most abundant in this country. These plants are frequently called Crow-Silks, and in some parts of the country, when dried, they have been used for the purpose of stuffing beds, also as wadding for stuffing garments. Dr. Lightfoot says he has seen at Edinburgh a kind of paper manufactured from the fibres of *Conferva fracta*. *C. ægagropila*, Globe Crow-Silk, or Moor-Ball, is found with its filaments rolled up into the form of a ball, so that it has the appearance of the balls of hair occasionally found in the stomachs of animals. It is an inhabitant of lakes, but is rarely found. It is not fixed to anything, but floats about at the mercy of the waves. The balls vary in diameter from half an inch to four inches.

The genus *Hydrodictyon* has filaments which form a network with regular polygonal meshes, and viviparous articulations. There is but one species, the *H. utriculatum*, Common Water-Net, which is a rare plant, and found only in ditches and pools in the middle and southern parts of England. It is a beautiful plant, forming a tubular net, which floats freely in the water. The meshes of the net-work are pentagonal or hexagonal, and vary in diameter from half a line to half an inch, and the filaments from the width of a human hair to that of the coarsest hog's-bristle.

The genus *Mougeotia*, named after J. B. Mougeot, a German botanist, has articulated simple filaments, which are finally united by transverse tubes. The endochrome is granular, at length forming roundish globules at the point of conjugation. This is one of the genera of confervoid plants whose filaments are said to unite before reproduction takes place. That this conjugation does take place previous to their granules possessing any reproductive power, in many of the species, there can be no doubt. But there are many species of *Confervæ* which belong to the conjugate group of genera, in which the phenomenon of conjugation does not take place previous to reproduction. These exceptions occur more particularly in the genus *Zygnema*. [ZYGNEMA.] Several species of *Mougeotia* are found in Great Britain; the most common is the *M. genuflexa*, which is abundant in pools and ditches, sometimes covering a space 30 or 40 feet in diameter, and being of a yellowish-green or dull yellow colour. The filaments are exceedingly fragile.

The genus *Tyndaridea* has simple filaments, inosculating by transverse tubes. The endochrome is in two roundish masses, which after conjugation unite to form a single globule. The species are found in ponds and ditches, mostly commencing their existence at the bottom of the water, and after a little time rising to the surface, where they form masses varying in size, of a yellowish and yellowish-green colour.

The *Ulvaceæ* include plants which are found in the sea, in fresh-water, or on the damp ground: they are generally of an herbaceous green or fine purple colour, and have a thin, tender, membranaceous, reticulated structure, rarely gelatinous; they are generally furnished with a very minute scutate root, which is either expanded or tubular and continuous; the reproductive organs consist of roundish, mostly quaternate granules, or minute opercular grains, which are imbedded in the delicate membrane of the plant. This order contains about ten genera, of which the five following are British:—*Porphyra*, *Ulva*, *Tetraspora*, *Enteromorpha*, and *Bangia*.

Porphyra (from πορφύρεος), the Purple Laver, has a plain frond, exceedingly thin, and of a purple colour. The reproductive organs are of two kinds:—1, Roundish granules arranged in fours, and imbedded in the whole substance of the frond; 2, Masses of smaller ovate granules, which are scattered without order, chiefly towards the margin of the frond. Four species of the Purple Laver are enumerated. The most common is the *Porphyra laciniata*, which has its fronds aggregated and deeply cleft, the segments dilated, and variously cut and waved. This plant is common in the sea from spring to autumn, and grows on rocks and stones, whence it is often torn by the violence of the waves, and thrown on the shore. The frond of this plant abounds in a viscid gelatinous matter, which is said to be very nutritious. On this account this plant, under the name of Laver, is much eaten in many places, especially the south of England. When collected, it is kept in jars with salt, and when brought to the table is served up with lemon-juice. Dr. Lightfoot states that in the Western Isles it is gathered in the month of March, and that, when pounded and macerated with a little water, the inhabitants eat it with pepper, vinegar, and butter. It is sometimes stewed with leeks and onions. But although this plant is abundant enough, it is only very partially used as an article of diet.

Ulva the Green Laver, has a membranaceous frond of a green colour with its reproductive granules arranged in fours. There are seven British species of *Ulva*: three growing in the sea, one in fresh water, and three in damp places on the land.

U. latissima, the Broad Green Laver, has a plain, widely-oblong or roundish frond, waved, and of a green colour and tender substance. It is an abundant plant on the rocks and stones of the sea in summer and autumn. In common with *U. Lactuca*, the Lettuce Green Laver, it is gathered and eaten in the same way as the Purple Laver. It is also known under the name of Oyster Green. This plant is popularly supposed to be good for scrofulous habits. It is sometimes applied to the forehead to relieve headache in fevers, and also to procure sleep. *U. bullosa*, the Blistered Green Laver, is the fresh-water species. It has an obovate, saccate frond, which is gelatinous, and at length becomes irregularly expanded, waved, and bullate. It is a very frequent plant in stagnant pools and ditches of fresh water, often covering the whole surface of the water, and giving it the appearance of being in a state of fermentation. Microscopically examined, this is an object of no common beauty; it seems as if composed of little green balls, about as big as the blood-cells in the human blood, having no sort of adhesion with each other, but holding together by a transparent thin jelly. It is by these little green balls, or by the matter they contain, that the *Ulva* is propagated. The common Laver of the shops very nearly resembles it, but is a marine species. The terrestrial species of *Ulva* are found growing on walls, rocks, the roofs of thatched houses, and especially in places exposed to much moisture. *U. thermalis* grows in hot-springs at a temperature of 117° Fahrenheit.

The genus *Tetraspora*, named from the quaternary arrangement of its granules, inhabits fresh water, and includes two British species. The fronds are tubular or inflated, and gelatinous.

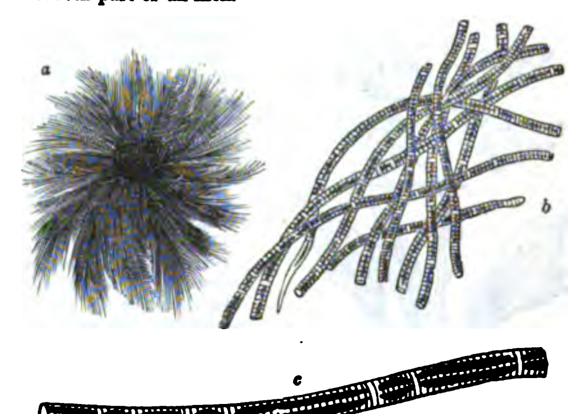
The *Enteromorpha*, Water-Gut, has a tubular, hollow, membranaceous frond, of a green colour and reticulated structure; the reproductive granules are arranged in threes or fours in the reticulations. Seven or eight species of this genus have been described as British. They are all inhabitants of the sea, or of pools and ditches of salt-water, with the exception of *E. intestinalis*, which is also found in fresh-water pools. All the species are long, varying from two or three inches to three feet in length, and when floating in the water very much resemble the intestines of an animal—hence their name.

Bangia was named after Hoffman Bang, a Danish naturalist, who wrote a work on the *Confervæ*. It has a flat, capillary, membranaceous frond, of a green, reddish, or purple colour.

The order *Oscillatoriaceæ* is composed of plants which are green or brown in colour, with continuous tubular filaments, seldom branched, though often joined together so as to appear branched. The fructification consists of an internal mass divided by transverse septa, finally separating into roundish or lenticular sporidia. This tribe of plants, like the others, is found wherever there is water, and is more abundant in fresh water than in the sea. There are however many of them found in the sea, and also in mineral-waters. Many of the species, especially of *Oscillatoria*, are endowed with a power of moving so apparently spontaneous, that some naturalists have placed them among animals, as well as the more minute forms of plants belonging to the order *Algæ*. Captain Carmichael, who devoted much attention to this subject, has made the following observations, which were published from among his MSS. by Mr. Harvey:—"I have been induced to bestow considerable attention on such of the species as fell under my notice, on account of the singular motion remarked in the filaments by various naturalists; and I do confess that the result is something like conviction that they belong rather to the animal than to the vegetable kingdom. This motion or oscillation has been attributed to various causes—to the rapidity of growth, to the action of the light, or to the agitation of the water in which the specimens were immersed for inspection; but none of these afford a satisfactory explanation. The last may be put to the proof by a very simple contrivance. Let a small portion of the stratum be placed in a watch-glass nearly filled with water, and covered with a circular film of talc, so that its edge may touch the glass; the water will be rendered as fixed as if it was a piece of ice. The glass may now be placed under the microscope, and the oscillation of the filaments viewed without any risk of disturbance from the agitation of the water. By following this course it will be speedily perceived that the motion in question is entirely independent of that cause. The action of light as a cause of motion cannot be disproved, because we cannot view our specimens in the dark; but indirectly there is nothing easier. If a watch-glass charged as above be laid aside for a night, it will be found that by next morning not only a considerable radiation has taken place, but that multitudes of the filaments have entirely escaped from the stratum; both indicating motion independent of light. Rapidity of growth will show itself in a prolongation of the filaments, but will not account for this oscillation to the right and left, and still less for their travelling in the course of a few hours to the distance of ten times their own length from the stratum. This last is a kind of motion unexampled, I believe, in the vegetable kingdom. There is another point in the natural history of the *Oscillatorieæ*, which favours the opinion that they are animalcules. It is the extremely limited term of their existence. The community, if I may so call it, lives for several months; but the individuals die off, and are succeeded by others with a rapidity to which there is no parallel among genuine plants. If a small portion of stratum, say one-fourth of an inch in diameter, be left for three or four days in a watch-glass filled with water, the whole area of the glass will be found covered with a thin transparent pellicle or incipient stratum, derived from the filaments that had successively radiated and died in the course of that short period."

There are several genera in the order *Oscillatoriaceæ*:—*Stigonema* has cylindrical, cartilaginous, branched, inarticulate filaments, including granules ranged in transverse dotted rings. *Scytonema* has branched, flaccid, tough, continuous, tubular filaments, with brown or olive-coloured endochrome, which is transversely striated, and at length separates at the striæ into lenticular sporidia. *Calothrix* has erect tufted or fasciculate filaments destitute of a mucous layer, fixed at the base, somewhat rigid, without oscillation. The tube is continuous, and the endochrome is at length dissolved into lenticular sporidia. Many of the species of *Calothrix* are parasitical on other plants. It is to this genus that the *Conferva nivea* of Dillwyn belongs. It is the *Calothrix nivea* of Agardh. This plant is remarkable for its habitat in springs impregnated with sulphuretted hydrogen. It was first found in the sulphur-springs of Croft in Yorkshire, by Dr. Williar, and has since been found by other observers. Dr. Daubeny found it in many of the sulphur-springs of the Continent, and Dr. Lankester collected specimens at Moffat, Harrowgate, Askern, and other places where there were springs impregnated with sulphuretted hydrogen. The decomposition of this plant, probably mixed with the remains of other organic beings inhabiting the springs, has led to the supposition that the springs in which it was found contained a pseudo-organic matter which has been called by the names of Baregine, zoogene, and glairine. This was the opinion of the late Professor Anglada; but Dr. Lankester, having been able to form glairine by the decomposition of the filaments of *Calothrix nivea*, renders it probable that there are no compounds in mineral-waters, except the salts, which have not been derived from plants or animalcules inhabiting the waters. ('Annals of Nat. Hist.,' 1841; 'Notice of Plants and Animals found in Sulphureous Waters,' by E. Lankester, M.D.) The genus *Lyngbya* has free, flexible, elongated, continuous, decumbent filaments, destitute of a mucous layer; the endochrome densely annulated, and separating at the annuli into lenticular sporidia. This genus was named after H. C. Lyngbye, a Danish botanist, and author of a work on the *Algæ* of Denmark. Some of the species are very common. The *L. muralis* is found almost on every damp wall or walk, forming an intensely green stratum of indefinite extent, which is very conspicuous after a shower of rain. Other species are parasitic upon some of the *Fuci* and are found in the sea.

The genus *Oscillatoria* has rigid, elastic, oscillating, simple, continuous filaments, which are invested by a common mucous matrix. The species are very numerous, but many of them are very difficult to distinguish. They are not all found immersed in water, but always occupy damp places. The *O. tenuissima* is an inhabitant of the warm springs of Bath, occupying broad velvet-like patches of a dark green colour. Its singular appearance, Sir J. E. Smith observes, "arises from the filaments being collected together into little ascending tufts, apparently rooted in the muddy deposit of the water. Each tuft proves, on examination, to consist of simple, reniform, even filaments, crowded together, and quite pellucid and equally destitute of joints and branches; their diameter is not more than an 8-1000th or 10-1000th part of an inch."



Oscillatoria distorta. a, natural size; b, c, magnified.

The order *Nostocaceæ* consists of plants with elliptical or globose cells connected in gelatinous moniliform strings. The filaments are separate, or several are united together in a gelatinous frond. The cells composing the filaments are of two kinds; first, a set of a bright green colour, which constitute the greater part of the filaments, and secondly, solitary cells of different form and size to the rest, destitute of colour, and covered with cilia. They occur at intervals in all the filaments, and are called 'connecting cells,' or 'heterocysts.' They probably represent the antheridia in the higher plants. The

Nostocaceæ are chiefly found in fresh-water streams and damp ditches.

The *Palmellaceæ* are amongst the lowest forms of the *Algæ*. They consist of globose or elliptical cells, which are more or less distinct, and are collected together by means of a string-layer into a frond. The genus *Protococcus* has only one species, the *P. nivalis*. This little plant has gained a large share of attention on account of its being supposed at one time to be the cause of red snow. Now however the animal kingdom has put in a claim for a share in the production of this phenomenon. [SNOW, RED.] Most of the species of *Hæmatococcus* are of a red colour, and give an appearance like that of blood to the rocks on which they grow. These appearances have often been regarded with a superstitious eye, and looked upon as warnings or omens from Heaven. One of the species of *Palmella*, the *P. cruenta*, has a dark blood-red colour, and on that account has been called 'gory dew.' It occurs on white-washed walls, especially in damp cellars; and in such situations has sometimes given occasion for alarm, on account of its having the appearance of stains of blood. The other species of *Palmella* have various colours, as yellow, green, and black. They are found in fresh water streams and on rocks on the sea-shore.

(Harvey, *British Marine Algæ;* Hooker, *British Flora;* Agardh, *Species Algarum;* Greville, *Algæ Britannicæ;* Lindley, *Vegetable Kingdom;* Hassall, *Fresh-Water Algæ;* Burnett, *Outlines of Botany.*)

ALGÆ, FOSSIL. The remains of sea-weeds in a fossil state are less common than their probable abundance in the ancient ocean and the generally marine origin of the strata might lead us to suppose. This arises perhaps from the cellular texture and destructible nature of the marine plants. Traces however of several genera occur in Silurian, Carboniferous, Liassic, Oolitic, Cretaceous, and later deposits.

ALGAROBA BEAN. [CERATONIA.]

ALHAGI (from the Arabic *Aghul* or *Algul*), a genus of plants belonging to the natural order *Leguminosæ*. The species are under-shrubs or herbs with simple leaves and minute stipules. The flowers are red, and disposed in racemes along the peduncles.

A. Maurorum is a native of the deserts of Egypt, Syria, Mesopotamia, and other countries of the East. This plant yields a species of manna which is called Trungibin or Terengabin. It is chiefly gathered in the neighbourhood of Tauris where the plant grows abundantly. The manna is a natural exudation from the leaves and branches of the plant, and is most abundant during hot weather. In Arabia it is supposed that the manna falls from heaven on the plant. It first appears in the form of a small drop as of honey, which goes on increasing in size till it is about as large as a coriander seed. The manna yielded by this plant does not appear to be imported into this country. It is principally made use of at the present day in Persia, and is known by the name of Persian Manna. It is employed as food for cattle. Two other species, *A. Camelorum* and *A. Nipaulensis*, are described by botanists, and cultivated in the greenhouses of this country. They also yield manna.

ALISMA. [ALISMACEÆ.]

ALISMA'CEÆ, a natural order of plants belonging to the class *Endogens*. It is known from all the other orders of the same division by its genera having the sepals and petals perfectly distinguishable from each other both in colour and situation, and by their carpels being extremely numerous. In many points they approach very nearly to the Crowfoot Tribe (*Ranunculaceæ*), from which the structure of their embryo and their endogenous mode of growth distinguish them.

Great Water Plantain (*Alisma Plantago*).

All the species are aquatic plants, with rather broad-ribbed leaves and white flowers. They appear to be destitute of any active properties, except a slight degree of acridity, which however does not prevent the rhizoma of some of them from being eaten in China.

The order receives its name from the genus *Alisma*, one species of which, *Alisma Plantago*, a common wild plant of Great Britain, in wet ditches and by river sides, has had the unfounded reputation of being a cure for hydrophobia. Its powdered root is given in doses of from half a drachm to a drachm, either infused in wine or mixed with syrup.

ALKANET. [ANCHUSA.]

ALLAGITE, in Mineralogy, is a variety of the tri-silicate of Manganese.

ALLALITE, in Mineralogy, a variety of *Diopside* or *Pyroxene*. [PYROXENE.]

ALLAMANDA, a genus of plants belonging to the natural order *Apocynaceæ*. It was named after Frederick Allamand, a surgeon who travelled in Guiana, in 1769, and afterwards in Russia. He was a correspondent of Linnæus.

The species of this genus are shrubs yielding a milky juice, with verticillate leaves, and many-flowered peduncles of large yellow flowers. They are worthy of cultivation on account of the beauty of their flowers and foliage. They are all natives of South America, and when cultivated require a strong moist heat to make them flower freely.

An infusion of the leaves of *A. cathartica* is said to act as a powerful purgative, and an overdose to produce poisonous effects.

ALLANITE, in Mineralogy, a synonyme of *Orthite*, which is one of the silicates of cerium mixed with other substances. [ORTHITE.]

ALLIGATOR, a name originally given by the British Colonists of the Southern States of the North American Union, to a large species of reptile closely resembling the Crocodile of Egypt, but which modern researches have shown to possess characters generically differing from those of that animal. The word is supposed to be a corruption of an old Indian name. According to its modern acceptation among zoologists, the name is no longer confined to the species most commonly found in Carolina, Louisiana, and the other Southern States of the Union; but it is applied generically to all the other American species which agree with it in its most prominent and influential characters, and which have been called Caymans, Jacarés, &c., by the Spaniards, Portuguese, and Indians of South America. The characters which are proper to the Alligators, and by which they are distinguished from the Crocodiles of the Old World, are by no means of such importance with respect to the influence they may be reasonably supposed to have upon the habits and economy of these animals as to warrant the formation of these reptiles into a distinct and separate genus: their manners and habits are precisely those of the true crocodiles, and if they differ in certain minor details of structure, this difference should be considered not as a generic character, but as purely specific.

M. Cuvier thus distinguishes the Alligators from the true Crocodiles: "The alligators have the head less oblong than the crocodiles; its length is to its breadth, measured at the articulation of the jaws, as three to two; the teeth are unequal in length and size; there are at least 19, sometimes even as many as 22, on each side in the lower jaw, and 19 or 20 in the upper. The front teeth of the under jaw pierce through the upper at a certain age, and the fourth from the front, which are the longest of all, enter into corresponding holes of the upper jaw, in which they are concealed when the mouth is closed. The hind legs and feet are round and neither fringed nor pectinated on the sides; the toes are not completely webbed, the connecting membrane only extending to their middle; and finally, the post-orbital holes of the cranium, so conspicuous in the true crocodiles, are very minute in the alligators, or even entirely wanting." The Crocodiles, properly so called, on the contrary, have the head at least twice as long as it is broad; 15 teeth on each side of the lower jaw, and 19 on each side of the upper. The incisor or front teeth, as in the alligators, pierce through the upper jaw, at a certain age, but the fourth or largest of the lower jaw, instead of being received into a corresponding hole of the upper, passes into a notch on each side of it; and finally, the hind feet are bordered by a denticulated fringe, and the toes are completely united by a swimming membrane.

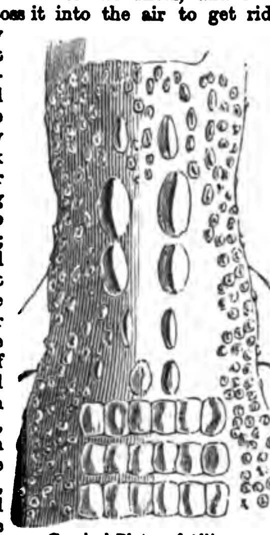
The characters here reported as peculiar to the alligators and crocodiles respectively, are evidently not of sufficient importance to exert any very sensible influence upon their general economy. Of the characters and organic modifications which they possess in common, the principal is the long taper tail, strongly compressed on the sides, and surmounted towards its origin with a double series of keel-shaped plates, forming two upright denticulated crests, which, gradually converging towards the middle of the tail, there unite and form a single row to the extremity. Its great size, and laterally-compressed form, render the tail an organ of the utmost importance to the crocodiles and alligators: it is true that its weight materially impedes their motions on dry land, but it is a most powerful instrument of progression in the water, and influences the aquatic habits of these animals much more than their webbed feet. The latter character, indeed, is comparatively of little weight: the hind feet are only used to assist the progression in slow and gentle motion, but in all sudden and violent actions the tail alone is the active instrument; and even when the animal is surprised on land, as we are assured by Adanson, it becomes a powerful weapon of offence. The compression of the tail is not peculiar among reptiles to crocodiles, though so powerfully influencing their habits; but the second character which is common to the entire genus, namely, the palmated or semi-palmated hind feet, is exhibited by no other genus of reptiles, though all are more or less addicted to an aquatic life. This fact sufficiently demonstrates the small influence which the palmated form of the extremities exerts upon the economy of these animals in general. Still this character is by no means devoid of importance, though in proportion to its utility in aquatic progression it renders the terrestrial motions of the animals extremely slow and awkward; and this effect is still further increased by the length and weight of the tail at one end, and by the anatomical structure of the neck at the other. Each of the cervical vertebræ has on either side a species of false rib, and their meeting at the extremities along the whole neck completely hinders the animal from turning its head to either side, and renders all its movements stiff and constrained. Neither is the pace of the crocodiles on land so swift as to make them objects of fear to ordinary quadrupeds; a man can easily outstrip them, and so sensible are these animals of their own inferiority in this respect, that they immediately retreat to their more congenial element upon the most distant appearance of the human species.

The other general characters of the crocodiles and alligators consist in their long flat heads, thick neck and bodies, protected by regular transverse rows of square bony plates or shields, elevated in the centre into keel-shaped ridges, and disposed, on the back of the neck, into groups of different forms and numbers, according to the species. The mouth is extremely large, extending considerably behind the eyes, and furnished in each jaw with a single row of conical teeth, all of different sizes, and standing apart from one another: these are hollow within, and never vary in number, but are successively pushed out and replaced by others of larger dimensions, as the animals increase in age and size. The tongue is short and fleshy, and attached to the under jaw throughout its whole extent. It is consequently incapable of protrusion, and from its small size and backward position seldom seen even when the animal opens its mouth, which circumstance occasioned the belief so universally prevalent among the ancients, that the crocodile was altogether deprived of this organ. The eyes are placed on the upper surface of the skull, are much approximated towards one another, and provided each with three distinct lids: the nostrils form a long narrow canal, placed at the extremity of the muzzle; the ears are closed externally by two fleshy valves, and beneath the throat are two small pouches or glands, which open externally and contain a musky substance. Finally, the feet are provided with five toes before, long and separate, and four behind, more or less perfectly united by membranes: of these, the three interior alone on each foot are provided with claws, so that the two outer toes on the fore-feet, and one on the hind, are constantly clawless.

Habits of the Alligator.—It is reported by Pliny, that the Egyptian crocodile retires to a secret cave or hiding-place, on the approach of winter, and spends three or four of the coldest months in a state of lethargy, and without taking any food: this phenomenon, usually called hybernation, is almost universal among reptiles and serpents, at least in temperate and high latitudes, and has been repeatedly observed with regard to the alligators. On the approach of the cold season these animals bury themselves in the mud at the bottom of some stagnant pond, where they remain concealed and inactive till the return of spring. Travellers assure us that they are never to be found in running streams, but that they frequent in preference some stagnant pond or the creeks of large rivers. Here they may be seen in almost countless multitudes, for they are extremely numerous in the remote unfrequented parts of South America, protruding their large flat heads through the leaves of the *Nymphæa*, *Pontederia*, and other aquatic plants which cover the surface of the water, and watching for prey; or sometimes basking in the sun or sleeping on the banks. They never come on shore, except during the hottest part of the day, and always retire to the water on the approach of night, during which time they are extremely active in search of prey. Their food consists principally of fish, and it is conjectured by some physiologists, that the musky fluid, secreted by the glands under the throat, acts as a kind of bait to attract their prey. The alligators are seldom known to attack the human species, unless in defence of their eggs or young; the females of these reptiles are reported to exhibit a much stronger degree of maternal affection for their offspring than usually belongs to their class. They generally lay from fifty to sixty eggs in one place, of about the same size as those of a goose, which they cover up with sand, and leave to be hatched by the heat of the sun; never however removing to any great distance. When the young ones come forth, they are about five or six inches long, and are immediately conducted to the water by the female alligator. Seldom more than half the entire brood live to reach the water. Many are destroyed while in the egg. The vultures waylay and watch the female alligator when she goes ashore to deposit her eggs, which they scratch up and devour as soon as she retires. Numbers of them also fall a prey to the grown males of their own species, and to various descriptions of ravenous fishes which greedily devour them. The Indians eat the flesh of the alligators, notwithstanding its strong musky flavour; and even Europeans, who have succeeded in overcoming their prejudices so far as to partake of it, report it to be both delicate and savoury. A single peculiarity of habit seems to distinguish the alligators from the real crocodiles: the former never leave the fresh water, whilst the latter are known to frequent the mouths of large rivers, and even to pass between different islands, at considerable distances from one another; and so perfectly is this characteristic of the two sub-genera, that the crocodile of the West India Islands differs from all the other American species, and exhibits only those modifications which properly belong to those of the Old World.

It was only at the commencement of the present century that the different species of alligators were properly distinguished from one another, or even that they were suspected to be specifically different from the crocodile of the Nile. This distinction is entirely due to the late Baron Cuvier, and since the publication of the first edition of his work 'Sur les Ossemens Fossiles' little further addition has been made to the subject. He enumerates three species, which he has definitely characterised; and describes a fourth, which he suspects to be distinct, but of which he did not at that time possess a sufficient number of specimens to enable him to determine the question.

1. The Alligator (*Crocodilus Lucius*, Cuvier) properly so called, which inhabits the fresh waters of the Carolinas, the Mississippi, and other southern parts of the United States, and of whose fierceness and voracity Bartram has related such extraordinary accounts. It grows, according to Catesby, to the length of 14 or 15 feet, the head being one-seventh of the entire length, and half as broad at the articulation of the jaws as it is long. It appears to be more fierce and voracious than the South American species, often attacks men and quadrupeds whilst bathing or crossing the rivers, and is even said to prefer the flesh of the negro to all other food; probably because the slave is more exposed to its attacks than his master. The alligators prey chiefly by night; they assemble in vast numbers, besetting the mouth of some retired creek into which they have previously driven the fish, and bellowing so loud that they may be heard at the distance of a mile. To catch the fish they dive under the shoal, and having secured one, rise to the surface, toss it into the air to get rid of the water which they necessarily take in along with it, and catch it again in its descent. When however they succeed in capturing a land animal, which is too large to be swallowed at a single mouthful, they conceal the body beneath the bank till it begins to putrefy, for as their teeth are not formed for cutting or masticating, they are unable to tear the tough flesh in its fresh state; it is then dragged on shore and devoured at leisure. When about to lay, the female digs a deep hole in the sand, and deposits her eggs in layers, separated from one another by intervening strata of leaves and dry grass. It would appear that she lays only one batch of eggs during the same season, though in the hotter parts of South America, if the report of Laborde is to be depended on, the Cayman, or alligator of Surinam and Cayenne, lays at two or even three different periods of the year; but as each batch is said to consist of only twenty or twenty-five eggs, it is probable that the whole does not exceed the number usually assigned to the common alligator. The female of this latter species, it is said, never loses sight of her nest till the young are hatched, and for months afterwards affords them the most unremitting care and protection.



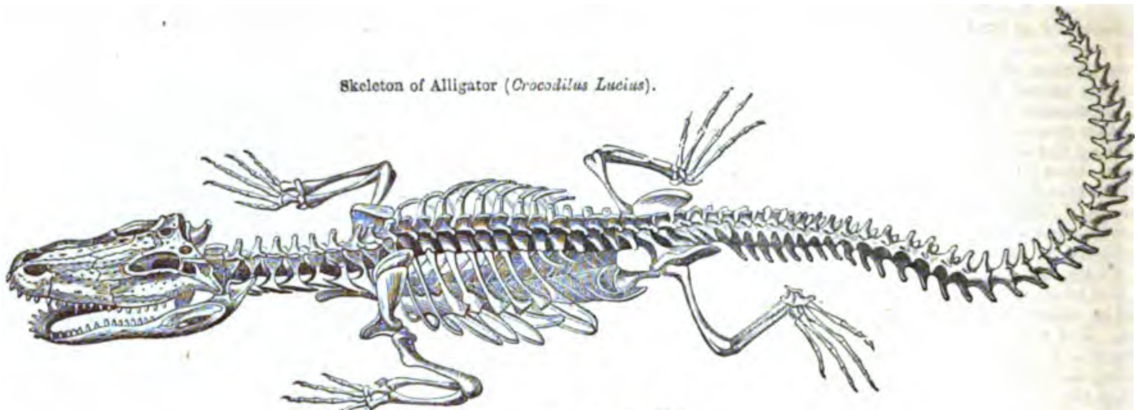
Cervical Plates of Alligator.

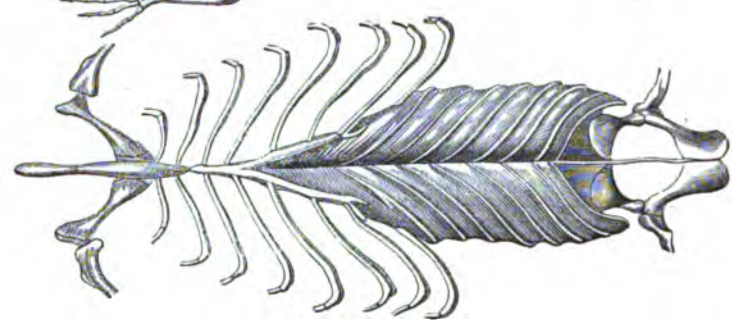
This species is frequently found up the Mississippi higher than the Red River. In general, the alligator of North America buries himself under the mud, at the bottom of the swamps and marshes which he inhabits, as soon as the cold weather fairly sets in, and continues in a lethargic sleep till the return of spring. During the very severe frosts, sensation is so completely suspended, that the body of the animal may be cut into slices without dispelling his lethargy; yet it is never actually frozen, and the partial return of a few hours' bright sunshine is at all times sufficient to restore suspended animation. It is particularly in the rivers, lagoons, and swamps of Florida, Georgia, South Carolina, and Louisiana, that the alligator reaches his greatest dimensions. Bartram found immense numbers of alligators and fish in a mineral spring near the Musquito River, in Florida, though the water, at its exit from the earth, was nearly at the boiling point, and strongly impregnated with copper and vitriol.

Besides the characters common to all the American crocodiles, this species exhibits the following modifications which distinguish it from others:—The snout is flattened on its upper surface, and slightly turned upwards at the extremity; the sides of it are nearly parallel, and the nose forms a regular parabolic curve. It was this similarity to the head of a pike that gave to the present species the name of *Crocodilus Lucius*, or the Pike-Headed Crocodile. The internal rim of the orbits is large and protuberant, but without being united by a transverse crest as in the *Crocodilus sclerops*, or Spectacled Alligator. The external openings of the nostrils are separated by a long knob; the skull has two shallow, oblique, oval pits, in the bottom of which are two small holes. On the back of the neck are four principal plates, elevated in the centre into keel-shaped ridges; and in front and rear of these respectively, two smaller ones of similar form. The back exhibits 18 transverse rows of similar plates, the first with only two crests or ridges, then two with four, afterwards three with six, then six with eight, then again two with six, and finally, the last four rows with four crests each. The ridges or crests on the body are of nearly equal size;

those of the tail are much larger, and amount to 38 in all, 19 before the union of the two lateral series, and as many afterwards. The colour is a deep greenish-brown above, and light-yellow on the under

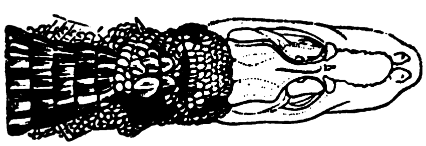
Skeleton of Alligator (*Crocodilus Lucius*).





Trunk of the same; ventral aspect.

Alligator (*Crocodilus Lucius*).



Outline of the head and anterior parts of *Crocodilus Lucius*, seen from above.

surface of the body; the sides regularly marked with alternate bands of both these colours.

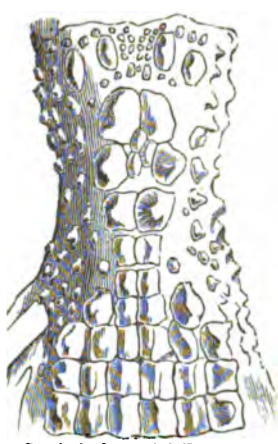
2. The Cayman (*Crocodilus palpebrosus*, Cuvier) is at once distinguished from all other species by the bony structure of the eyebrows, which form large knobs of the size of a man's fist; and by the small extent of the membrane connecting the toes of the hind feet, which in prepared specimens can scarcely be recognised. The skull of this species shows not the slightest trace of those post-orbital perforations, which are so conspicuous in the crocodile of the Nile, and more or less developed in all the other species.

This is the common species of Surinam and Guiana: it is there called Cayman, a word most probably of native origin, whilst the following species, which is likewise found in the same countries, though its more appropriate locality would appear to be Brazil and Buenos Ayres, is distinguished by the name of Crocodile. The Cayman does not attain so large a size as the other species, nor will he venture to attack a man on dry land, or even in the water, so long as he keeps his legs and arms in motion. The female deposits her eggs in a single layer, and after covering them slightly with sand, abandons them to the vivifying influence of the tropical sun, without taking any further charge either of them or of the young progeny.

3. The *Crocodilus trigonatus* of Schneider is a species of crocodile, exhibiting all the peculiar characters which properly distinguish the alligators of America, and yet suspected to be of African origin. It is even so closely allied in form and general characters to the Cayman

that Baron Cuvier has described it as a mere variety of that species. The principal distinction between this and the foregoing species consists in a ridge which rises in front of the orbits, and runs towards the snout, and a small notch in the posterior border of the skull; the second row of cervical plates is larger than the others, and towards its

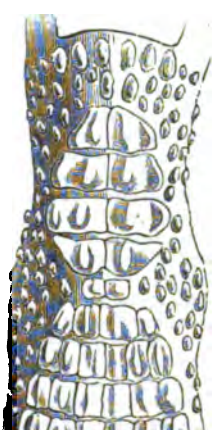
Cervical Plates of the Cayman (*C. palpebrosus.*)



Cervical Plates of *C. Trigonatus.*

middle are two or three small scales, with irregularly disposed crests; the large ridges assume the form of scalene triangles, which gives the whole animal a rough and bristly appearance; there are 16 transverse bands on the back, the number of plates appearing to vary according to the species, and from 19 to 28 on the tail, 9 or 10 before the junction of the lateral ridges, and from 10 to 17 afterwards. Nothing whatever is known of the manners or habits of this species or variety.

4. The Jacaré (*Crocodilus sclerops*, Schneider) appears to be spread over the whole of tropical America, but is more especially numerous in Brazil, where it attains a very large size, and is found in all the rivers and lakes. Its head is more attenuated than in the alligator of North America; the sides converging towards the snout, so as to form very nearly an isosceles triangle; the surface of the bones of the skull has a rough scabrous appearance, as if arising from disease; the orbits of the eyes are surrounded by large prominent rims of bone, and these are connected together by an intermediate ridge, giving the whole very much the appearance of a pair of spectacles; finally, the skull is pierced by two very small holes behind the orbits. The cervical plates are remarkably large; they are arranged in four transverse bands, of which the first two contain four each, and each of the others two. The transverse bands of the back vary according to age, and it would even seem according to the individual; they most commonly consist of two rows, with two plates each, four with six, five with eight, two with six, and four with four. The colour of the animal is greenish-brown above, marbled irregularly with different shades of green, and pale greenish-yellow below. This species grows to the size of from 14 to 18 feet in length; the whole length is from eight to eight and a half times that of the head.



Cervical Plates of the Jacaré (*C. sclerops.*)

The Jacarés, according to Azara, are never known to attack men, or even dogs, in passing the rivers, unless it should happen to be near the place where they have deposited their eggs; and even then, they are never known to prey upon the body, contenting themselves with the fish and water-fowl which they find so plentiful in their own element. During the night they are exceedingly active, and always keep in the water, showing only their heads above the surface, but towards the middle of the day they come ashore to enjoy the heat of the sun; they then sleep profoundly, but always retreat to the water on being disturbed. The eggs are about the size of those of a goose; they are white, and much sought after by the free Indians, who also eat the flesh of the Jacaré itself, though it has a strong musky smell, and scarcely any juice. The female deposits her eggs in the sand in a single layer, and covers them with straw or leaves; few of them, however, escape the quick eye of the vulture, and even many of the young fall a prey to the full-grown males, which at the period of their first appearance, in the hottest part of summer, are particularly fierce and ravenous, the marshes which they inhabit being then dried up, and their food difficult to obtain. This species appears to have pretty nearly the same range towards the south of the continent, that the alligator, or pike-headed crocodile, has to the north. According to Azara, it is never found beyond 32° of south latitude. Many interesting facts regarding the habits of this species are recorded in the narratives of Prince Maximilian, Spix and Martius, and other Brazilian travellers. [CROCODILIA, SUPPLEMENT.]

ALLIUM, a very extensive genus of bulbous Monocotyledonous plants, belonging to the natural order *Liliaceæ*. The species are all remarkable for having, in a greater or less degree, the odour of garlic, and for the agreeable stimulating effects that accompany it. For this reason some of them have been objects of cultivation from the highest antiquity.

As a genus, *Allium* is known among other *Liliaceæ*, by the flowers growing in round heads or umbels, by the perianth being deeply divided into six spreading lobes, and by having a capsule with three angles, three valves, and three cells, sometimes so deeply lobed, as to have the appearance of six cells. The number of species is very considerable; they are almost exclusively natives of the northern hemisphere, and are principally found wild in the meadows and groves of Europe, in the north of Asia, and the north of Egypt; a small proportion only inhabiting corresponding latitudes in North America. Many of them are handsome flowering plants, but as they are more important on account of their useful properties, we shall confine ourselves to some account of the kinds commonly cultivated in the kitchen-garden.

Allium Cepa, the Common Onion, is too well known to require description. It is not certain of what country it is a native, but it has from time immemorial been cultivated in Egypt. Its varieties are not very numerous, considering that it is almost exclusively increased by seed: the most remarkable are the Blood-Red Onion, which is the most pungent; the Strasburg Onion, which is the hardiest; the Silver-Skinned Onion, which is the smallest, and the most fitted for pickling; and the onions of Portugal and Tripoli, which are the largest and the most delicate. In this country the bulbs do not generally arrive at the large size of those imported from Portugal and Spain; but skilful gardeners have nevertheless succeeded in procuring them fully as fine. Their method has been to take the small onions of a late-sown crop of the previous year, and to plant them in rows in the beginning of April, laying them on the surface of the soil, each surrounded with about a handful of decayed and nearly dry manure. All the time that is usually lost in seed-sowing is thus avoided, and the moment the bulbs push forth new roots, they find themselves in the midst of an abundant store of food, which continues to supply them with nutrition during the whole of the growing season. As they advance in size, the soil round the bulbs is frequently disturbed by the hoe, for the sake of exposing as much as possible the carbonaceous matter of the manure to the action of the atmosphere. This process is only discontinued when the leaves begin to turn yellow; the bulbs are then allowed to ripen as usual.

Allium schœnoprasum, the Chive, is a little tufted plant, with slender, cylindrical, taper-pointed, dark-green leaves; its flowers are arranged in a small compact round head, and are of a purplish or pale violet colour; the bulbs are small, long, and white, and grow in dense, matted tufts. It is a native of the mountainous regions of Europe, from Lapland to Italy; and is found here and there in Great Britain. It is more employed by the French for their cookery than in this country.

Allium fistulosum, the Welsh Onion, is a native of Siberia, and is supposed to have gained its English name from having been imported originally from Germany, with the name Wälsch, or foreign, attached to it. It is a perennial, and cultivated chiefly for the purpose of being sold in the markets when very young, at which time its flavour is delicate; its hardiness enables it when young to brave our spring cold better than the common onion.

Allium Ascalonicum, the Shallot, a native of Asia Minor, is in many respects similar to the chive, from which it is known by its larger leaves, its smaller and more deeply-coloured flowers, and by its stamens having alternately three points on the filaments. It moreover produces bulbs of sufficient size to be fit for use, and accordingly, while the leaves only are employed in the chive, the bulbs are the parts sought for in the shallot. These multiply abundantly, so that every year, when the crop is taken up, there is plenty of small bulbs which can be reserved for planting the succeeding season, while the fine fully-formed ones are selected for the kitchen. To obtain the bulbs in the greatest perfection, they should not be buried in the earth, as is the common practice, but merely placed on the surface of the soil.

Allium sativum, Garlic, has been found wild in Sicily, and some parts of Provence. Its stem is simple, erect, and furnished with flat, narrow, pointed leaves; the flower-heads have usually a number of little bulbs lying among the flowers, which are white or pinkish; the bulbs are remarkable for the development of the greater part of the axillary buds of their scales; these buds grow rapidly, and acquire a bulbous state, and form what are called the cloves of the garlic, which are the parts employed in cooking.

Allium ophioscorodon, Rocambole, or Spanish Shallot, is very slightly different from garlic, being chiefly distinguished by its larger size in all the parts, and by the upper part of its stem being generally twisted spirally just before flowering. It is a native of most parts of the south of Europe.

Allium porrum, the Leek, has, like many other cultivated plants, disappeared in a wild state, so that its origin is unknown. It is a broad-leaved succulent species, not capable of forming a bulb, because the leaves do not perish till the plant itself dies away, but producing instead a cylindrical body composed of the tender, colourless bases of the leaves, which are rolled round each other in a compact manner. As the excellence of the leek depends entirely upon the large size of this part, the attention of the cultivator is exclusively directed to that before all other considerations. It has been found that no method is so successful as to sow the seed early in a light and well-manured soil, and then, when the young leeks have arrived at the thickness of the little finger, or even sooner, to drop them into holes about 2½ or 3 inches wide, and 6 inches deep, in the bottom of which some very fine manure has been deposited.

ALLOCHROITE, in Mineralogy, a variety of Garnet, characterised with other minerals by possessing free silica. [GARNET.]

ALLOMORPHITE, in Mineralogy, a variety of Heavy Spar, which is a sulphate of barytes.

ALLOPHANE, a mineral belonging to the group of Clays which contain a large proportion of water. It occurs reniform, botryoidal, globular, and massive. No cleavage. Colour blue, green, brown. Fracture conchoidal. Hardness 3·0 nearly. Lustre vitreous, transparent, translucent. Specific gravity 1·852 to 1·859. It is found at Saalfeld in Thuringia, at Schneeberg in Saxony, and other places. Its analysis, by Stromeyer, gives:—Silica, 21·922; alumina, 32·202; lime, 0·730; sulphate of lime, 0·517; carbonate of copper, 3·058; hydrate of iron, 0·270; water, 41·301.

ALLSPICE. [EUGENIA.]

ALLUVIUM, a name given to those accumulations of sand, earth, and loose stones or gravel brought down by rivers, which, when spread out to any extent, form what is called Alluvial Land. The word is derived from the Latin verb *alluere*, signifying 'to wash upon,' as the sea does upon the coasts, or a river upon its banks, and is chiefly used as a term in geology. Many geologists restrict the expression to such water-worn materials as have been deposited either recently or within the historical era, and which do not include the remains of extinct species of organised bodies: but as there are similar accumulations of transported materials, belonging to almost every geological period in the history of the earth, it is an unwarranted restriction of the term to confine its use to the recent period only. There is, no doubt, this distinction between modern alluvia and those of ancient periods, that in the latter, besides the remains of extinct species of animals and plants, there is more frequently a consolidation into stone. To these last accumulations of water-worn materials some geologists apply the name *Diluvium*, which is objectionable, because it expresses, not a particular state of the materials, but a theory of their formation; that is, that they were produced by a deluge,—some indeed go so far as to assert that they were accumulations from the Mosaic flood. The word Alluvium might be conveniently used as a general term, and we might say Ancient Alluvium and Modern Alluvium, as the French geologists say *Terrains de Transport—Anciens* and *Modernes*. We might go farther, and say Secondary and Tertiary Alluvium, and the Alluvia of particular groups of strata.

In treating of this subject we have to consider three operations: 1, The disintegration and decay of the superior crust of the earth by the action of meteoric agents, of tides, currents, and streams of running water; 2, The transportation of the loosened materials by streams and currents; and 3, The deposition of the matter at the bottom of rivers, lakes, estuaries, and the ocean. The surface of the earth is subject to unceasing changes from the operation of three great classes of agents, namely, the meteoric, the aqueous, and the igneous. Under the first of these classes are comprehended, the air of the atmosphere, the vicissitudes of heat and cold, moisture and rain, light, electricity, and the wind: under the second class, running water of every kind on the surface of the land, the tides, waves, and currents of the sea as they strike against its shores: the third class comprehends volcanoes and earthquakes, which will be discussed under another head. It is the second class with which we have chiefly to do at present, and we shall only briefly touch upon the first as subservient to the subject with which we are occupied.

All rocks, and indeed almost all mineral substances, have a greater or less tendency to combine with the oxygen of the atmosphere, especially when under favourable circumstances of heat and moisture, and probably also of electricity and light: carbonic acid and water also are absorbed by rocks in considerable quantity; and the effect of these combinations, whether chemical or mechanical, is to loosen the cohesion between the particles of the stone, and induce a tendency to disintegration. This separation of the parts is very much accelerated by those sudden expansions and contractions which are occasioned by vicissitudes of temperature, and especially during frost, when the imbibed moisture is converted into ice. This slow and silent work of waste is unremittingly going on wherever rocks are exposed to the weather. No species of stone is exempt; and even granite, which in general is so little subject to change as to be proverbially a symbol of endurance, and is selected for our bridges and other great works of architecture, under particular circumstances of constitution and exposure, is remarkably disposed to disintegration. "The granite of some parts of Finland," says Mr. Strangways, "is so liable to decomposition, that a great boulder of it may often be seen with a hole cut in it large enough to admit a cart and horse; and the stone, though at a small distance it seems calculated to last for ages, is cut down and shaped away with the same ease, and much in the same manner, as a hay-rick." The same agents sometimes give more marked proofs of their destructive power, when lightning shivers a pinnacle of rock, or when a mass of water, enclosed in a cleft and converted into ice, rends, by its great expansive force, vasts blocks asunder. The effect of these several indefatigable agents, all working together, with gravity in their favour, is a system of universal decay and degradation, which may be traced over the whole surface of the land, from the mountain-top to the sea-shore. The wind, though it may sometimes detach particles, is chiefly instrumental in transporting to a distance matter already separated. Every drop of rain that falls, as soon as it touches the earth becomes an instrument of destruction, and the minute fragments which every shower washes away are hurried along the streams into a river, and are either deposited at a lower level, or are transported to the sea: thus, a solid body which once formed a part of a mountain-top among the Andes, after being swept along for thousands of miles through the bed of a river into the waters of the Atlantic, may, by ocean-currents, be deposited at the bottom of the Gulf of Mexico, while the fragment with which it was once united may be carried far into the depths of the Pacific.

To this assertion of the constant waste of the land, and the conclusions which are drawn from it, it has been objected, that we can hardly discover any change in the shapes and altitudes of mountains, that the forms of many lands have continued unaltered since the earliest records, and that even productions of human art exposed to the action of the weather for many centuries have undergone no perceptible decay. No doubt the process is slow, if compared with the progress of events in which the human race has had concern, but no one will deny that rivers are loaded during every flood with solid matter; and, as the matter so suspended can only be derived from the land, it necessarily follows that a continuance of the process must in time wear down the loftiest mountains, where the rocks are not protected by a covering of turf from the action of the destructive agents. Of the rapidity of this waste we have no means of judging, and any attempt to express our conjectures by figures would be little better than an idle occupation. It is almost within our own time that any accurate measurements of heights have been made: and as two estimates of the same mountain, made with all the accuracy of which our instruments are capable, often give a difference of several feet, we are not even now able to leave behind us data by which posterity may mark the progress of this species of geological change; for the removal of such a mass of matter as should diminish the height of a mountain by three or four feet, by ordinary agents, may require thousands of years for its accomplishment. If Mont Blanc, by our most accurate measurements, be now 15,744 feet above the level of the sea, and if the geologist, many centuries hence, by newly-discovered methods not liable to error, should find it only 15,740, it would be impossible for him to know whether the difference was to be set down to geological change, or to the imperfection of the instruments of his ancestors.

In geological speculations we must lay aside all considerations as to time: we have only to do with that element when our inquiries relate to man; and if we are to be guided by analogy in our reasonings, we must be satisfied that a space of time of vast duration must have been requisite to produce any great amount of geological change. We see even in many chemical processes, that long-continued action gives birth to substances which could not otherwise be obtained,—as, for example, crystals of felspar are formed if the heat be maintained for some weeks, but not otherwise; and long-continued action in the great laboratory of Nature has no doubt been an equally powerful instrument.

Although we can, in strictness, only say that certain geological events must have preceded others, we are not warranted in withholding any length of time for the accomplishment of the change, merely because we are unable to form a conception of an indefinite period: it would be as irrational as if we were to withhold our assent to some of the established truths in astronomy, merely because we are incapable of forming an idea of indefinite space. It has been eloquently said by Playfair, that "It affords no presumption against the reality of the progress of decay that, in respect of man, it is too slow to be immediately perceived. The utmost portion of it to which our experience can extend is evanescent in comparison with the whole, and must be regarded as the momentary increment of a vast progression, circumscribed by no other limits than the duration of the world. Time performs the office of integrating the infinitesimal parts of which this progression is made up; it collects into one sum, and produces from them an amount greater than any that can be assigned." But slow and silent as the work of these agents of destruction is, we have only to direct our view towards those parts of the earth where the machinery of Nature is to be found on its grandest scale, to be sensible of the prodigious effects which their unceasing operation must produce in the long lapse of ages.

The force of water, when directed against any obstacle in its course, is very considerable, even by its own weight alone, especially if it be flowing over a highly-inclined surface; but its destructive power is greatly augmented if it be loaded with sand and gravel. In floods, very considerable blocks are carried by the stream to great distances; for it must be remembered that these are much more easily moved in water than on land, in consequence of the law in hydrostatics, that a solid body fully immersed in water weighs so much less than it does in air by a sum equal to the weight of the mass of water which it displaces. If the water flows with a velocity of 3 inches per second, its force, when free from suspended matter, is sufficient to tear up fine clay; 6 inches per second, fine sand; 12 inches per second, fine gravel; and 3 feet per second, will tear up beds of loose stones of the size of an egg. The flood occasioned by the bursting of the barrier of a lake in the valley of Bagnes near Martigny, in the Vallais, moved at first with the tremendous velocity of 33 feet per second, afterwards diminished to 18, and 11; and at the end of its course, when the water reached the Lake of Geneva, it was still running at the rate of 6 feet per second. From the barrier to this point the fall is 4462 feet; the distance is 45 miles; and the mass of water passed over this large space in 5½ hours. It swept along houses, bridges, and trees; masses of rock equal in dimensions to houses, which it tore out of an ancient alluvial soil, were carried a quarter of a mile down the valley. A flood which happened in the north of Scotland in 1829 afforded numerous examples of the power of running water to transport large blocks of stone. In the river Nairn, a fragment of sandstone rock, 14 feet long, by 3 feet wide, and 1 foot thick, was carried above 200 yards down the river. The river Don forced a mass of 400 or 500 tons of stones, many of them 200 or 300 pounds weight, up an inclined plane, rising 6 feet in 8 or 10 yards, and left them in a rectangular heap, about 3 feet deep, on a flat ground. The small rivulet called the College, in Northumberland, swollen by a flood in August, 1827, carried several masses of stone, weighing from a half to three-quarters of a ton, two miles down its course; a large block, weighing nearly two tons, was transported to the distance of a quarter of a mile.

Thus it appears that the instruments of waste employed by Nature are far more powerful in their effects than is generally supposed. It is also evident that such powers, unremittingly exerted, must, after a long period, cause changes in the configuration of the earth's surface, and we shall now proceed to point out some of the effects which are produced by the working of this powerful machinery.

The cause of the formation of valleys is a subject of great controversy among geologists. Some ascribe their formation to extraordinary floods, waves, or deluges, which in their sudden passage scooped out the land; others, to the gradual effect of those natural agents of whose existence and power we have had experience. It may fairly be presumed that, when the continents were raised out of the sea, their surfaces did not present a uniform plain, but were broken by numerous ridges and inequalities, and that the ridges themselves were traversed by numerous fissures, one of the effects of the power by which they were raised. The first rains that fell, and the first springs which burst forth, would necessarily collect in the lowest levels, and thus the direction of the great trunk of a river would be determined; and it might also happen that other clefts—depressions at a higher level—would communicate with this main channel. But that every such great depression would have a direct communication with the sea, and that such a combination of subordinate valleys as compose a river-system could have been formed by the breaking up of the earth's crust, either by elevation or subsidence, can hardly, we think, be maintained by any one. A river-course, or system, may be not inaptly compared to a picture of a great tree, whose branches gradually diminish in size, but increase in number, as they recede from the stem. The great trunk of the river is divided into many branches, which spring from it at various distances from one another; and these again are subdivided into an infinity of smaller ramifications, each diminishing in size as it increases in distance from the main trunk—a regular communication being kept up between every point and the line of greatest depression; "forming together a system of valleys communicating with one another, and having such a nice adjustment of their declivities, that none of them join the principal valley either on too high or too low a level." Some idea may be formed of the extent to which the surface of the land has thus been furrowed by means of the subordinate streams that feed a great river, from what Riede says of the tributaries of the Isar, which, flowing from the Tyrolese Alps, and passing by Munich, joins the Danube some miles above Passau. This river is fed on its right bank by 433 streams, on its left by 800; the former joining the main bed by 59 channels, the latter by 44. But the Isar is only one of the 34 great branches of the Danube, and holds only a fourth rank among them; and even the Danube is a river of the third magnitude in the physical history of the earth.

We have direct proofs of the power of water to wear a channel in the hardest rocks in almost every country, and even in a remarkably short time. A stream of lava, poured out from Ætna in 1603, flowed across the bed of the Simeto, the largest river in Sicily, which flows along the base of the mountain and falls into the sea near Catania. The stream has now cut a passage through the hard rock, which is only a little less compact than basalt, to the depth of from 40 to 50 feet, and from 50 to several hundred feet wide.

The Nerbudda, a river of Hindustan, has worn a channel in a basaltic rock to the depth of 100 feet. Professor Sedgwick and Sir Roderick Murchison state, that in the enormous masses of horizontal coarse conglomerate, found in many of the valleys of the Eastern Alps, rivers have often scooped out gorges to the depth of 600 or 700 feet; and that in the valley of the Inn, near Innspruck, and in that of the Drave, between Klagenfurt and Marburg, there are splendid examples of these phenomena.

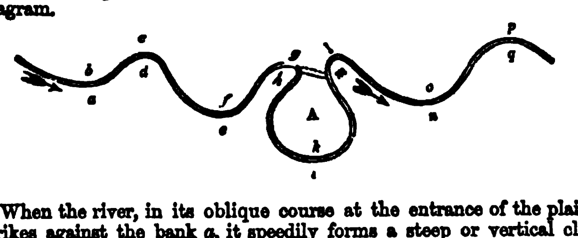
The rock over which the water of the Niagara is precipitated at its celebrated Falls is undergoing a daily waste; so that the cataract has receded nearly 50 yards in the last 40 years. The river below the Falls runs in a channel above 150 feet deep, and 160 yards wide, for a distance of 7 miles, where it emerges into a plain; and this channel has evidently been formed by the same operation as that which is now in progress. Sir Charles Lyell computes, from this and other data, that the Falls have been 30,000 years in wearing this channel. The waste is accelerated by the action of the water at the Falls on an under-bed of soft clay, which being washed away leaves the superincumbent limestone strata unsupported, when they fall down in huge masses. A similar effect is produced, even in mountains of considerable elevation, when the superficial water, or underground springs, obtain access to an inferior bed of soft materials, and gradually wash it away. This took place in 1806 at the Rossberg, near the Lake of Zug in Switzerland, a mountain more than 5000 feet above the level of the sea. The stony masses which were undermined were inclined at an angle of 45°; and thus slid down, covering the valley below with an enormous heap of blocks of stone and earth, and overwhelming several villages, in which above 800 persons perished.

There are many valleys and narrow defiles, which, on account of deep lakes that occur in them, the barriers by which they are inclosed, and the levels of the adjoining country, could not have been formed by the action of the waters now passing through them, however much we may suppose them to have been swollen by floods. In such cases, elevations and subsidences of the land, brought about by those subterranean agents which give rise to earthquakes, must be looked to as the most rational explanation. But there is perhaps not one of these which has not been subsequently modified in a considerable degree by the action of running water operating during a long period.

The wearing and transporting powers of rivers depend upon the volume of water, the quantity and size of the solid matter suspended, and the velocity with which it moves. A river generally runs with greatest rapidity in the higher parts of its course, where indeed it often consists of a succession of torrents and cataracts for many miles, but it has not yet acquired its full destructive force, because the mass of water is still comparatively small, nor has it yet become loaded with solid matter. In the lower part of its course, long before it joins the sea, it has usually reached a level country, and there its velocity becomes greatly retarded. The Senegal in Africa does not, according to Adanson, fall more than 2½ feet from Podor to the sea, a distance of 60 leagues. The destructive force is thus lessened by the diminished velocity, and by the consequent inability of the stream to drag its heavy artillery along with it. It is, therefore, in the middle part of its course that a river commits the greatest waste—after it has acquired a considerable volume, has become loaded with solid matter, and, from the inclination of the ground, still possesses power to wield its more mighty weapons of destruction.

The increase of the volume of water in rivers during the flood-seasons is often prodigious. The bed of the Mississippi, at Natchez, about 300 miles above New Orleans, measuring along the course of the river, scarcely exceeds a mile in breadth when the water is low; whereas in the flood-season the mass of water is nearly 30 miles wide. The Orinoco, at St.-Thomas's, 200 miles from its embouchûre, is about 3½ miles wide in the dry season; but when flooded, its waters, according to Dupens, stretch out to the enormous breadth of 70 miles.

The loss of destructive power, by diminished velocity in the level country, is sometimes compensated, in a considerable degree, by the effects produced by the weight of the great volume of water impinging upon certain parts. This will be better understood by the annexed diagram.



When the river, in its oblique course at the entrance of the plain, strikes against the bank *a*, it speedily forms a steep or vertical cliff which turns off the water in its downward course into an opposite direction. The river now falls with its whole force against the point *c*, which, in its turn, becomes precipitous, and deflects the water towards the point *e*; and in this manner the process is repeated, at short intervals, producing a series of salient and re-entering angles.

The diagram represents a river after the process of erosion has considerably advanced; at first the course would be much less tortuous. If the country be composed of rock, both banks are usually steep; but if the ground consist of looser materials, the spaces between the precipitous parts of the banks—that is, between the salient angles—

consist of flat, fertile, alluvial land, with a gravelly bottom, the gradual creation of the stream. Sometimes the course of the river is so tortuous that two points, *h* and *m*, may be within a few hundred yards of each other, and yet, following the line of the stream, they may be some miles asunder. In this case, the narrow neck of land is acted upon doubly; for the force of the water is directed against it on each side. In time this isthmus is breached, and the river either flows entirely through the new channel, or, dividing, forms the land A into an island.

Such tortuous courses, when they are cut through solid rock, as in the case of the Moselle, whose banks are sometimes 600 feet high, are among the strongest proofs of the destructive power of running water, for no sudden deluge, however powerful, could have scooped out such a trough; and that a cleft of such a nature should be occasioned by any disruption of the earth's crust, is not less improbable. More sudden and therefore more striking instances of the waste of the land occur where a river flows through a lake, and by its wasting action causes a breaking-down of the barrier. We have already alluded to the bursting of a lake in the valley of Bagnes in Switzerland. That flood was produced by the melting of ice, which, falling in successive seasons from neighbouring glaciers, had formed so continuous a mass as to dam up the water of a stream which flowed in the bottom of the valley. If the barrier of a lake consist of strata of rock, supported by beds of clay or sand, and if, by any change of circumstances, the running water get access to this inferior bed, and gradually wash it away, the superincumbent rock, thus undermined, suddenly breaks down, and devastation and ruin overwhelm the country below.

The distance to which the detached fragments are carried depends upon the volume of water, and the nature of the ground over which it flows. The torrents from the south-western Alps, rushing over a steep uninterrupted slope, transport large blocks to the sea; but a river that runs through a long stretch of level country deposits the grosser matter in the upper part of its course, and carries to its mouth only that which is more easily held in suspension. The larger stones, after being detached from their parent rock, have therefore to undergo an intermediate process of abrasion, by being rubbed against each other in the bed of the stream before their particles are finally committed to the deep. If a river pass through a lake in its course, the solid matter will be deposited in that trough until it has filled it up; and if the lake be very large, even the lighter particles will have time to fall, and the water will flow out clear from the other extremity. The Lake of Geneva affords a remarkable instance of this process; for the Rhône, where it enters, is extremely turbid; but at Geneva, where it leaves the lake, it is beautifully transparent. At the upper end there is a tract of alluvial land nearly 8 miles in length, which has been gradually formed by the deposits from the river; and some measure of its progress is obtained by the change in the situation of the town of Port Vallais, which was once at the water's edge, but in the course of about 800 years has been left a mile and a half inland. Other torrents, on both sides of the lake, likewise pour in large quantities of solid matter; and thus, although from its great depth a long period must elapse if the present order of nature remains undisturbed, the Leman Lake will be converted into green meadows, and cattle will graze where there are now 160 fathoms of water. Nor is this an extravagant expectation, or more than has taken place elsewhere in past times. The vast fertile valley between the Vosges Mountains and those of the Black Forest, through which the Rhine flows for above 100 miles, between Strasburg and Worms, without falling more than two feet in a mile, is in great part covered with alluvium, and is filled to an unknown depth under the soil with sand and gravel similar to that now transported by the Rhône. There is every reason to believe that this valley was at one time the site of a lake far larger than that of Geneva, and probably quite as deep.

The Rhine, in the higher part of its course, is filling up the Lake of Constance, where a considerable tract of alluvial land has been formed; and, after issuing pure from the lower end, it appears from the observations of Hammer to have carried on the work of destruction so powerfully in the comparatively short distance between the Lake of Constance and the bottom of the falls at Schaffhausen, as to have supplied materials sufficient to fill up several lakes between Schaffhausen and Strasburg, besides the great lake below Strasburg already spoken of. There are numerous instances of this gradual filling up of lakes, especially in the courses of the greater rivers, as in the Danube between Ulm and Neuburg above Vienna, and most eminently so in the case of the St.-Lawrence. Simond states that the river Lint, in Switzerland, is perpetually filling up its old channel, and overflowing into a new one, in consequence of the mass of rubbish and stones brought down from the Glarus Mountains; and that the level of the Lake of Wallenstadt had been actually raised 10 feet in the previous 60 years by this accumulation. If the river does not meet with lakes in its course, and flows over a great extent of country having a slight degree of inclination, the transported matter very often so accumulates as to raise the bed of the stream itself. One of the most striking instances of this kind is afforded by the Po, the common receptacle of the waters of the numberless torrents which rush down on both sides of it, loaded with spoils from the Alps and Northern Apennines. The effect of this has been that the river has frequently shifted its course; and, to prevent the damage that ensues from such events, the inhabitants of Lombardy have protected their lands by embankments, which confine the river to its channel. This, however, is a work of incessant labour, and deceptive security, for the accumulation of matter in the bed goes on with unremitting constancy; and, to prevent the water from overflowing, the matter must be taken from the bottom and thrown upon the banks, sometimes as much as a foot in a season. The effect of this has been, that in the lower parts of its course the Po runs on the top of a high mound, which even overtops the houses in Ferrara.

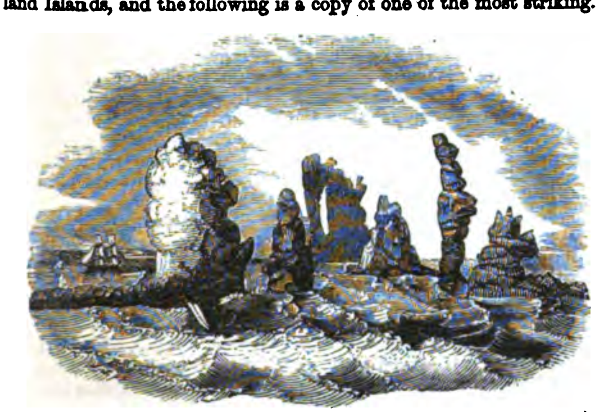
In a mountainous country where the land rises rapidly from the shore, the rivers descending over a steep bed sweep all the contents into the sea. If the neighbouring sea be deep, and the tides be strong, an estuary or inlet is formed at the mouth of the river—that is, the sea forms a deep indentation into the land, of a triangular shape, forming what Rennell and other geographers have fancifully called a 'negative delta.' If, on the other hand, a low shelving shore, and the absence of strong tidal currents favour the gradual and tranquil deposit of the solid matter brought down by the river, an extensive level of alluvial land is formed. In this case the main river, at a distant point inland, often divides itself into two streams, which, gradually diverging until they reach the sea, inclose a triangular space of land having the form of the fourth letter of the Greek alphabet, Δ, and hence called a *delta*. The mass of water does not, however, long continue divided into two streams only; the process of separation is repeated several times, and thus the delta is traversed by several channels, and the great river empties itself into the sea by many mouths, as may be seen by the inspection of the Nile and Ganges in any map of Egypt or Hindustan on a tolerably large scale. In this way a delta is formed at the mouths of the Rhine, Rhône, Po, Danube, Wolga, Nile, Indus, Ganges, Orinoco, and many others. The magnitude of the delta, generally, although not always, corresponds to the volume of the waters by which it has been created. The head of that of the Rhine is about 90 miles distant from the general line of sea-coast of Holland; and although the name of the main river is almost lost by the subdivision of its waters and the junction of other rivers, we include within the Rhine delta the whole of the low-land from the neighbourhood of Calais to the north-eastern shores of the Zuyder Zee, which makes the base of the triangle nearly 200 miles. The head of the delta of the Ganges is 220 miles from the sea, its base is 200 miles long, including the space occupied by the two great arms of the Ganges which bound it on either side. The tract in the lower part of this delta, called the Sunderbunds, a wilderness infested by tigers and crocodiles, is, according to Rennell, equal in extent to the principality of Wales. The whole of a deposit within a delta, as well as much above and on each side of it, is therefore an encroachment of the land upon the sea, and in many rivers this growth of the land is in a steady progress of advancement; as, for example, the city of Ravenna, formerly a seaport of the Adriatic, is now 4 miles inland. There are causes, however, which often prevent the farther increase of a delta after it has advanced a certain length: such seems to be the case with the delta of the Nile, which does not advance with the rapidity that might be expected from the quantity of matter brought down by the river. [Nile, in Geog. Div.]

Great as is the amount of new land thus formed, it is insignificant in comparison with the quantity of solid matter carried down by rivers, and deposited in the depths of the sea. It is impossible to form any estimate of this upon which reliance can be placed, because no accurate observations have been made to supply the data. To come to anything like a satisfactory conclusion, it would be necessary to have a vertical section of the river at a given point, obtained by numerous soundings, so as to get the profile of the bed, and by observations at different seasons to get the mean height; we must also have the results of experiments throughout the year, to ascertain the mean velocity, and the volume of solid matter contained in a given bulk of the water. The quantity of mud and sand poured by the Ganges into the Bay of Bengal is so great, in the flood-season, that the sea recovers its transparency only at the distance of 60 miles from the coast. Sir Charles Lyell, in his 'Principles of Geology,' makes a calculation (founded upon the computations of Major Rennell) as to the mean quantity of water discharged by the Ganges into the sea, by which he shows that, supposing the water to contain one hundredth part of solid matter, a mass equal in bulk to the greatest of the Pyramids of Egypt is brought down by the Ganges every day. The sea is discoloured for many leagues from the mouths of the Orinoco, and the solid contents, swept by ocean-currents through the Gulf of Paria, after being partly deposited on the shores of Guiana and the island of Trinidad, are carried into the Caribbean Sea and Gulf of Mexico. By the observations of Colonel Sabine, it appears that the muddy waters of the river Amazonas may be distinguished 300 miles from its mouth. The great basin of the Amazonas, which is drained by that mightiest of rivers and its vast and countless tributaries, embraces an area, according to Humboldt, only one-sixth less than the whole of Europe, and through this the main stream flows for nearly 3400 miles. The river, at the point where its waters unite with those of the Atlantic, is, according to the same illustrious traveller, 40 miles broad.

If a river loaded with sand encounter a marine current at its mouth, the effect frequently is to throw up a great sand-bank or bar, often to the detriment of the navigation in the adjoining sea, and sometimes to the entire destruction of a harbour. If such sand-banks be thrown up opposite to the delta of a great river, they accelerate its formation, for the matter brought down, in place of being carried far out to sea, is deposited in the intermediate space, and the sand-bank in time becomes united to the delta.

An extensive waste of the land is in constant progress along every line of coast which presents an abrupt face to the sea. The amount and rapidity of that waste depend upon a variety of circumstances:—the nature of the rocks of which the cliffs are composed, according as they are capable of long resistance, or are easily acted upon by the weather and the sea; the force of the tides and currents; the greater or less frequency of storms;—all these accelerate or retard the destructive force of the ocean. In this case also, as well as in the action of running water on the land, the force is greatly augmented when the water is charged with solid matter. The violent surge of a tempest dashing against a cliff detaches large blocks, and sweeps them away; but the next returning wave hurls them back again against the cliff, and thus a powerful artillery is supplied by the land for its own destruction. When we look upon a map of the world, and see the irregular form and indented line of coast of every continent and island, we have before us the most irresistible proof of the powerful force of the waves, and that the line of the shore must have been formed, in a great degree, by the action of the sea.

The east and south coasts of Great Britain, from the nature of the rocks of which they are composed, and from the violent storms to which they are exposed, are extremely subject to decay. The Shetland and Orkney Islands are laid open to the whole violence of the waves of the Atlantic, and the ocean-current runs in the Pentland Frith, in ordinary spring-tides, at the rate of 10½ miles an hour, and about 13 miles during storms. The steep cliffs on the shores of the Shetland Islands are hollowed out into caves, so that the sea enters in some places to the depth of 250 feet, lofty arches are worn in projecting rocks, and almost every promontory ends in a cluster of pillars, obelisks, and towers, the last fragments of extensive continuous strata. In stormy winters, vast blocks are moved from their seat, overturned, dashed into the sea, or carried considerable distances up acclivities. In this case, even rocks of the hardest composition have been unable to withstand the force with which they have been assailed. Islands have been wholly destroyed, and the remains of others rise like the ruins of a Palmyra in the desert of the ocean. Representations of these have been given by Dr. Hibbert in his description of the Shetland Islands, and the following is a copy of one of the most striking.



In the year 1795 a village on the coast of Kincardineshire was swept away by a storm in one night, and the sea penetrated 150 yards inland, where it has maintained its ground ever since. Almost the whole coast of Yorkshire, from the Tees to the Humber, is in a state of constant decay, especially between Flamborough Head and the Spurn Point, the rate of encroachment at Owthorpe being at present about four yards in a year. An inn at Sherringham, on the Norfolk coast, built in 1805, 70 yards from the sea, in 1829 was separated only by a small garden from the edge of the cliff. There is now a depth of water sufficient to float a frigate at one point in the harbour of that place, where, only half a century ago, there stood a cliff 50 feet high, with houses upon it. The whole site of ancient Cromer now forms a part of the German Ocean. Dunwich, once a flourishing and populous town, and the most considerable sea-port on the coast of Suffolk, has been gradually swept away, so that there now only remain about twenty houses. The church of Reculver, on the coast of Kent, was nearly a mile inland in the reign of Henry VIII.; it is now little more than 60 yards from the water's edge.

The whole coast of Sussex has been incessantly encroached upon by the sea from time immemorial; tracts of 400 acres have been carried away at one time; and the old town of Brighton, which stood between the site of the present cliff and the sea in the reign of Elizabeth, has been wholly destroyed. The projecting foreland of Beachy Head is falling away rapidly: in the winter of 1852 many large portions gave way and fell into the sea, among which were some of a picturesque form, known as the Charlesee, which were much visited by tourists. By the undermining of the sea on the coast of Dorsetshire, in 1792, a portion of land 600 yards from east to west, and a mile and a quarter from north to south, sunk 50 feet in 24 hours. The island of Heligoland, off the entrance of the river Elbe, has been reduced to the fourth part of its size within the last 500 years, and since 1770 has been divided into two parts, the channel between them being navigable by large ships. Nowhere has the sea made greater inroads than on the coast of Schleswig. The island of Nordstrand, in the earlier part of the 13th century, was separated from the main-land by a narrow stream, and was 50 miles long and 35 broad, populous and highly cultivated. In the year 1240 a great part of it was destroyed, and at the end of the 16th century it was reduced to an area of 20 miles in circumference. The industrious inhabitants endeavoured to save their territory by the erection of lofty dikes; but in October, 1634, a great storm devastated the whole island, destroyed 1340 people, and 50,000 head of cattle; and three small islets, which have since considerably diminished, were all that remained of the once fertile and populous Nordstrand.

It would be superfluous to give, in this place, farther instances of the like nature: those we have already mentioned have all occurred within the historical era; others, however, still more remarkable in extent, date from a much earlier period of the earth's history, and the evidence of their occurrence is supplied by the identity in composition of the opposite portions of the separated lands. There is every reason to believe that England once formed a part of France: the cliffs on the opposite sides of the channel are identical with those at the Straits of Dover; and between Folkestone and Boulogne a submarine chain of hills is, in some places, only 14 feet below the surface at low water. From the German Ocean to the Straits the water becomes gradually more shallow, diminishing, in a distance of 200 leagues, from 120 to 18 fathoms; and in the same manner, from the Straits to the mouth of the English Channel, there is a gradual increase of the depth of the water, so that at the Straits there is a ridge with a fall to the west and to the east. In the wearing of the sides, and consequent widening of the Straits, which is now going on, we see only an advanced stage of a work of destruction which has been many thousand years in operation. That Sicily was at one time united to Italy was a tradition in the time of Virgil ('Æneid,' iii. 414):—

> ———— "Th' Italian shore
> And fair Sicilia's coast were one before
> An earthquake caused the flaw: the roaring tides
> The passage broke that land from land divides;
> And where the lands retired the rushing ocean rides."
> Dryden's *Trans.*

All modern observations on the structure of the opposite shores, the bottom of the intervening sea, and the violence with which it is often agitated, give every degree of credibility to the tradition. But as Sicily is in that part so frequently convulsed by volcanic fires, it is very probable that subterranean movements have greatly contributed to the formation of the Straits of Messina. In like manner, there is every reason to believe that the island of Ceylon was at one time united to the continent of Hindustan. [ADAM'S BRIDGE, in GEOG. DIV.] Humboldt is of opinion that the Caribbean Sea was once mediterranean, inclosed by a circuit of land, of which St.-Domingo, Jamaica, and Cuba, are the principal remains; and the whole form of the land from the promontory of Yucatan, through the above-named islands to Trinidad, and the coast of Cumana, with its deeply-indented shores, the numerous islets and shoals, give countenance to the conjecture, and justifies the belief that we see in the West India Islands the monuments of the irresistible force of the waves of the Atlantic, co-operating with subterranean agency, through an indefinite succession of ages.

To what, it may be asked, does all this lead? If such a constant destruction of the land be a part of the system of Nature, it necessarily follows, that, if her laws continue to endure, the whole of our present continents must in time disappear under the surface of the sea. Undoubtedly to that, and to no other conclusion must we arrive; but such a transference of the land which now rises above the surface of the sea is in perfect accordance with what geology tells us has been the economy of Nature in times past. All the stratified masses of which the crust of the earth is composed, however high their position may now be, must at one time have been at the bottom of the sea; and the materials of which they are composed must have constituted the component parts of other rocks, which, in a former condition of the earth's surface, must have been acted upon and abraded by similar agents. In every great group of strata we find beds composed of large water-worn fragments, materials supplied, most probably, by rivers which had a rapid descent to the sea; but as such water-courses form but a small proportion to those which traverse low and level countries, and carry only the finer particles to the sea, so we find that the beds of conglomerates bear only a small proportion to those strata the materials of which are in a comminuted state—an additional fact in support of the doctrine, that the formation of strata in past times took place under circumstances analogous to those which are now in progress; that is, that the laws of the material world have continued unaltered. But renovation as well as decay is a part of the economy of Nature; and the same subterranean forces which raised our present continents, may, in after ages, repeat the process, and other Alps and other Andes may be produced from the materials which are now washed from our shores, and are accumulating in the unfathomable depths of the ocean. We can in no way conclude these observations so well as by quoting the following eloquent passage from the 'Illustrations of the Huttonian Theory:'—"How often these vicissitudes of decay and renovation have been repeated, it is not for us to determine: they constitute a series, of which we neither see the beginning nor the end—a circumstance that accords with what is known concerning other parts of the economy of the world. In the planetary motions, where geometry has carried the eye so far both into the future and the past, we discover no mark either of the commencement or the termination of the present order. It is unreasonable, indeed, to suppose that such marks should anywhere exist. The Author of nature has not given laws to the universe, which, like the institutions of men, carry in themselves the elements of their own destruction. He has not permitted, in His works, any symptom of infancy or of old age, or any sign by which we may estimate either their future or their past duration. He may put an end, as He no doubt gave a beginning, to the present system, at some determinate period; but we may safely conclude that this great catastrophe will not be brought about by any of the laws now existing, and that it is not indicated by anything which we perceive."

ALMANDINE, in Mineralogy, the precious Garnet. It is the mineral which is most commonly employed in jewellery under the common name of garnet. It is a silicate of alumina and magnesia. [GARNET.]

Almandine-Ruby is a name given to a variety of Spinell which is an aluminate of magnesia. [SPINELL.]

ALMOND. [AMYGDALUS.]

ALNUS, a genus of plants belonging to the natural order *Betulaceæ*. It was formerly united with the birch in the same genus, but modern botanists have separated it, because its fruit is wingless and its stamens only four.

Several species are described in botanical works, most of which are found in America, between the mountains of New Granada and Hudson's Bay: a small part belongs to Europe, and northern and middle Asia. Of these, the only species that need be noticed here are, the Common Alder, the Turkey Alder, and the Heart-Leaved Alder.

Alnus glutinosa, the Common Alder, is an inhabitant of swamps and meadows in all Europe, the north of Africa and Asia, and North America. Its favourite station is by the side of rivulets, or in the

Common Alder (*Alnus glutinosa*).

elevated parts of marshy land where the soil is drained; it does not thrive so well if placed in absolutely stagnant water. Next to the charcoal from Black Dogwood (*Rhamnus frangula*), that supplied by the Common Alder is of the best quality; and this tree is in consequence extensively cultivated in plantations for use in the manufactories of gunpowder. Its juice contains a great abundance of tannin, which renders the bark valuable for tanning, and the young shoots for dyeing various colours when mixed with other ingredients; the veiny knots of its wood are cut into veneer by cabinet-makers for ornamental purposes; and its stems, hollowed out, are among the best materials, next to metal, for water-pipes and underground purposes.

Its foliage being large, and of a deep handsome green, the alder is rather an ornamental tree; and when old it frequently becomes a picturesque object, if unbroken or uninjured by the hatchet of the woodman.

Several varieties of the Common Alder are met with in collections, and among them one, called the Cut-Leaved, which is extremely ornamental when young: there is also another, with very much-lobed leaves, called the Hawthorn-Leaved, in which almost all trace of the usual appearance of the alder has disappeared.

Alnus incana, the Turkey Alder, or Upland Alder, is distinguished from the preceding by its more erect mode of growth, and by its leaves being destitute of clamminess, but covered instead with copious white down on the under side. It is found all over continental Europe, from Sweden to the north of Italy, and east beyond the Caucasus, as far even as Kamtchatka. Like the Common Alder, it shows itself in a number of varieties, among which several are of dwarfish stature; but its general character is to grow more rapidly and to acquire a larger size than the Common Alder. What makes it particularly valuable is, that it will grow on light land where there are neither rivulets nor ditches; an important property, as it can scarcely be doubted, from its appearance, that it possesses whatever useful qualities are found in the Common Alder. Botanists seem to suppose that the Turkey Alder is their *A. oblongata*, but this is a manifest error.

A. cordifolia, the Heart-Leaved Alder, resembles but little in appearance either of the preceding. It forms a rather large and very handsome round-headed tree, with broad, deep-green, shining leaves, deeply heartshaped at the base. It grows with rapidity, and is one of the most interesting ornamental trees that have of late years been introduced into cultivation. Though a native of the kingdom of Naples, and a most distinct species, its very existence was unknown till within a few years. It is a perfectly hardy plant, notwithstanding its southern station.

All the Alders are increased with great facility by layers; they will also strike readily enough from cuttings, but the latter are longer in becoming handsome plants. Common Alder is obtained by the nurseryman from seed; which should, if possible, be sown in very light, rich, damp soil, in the autumn, soon after it is ripe. If kept till the spring, even if preserved in sand, it loses in a great degree its power of vegetating; and if not kept in sand, it will scarcely ever grow at all.

ALOE, a genus of succulent plants belonging to the natural order *Liliaceæ*. It comprehends a very considerable number of species which differ from each other exceedingly in the size, form, and surface of their leaves, in stature, and in the colour, size, and structure of their flowers. The greater part of them are mere objects of curiosity, and are only seen in collections of succulent plants; but among them are species of much value, on account of their yielding the well-known medicinal drug called Aloes.

From what particular species the resinous substance called Aloes is procured, and whether the different samples known under the name of Hepatic Aloes, Socotrine Aloes, and Horse Aloes are yielded by different species, or are only different qualities of the same species, are points not settled.

All that appears certain is that plants nearly related to *Aloe perfoliata* of Linnæus, which some consider distinct species, while others pronounce them mere varieties of each other, are what the drug is prepared from. In all probability, all the species of the genus having an arborescent stem and thick succulent leaves will yield the substance equally well.

That which has the reputation of producing the best aloes is *A. Socotrina*, a plant having, when old, a round stem 3 or 4 feet high; leaves of a sword form, 1½ to 2 feet long, sharp-edged, sawed, hard, and pungent at the apex, often collected in clusters at the top of the stem; and red flowers tipped with green, borne in clusters on tall stalks which rise erect from among the leaves. This is a native of the Cape of Good Hope, and the island of Socotra, but it is now commonly cultivated in the West Indies. The processes of preparing the drug are various. Sometimes the leaves are cut off at their base and placed in iron vessels to drain, until they have discharged all their juice, which is then inspissated; in other places, the leaves are cut into slices and boiled for ten minutes, after which the water in which they have been boiled is evaporated; occasionally pressure is resorted to for the purpose of procuring the greatest quantity of juice.

Socotrine Aloes seem to be the purest kind obtained by draining only; Hepatic or Barbadoes Aloes, which are obtained from the *Aloe vulgaris*, are less pure, and may be obtained by boiling or slight pressure; while Horse Aloes are undoubtedly a coarse preparation of the dregs of the last-mentioned. [ALOES, in ARTS AND SC. DIV.]

No plants can be more easy to cultivate artificially than the Aloe Tribe. They are incapable of parting rapidly with water, and therefore require to be planted in a soil that is very slightly retentive of moisture, so that they may not be gorged with it by their roots; for this reason, they are potted in a compost consisting of little more than lime rubbish mixed with a small quantity of ordinary soil, and carefully drained.

They require a green-house which is capable of being maintained at a temperature of not less than 40° in the depth of winter, at which time they should have no water whatever; in the summer they want no fire-heat, but may be watered regularly, the supply being always in proportion to their rate of growth and to the temperature of the air; that is to say, when in full growth and in a high temperature, they may have abundance of water, and when growing slowly in a low temperature they should have but very little.

ALOPECU'RUS, a genus of plants belonging to the natural order *Graminaceæ*. It is distinguished from all other British grasses by its flowers, which grow in close cylindrical heads, consisting of two glumes of equal size and a keeled compressed figure, inclosing a single palea, from the base of which arises an arista or beard. It contains many species.

Meadow Foxtail Grass (*Alopecurus pratensis*).

Alopecurus pratensis, the Meadow Foxtail Grass, is a valuable plant to the farmer. It is so much larger than any other British species of *Alopecurus* as to be easily recognised; and from *Phleum pratense*, which it resembles, it may be immediately known by its not having two paleæ, and by its beard proceeding from its palea and not from its glumes. It grows commonly in meadows, where it forms rather a coarse but an abundant and early herbage, of which cattle are very fond. In such situations it is invaluable, but it becomes worthless if sown on light dry soil.

A. agrestis, Slender or Field Foxtail Grass, has a fibrous root, and blossoms in July or August. Although a troublesome weed amongst wheat, it is useful for sowing on light sandy soils on the sea-coast. In such situations it grows better than even the common rye-grasses.

ALOYSIA, a genus of plants belonging to the natural order *Verbenaceæ*. *A. citriodora* is the Sweet-Scented Vervain of our gardens. [VERBENA.]

ALPINIA, a genus of plants belonging to the natural order *Zingiberaceæ*. The species have thick tuberous horizontal roots. The stems are numerous and perennial, with lanceolate leaves, having a slit ligulate sheath. The flowers are in panicles, or loose racemes or spikes. The tube of the corolla is short, the inner limb 1-lipped. The filament of the stamens linear. The fruit is capsular and 3-celled, with winged seeds.

A. Galanga is a native of Sumatra, and is cultivated in the Indian Archipelago. Its roots are pungent, acrid, and aromatic, and are often substituted for ginger. They are sold by druggists under the name of *Galanga major*. A plant related to, if not identical with, the *A. exaltata* of Meyer, the *Renealmia exaltata* of Linnæus, is called *Corowatti* in British Guyana, and is described by Dr. Hancock as a bitter pungent plant, and when taken acting as a diaphoretic and diuretic, and in large doses as emetic. [GALANGA.]

ALTERED STRATA. In addition to the consolidation and division by cracks, joints, and fissures, to which all rocks have been subjected, in unequal degrees, there are special cases of uncommon induration, internal re-arrangement of particles, and even the production of new mineral ingredients, which happen in the strata near to rocks of igneous origin, and along certain great fractures and flexures. Heat is usually appealed to for these effects, and justly; but in addition to mere pervading warmth, Von Buch supposes vaporisation of some ingredients (as magnesia, which converts limestone to dolomite), and the solution of others in hot water, to be necessary to explain the various contents of mineral veins.

ALTERNATION OF GENERATIONS, an expression introduced into natural history by Professor Steenstrup, a Danish naturalist, to designate the difference of form observable between the parents and immediate offspring in the lower animals, as in the *Acalephæ* [ACALEPHÆ], *Salpæ* [SALPACEÆ], and some others. [GENERATIONS, ALTERNATE.]

ALTHÆA, a genus of plants belonging to the natural order *Malvaceæ*. It is known by its double calyx, the outer whorl of which has six to nine sepals, whilst the inner has five. *A. officinalis* is the Marsh-Mallow, a plant the use of whose mucilaginous roots and leaves, in all cases in which emollient or demulcent substances are required, is of great antiquity. It is a common European plant, and is often found in marshes, especially near the sea, in great abundance. It is a perennial, with a carrot-shaped white fleshy root, as thick as the thumb, and a foot or more long. The stems are two or three feet high, covered all over with a soft down, which also is found on the leaves, to which it gives a hoary aspect. The leaves are soft, stalked, often a little heart-shaped, divided into three or five shallow serrated lobes. The flowers are of a pale rose colour, and appear in very short clusters from the bosom of the leaves; their calyx is 5-toothed, and surrounded with eight or ten or even more bracts. The corolla and other parts are like those of the Common Mallow. The demulcent lozenges sold in the shops under the name of Pâte de Guimauve, are made of Marsh-Mallow.

Marsh-Mallow (*Althæa officinalis*).

Althæa rosea, the Hollyhock, is another species. It is found wild in China, and is now extremely common in our gardens. Linnæus considered it a distinct genus, which he called *Alcea*.

ALUM-ROOT, the root of *Geranium maculatum*. It contains alum, and is a powerful astringent. [GERANIUM.]

ALUM-SLATE, a rock from which, as its name implies, alum is prepared. It is found in Germany, Sweden, &c.; and in Yorkshire a stratum occurs, which, according to Mr. Winter (Nicholson's 'Journal,' No. 25, p. 241), is 28 miles in length, extending from 10 miles to the southward of Whitby to 18 miles to the northward; the cliffs are in general precipitous, and their height is from 100 to 750 feet. The colour of this slate is bluish-gray: its hardness varies; at the top part of the stratum it may be crumbled between the fingers, whereas at a considerable depth it is as hard as roofing-slate. The specific gravity is about 2·48. By exposure to the air it effloresces, and acquires the taste of alum. Alum-slate has not been accurately analysed; it contains silica, alumina, and, before efflorescence, probably pyrites or bisulphuret of iron.

At Hurlett, near Paisley, and Campsie, near Glasgow, alum is manufactured from what appears to be slate-clay impregnated with bisulphuret of iron; it is obtained from old coal-pits, and having been long exposed to air and moisture, sulphate of iron and sulphate of alumina are formed, and crystallise so as completely to destroy the texture of the slate.

This double sulphate of iron and alumina occurs in the form of soft delicate fibres, easily separable from each other; it is nearly colourless, of a silky lustre, and resembles asbestos in appearance. It is readily soluble in water; the solution yields crystals of sulphate of iron; and when potash-salts are added to the remaining solution of sulphate of alumina, crystals of alum are immediately formed; and this is the process of alum-making already noticed.

ALUM-STONE, a mineral which occurs in a secondary rock at La Tolfa in Italy, and is there used in the preparation of alum; it is found in small masses and veins, and according to Cordier it exists in most burning volcanoes. It is said to be met with also in Tuscany and Hungary.

This mineral is either massive or crystallised; the former is usually grayish-white, and sometimes red. It is translucent, easily frangible, scratches calcareous spar, but is scratched by fluor spar. When heated by the blowpipe it decrepitates, and by continuing the heat emits a sulphureous smell.

The crystals are generally situated in the cavities of the massive substance; they are small, shining, sometimes externally brownish; their form is an obtuse rhomboid, variously modified.

Both varieties have been analysed—the massive by Vauquelin, and the crystallised by Cordier; the results are—

Massive.		Crystallised.	
Sulphuric acid	25·00	Sulphuric acid	35·495
Alumina	43·92	Alumina	39·654
Potash	3·08	Potash	10·021
Silica	24·00	Water, a trace of oxide of iron and loss	14·830
Water	4.00		
	100·00		100·000

ALUMINITE, in Mineralogy, a variety of native Sulphate of Alumina, also called *Websterite*. It is found in reniform masses and in botryoidal concretions in Halle in Prussia, Epernay in France, and at

Newhaven in Sussex. It has a white or yellowish-white colour. It is soft and friable, and has an earthy fracture. It is occasionally translucent, but more frequently opaque. It has a specific gravity of 1·7. It is a hydrous sub-sulphate of alumina, and has the following composition:—

Sulphuric Acid	23·27
Alumina	29·87
Water	46·86
	100·00

ALUMO-CALCITE, a mineral belonging to the group of Clays containing a large quantity of water. It occurs in the clefts of ironstone veins at Eybenstock, in the Erzgebirge. It is massive, and has a white colour inclining to blue. It has a white streak, a conchoidal fracture, and is so soft that it may be crushed between the fingers. It adheres strongly to the tongue. The specific gravity is 2·714. Its analysis by Kersten gives—

Silica	86·60
Alumina	2·25
Lime	6.25
Water	4·90
	100·00

ALUNITE, in Mineralogy, a name for the Alum-Stone. [ALUM-STONE.]

ALVEOLI'TES (Lamarck), a genus of Fossil *Polypiaria*, from the Cretaceous and Tertiary Strata.

AMADO'U, the name of an inflammable substance occasionally used as tinder. It is prepared from the dried plant of the *Boletus igniarius*, steeped in a strong solution of saltpetre, and cut into thin slices. This plant grows horizontally from the sides of the cherry, the ash, and other trees. When it first makes its appearance it is a little round wart-like body, the size of a pea of a yellow colour, and

Boletus igniarius.

of a soft yielding substance; it gradually increases in size and hardness till it becomes of a darkish-brown, and is as large as an apple. It afterwards takes a horizontal direction, forms a border and becomes covered with numerous closely-packed tubes on its under surface, which are exceedingly minute. When the plant is full grown the tubes are of a reddish-brown colour, and of a hard woody texture; and the upper surface is of various colours disposed in gray, brown, or clouded concentric elevated circles. The plant is perennial, and increases yearly in size.

AMARANTA'CEÆ, Amaranths, a natural order of Apetalous Dicotyledonous plants, remarkable for the dry coloured scales of which all their bracts and floral envelopes are composed—a character by which they are principally known from *Chenopodiaceæ*. Their essential distinction is briefly this: calyx, dry, coloured, not falling away; petals, wanting; stamens, five or more; ovarium, quite simple, superior; fruit, an utricle, containing a single seed, which has an embryo curved round a central farinaceous albumen; leaves, destitute of stipules.

The species are found chiefly in tropical countries, where they are often troublesome weeds. The Cock's-Comb, the Globe-Amaranth, the Prince's-Feather, the Love-Lies-Bleeding, of our gardens, belong to this order.

Many of the species are used in the countries where they grow as pot-herbs, and indeed none of them present any unwholesome properties. The seeds of *Amaranthus frumentaceus* and *A. Anardhana* are gathered as corn crops in India. A large number of the species have a reputation for possessing medicinal properties, but, as is the case with the majority of such remedies, they seldom bear out the encomiums bestowed upon them by the ignorant. (Lindley, 'Vegetable Kingdom.')

Amaranthus polygamus.
1. A calyx and bract with stamens. 2. The same with the pistil. 3. The pistil opening. 4. A seed. 5. A seed cut down, showing the embryo. 6. The embryo. All magnified.

AMARYLLIDA'CEÆ, Amaryllids, the Narcissus Tribe, a natural

Amaryllis reticulata, diminished in size.
1. The flower cut open. 2. A stamen the natural size.

order of Monocotyledonous plants, to which the Daffodil, the Belladonna

Lily and Guernsey Lily, the showy Brunsvigias and Blood-Flowers (*Hæmanthus*) of the Cape of Good Hope, and the American Aloe belong. They are characterised by having six stamens, a highly-coloured flower, and an inferior ovary. The beauty of their blossoms serve as a cloak to their poisonous properties, and shows how little the external appearances of plants are to be trusted in judging of their virtues. To form an opinion only from their aspect, these would be pronounced the most harmless of plants, while in fact their bulbs are dangerous poisons. The juice of that of *Hæmanthus toxicarius* is inspissated by the Hottentots, who smear their arrow-heads with it; other kinds are not less fatal, and even the common daffodil and snowdrop contain within their bulbs an acrid irritating principle which renders them emetic. Like many other poisonous families, this occasionally secretes a kind of fœcula, or flour, which, when separated from the juice that is naturally mixed with it, becomes a wholesome article of food. The arrow-root of Chili is yielded by an *Alströmeria*, which belongs to *Amaryllidaceæ*.

The species, which are chiefly scattered over Brazil, Africa, and tropical Asia, are nearly all bulbous; a few only acquire a high degree of development, and lose their bulbous character, as the *Doryanthes*, *Agave*, and *Littæa*. [AGAVE.]

AMAZON-STONE, in Mineralogy, a green variety of Felspar. [FELSPAR.]

AMBER, a carbonaceous mineral which occurs in beds of lignite, in Greenland, Prussia, France, Switzerland, and some other countries. The greater portion of it comes from the southern coasts of the Baltic Sea, where it is thrown up between Königsberg and Memel. (Berzelius, 'Traité de Chimie,' vi. 589.)

It is also stated ('Annales de Chimie,' xvi. 215) that it is obtained by mining at a distance of 200 feet from the sea, and at a depth of about 100 feet, and is found in small cavities. It is occasionally met with (Aikin's 'Dict. of Chemistry,' i. 57) in the gravel beds near London, in which case it is merely an alluvial deposit. Amber occurs generally in small pieces, which are sometimes colourless, frequently light-yellow or deep-brown, and very commonly translucent; two large masses have, however, been found, one of them weighing upwards of thirteen pounds, and the other more than eighteen.

Amber is rather harder than common resins, which it resembles in several properties: it is susceptible of a good polish, and when rubbed becomes electrical; indeed the word *electricity* is derived from ἤλεκτρον, the Greek name for amber. Its density varies from 1·065 to 1·070. When bruised it exhales a slight aromatic odour; and when heated to 448° Fahrenheit it melts, inflames, burns with a bright flame, and emits a smell which is not disagreeable.

The subject of the origin of amber is one which has been much discussed. According to Berzelius ('Chimie,' vi. 589), it was originally a resin dissolved in a volatile oil or natural balsam. The proofs of this opinion are, he conceives, numerous. Thus, it has often the impression of the branches and bark upon which it has flowed and solidified; it often contains insects, some of which are so delicately formed, that they could not have occurred except in a very fluid mass. Dr. Brewster ('Edinburgh Phil. Journal,' iv. 332) concludes, from an examination of the optical properties of amber, that it is an indurated vegetable juice.

Amber consists of a mixture of a volatile oil, two resins soluble in alcohol and in ether, succinic acid, and a bituminous body that resists the action of all solvents, and which is the principal part of amber.

Water does not act upon this substance; it does not even dissolve any of the succinic acid. Alcohol takes up a soft, yellow, limpid resin. Cold concentrated sulphuric acid dissolves amber; the solution has a brown colour, and when water is added to it, the greater part of the amber is precipitated. Nitric acid converts it into a resinous substance, and dissolves it totally.

When amber, in the state of fine powder, is boiled in a solution of potash, a great quantity of succinic acid is dissolved.

According to Drapiez, the composition of amber is as follows:—

Carbon	80·59
Hydrogen	7·31
Oxygen	6·73
Ashes	3·27
Loss	2·10
	100·00

The ashes consist of lime, silica, and alumina. This analysis can only be considered as an approximation.

Amber is employed for ornamental purposes, in the manufacture of necklaces, &c. It is used also for preparing amber-varnish, for obtaining a peculiar oil used in medicine, and it yields succinic acid employed in chemical investigations.

AMBERGRIS, a substance of animal origin, found principally in warm climates, floating on the sea, or thrown on the coasts. The best comes from Madagascar, Surinam, and Java. It has been found in the intestinal canal of the *Physeter macrocephalus*, mixed with the remains of several marine animals which have served it for food. On this account it has been supposed to be a morbid product, analogous to biliary calculi.

Ambergris of good quality is solid, opaque, of a bright gray colour, which is darkest externally, and intermixed with yellow or reddish striæ. When it is heated or rubbed, it exhales an odour which is agreeable to most persons. It is sufficiently soft to be flattened between the fingers. Its fracture is fine-grained, with traces of lamellar structure. The heat of the hand is sufficient to soften it. Its specific gravity varies from 0·908 to 0·920.

When ambergris is heated with boiling alcohol of the specific gravity 0·833, until it is saturated, a peculiar substance, called *Ambrein*, is obtained as the solution cools, grouped in mammillated, small, colourless crystals. The solution, by evaporation, yields a further portion of ambrein, which may be rendered pure, by being redissolved in alcohol, and then crystallised.

Ambrein, thus obtained, is brilliant, white, and insipid; it has an agreeable odour, which appears, however, to be adventitious, because it is diminished by repeated crystallisations; by fusion or a long-continued gentle heat it acquires a resinous odour. Nitric acid converts it into a peculiar acid, called *Ambreic Acid*. The caustic alkalies do not form soap with it.

According to Juch and Bouillon-Lagrange, benzoic acid exists in distilled ambergris; by the analysis of John, ambergris appears to be composed of ambrein 0·85, an extractive matter soluble in alcohol, and probably containing benzoic acid, 0·025; watery extract with benzoic acid and common salt, 0·015; with 0·11 not accounted for.

Ambergris is used as a perfume; and as the alcoholic solution is the most odorous preparation of it, it is generally employed in that form.

AMBLIGONITE, a mineral, consisting of phosphate of alumina and lithia. It has a greenish-white colour, and occurs both massive and in rhombic prisms. It is found at Chursdorf, near Penig, in Saxony, and at Avendal in Norway. The cleavage is parallel to the sides of the prism. It has an uneven fracture, and in thin laminæ is translucent or transparent. The following is the analysis of Berzelius:—

Phosphoric Acid	54·12
Alumina	38·96
Lithia	6·92
	100·00

AMBLYSE'MIUS (Agassiz), a Fossil Fish, from the Oolite of Northamptonshire.

AMBLYU'RUS (Agassiz), a genus of Fossil Fishes, from the Lias of Somersetshire.

AMBURIA, a genus of plants belonging to the natural order *Chenopodiaceæ*, several of the species of which yield volatile oils that are employed as medicines in the countries where they grow. *A. anthelmintica* is a native of North America, and its oil is extracted and used as an anthelmintic under the name of Worm-Seed Oil.

AMELANCHIER (the Savoy name of the Medlar), a genus of plants belonging to the sub-order *Pomeæ* (*Pomaceæ*, Lindley), of the order *Rosaceæ*. It has a 5-cleft calyx with lanceolate petals, and an ovary of 10 cells, with a solitary ovule in each. The mature fruit is 3-5-celled, with one seed in each cell. The species are small trees, with simple serrated deciduous leaves, and racemes of white flowers.

A. vulgaris, the common species, is a native of rugged places throughout Europe. It is the *Avonia rotundifolia* of Persoon.

A. Botryapium, the Grape-Pear or Canadian Medlar, is a very common plant in Canada; it is also a native of Newfoundland, Virginia, and the higher parts of Columbia. It is a shrub 6 or 8 feet in height, with a purple fruit.

A. ovalis is also a shrub 6 or 8 feet high, and is a native of North America, throughout Canada from Lake Huron to the Saskatchewan and Mackenzie rivers, and as far as the Rocky Mountains. Sir John Richardson says that it "abounds on the sandy plains of the Saskatchewan. Its wood, named by the Crees *Meesass-quat-ahtick*, is prized for making arrows and pipe-stems, and is thence termed by the Canadian voyageurs 'Bois de Flêche.' Its berries, about the size of a pea, are the finest fruit in the country, and are used by the Crees under the name of *Meesasscootoom-meena* both in a fresh and dried state. They make a pleasant addition to pemmican, and excellent puddings very little inferior to plum-pudding."

Another North American species is known by the name of *A. sanguinea*. Its fruit is of a blood-red colour.

(Don, *Dichlamydeous Plants*.)

AMENTA'CEÆ, a name sometimes given to a group of plants, chiefly forest-trees, found in the north of Europe, Asia, and America; the flowers of which are arranged in a dense cylindrical deciduous spike, called by botanists an *Amentum*. Such are the poplar, the birch, the hazel, the willow, the oak, and many others. But as these genera are in fact constructed in very different manners, *Amentaceæ* are more correctly separated, by modern botanists, into several different orders. [CORYLACEÆ; SALICACEÆ; BETULACEÆ, &c.]

AMETHYST. This name has been applied to two precious stones of essentially different natures. The *Oriental Amethyst* is a rare variety of *Adamantine Spar* [ADAMANTINE SPAR] or *Corundum*. The *Occidental*, or *Common Amethyst*, now to be described, is a variety of quartz or rock crystal, which is met with in many parts of the world, as India, Siberia, Sweden, Germany, Spain, &c. It occurs in various forms, as massive, in rounded pieces, and crystallised. The primary form of the crystal, like that of quartz, is a slightly obtuse rhomboid, but it is usually found in the secondary form of a 6-sided prism, terminated at one or both ends by a 6-sided pyramid; sometimes, though rarely, the prism is wanting, and the pyramids being then united base to base, the secondary crystal is a dodecahedron with triangular faces.

The amethyst is principally distinguished from common quartz by its colour, which is occasionally of every shade of violet, or rather purplish-violet, and this in the perfect amethyst is pretty equal throughout the crystal: very commonly the summits only of the crystal are amethystine, the lower part being nearly colourless, or tinged with green. By long-continued heat the colour is destroyed and the crystals become white and opalescent. Sometimes the crystals are aggregated or fasciculated; in the Palatinate they are found lining geodes of agate, and in Silesia capillary crystals occur mixed with micaceous iron ore.

The crystals of the amethyst vary from diaphanous to translucent, and they exhibit various degrees of splendour, both externally and internally. The fracture is commonly conchoidal, and the fragments are of indeterminate form. Like quartz, the amethyst is sufficiently hard to give fire with steel and to scratch glass; and has also been found, like it, with cavities containing water; it is infusible by the common blow-pipe. According to Rose, it consists of—

Silica	97·50
Alumina	·25
Oxide of Iron and Manganese	·50
	98·25

AMMANIA (in honour of John Amman, a distinguished botanist), a genus of plants belonging to the natural order *Lythraceæ*. The species are aquatic plants, with smooth opposite entire leaves, 4-cornered stems, and small pink or red flowers. They are natives of both the New and Old Worlds, and very generally distributed. One species, *A. vesicatoria*, has a strong peculiar smell, and the leaves are very acrid. They are used by the native doctors of India for the purpose of raising blisters, which they do in the course of half an hour.

AMMODYTES, a genus of fishes belonging to the division of *Apodal Malacopterygii* and family *Anguillidæ*. The body is very long and the head lanceolate. On the back is a dorsal fin extending nearly its whole length. The anal fin is also long; and the caudal, which is forked, is separated from both the dorsal and anal. Two species occur on the coasts of the British Islands, the *Ammodytes tobianus* and the *Ammodytes lancea*. The former is the larger, and is distinguished by the greater size of the head, and by the dorsal fin, which commences in a line with the extremities of the pectorals, whilst in the *A. lancea* it commences in a line with the middle of the pectorals. The Sand-Eel, by which name the first species is popularly known, attains a length of between 12 and 15 inches. When alive the back is of a dark bluish-green, and the sides and belly bright silvery-white. It frequents sandy shores in great numbers, but is capricious in its visits, more so than its congener. At the ebbing of the tide it buries itself with great dexterity and rapidity in the wet sands to the depth of from 4 to 6 inches, whence it is extracted by means of various instruments, such as peculiarly formed gripes and sickles with blunt edges, made for the purpose. It is much esteemed by fishermen as a bait, and is also sought after on many parts of the coast as an article of food, being very delicate eating when fresh, and excellent when dried in the sun and grilled.

The Sand-Launce, *Ammodytes lancea*, is a smaller species, and usually of a more brownish hue, with a tinge of red about the head. It is more abundant than the Sand-Eel, and has always been distinguished from it by the fishermen, though for a long time confounded with it by naturalists. The distinctions between the two species were first pointed out by M. Lesauvage of Caen. Both appear to be generally distributed through Northern and Western Europe. In Scotland the Sand-Eel is known by the name of the Horner, and in the Isle of Man the two species are distinguished from each other as the Gray Gibbon and Red Gibbon.

(Yarrell, *British Fishes*, vol. ii.; Parnell, *Fishes of the Frith of Forth*.)

AMMONITES, a fossil genus of Cephalopodous *Mollusca*, allied to the recent genus *Nautilus*. The species are known by the old Latin name *Cornu Ammonis*. These *Cornua Ammonis*, *Cornes d'Ammon* of the French, were so called from a fancied resemblance to the horns with which the head of Jupiter Ammon was sculptured. In the earlier times their origin was variously accounted for. Some thought them petrifactions of real rams' horns, taking the name above-mentioned in a strict and downright matter-of-fact sense; others thought they were the curled tails of certain animals; some took them for petrified marine worms rolled up; others saw in them coiled serpents, whence they were called Snake-Stones. The legends of the saints invested them with a sacred interest.

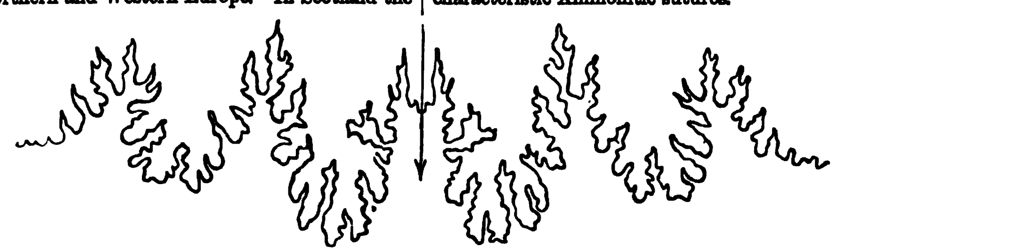
> Of thousand snakes, each one
> Was changed into a coil of stone,
> When holy Hilda pray'd.

And the prayer, we are told, was not only followed by petrifaction, but by decapitation. We believe that there is a similar tradition of St. Keyna, who, when she found herself in a wood at Keynsham, between Bath and Bristol, surrounded by serpents, changed them by the fervour of her devotions into headless stones. Nor were these opinions confined to the mere vulgar. Wormius described Ammonites as petrified adders. Langius considered them to be either the vertebræ of serpents or convoluted marine insects. These notions were not lost on the dealers; and there are few fossil collections which do not even now possess what was called 'a perfect *Cornu Ammonis*,' that is, an Ammonite with a carved serpent's head ingeniously fitted on to the fossil shell by way of aperture. Our limits will not permit us to dwell on this fabulous part of the history of Ammonites further than to observe that other learned men, Torellus Sarayna, Fracastorius, and others, considered them as *lusus Naturæ*, formed by the plastic power of the earth. The ancients held them in high estimation as very sacred and of the highest value to the dreamer. Thus Pliny ('Hist. Mund.,' xxxvi. 10), "Hammonis cornu inter sacratissimas Æthiopiæ gemmas, aureo colore, arietini cornus effigiem reddens, promittitur prædivina somnia repræsentare;" and even to the present time the Indians are said to ascribe extraordinary properties to them.

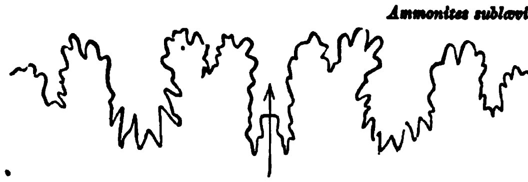
To the zoologist Ammonites are objects of great interest, and to the geologist they are of the utmost consequence. "It is easy," says Mr. Phillips, in his 'Guide to Geology' (8vo. 1834), "to see how important, in questions concerning the relative antiquity of stratified rocks, is a knowledge of Ammonites, since whole sections of them are characteristic of certain systems of rocks." (sec. 82.) Dr. Buckland ('Bridgewater Treatise,' p. 333), thus comprehensively describes the range of these extinct cephalopodous mollusks: "The family of Ammonites extends through the entire series of the fossiliferous formations, from the transition strata to the chalk inclusive."

According to Mr. Owen's system, the Ammonites form the fourth genus of his second family (*Ammonitidæ*) of his first order *Tetrabranchiata*, of the class *Cephalopoda*. In the opinion of all naturalists this great group of fossils requires to be subdivided. The *Goniatites* [GONIATITES] of the Palæozoic rocks have been effectually separated; the *Ceratites* of the triassic strata may be also withdrawn, but still the number of genuine *Ammonites* which remain is too enormous to be treated except in sections more or less founded on structural affinities. Without discussing what may be the best principles for such a classification, we may refer to that of Von Buch, as most generally accepted by geologists. This is mainly founded on a consideration of the sutures, or sinuous lines at the surface of the shell, formed by the edges of the diaphragmal plates which separate the chambers.

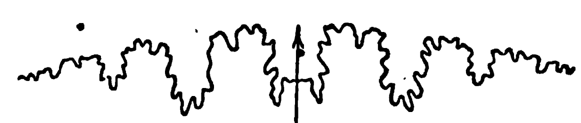
To illustrate this view of the subject we subjoin a few examples of characteristic Ammonitic sutures.



Ammonites sublævis (Sowerby). From Kelloway rock.



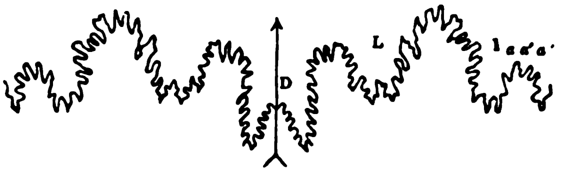
Ammonites Walcottii (Sowerby). From the Lias.



Ammonites venustus (Phillips). From Speeton Clay.

The following are Von Buch's groups, with their prevalent geological distribution :—

Arietes.—The back is usually broad, and carinated (often a furrow on each side of the keel); the ribs are simple and strong. The sutural line formed upon the following general model :—



The group of *Arietes*, including *A. Bucklandi, A. Conybeari*, &c., belongs almost wholly to the Lias formation.

Falciferi.—The back is narrow, acuminated to a sharp keel (no furrow on its sides); the ribs are elegantly and sigmoidally bent. The sutures differ from those of *Arietes*, the dorsal sinus D being much less deep, with diverging and not parallel sides; the sinus L is very much deeper, and there are three or four smaller ones, *a a' a"*, near the inner edge of the whorls. The latter whorls usually embrace the preceding ones.

These *Ammonites* are numerous in the Upper Lias and Lower Oolite formations. *A. Strangwaysii* of Sowerby is an example. (*Ammonites Walcottii* does not belong to this division.)

Amalthei.—The back is generally acute and keeled, the keel generally crenated; the ribs generally a little sigmoidal; the latter whorls embracing the preceding ones. The sutures are in general form much like those of the last division, but more richly laciniated and foliaceous.

This group belongs to the Upper Lias and Oolitic formations. *Ammonites amaltheus* of Schlottheim (*A. Stokesii*, Sowerby) is an example from the Lias.

Capricorni.—The back broad, without a keel. The ribs simple, straight, strong, and crossing the back. Inner whorls exposed. The sutures often approach to those of the *Arietes* in respect of the sinus D; but the posterior edge of D, L, and l range on the same line, and the undulations are all lower and less foliaceous than in the *Falciferi* and *Amalthei*. *Ammonites planicostatus* (Sowerby) is an example. The species are common in the Lias.

Planulati.—The back and sides rounded; no keel; the inner volutions exposed. The ribs are often divided over the dorsal region. The sutures are remarkably laciniated and complicated; the sinus (L) extremely deep, and generally trifurcate.

The species occur commonly in the Lias and Oolitic formations. *Ammonites communis* (Sowerby) is an example from the Lias; *A. plicatilis* (Sowerby) from the Coralline Oolite.

Dorsati.—The back is broad and not keeled; the whorls often quadrate : the ribs are simple on the sides, but divided over the back, and generally bear a tubercle at the point of division. *Ammonites Davœi* (Sowerby) is an example from the Lias.

Coronarii.—The back without a keel, usually broader than the sides; the ribs are straight and simple on the sides, but divided into two, three, or more, as they cross the back, and the point of division is usually sharply tuberculate. The sutures resemble those of the *Planulati*. The species occur in the Oolites, as *A. Humphresianus* (Sow.); *A. Gowerianus* (Sow.); and in the Lias, as *A. Bechei* (Sow.).

Macrocephali.—The back is without keel, and round and broad, and the umbilicus deep. The ribs are straight on the umbilical face and simple, but sometimes arched, and generally divided across the back. The sutures resemble those of the *Planulati*, but are somewhat differently proportioned to the dorsal and umbilical surfaces. The species occur in the Oolite and Chalk. The *Ammonites sublævis* (Sow.), is a good example, from the Kelloways Rock.

Armati.—The back without a keel, often broader than the sides; ribs tuberculated on the sides. The inner whorls exposed. The sutures have the dorsal sinus (D) large and deep, the lateral sinus (L) widely removed from it and very deep, and somewhat trifurcate. Occurs in the Lias and Oolite, and more plentifully in the Chalk. *Ammonites Bakeriæ* of Sowerby is an example.

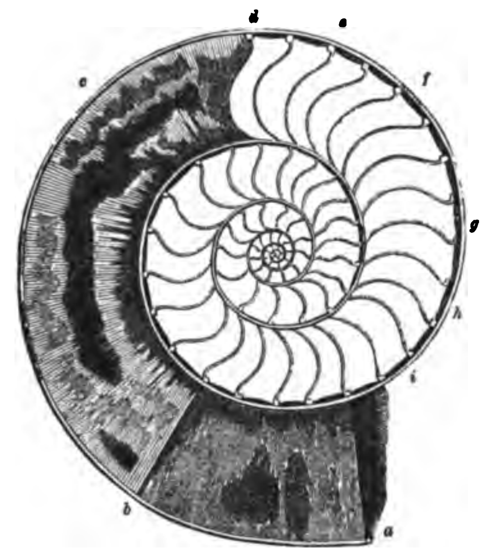
Ornati.—The back flat or even hollow, narrow, and not keeled; the broad sides joining it at a right angle, marked in general by a row of small tubercles or the numerous fine ribs which cross the back and toward the inner edge unite in parcels to form acute or knotted ridges. (The old shells are often plain.) The sutures have the dorsal sinus (D) shallow, the lateral (L) deep. The species are almost confined to the Oxford Clay and Kelloways Rock: as *A. Calloviensis* (Sow.); *A. Duncani* (Sow.); *A. gemmatus* (Phil.), &c. (Von Buch rightly separated from those the *Dentati* in his original memoir, though they have been injudiciously reunited again.)

Dentati.—To this group we refer *Ammonites splendens, A. lautus, A. dentatus*, &c. of the Gault. The back is flat or concave, and margined by tubercles, or prominent ends of strong ribs, often united near the inner edge into tuberculated ridges, but not crossing the back. The sutures resemble in general form the preceding.

Flexuosi.—The back narrow, with borders tuberculated or serrated by the terminations of the ribs, and in a young state with a tuberculated keel. The ribs are ridged or tubercled near the inner edge. This group is quoted from the upper Oolitic and Chalk formations, and *A. asper* and *A. flexuosus* are examples.

The classification above sketched is very far from perfect. It is difficult to define the groups, when we pass from the typical to the ordinary species, and there are many forms which refuse to be included in the formulæ. Still it is an admirable sketch, and when the *Ammonitidæ* are fully developed, according to the principles thus exemplified by Von Buch, we shall have them recognised, not as a genus with subdivisions, but as a family including many genera. (D'Orbigny's 'Palæontologie Française;' 'Annales des Sci. Nat.,' 1841, N.S., xvi. p. 113, also (1829) xvii. 267; xviii. 417; xxix. 5.)

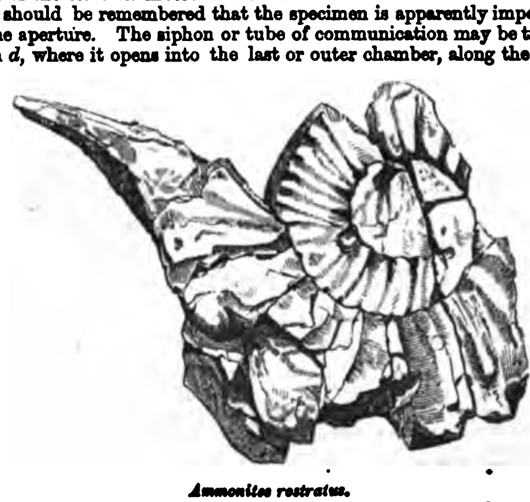
Having given this sketch, it will be necessary to meet the question whether the *Ammonites* were external or internal shells. Cuvier and Lamarck thought that they were internal. The former says ('Règne Animal,' last edition), "The smallness of the last chamber might induce us to believe that, like the Spirula, they were internal shells." Mr. Owen, in his arrangement above quoted, says, "Animal unknown, presumed to resemble the Nautilus; shell external . . . . The last chamber the largest and lodging the animal;" and probably this was the actual state of things. Dr. Buckland, in his 'Bridgewater Treatise,' says, "The smallness of the outer chamber or place of lodgment for the animal is advanced by Cuvier in favour of his opinion that Ammonites, like the Spirula, were internal shells. This reason is probably founded on observations made upon imperfect specimens. The outer chamber of Ammonites is very seldom preserved in a perfect state; but when this happens, it is found to bear at least as large a proportion to the chambered part of the shell as the outer cell of the *Nautilus Pompilius* bears to the chambered interior of that shell. It often occupies more



Ammonites obtusus. a, b, c, d, outer chamber.

than half, and, in some cases, the whole circumference of the outer whorl. This open chamber is not thin and feeble, like the long anterior chamber of the Spirula, which is placed within the body of the animal producing this shell, but is nearly of equal thickness with the sides of the close chambers of the Ammonite."

It should be remembered that the specimen is apparently imperfect at the aperture. The siphon or tube of communication may be traced from *d*, where it opens into the last or outer chamber, along the edge



Ammonites rostratus.

of the section, *e*, *f*, *g*, *h*, *i*, to the very nucleus of the shell. The waved transverse lines represent the partitions of the chambers.

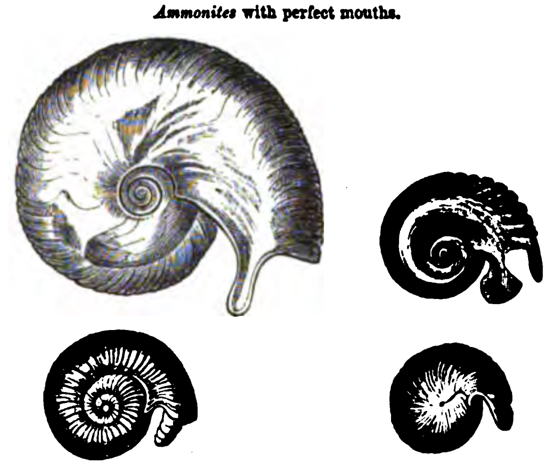
The large proportion of the outer chamber is very strongly marked in specimens of *Ammonites rostratus*, that have the aperture perfect or nearly so.

"Moreover," continues Dr. Buckland, "the margin of the mature Ammonite is in some species reflected in a kind of scroll, like the thickened margin of the shell of the garden snail" (*bourrelet* of the French), "giving to this part a strength which would apparently be needless to an internal shell. The presence of spines also in certain species (as in *Ammonites armatus*, *A. Sowerbii*) affords a strong argument against the theory of their having been internal shells. These spines, which have an obvious use for protection, if placed externally, would seem to have been useless, and perhaps noxious, in an internal position, and are without example in any internal structure with which we are acquainted."

Sir Henry de la Beche has proved from the mineral condition of the outer chamber of Ammonites from the Lias at Lyme Regis, that the entire body was contained in it, these animals having been suddenly destroyed, and buried in the earthy sediment of which the Lias is composed, before their bodies had either undergone decay or been devoured by the then existing crustaceans.

Dr. Buckland very happily illustrates the different arrangements by means of which a union of lightness and strength is secured to the shell, both from the external conformation and the mode in which the transverse plates are disposed; and as our limits will not allow us to enter minutely into the subject, we must refer the reader to the 'Bridgewater Treatise' for the interesting details, which show that a more perfect instrument for affording universal resistance to external pressure—an instrument in which the greatest possible degree of lightness combined with the greatest strength was required—could scarcely be imagined; and must confine ourselves to the doctor's summary:—"As the animal increased in bulk, and advanced along the outer chamber of the shell, the spaces left behind it were successively converted into air-chambers, simultaneously increasing the power of the float. This float being regulated by a pipe passing through the whole series of the chambers" (see the cut of *Ammonites obtusus*), "formed a hydraulic instrument of extraordinary delicacy, by which the animal could at pleasure control its ascent to the surface or descent to the bottom of the sea. To creatures that sometimes floated, a thick and heavy shell would have been inapplicable; and as a thin shell inclosing air would be exposed to various and often intense degrees of pressure at the bottom, we find a series of provisions to afford resistance to such pressure in the mechanical construction both of the external shell and of the internal transverse plates which formed the air-chambers. First, the shell is made up of a tube coiled round itself, and externally convex. Secondly, it is fortified by a series of ribs and vaultings disposed in the form of arches and domes on the convex surface of this tube, and still further adding to its strength. Thirdly, the transverse plates that form the air-chambers supply also a continuous succession of supports, extending their ramifications, with many mechanical advantages, beneath those portions of the shell which, being weakest, were most in need of them."

Ammonites with perfect mouths.



Reinecke,* Von Buch,† Zieten,‡ and De Haan § are among those

* Maris protogæi Nautilos et Argonautos, vulgo *Cornua Ammonis*, in agro Coburgico et vicino reperiundos, descripsit et delineavit, etc., D. I. C. M. Reinecke. Coburgi, 1818, 8vo.

† Ueber die Ammoniten in den älteren Gebirgs-Schichten. Gelesen in der Akademie der Wissenschaften, am 1 April, 1830. 4to. Recueil de Planches de Pétrifications remarquables, par Leopold de Buch. Berlin, 1831, folio.

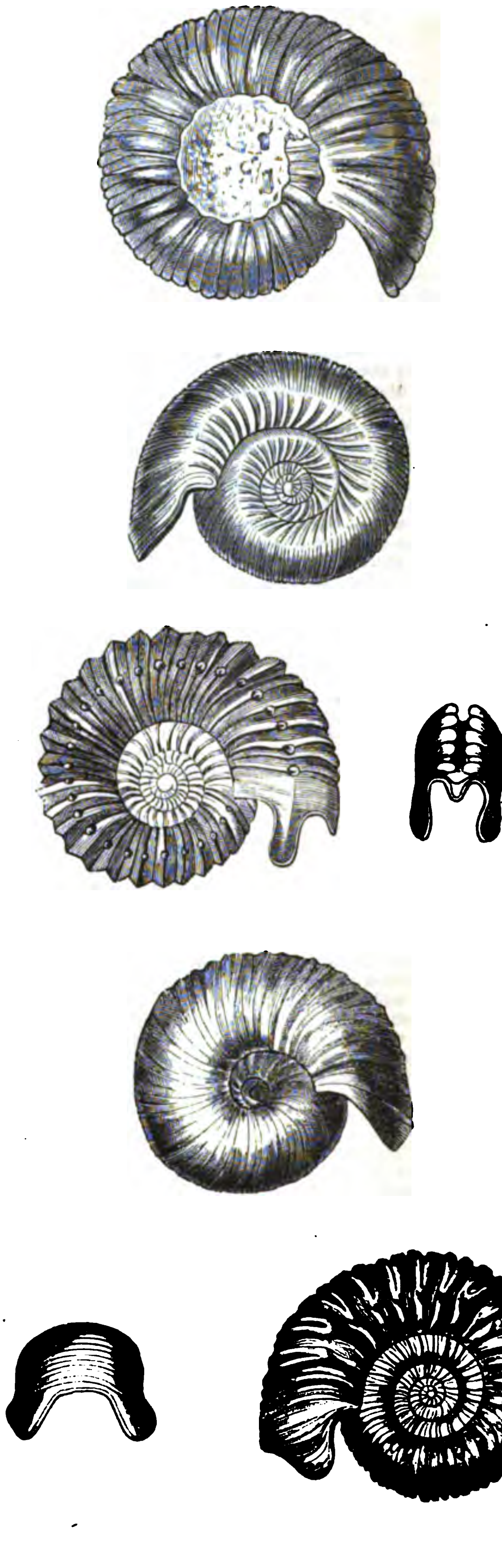
‡ Die Versteinerungen Würtembergs, &c. Stuttgart, 1830, and following years, folio.

§ Specimen Philosophicum Inaugurale, exhibens Monographiam Ammoniteorum et Goniatiteorum, etc. 1825. Lugduni Batav.

who have written treatises on this interesting genus, or have illustrated it.

The species of Ammonites are very numerous, and although the arrangement of Von Buch is at present the best, it is probable that when more is known of the form of the aperture, it will serve as a leading character.

Ammonites with perfect mouths.—(*Continued.*)



The accompanying cuts, which are copied from De Blainville, will not only give the reader some idea of the shape of the aperture, but also of the external appearance of the shell, while the following, from Dr. Buckland's 'Bridgewater Treatise,' will convey a notion of the concamerations in some of the species. An internal view of a very simple form of these and of the siphon or pipe will be seen in the cut of *Ammonites obtusus*.

Ammonites nodosus.

Geological Distribution.—Professor Phillips, in his 'Guide to Geology,' published in 1834, since which time numerous additions have been made, thus distributes the Ammonites among the different formations.

SUB-GENERA OF AMMONITES.

	Goniatites.	Ceratites.	Arietes.	Falciferi.	Amalthei.	Capricorni.	Planulati.	Dorsati.	Coronarii.	Macrocephali.	Armati.	Dentati.	Ornati.	Flexuosi.
In Tertiary Strata . . .														
In Cretaceous System . .	..	..	..	2	4	..	..	..	..	9	14	13	2	2
In Oolitic System . . .	..	..	..	22	27	19	26	5	11	11	11	4	5	3
In Saliferous System . .	..	3	12											
In Carboniferous System .	7													
In Primary Strata . . .	17													

Total, 223 species.

Geographical Distribution.—As the Ammonites were evidently principal agents for keeping within bounds the mollusks, &c., the crustaceans, and perhaps fishes of the periods prior to the Chalk Formation, and belonging to the latter epoch, we should expect to find them widely distributed. Accordingly, they occur in Europe, Asia, and America in strata apparently of the same date. In some instances, the genera and even the species are identical. Dr. Gerard found in the Himalaya Mountains, at an elevation of 16,000 feet, *Ammonites Walcottii* and *Ammonites communis*, fossils that are found in the Lias of Lyme Regis. M. Ménard met with one in the Maritime Alps at an elevation of 1500 toises. Their numbers must have been great. M. Dufresne informed Lamarck that the road from Auxerre to Avalon in Burgundy was absolutely paved with them. The individual agency too of some of these carnivorous instruments for preserving the balance of marine animal power must have been of no small importance. Lamarck says that he has seen Ammonites of two feet (French) in diameter. Mr. James Sowerby and Dr. Mantell record Ammonites in the Chalk with a diameter of three feet; and Dr. Buckland states that Sir T. Harvey and Mr. Keith measured Ammonites in the Chalk near Margate which exceeded four feet in diameter; and this in cases where the diameter could have been in a very small degree enlarged by pressure. [*See* SUPPLEMENT.]

AMOIBITE, in Mineralogy, a variety of Arsenical Nickel, containing from 40 to 50 per cent. of nickel and 14 per cent. of sulphur.

AMO'MUM, a genus of plants belonging to the natural order *Zingiberaceæ*. It consists of species having white flowers collected in close heads, which arise from the base of the leaves, and only just raise themselves above the ground; the lower lip of the flower is very broad and large compared with the others, and the other has a two-lobed crest. The seeds are contained in a loose skin, and are inclosed in a rather tough capsule, which is separated into three cells by as many membranous partitions, and finally opens into three valves. The leaves are of a broadly lanceolate or oval figure tapering to the point, and enwrapping the stem like a sort of sheath.

A. Cardamomum has a root-stock creeping under the surface of the soil like that of the Ginger, but it is smaller. The stems rise obliquely to the height of from two to four feet. The leaves are alternate. Flowers in spikes, seated in lanceolate acute villous scarious ash-coloured bracts. The tube of the corolla slender. The anther double, with a large three-lobed concave crest. The fruit a capsule containing roundish angular dotted brown seeds. This plant is a native of the mountainous parts of Java and Sumatra, and is commonly cultivated in the gardens of India. The seeds are aromatic, and are used by the Malays instead of the true Cardamoms, which are the produce of the *Elettaria Cardamomum*. [ELETTARIA.] Sir J. E. Smith states that this plant is the *Amomum verum* of the older botanists.

Amomum Cardamomum.

A. angustifolium is a sharp-leaved species, and a native of marshy ground, in Madagascar. It is cultivated in the Mauritius. It has a deep blood-red calyx, and the outer segment of the corolla is red. The whole plant is aromatic, and the fruit constitutes the *Cardamomum majus* of the older writers.

A. aromaticum is a native of the valleys on the eastern frontiers of Bengal. The fruit has similar qualities to those of the true Cardamoms, for which they are often sold to the druggists of India.

A. Grana-Paradisi has a perennial root-stalk, giving off erect slender stems, 3 feet high. The leaves are numerous and crowded. The capsule is large, $1\frac{1}{4}$ inch long, and half-an-inch in diameter. It has a very strong aromatic odour and flavour. The seeds have the same properties as the Cardamoms. The plant is a native of Guinea, near Sierra Leone. The fruits are known by the name of Grains of Paradise, and Melligetta or Malagueta Pepper.

A. grandiflorum, of Smith, is also a native of Sierra Leone. It has large flowers, and yields seeds, which differ from those of Grains of Paradise in being gray or lead-coloured, much less polished, and possessing a totally different flavour, resembling that of camphor. They may be used for the same purposes as the Cardamoms.

The Cardamoms of commerce are the capsules, which are gathered as the seeds ripen, are dried in the sun, and are then fit for sale. The small capsules, or Lesser Cardamoms, are the most valuable. [CARDAMOMS, in ARTS AND SC. DIV.]

(Lindley, *Flora Medica*.)

Amomum grandiflorum.

a. The lip and a back view of the anther. *c.* Calyx.
b. A front view of the anther. *d.* Stigma.

AMPELI'DEÆ, one of the names of the Vine Tribe. [VITACEÆ.]

AMPHERI'STUS, a Fossil Fish, from the Isle of Sheppy. (König, *Icon. Fossil.*)

AMPHI'BIA (from the Greek word ἀμφίβιος, which signifies 'having a double life'), the name of an order of the class of *Reptiles*. In common conversation we are accustomed to call all mammals, such as seals, otters, beavers, &c., amphibious, whose organisation disposes them to resort indifferently either to the land or water for procuring food, and other purposes, or whose habits are at once terrestrial and aquatic; thus we usually denominate the Common Campagnol (*Arvicola amphibia*), and the White-Bellied Shrew (*Sorex fodiens*), the Water-Rat, and Water-Shrew respectively, and consider them in every respect as amphibious animals. But in this sense of the word every land-animal is more or less amphibious, for all resort occasionally to the water, and, with the single exception of man, all appear to have an instinctive power of swimming. Previous to the time of Linnæus, the earlier naturalists attached no more definite meaning to the word than that which was sanctioned by popular custom, and which, it will be observed, is more properly expressed by the term aquatic. The great Swedish philosopher, however, rejected this vague and improper signification, and applied the term generally to the third class of his system of zoology, which comprised not only all the animals since more properly denominated *Reptiles*, such as the tortoises, lizards, serpents, and frogs, but likewise the Cartilaginous Fishes. Linnæus was evidently ignorant of the true characters and natural limits of this class of animals. The term *Amphibia* was certainly very applicable to many of the genera and species which it embraced, but with regard to the great majority of them it was an absolute misnomer. The shark and the ray are as incapable of existing out of the water as many of the common lizards are of living in it, and consequently neither the group which Linnæus proposed to establish, nor the name by which he designated it, has been adopted by more recent zoologists. The Cartilaginous Fishes have been referred to the other aquatic tribes, with which their habits and organic conformation naturally connect them, and the remainder of the class, which stands in Gmelin's celebrated edition of the 'Systema Naturæ' under the name of *Amphibia*, is admitted into modern systems under the more appropriate designation of *Reptiles*.

Taken in its strict and literal sense, the term amphibious would apply only to such animals as have the power of living indifferently at the same time, either upon land or in water. To fulfil this condition it is necessary that a truly amphibious animal should be provided with the means of breathing in either of these elements, that is, that it should simultaneously possess both lungs and gills. Now there are four genera of batrachian reptiles which actually do possess this extraordinary double apparatus for extracting the principle which supports animal life indifferently from either element; and these, as Baron Cuvier has justly observed, comprise in reality the only known vertebrated animals which are truly amphibious. They are the *Axolotls*, the *Menobranchi*, and the *Sirens*, all of which inhabit the rivers and lakes of America, and the *Proteus*, which is found in subterraneous streams connecting certain lakes in Carniola and Hungary. These, then, are the only strictly amphibious reptiles; but if the term is taken in a little more extended sense, it may, without impropriety, be applied to the entire order of *Reptiles* which M. Brongniart, and after him most modern naturalists, denominate *Batrachians*, because all these animals, without exception, breathe by means of gills in their tadpole state, and only acquire lungs when they assume the more mature and perfect form of reptiles. In this sense the term is now employed by English naturalists.

Some, indeed, as Mr. Bell, Dr. Grant, and other writers, separate the *Amphibia* from the *Reptiles*, as a distinct class.

The *Amphibia* differ essentially from the other three orders of Reptiles: *Chelonians* (Tortoises), *Saurians* (Lizards), and *Ophidians* (Serpents). They have no ribs, or rudiments of ribs only. Their skin is naked, being without scales. They have feet. The male has no external organs distinctive of sex. In the Frog Tribe the ova are fecundated on their exclusion from the body of the female: they are shelless and generally laid in the water. The young, which are called *Tadpoles*, when first hatched, breathe by means of branchiæ, or gills, very much after the manner of fishes, being in their early stage of growth quite unlike their parents, and, in that state, forming a natural passage to the last-named class of animals. These branchiæ disappear in the higher *Amphibians*, and one order has therefore been named the *Caducibranchiate Amphibia*, which have been divided into—first, the *Anourous* or *Tailless Batrachians*, having no tails except in their young state, including the Frogs and Toads; and second, the *Urodèles* or *Tailed Batrachians*, such as the Salamanders.

Under the *Perennibranchiate Amphibia* are included the *Proteus*, *Siren*, *Menobranchus*, and *Axolotl*.

The following arrangement of the *Amphibia* or *Batrachians* has been published by Messrs. Dumeril and Bibron, in their elaborate 'Erpétologie Générale':—

Characters:
- Body, varied in form; skin naked; most frequently without either carapace or scales.
- Head, with two occipital condyles, not carried upon a narrower neck.
- Feet, variable, as regards their presence, their number, their proportion; toes most frequently without claws
- Sternum, most frequently distinct, never united to the ribs, which are short or null.
- Male organs of generation not projecting. Eggs with soft not calcareous shells. Young, subject to metamorphosis.

Limbs	Suborders.		Groups.			Families.
Null. Body serpentiform	*Peromèles*		*Ophiosomes*			1. *Cæciloïdes.*
Four or two.	No tail, *Anoures*, with a tongue	Distinct	*Phaneroglosses*: with the upper jaw	Toothed: ends of toes	Little or not dilated	2. *Raniformes.*
					Very dilated	3. *Hylæformes.*
				Without teeth		4. *Bufoniformes.*
		Null	*Phrynaglosses*			5. *Pipæformes.*
	A tail, *Urodèles*, with a neck	With neither holes nor branchiæ	*Arètodères*			6. *Salamandrides.*
		With slits or distinct holes	*Trématodères*: with branchiæ		Null	7. *Amphiumides.*
					Visible and persistent	8. *Protéides.*

In this article we shall speak of the organisation and natural history of the *Amphibia* in two groups: first, the *Anourous* or *Tailless Amphibia*, and secondly, the *Urodèles* or *Tailed Amphibia*.

ANOUROUS OR TAILLESS AMPHIBIA.

Skeleton.—The skull, in the Reptiles generally, is made up of the same parts nearly as that of the mammiferous animals, though the proportions are different. But the lower *Amphibia*, which approach the fishes in this particular, have not the internal cavity corresponding so completely with the surface of the encephalon as the other Reptiles. The skull is very much flattened; and small as the cerebral cavity is, it is by no means filled with the brain. It is narrower and more elongated in the species which pass their whole lives in the water than it is in the *Anourous Amphibia*, or True Frogs.

The vertebral column commences at the posterior part of the head, and, unlike the rest of the Reptiles, the *Batrachians*, like the rays, the sharks, and the mammiferous animals, possess two condyles situated on the sides of the vertebral hole. In the Tadpole the vertebræ are of the same calibre throughout, but a difference takes place when the limbs are developed. At this period, the vertebral canal diminishes gradually in length, the spinal marrow contracts, and no trace of the canal is left in the elongated coccyx. It is in the *Tailless Amphibia* that the vertebral column is shortest, for the Frogs have only ten and the Pipas but eight vertebræ.

As a general rule, the anterior extremities are shorter than the posterior limbs; but in some of the Frogs especially, the lower extremities are twice or thrice as long as the anterior feet, as might be expected in animals whose progression is principally effected by leaps. Ribs there are none; but the sternum is highly developed and a large portion is very often cartilaginous. It receives anteriorly, or in its mesial portion, the two clavicles and two coracoids which fit on to the scapula. The whole makes a sort of band which sustains the anterior extremities, and an elongated disk which forms a support for the throat, and assists in the offices of deglutition and respiration. Another disk extending backwards, being for the insertion of the recti muscles, protects the abdominal viscera in some species. The pelvis is well developed in the Frogs, especially in the Pipa, and though apparently deprived of all traces of a tail after undergoing their last transformation, there remains, internally, a true coccygeal piece, most frequently even moveable and elongated, but without anything like vertebral form.

Skeleton of the Common Frog.

The bone of the humerus or arm is single, and is long in proportion to the bones of the fore-arm, which are united throughout their length, their duality being manifested by a simple furrow or depression. These bones are distinct in the reptiles generally, and the radius is generally rather the longest; the ulna is prolonged backwards into a kind of olecranon, and sometimes this apophysis is distinct, and becomes a sort of sesamoïd-bone in the thick part of the tendon of the extensor muscles. The Pipas, the Tortoises, and the greater part of the Saurians have this conformation. The bones of the carpus, or wrist, exhibit nothing extraordinary in their structure; nor do those of the fingers, which are without nails or claws, require particular notice.

The bones of the well-developed pelvis present considerable differences in the various genera of *Anourous Amphibia*. Thus in the Frogs (*Rana*) and the Tree-Frogs (*Hyla*), the ossa ilii are very much elongated, articulated in a moveable manner on the sacrum, and very much approximated below towards the cotyloid cavity; so that the two heads of the thigh-bones seem to be placed in contact, a conformation which much influences the action of the posterior limbs upon the trunk in the execution of the motions of swimming and leaping. In the *Pipa*, or Surinam Toad, the ossa ilii are very much widened at the point of junction with the sacrum, which is, itself, dilated, forming a strong union by means of a true symphysis. The femur, or thigh-bone, is very much elongated, and slightly curved in the form of the letter S in the Frogs (*Rana*), and in the Tree-Frogs (*Hyla*); it is a little shorter in the Toads (*Bufo*), and is flattened in the *Pipa*. The bones of the leg (tibia and fibula) are, in the Reptiles, generally distinct; but in the *Anourous Amphibia, Rana, Hyla*, and *Pipa*, for instance, they are so soldered together as to form but a single articulation with the femur and tarsus, and to present the appearance of a single very-much-elongated bone, which some have erroneously considered as a supernumerary bone, or second femur. The knee-joint and articulating bones are so disposed that the feet have always a direction outwards. In the Reptiles generally, the posterior feet are more developed than the anterior limbs; and this modification is particularly observable in the *Anourous Amphibia*, which have the tarsus so much elongated as to induce some to consider the first bones composing it to be a fibula or tibia. The bones of the metatarsus correspond to the number of toes.

The Teeth.—As these are very important organs in the whole of the *Amphibia*, we shall now present an abstract of this subject from Professor Owen's celebrated work entitled 'Odontography.' He remarks that the variations which the dental system presents in the *Amphibia* are more conspicuous in the number, situation, and structure of the teeth, than in their form or mode of attachment. Certain Batrachians, he observes, are edentulous, the genus *Hylaplesia* among the Tree-Frogs, for example, and the *Bufonidæ*, or Toad Family, with the exception of some species of *Bombinator*. The teeth when present are described by him as generally numerous, simple, of small and equal size, and close-set, either in a single row or aggregated, like the teeth of a rasp, and he points out a characteristic condition of the dental system in fishes, namely, the absence of teeth on the superior maxillary bone, as being continued in those genera of Perennibranchiate Batrachians which stand lowest in the class of Reptiles; not only the superior maxillary teeth, but the bones themselves are absent, he observes, in *Siren, Menobranchus*, and *Proteus*. In the *Siren*, he describes the lower margin of the intermaxillary bones, and the sloping anterior and upper margin of the lower jaw, as trenchant, and each encased in a sheath of firm, albuminous, minutely fibrous tissue, harder than horn. The bones thus armed slide upon each other, he tells us, like the blades of a pair of curved scissors, when the mouth is closed, and are well adapted for dividing the bodies of small fish, aquatic larvæ, worms, &c. The horny substitute for teeth in the lower jaw is supported by the bony element corresponding with the premandibular of the *Lepidosiren*. [PROTOPTERUS.] A second bony piece applied to the inner surface of the branch of the jaw (representing the splenial or opercular element in the jaw of the crocodile) is beset with numerous minute pointed teeth, set in short oblique rows, and directed obliquely backwards. The palatal surface of the mouth is described as presenting on each side two flat, thin, and moderately broad bones, forming an apparently single, oblique, oval plate, which converges to meet its fellow at the anterior part of the palate, so as conjointly to constitute a broad rasp-like surface in the form of a chevron. The Professor regards the anterior long plate on each side as the representative of the divided vomer, and it supports 6 or 7 oblique rows of small pointed retroverted teeth; the smaller posterior plate, which he thinks may probably be the homologue of the pterygoïd, is beset with 4 rows of similar teeth; and thus we have 10 or 11 rows on each side of the chevron of the palate. The greatest number of denticles (11 or 12) is in the middle rows; in the anterior and posterior rows they are fewer; all are of similar size and form, corresponding with those of the lower jaw opposed to them. "The condition of the dental system in this, the lowest of the class of reptiles," says Mr. Owen, "is not without interest, independently of the absence of the superior maxillary teeth, and of the presence of the palatal and inferior maxillary *dents en cardc*." If, for example, the dense sheath of the trenchant anterior parts of the upper and lower jaws had been completely calcified and converted into hard dentine, the correspondence between the *Siren* and the *Lepidosiren* would have been very striking in this part of their structure; but the maxillary sheaths of the *Siren* being composed of horn, and being moreover easily detached from the subjacent bones, much more closely resemble the deciduous mandibles of the Tadpoles of the higher Batrachians. (Part ii., pp. 188, 189.)

In the *Axolotl* also the ichthyic character of the rasp-like teeth are aggregated in numerous rows upon the palatal region of the mouth, and upon the splenial or opercular element of the lower jaw; but here, Mr. Owen observes, the superior maxillary bones are developed, and support teeth. The premandibular and the intermaxillary bones, he adds, instead of presenting the larval condition of the horny sheath, have their alveolar border armed with a single row of small, equal, fine, and sharp-pointed denticles, which are continued above along the maxillaries; thus, he observes, establishing the commencement of the ordinary Batrachian condition of the marginal teeth of the buccal cavity. As in the *Siren*, the dentigerous bones of the palate consist of two plates on each side; the anterior pair, or vomers, converge and meet at their anterior extremities, and the minute denticles which they support are arranged quincuncially. The posterior pair of bones continued backwards, according to the usual disposition of the pterygoïds, abut against the tympanic or quadrate bones; and the denticles are confined to the anterior part of their oral surface, resembling, in their arrangement and anchylosed attachment, those of the palatal series, of which they are the posterior termination.

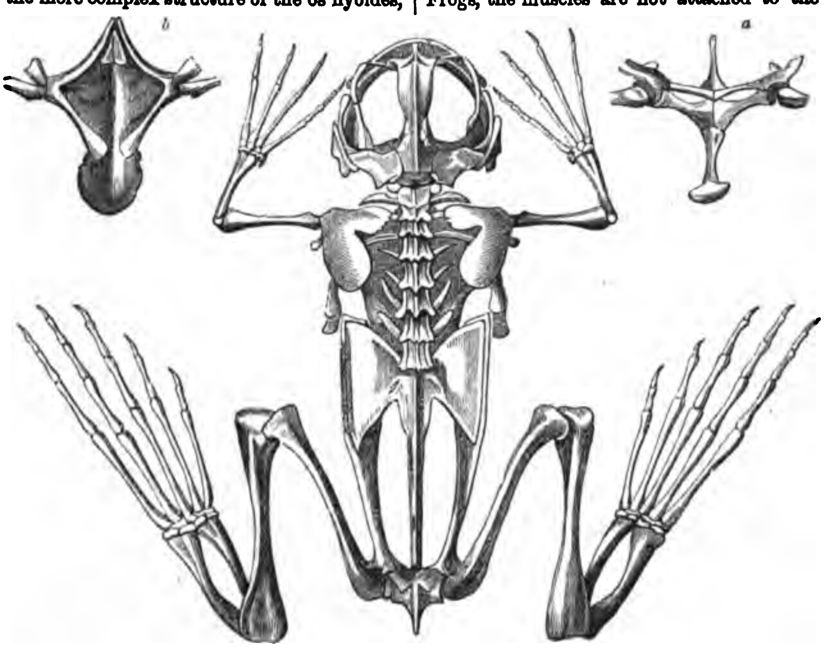
The superior maxillaries and their teeth are, it appears, wanting in *Menobranchus* [NECTURUS]; but in this form an advance to a higher type of dentition is perceptible by the arrangement of the teeth in a single row, both upon the roof and at the margins of the mouth. The intermaxillary bones are produced backwards, and the single row of small pointed teeth which they support is opposed to a similar series upon the premandibular bones below. The palatal teeth form a single row on each of the broad bones which correspond with those described by Cuvier as the divided vomer in the higher Batrachians, and extend backwards upon the pterygoïds, which support a few teeth.

The three preceding genera are perennibranchiate, and though the *Proteus*, like them, always retains its external gills, it offers a further advance to the dentition of the higher Batrachians, and to that of the *Amphiuma* especially. Each intermaxillary bone carries on its alveolar border a row of 8 or 10 minute, fine, sharp-pointed teeth, and each premandibular bone is armed with a greater number of similar but larger teeth, arranged also in single series. The palatine bones (two vomers of Cuvier) support a row of denticles, similar to the intermaxillary crescentic series, and parallel with them; but Mr. Owen points out that the horns of the palatal dental crescent are continued much farther back, terminating, as in *Menobranchus*, on the anterior part of the pterygoid bones. Twenty-four teeth are contained in each half of the "crescentic or chevron-shaped series," as the arrangement is appropriately designated by the Professor, who adds that the superior maxillary bones are represented in this form by mere cartilaginous rudiments.

The *Amphiuma*, like the *Proteus*, presents the Batrachian disposition of the teeth in a single close-set series along the alveolar border of both upper and lower jaws. "The upper series extends along well-developed maxillary and intermaxillary bones, and in the extent of the maxillary and palatal series, especially in *Amphiuma tridactylum*, the indication of a highly interesting character in regard to the affinities of an extinct race of gigantic Batrachians with biconcave vertebræ is discernible."

In the *Amphiuma* the palatal teeth run in a single close-set row along the lateral margins of the vomer, forming an acute angle at its anterior portion, whence the series is extended backwards on either side nearly longitudinally, and parallel with the maxillary teeth. "All the teeth are conical, pointed, slightly curved backwards and inwards; their points glisten with a yellow metallic lustre," whence Dr. Mitchell's name *Chrysodonta*. The number of teeth in *Amphiuma means* is considerably less than in *Amphiuma tridactylum*.

"The *Menopome* exhibits," says Professor Owen, "the same essentially Batrachian condition of the teeth as the *Amphiuma*; but in their disposition, and in the disposition and form of the vomer, it makes a near approach to the Caducibranchiate group, and allies itself most closely with the gigantic Newt of Japan (*Sieboldia*, Bonap.), and with that equally gigantic extinct species of Newt so noted in palæontology as the *Homo Diluvii Testis* of Scheuchzer. In the persistence of the branchial apertures, and the more complex structure of the os hyoïdes, the *Menopome* however manifests its generic distinctness from the *Sieboldia*. The single close-set series of small, equal, conical, and slightly-recurved teeth describes a semicircle on both the upper and lower jaws: the row of similar but smaller teeth on the anterior expanded border of the divided vomer runs parallel with and at a short distance behind the median part of the maxillary series. The premandibular teeth are received into the narrow interspace between the two rows in the upper jaw when the mouth is closed. The teeth of the *Menopome*, as of the *Amphiuma*, are anchylosed by their base and part of its outer side to a slightly elevated external alveolar ridge.



Skeleton of *Dactylethra Lalandii*.

The figures on each side show the difference of the sternum in the Common Frog, and in the *Dactylethra*; *a* represents the sternum of the former; *b* that of the latter.

"*Sieboldia*.—The Perennibranchiate or Fish-like *Amphibia*, 'doubtful reptiles' as they have been termed, lead by so easy a series of transitions to the Caducibranchiate group, in which all external trace of the branchial apparatus is lost, that the artificial nature of such a division of the order is evident, and some naturalists have even hesitated whether to separate, generically, the last of the Perennibranchians from the species *Sieboldia gigantea*, with which the description of the dental system in the higher division of the Batrachians is here commenced. As regards the teeth, the difference between the great aquatic Salamander of the volcanic mountains of Japan and that of the Alleghanies is very slight, and merely specific; the form, disposition, and attachment of the teeth are the same in *Sieboldia* as in *Menopome*; they differ slightly in the relative size, those of the Japanese Newt having the advantage in this respect, with a somewhat deeper implantation of their anchylosed base, and the alveolar parapet of the intermaxillary bones is higher and is slightly incurved. There are 14 teeth in each intermaxillary, 72 in each superior maxillary, and 64 teeth in each vomer of the *Sieboldia gigantea*."

All the *Caducibranchiate Amphibia* with tails, as the Newts and Land Salamanders, have teeth on the inferior maxillary and vomerine bones, as well as on the intermaxillaries and superior maxillaries.

The Frogs have no teeth on the lower jaw, though in some species (*Ceratophrys* for example) the alveolar edge of the lower jaw-bone is finely notched or dentated. The *Bufonidæ*, as a general rule, are toothless, but in the *Bombinatores* the subgenus *Hyladactylus* has teeth upon the vomer, and *Sclerophrys* has teeth on both the intermaxillary and maxillary bones.

Muscular System, particularly as relating to Locomotion.—The muscles destined to give activity to the framework, examples of which are given below, are, like those of all the Reptiles, remarkable for their irritability. There are not wanting zoologists who have seen Toads, Salamanders, Tortoises, and Serpents, deprived of their heads and skins, but kept moist, display muscular motion for whole weeks. In the *Anourous Amphibia*, the Frogs especially, the muscles of the abdomen are more developed than in the other Reptiles, offering in this particular some analogy to the abdominal structure of the Mammifers. But it is in the disposition of the muscles of the thigh and leg in the Frogs and others of this group, that the greatest singularity is manifested. These, whether taken conjointly or singly, present the greatest analogy with the muscular arrangement of the same parts in Man. We find the rounded, elongated, conical thigh, the knee extending itself in the same direction with the thigh-bone, and a well-fashioned calf to the leg, formed by the belly of the gastrocnemii muscles. It is impossible to watch the horizontal motions of a frog in the water, as it is impelled by these muscles and its webbed feet, without being struck with the complete resemblance in this portion of its frame to human conformation, and the almost perfect identity of the movements of its lower extremities with those of a man making the same efforts in the same situation.

We have seen that the ribs are absent in the *Anourous Amphibia*, and the functions of respiration, as well as those of deglutition, being carried on by means of particular muscles, as we shall presently have to notice, those bones would have been mere incumbrances. In the Frogs, the muscles are not attached to the skin, which envelops the whole muscular arrangement in a sort of insulated, insensible, moveable bag: in the *Urodèles*, on the contrary, the integuments serve as the point of insertion to almost all the active organs of motion.

The locomotion of the *Anourous Amphibia* on land consists in walking, running, and leaping, in its various modifications; the latter being the motion most prevalent. The greater part of them are excellent swimmers; and when they betake themselves to this exercise, the body is extended horizontally, and the animal is propelled by the mechanism of the lower extremities alone—a mechanism admirably adapted to this mode of progression, as well as to the other varieties of movement which the necessities of the animal require. By the aid of these well-developed lower limbs, and the prodigious power of their muscular and bony levers, a Frog can raise itself in the air to twenty times its own height, and traverse, at a single bound, a space more than fifty times the length of its own body.

Digestive Organs.—The *Anourous Amphibia*, in their adult state, are, like the greater part of the existing Reptiles, carnivorous, and swallow their living prey without mastication. The mouth in many of them is very wide; so wide, indeed, in some (the large Frogs and Pipas, for instance), as to admit of their swallowing vertebrated animals; but insects, annelides, and mollusks form the chief portion of their food. They have no true fleshy lips, nor indeed have any of the Reptiles; but the fresh-water tortoises are furnished with folds of skin as a covering for their cutting jaws, and perhaps as a more complete apparatus for shutting the mouth. The same conformation is observable in the greater number of the Tadpoles of the Batrachians, the larger portion of which, in their adult state, have the lower jaw received under a soft skin which covers and edges the mandible. The branches of the lower maxillary bone are rarely soldered at the symphysis, and sometimes, as in the genera *Rana* and *Hyla*, there is, at the point of junction, a mere cartilage which admits of a certain amount of motion. In the Frogs and the *Urodèles*, the number of pieces composing each of the branches amounts to three. One of these pieces corresponds with the symphysis, and is armed with teeth; the second serves for articulation, and the third is situated backwards, and prolonged below. On the palate of many of these *Amphibia* are certain processes which may be termed teeth; but these are pointed, and not tubercular, as the old error of naming some of the teeth of fossil fishes *Bufonites* might lead us to suppose. These palatal teeth form a part of the bones to which they are attached, as in the case of fishes.

The tongue performs a leading part in the capture and deglutition of the prey. In the greater portion of this group the structure of this organ is altogether anomalous, and its insertion is equally at variance with the mode adopted in the other vertebrated animals. It is very soft, fleshy almost throughout, and is not supported at its base by an os hyoïdes. Its attachment is the reverse of that generally seen, for it is fixed in the concavity which is formed by the approach of the two branches of the lower jaw towards the symphysis. In a state of repose, and when the mouth is shut, this tongue, which has its root, so to speak, in the interior edge of the anterior part of the lower jaw, has its free extremity in the back part of the mouth and before the aperture of the air-passages; but when the animal puts it forth, it is considerably elongated and thrown sharply out of the mouth, as if by an effort of expulsion. The end reaches to a considerable distance, as, turning on the pivot of its anterior fixture, it is reversed in such a manner that the surface which was below when the tongue was in the mouth, and in a state of repose, is, when it is thrown out, above; and when the tongue is returned into the mouth, the surface, which was an instant before above, resumes its original position, and is again beneath. The organ is armed with a tenacious viscous secretion; and when it touches the prey, the latter adheres so firmly to it, that it is carried back with the tongue into the mouth. There it is, in most cases, compressed, involved again in a glutinous sort of saliva, and almost instantly submitted to the act of deglutition. The motion of throwing out and returning the tongue is often performed with a rapidity which the eye can hardly follow. If any one will observe a toad in a melon-frame, he will see the ants or other insects which come within shot of its tongue disappear; but his vision must be very acute and prompt to detect the action of the tongue. The muscles, whose office it is to move the bones, cartilages, and other parts of the mouth, act more especially upon the lower jaw, upon the bone of the mandible, and upon the tongue, which, after being shot forth as we have endeavoured to describe, is returned and swallowed, as it were, with the captured prey, and the act of deglutition is continued till the food is lodged in the stomach.

The pharynx in mammiferous animals consists of that backward cavity of the throat, into which the lower orifices of the nostrils, the orifice of the mouth, the canal of the ear, the larynx, and the œsophagus open; but in the reptiles there cannot be said to be any true pharynx; for the nostrils, as well as the glottis, open into the mouth, the œsophagus commences immediately behind the nostrils, and the muscles that act more especially upon these parts and upon the tongue are those that begin the act of deglutition: we shall presently see that these same muscles are also put in requisition to force the air necessary for respiration into the glottis and trachea, in order to supply the cavity of the lungs. The stomach of the *Anourous Amphibia* does not require any particular notice; but the maxim that the more carnivorous an animal is, the shorter and the less flexuous is its intestinal canal, is well illustrated in that tribe. The Tadpole, which lives upon vegetables, possesses an extremely long digestive tube; but in its perfect state, and when its appetite has become altogether carnivorous, the intestines become very much shortened, losing four-fifths of the length which distinguished them when the animal was in its early stage of existence. The vent is rounded and wrinkled. The liver generally consists of three lobes, and the gall-bladder adheres to and is hidden in the concavity of the liver, very high up. The spleen in the Frog and Toad is rounded, not of large dimensions, and situated in the mesial region, under the intermediate lobe of the liver. There is also a pancreas, and the chyliferous veins may be distinctly traced. The digestive organs vary considerably in the Tadpole. In this early stage they have a mouth furnished with lips, and horny cutting processes, that act as jaws in the division of the vegetable food which forms their principal nourishment, and their intestinal canal is coiled spirally within their large rounded abdomen. The metamorphosis is complete, internally as well as externally, when this armed little mouth is changed into the widely-opening gape, which reaches beyond the eyes, and the animal swallows its living prey entire. In this their last stage they can endure a long abstinence. They grow slowly, and they live to a considerable age. The skin which edges their jaws is soft, and forms a sort of gum or external lip; their under-jaw is received into a kind of rim or groove, which runs along the upper-jaw, and its two branches are slightly moveable towards the symphysis: this junction of the jaws is as complete as the shutting of a well-fitted lid of a snuff-box.

Circulating System.—The circulation in the *Anourous Amphibia* varies with the different metamorphoses which the animal undergoes. In the early or tadpole stage the whole of the blood is driven by the heart into the branchial vessels, the circulation at that period being the same as it is in fishes. The apparently single auricle (for according to the observations of Dr. Davy and of Messrs. Saint Ange and Wébert, it is in fact separated into two divisions), or rather the partition which exists at the point where the oxygenated blood arrives through the pulmonary veins, can hardly be said to be distinct, and the venous blood, which is poured into it by the large vena cava, penetrates finally into the single ventricle, which, by contracting, pushes the blood into the single arterial trunk, furnished at its base, near the valvules, with a sort of bulb, or contractile swelling. This artery, which contains the black or venous blood, is divided into two trunks, one directed to the right, the other to the left; and these are then subdivided into two, three, or four branches, according to the number of the branchial leaflets: on their arrival there, they inosculate with the venous trunks, and by that time the blood has assumed its arterial quality and colour. These arterial veins unite successively, so as to form, by means of two principal trunks, the origin of one great artery, or aorta descendens, which is, at the point of its formation, placed near the head, to which it gives off many branches, and continues to descend down the vertebral column.

But when the time of metamorphosis arrives, and when the animal which had been breathing by means of gills is to respire through the medium of lungs, an entire and necessary change takes place. In proportion as the branchiæ of the Tadpole are destroyed and absorbed, the calibre of the venous arteries, which were distributed to them, diminishes gradually, till they are at last entirely obliterated. The first of these vessels then develops itself, and receives on each side the whole of the blood, giving off three principal trunks—one for the head, corresponding to the carotid artery; one for the anterior limbs, or a branchial artery; and one, the longest of all, for the cellular lung, which is of considerable volume. The rest of the principal trunk follows the mesial line, and unites with its congener, so as to form a true aorta for the supply of the viscera and lower extremities, which acquire their large dimensions at this period.

Respiratory System and Vocal Organs.—The absence of the ribs prevents any application of costal influence upon the respiratory organs of the *Anourous Amphibia*, as is the case with the mammiferous animals; but though their form, as well as the medium in which they live, is so totally different in the early and late part of their life, the principle of action on these organs is nearly the same. The young may be said to swallow water, or at least receive it into the cavity of the mouth, before they force it into the branchial vessels; and though the mode of breathing is so entirely changed in after-life, the operation consists in the perfect animal of a succession of deglutitions of air.

When the *Amphibia* leave the egg, their branchiæ appear externally like little coloured fringes on each side of the neck, and so they remain in the *Urodèles*, as long as their lungs are not sufficiently developed to serve for complete respiration. But in the Frogs and the *Anourous Amphibia* the first stage of the animal's life endures but a short time. It soon assumes the Tadpole form, with an enormous belly and head, in one undistinguished outline, and a long tail. At this period the branchiæ, or gills, are hidden, being contained in a cavity, and then the water enters the mouth by the orifice of the nostrils, which are supplied with valves. When in the cavity of the mouth, which is well closed on all sides, with the exception of the throat, where are placed the branchial slits, the water, acted upon by the muscles which cover them, traverses these spaces, and bathes the branchiæ before its exit through the branchial holes. The blood which is pushed into these branchiæ is then distributed, as it is in the fishes, and passes, as we have seen, from the arterial venous vessels into the arteries which unite to form the aorta.

On acquiring their perfect form, and when the obliteration of certain points, and the development of the others, have adapted the *Anourous Amphibia* for breathing air, by means of its two large lungs, the muscles employed in deglutition are the great agents for carrying on the respiration. The anterior nostrils, as we have before stated, open nearly straight, by means of simple apertures in front of the palate; the tongue is applied as a kind of stopper upon the back nostrils, and the trachea is terminated by a glottis opening into the mouth. The air thus imprisoned is forced or pumped at each gulp through the glottis, to be distributed over the lungs.

In the museum of the Royal College of Surgeons are several preparations, illustrative of the aëration of the blood, by means of branchiæ, in the early stage of *Rana paradoxa*, and also of the mode of respiration in the adult forms of the same group of animals.

The activity of respiration is increased in proportion to the elevation of the temperature of the surrounding air. M. Delaroche found that

Frogs exposed to a temperature of 27 degrees Centigrade (80° Fahr.), absorbed four times as much oxygen as those submitted to a temperature of 6 or 7 degrees (42° to 47° Fahr.) only.

The organs of the voice in the *Anourous Amphibia* are only put in action, generally speaking, at the season of reproduction, and then principally by the males: their croakings and cries seem intended to make the one sex sensible of the presence of the other. The trachea is indeed very short in the Frog; but it is longer in the male than it is in the female, and the rima glottidis is also longer in the former. But in some Frogs the males are distinguished by peculiar membranous bags. Thus, the Green Frog has two cheek-pouches, which are inflated by the animal in the breeding season, by means of two apertures close to the rima glottidis; and the chordæ vocales are very large and distinct in many species. The glottis bears, apparently, considerable analogy to the upper larynx in birds; but in the birds the voice receives its modification only from the edges of the glottis, which shuts the trachea at the point where it opens into the mouth; the sounds being produced by the lower larynx, which is formed at the point of junction of the two branches which constitute the origin of the trachea. When the air-passages of the reptiles emit sounds, they are produced by the single larynx and the glottis: from the absence of moveable lips, and the velum palati, or their inconsiderable development, those sounds cannot be much modified. Nevertheless, the vocal powers of these animals vary very much, according to the varying mechanism manifested in each. The cries of the different species of *Rana*, from the well-known croaking of the Common Frog to the bellowing of the Bull-Frog; the shrill trebles of the species of *Hyla*, of the males especially; the flute-like and metallic sounds occasionally given out, and the sort of seemingly ventriloquous grumbling which some species of Toads exert, are vocal sounds emitted above the larynx—a sort of falsetto or *voce di testa*—from the buccal cavity, or some of the accessory sacs.

Connected with the phænomena of breathing, it should be stated that the naked skin of the Frogs, and indeed of the Batrachians generally, has the power of acting upon the air in such a way as to fulfil, in a great degree, the functions of the lungs, and that aërated water may be made subservient to this cutaneous respiration. The experiments made on frogs which have been kept in vessels, and under water charged with air renewed from time to time, and on toads which have been kept alive for months in nets sunk under running water, at a low temperature, without any direct access to atmospheric air, prove this. These powers, the faculty of enduring long abstinence, their hybernation, and the age (as great as 36 years) to which the *Anourous Amphibia* are said to attain, naturally lead us to the consideration of the stories told of the discovery of toads, 'antediluvian toads' as they were once called, inclosed in solid rocks and in the heart of trees, where they had been supposed to have existed for centuries, deprived of the possibility of access to either food or air, though when found they were alive and vigorous. Nor do these stories rest solely on the doubtful hearsay evidence of uneducated persons. Thus Smellie, in his 'Philosophy of Natural History,' alludes to the account in the 'Memoirs of the Academy of Sciences' for the year 1719, of a toad found alive and healthy in the heart of an old elm; and of another discovered in the year 1731, near Nantz, in the heart of an old oak, without any visible entrance to its habitation. From the size of the tree it was concluded that the animal must have been confined in that situation at least 80 or 100 years. He adds, that in the many examples of toads found in solid rocks, exact impressions of their bodies, corresponding to their respective sizes, were uniformly left in the stones or trees from which they were dislodged; and he asserts that it was said that there existed, when he wrote, a marble chimney-piece at Chatsworth with a print of a toad in it; and that there was a traditionary account of the place and manner in which it was found.

That frogs, toads, snakes, and lizards "occasionally issue from stones that are broken in a quarry, or in sinking wells, and sometimes even from strata of coal, at the bottom of a coal-mine," may be readily admitted; but, as Dr. Buckland well observes, in a paper recording some experiments on this subject—and to these we shall presently allude—"the evidence is never perfect to show that the reptiles were entirely inclosed in a solid rock; no examination is ever made until the reptile is first discovered by the breaking of the mass in which it was contained, and then it is too late to ascertain, without carefully replacing every fragment (and in no case that I have seen reported has this ever been done), whether or not there was any hole or crevice by which the animal may have entered the cavity from which it was extracted. Without previous examination, it is almost impossible to prove that there was no such communication. In the case of rocks near the surface of the earth, and in stone quarries, reptiles find ready admission to holes and fissures. We have a notorious example of this kind in the lizard found alive in a chalk-pit, and brought alive to the late Dr. Clarke." The same author remarks, that the first effort of the young toad, as soon as it has left its tadpole state, and emerged from the water, is to seek shelter in holes and crevices of rocks and trees. "An individual, which when young may have thus entered a cavity by some very narrow aperture, would find abundance of food by catching insects, which like itself seek shelter within such cavities, and may have soon increased so much in bulk as to render it impossible to go out again through the narrow aperture at which it entered. A small hole of this kind is very likely to be overlooked by common workmen, who are the only people whose operations on wood and stone disclose cavities in the interior of such substances."

Without, then, attempting to throw discredit upon the observations published upon this curious subject by authors whose character for veracity is unquestionable,—those of Guettard, in 1771 ('Mémoire sur différentes Parties des Sciences et des Arts,' tom. iv.); of Edwards, 1824 ('De l'Influence des Agens Physiques sur la Vie'); and of Mr. Thomas, in Silliman's Journal, in addition to those above alluded to for example—we may conclude with Dr. Buckland, in his remarks on the last publication, that the several authentic and well-attested cases to be found in such memoirs, "amount to no more than a repetition of the facts so often stated and admitted to be true, namely, that reptiles occur in cavities of stone, and at the depth of many feet in soil and earth; but they state not anything to disprove the possibility of a small aperture by which these cavities may have had communication with the external surface, and insects have been admitted. The attention of the discoverer is always directed more to the toad than to the minutiæ of the state of the cavity in which it was contained."

Dr. Buckland made some experiments on this subject which he commenced in November, 1825. He caused 12 circular cells to be prepared in a large block of coarse Oolitic Limestone, from Heddington quarry, near Oxford. Each cell was about 1 foot deep, and 5 inches in diameter, and had a groove or shoulder at its upper margin, fitted to receive a circular plate of glass, and a circular slate to protect the glass; the margin of this double cover was closed round, and rendered impenetrable to air and water, by a luting of soft clay. Another block of compact silicious sandstone (Pennant Grit, of the Bristol coal-formation) was made to contain 12 smaller cells, each 6 inches deep and 5 inches in diameter, and each under the same double cover as the first-mentioned cells. A live toad was placed in each of these 24 cells on the 26th November, 1825, and the double cover of glass and slate was placed over each of them, and cemented down by a luting of clay. Dr. Daubeny and Mr. Dillwyn, who were present, ascertained and noted the weight of each toad (they had all been imprisoned together in a cucumber frame, some of them for two months previously), as it was immured. The largest weighed 1185 grains; the smallest 115 grains; and they were distributed equally, small and large, among the Limestone and Sandstone cells. The blocks were buried in the earth of Dr. Buckland's garden, 3 feet deep. On the 10th of December, 1826, these blocks, which had remained unopened from the period of their inhumation, were examined. Every toad in the smaller cells of the Sandstone block was dead, and so much decayed, that they must have been dead for some months. The greater part of those in the larger cells of the oolitic block were alive. No. 1, which weighed when placed in its cell 924 grains, was reduced to 698 grains. No. 5, whose weight at the same period was 1185 grains, had increased, it is asserted to 1265 grains. Dr. Buckland observes, that the glass cover over this toad's cell was slightly cracked, so that minute insects might have entered; but none were discovered therein. In another cell, the glass of which was broken, and its tenant dead, there was a large assemblage of minute insects; and a similar assemblage was observed also on the outside of the glass of a third cell. In the cell, No. 9, a toad which weighed at its entrance 988 grains, had increased to 1116 grains. The glass cover of this cell was entire, but the luting that secured it was not attentively examined; and Dr. Buckland observes, that it is probable that there was some aperture by which small insects found admission. No. 11 had decreased from 936 to 652 grains.

The result of Dr. Buckland's experiments was, that all the toads, both large and small, inclosed in Sandstone, and the small toads in the Limestone, were dead at the end of 13 months, a fate which befel all the large ones also, before the expiration of the second year: these last were examined several times during the second year, through the glass covers of their cells, but without removing them to admit air; they appeared always awake, with open eyes, and never in a state of torpor; but at each successive examination they became more and more meagre, till at last they were found dead. The two toads which when first examined had increased in weight, and were at the end of the first year carefully closed up again, were not exempt from the common annihilation, but were emaciated and dead before the expiration of the second year.

When Dr. Buckland inclosed these toads in stone, he at the same time placed four other toads, of moderate size, in three holes cut for that purpose, on the north side of the trunk of an apple-tree. Two were placed in the largest cell, and each of the others in a single cell, the cells being nearly circular, about 5 inches deep and 3 inches in diameter. These were carefully closed with plugs of wood, so as to exclude access of insects, and were apparently air-tight. Every one of the toads thus 'pegged' in the knotty entrails of the tree was found dead and decayed at the end of the first year.

Four toads were, at the time the others were shut up, each placed in a small basin of plaster of Paris, 4 inches deep and 5 inches in diameter, having a cover of the same material luted over them: these were buried at the same time and in the same place with the blocks of stone, and on being examined at the same time with them, in

December, 1826, two of the toads were dead; the other two alive, but greatly emaciated.

Dr. Buckland concludes from the experiments generally, that toads cannot live a year excluded totally from atmospheric air; and from the experiments made in the larger cells in the Oolite, that there is a probability that those animals cannot survive two years entirely excluded from food. ('Zoological Journal,' vol. v. p. 314.)

Absorption of Air and Water, Exhalation, and Transpiration.—A rapid process of absorption and evaporation of fluids, by the pores of the skin, gives to the *Anourous Amphibia* the power of resisting heat. If a frog be plunged into water, of a temperature of 40° Centigrade (104° Fahr.), it will not, it is asserted, live more than two minutes, though the head be left out so as to enable it to respire freely; yet a frog will sustain the action of humid air heated to the same temperature, for four or five consecutive hours. A sudden transition, however, from a low temperature to a high one, is generally speedily fatal to these animals. Their proper balance of animal heat is kept up by a regulation of the evaporation of liquid absorbed, or by the transpiration of the matter, the quantity of which is augmented in proportion as the external heat is more intense; and the animal resists it as long as the moisture is not desiccated by the air. When it can no longer repair the loss of the moisture already taken up, by a fresh absorption of liquid, it perishes. The Frogs, in this particular of their organisation, have been compared to the vessels which in Spain are called Alcarazas, used for cooling water, by the transudation permitted by their porous structure. Dr. Townson, who made observations to some extent upon this subject, and had two frogs, which he named Damon and Musidora, found that a frog would sometimes absorb in half an hour as much as half its own weight in water, and, in a few hours, nearly its entire weight. When the animal so filled was placed in a warm and dry situation, it gave off this fluid nearly as rapidly as it had accumulated it. He contends that the Frog Tribe never drink, and general observation goes to prove that the Frogs, Tree-Frogs, and Salamanders do not swallow liquids, being supplied by the process before mentioned. The meagreness of some of these animals, in a state of comparative desiccation, and their apparent plumpness after they have renewed their supply of moisture, is very striking. If, when so supplied, they are suddenly surprised, they can get rid of their load instantaneously. Few who have come on a frog by surprise, in a moist meadow, have not observed that, during its first leap, it emits a quantity of liquid from its vent. "Whatever this fluid may be," says Dr. Townson, "it is as pure as distilled water and equally tasteless. This I assert as well of that of the toad, which I have often tasted, as that of frogs." This fluid is the liquid absorbed, by the skin of the abdomen principally, and for which toads and frogs are ever on the look-out. The dew on the herbage is a frequent source of this necessary supply, and in dry seasons toads will bury themselves in moist sand or earth for the purpose of sucking up through their skin any aqueous particles which may be around them. The fluid is contained in a sac, generally consisting of two lobes, situated in the lower part of the abdomen under the viscera, and is conducted to the receptacle by particular vessels, which are certainly not the ureters or urinary canals from the kidneys: these urinary canals have their exit lower down in the cloaca. Blumenbach, and even Cuvier, in his 'Leçons d'Anatomie Comparée,' considered this bilobated bag as the urinary bladder in the frog and toad; but Townson shows that it has no connection with the ureter, which, as we have seen, has its posterior opening lower down in the cloaca, while these receptacles terminate in the front of that intestine.

Brain, Nervous System, and Senses.—The brain and nervous system of the *Anourous Amphibia* are, as in the Reptiles generally, composed of an encephalon consisting of a cerebrum, cerebellum, and medulla oblongata; a spinal cord; and the nerves which are given off from these sources to the different organs of the body. So far the system is modelled upon that of Mammiferous Animals and Birds, but the cerebellum is proportionally much less. The Reptiles have also a ganglionary nervous system, or a great double sympathetic nerve.

Touch.—The naked skin and its sensibility to variations of temperature would seem to indicate a considerable degree of perception, as to the physical and even chemical nature of the bodies with which it comes in contact. But touch, properly so called, can hardly exist in a high state of development in the greater part of the *Anourous Amphibia*. They have, indeed, no nails on their toes, which are much longer in the frogs than in the toads; and in many of the genera and species the toes are terminated by fleshy appendages, as in *Pipa*, which has also an elongated fleshy muzzle; the Tree-Frogs (*Hyla*) also, have the extremities of their toes dilated into fleshy disks, which, like the acetabula of the *Sepiadæ*, adhere by their circumference. These enable the animals to walk in all directions upon flat surfaces, and to adhere to them even when they are of the smoothest nature. The sense of touch is probably more highly developed where this organisation is manifested.

Taste.—Probably not at all acute. The tongue, as we have seen, is an organ for the capture of the prey, which is swallowed entire almost in the same moment that it is taken.

Smell.—This sense would seem to be almost rudimentary in the *Amphibia*. A simple opening pierced from the end of the muzzle to the front of the palate, with a fleshy and concave membrane at its external extremity, moving in unison with the respiratory action, is strongly contrasted with the intricate and beautiful structure of the nasal organs which are so highly developed in the Carnivorous Mammalia and Birds.

Hearing.—There is a considerable difference in the structure of the organ of hearing among the *Anourous Amphibia*. The *Pipa*, for instance, has a sort of small valve upon the tympanum, somewhat similar to that possessed by the crocodiles, and probably intended to protect the membrane against the pressure of the water when the animal resorts to great depths. *Hyla* and *Rana* have the tympanum distinctly manifested by the delicacy of its structure when compared with the other integuments of the head. In the Toads the tympanum is not apparent. Examples of the structure of the ear may be seen in some of the preparations in the museum of the College of Surgeons.

Sight.—The precision with which a Toad measures the distance of an insect, and captures it with its tongue the moment the victim is within reach of that organ, shows a high and accurate development of the organs of sight, as applicable to short distances at least. The pupil is, in general, round, but in the *Anourous Amphibia* whose habits are nocturnal (the toad, for instance) it is angular or linear. The humours vary in their proportions in the different genera, but the crystalline humour has been noticed of greater density and of a more spherical figure in the aquatic species. The orbits are generally incomplete, and sometimes protected, as in *Ceratophrys*, by folds of thickened cuticle.

Reproduction.—The special reproductive tissues of the male in the *Anourous Amphibia* are situated in the cavity of the abdomen below the kidneys, and the deferent canals terminate in the cloaca. The ovaries in the females are found in the same situation with the corresponding parts in the males, and are of considerable volume. Their free extremity forms a sort of trumpet-shaped opening, and the oviduct terminates in the cloaca, whence the eggs are excluded. Blumenbach describes the Frogs of his country as having a large egg-cavity, divided by an internal partition into two parts, from which two long convoluted oviducts arise, and terminate by open orifices at the sides of the heart. The ovaria, he says, lie under the liver, so that it is difficult to conceive how the eggs get into the above-mentioned openings. The egg-cavity, he adds, opens into the cloaca. The Toads, according to him, have not a large egg-cavity; but their oviducts terminate by a common tube in the cloaca.

At the season of reproduction, besides the vocal manifestations, there are others which visibly distinguish the male in many of the *Amphibia*. At each croak, the male Green Frogs project from the commissure of the mouth two globular bladders into which the air is introduced, and the throat swells and becomes coloured. In the males of the Red Frog the thumbs of the anterior feet become considerably swollen and covered by a black and rugose skin at this period. The eggs are not fecundated until after they have been extruded into the water. These eggs are enveloped in a sort of delicate, mucous, permeable membrane; they are, when excluded, most frequently agglomerated either in glutinous masses or chaplets, and increase considerably after they are plunged in the water. There are however some curious modifications of the disposition of the eggs in certain species of the *Anourous Amphibia*. In the Toad, called by Laurenti from its habits *Bufo obstetricans*, the male, for instance, after the exclusion of the eggs, takes up the chaplets, and disposes them round his thighs, something in the form of a figure of 8. He is then said to carry them about till the eyes of the embryo become visible. At the proper period for hatching, he conveys his progeny to some stagnant piece of water, and deposits them, when the eggs break and the tadpoles come forth and swim about. The male *Pipa*, or Surinam Toad, as soon as the eggs are laid, places them on the back of the female, and in that situation they become fecundated. The female [see figures] then takes to the water, and the skin of her back swells, and forms cellules, in which the eggs are hatched, and where the young pass their tadpole state, for they do not quit their domicile till after the loss of their tail and the development of their legs. At this period the mother leaves the water, and returns to dry land.

Swammerdam gives the number of eggs in a female frog as 1400, and M. de Montbeillard counted 1300. In these eggs there is a greenish albumen which is not easily coagulable. The yolk or vitellus is absorbed by the embryo, and an abdominal cicatrix indicates the umbilicus in young individuals. It is not rare to meet with double germs in a single egg, but most of these prove abortive, though some produce monsters with two heads, six legs, and two tails, as well as hermaphrodites. In our climates, the early part of the spring is the season of mating, when the frogs and toads of both sexes quit the localities of their late hybernation and their ordinary haunts, and move instinctively to those stagnant waters which are proper for their purpose, and where they are then collected in swarms.

The young of the *Amphibia* enter life under an entirely different form from that which they are afterwards to assume; and undergo, like the insects, a series of metamorphoses or transformations, till they arrive at their perfect state. In their first stage, the young have an elongated body, a laterally compressed tail, and external branchiæ;

their small mouth is furnished with horny hooks or teeth for the separation of vegetable matter, and they have a small tube on the lower lip by which they attach themselves to aquatic plants, &c. The external branchiæ next disappear, and become covered with a membrane, being placed in a sort of sac under the throat; and the animal then, as we have observed when treating of its respiration, breathes after the manner of fishes. The head, which is furnished with eyes and nostrils, is confounded with the large globular trunk distended with the great extent of the digestive canal, and it has a large tail for swimming. In this state it is called in English a *Tadpole*, and in French *Têtard*, from the great apparent volume of the head. Soon the posterior limbs are gradually put forth near the origin of the tail, and are developed first; the anterior feet then begin to show themselves; the tail gradually becomes less and less, shortens, shrinks, and seems at last to be absorbed; the mouth widens, and loses its horny processes or jaws; the eyes are guarded by eye-lids; the belly lengthens and diminishes in comparative size; the intestines become short; the true lungs are developed, and the internal branchiæ are obliterated; the circulation undergoes an entire change; and the animal, hitherto entirely aquatic and herbivorous, becomes carnivorous, and for the most part terrestrial.

Mr. Thomas Wharton Jones ('Zool. Proc.,' March, 1837) observes, that when the right gill of the Tadpole disappears, it is not, as is usually supposed, by the closure of the fissure through which it protrudes, but by the extension of the opercular fold on the right side towards that of the left, forming but a single fissure, common to the two branchial cavities, through which the left gill still protrudes. He also remarks, that conditions analogous to those which occur during several stages of this process exist in the branchial fissures of the Anguilliform genera, *Sphagebranchus*, *Monopterus*, and *Synbranchus*.

Particular Excretions.—The alleged venom of the Common Toad, so long a subject of popular belief, had been rejected by many modern naturalists, among whom Cuvier may be particularly mentioned. Dr. Davy, however, found the venomous matter to be contained in follicles, chiefly in the true skin and about the head and shoulders, but also distributed generally over the body and on the extremities. Pressure causes this fluid to exude or even spirt out to a considerable distance, and a sufficient quantity may be thus collected for examination. Dr. Davy found it extremely acrid when applied to the tongue, resembling the extract of aconite in this respect; and it even acts upon the hands. With a small residuum it is soluble in water and in alcohol; acetate of lead and corrosive sublimate do not affect the solutions. It remains acrid on solution in ammonia; and when dissolved in nitric acid, it imparts a purple colour to it. Combined with potash or soda, it becomes less acrid, apparently in consequence of partial decomposition. It is highly inflammable as left by evaporation of its aqueous or alcoholic solutions; and the residuum which appears to give it consistence seems to be albumen. More acrid than the poison of the most venomous serpents, it produces no ill effect when introduced into the circulation. A chicken inoculated with it was not affected. Dr. Davy conjectures that this 'sweltered venom' is a defence to the Toad from carnivorous animals; and we have seen a dog, when urged to attack one without hesitation, drop the animal from its mouth in a manner that left no doubt that he had felt the effects of this excretion, which Dr. Davy thinks may be auxiliary in decarbonising the blood.

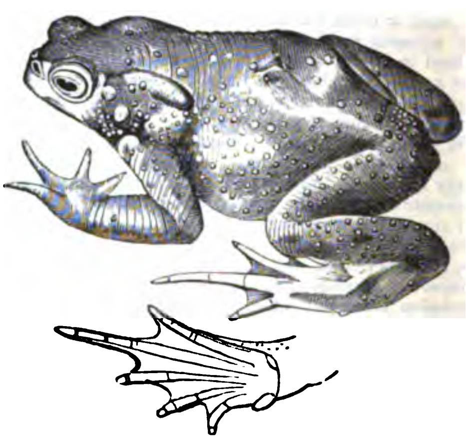
The Toads are also said to possess, besides, two glandular masses (parotids), which, when pressed, exude through small holes a yellowish thick humour of a musky odour. The other odours also which many species of Toads produce, it does not seem yet ascertained from what source, are very remarkable. Roesel, author of the beautiful work on Frogs, compares some of these to the smell of garlic or of volatilised vapour of arsenic, or even ignited gunpowder; others again, he says, produce an effect on the nose like the vapour of horse-radish, mustard, or the leaves of monk's-hood rubbed between the fingers. In one instance only he states it to be probable that this emanation comes from the cloaca; and such seems to be the opinion of M. Duméril, who states that he has been assured that, in certain instances, the water in which some of these animals had been placed and there purposely irritated or excited, had become so acrid that the tadpoles of frogs and salamanders introduced therein hardly survived the immersion.

Geographical Distribution and Habits.—Warm and temperate but moist climates are the localities most favourable to the *Anourous Amphibia*. Extreme cold is fatal to them, and so is extreme dry heat. They are unable to sustain violent and sudden changes of temperature. In moderately warm climates, and those where there is a considerable degree of cold during a part of the year, they bury themselves, in winter, either under the earth or in the mud at the bottom of the water, and there pass the season of hybernation without taking food or air, till the spring calls them forth; when the same frog which had passed so many months without respiration would expire in a few minutes if prevented from shutting its mouth and so supplying itself with air by deglutition. The general habits of the tribe may be collected from the different sections of this article, and from the descriptions of those forms in it which may be noticed in the course of this work.

The following cuts will convey to the reader an idea of some of the leading forms among the *Anourous Amphibia* in their adult state:—

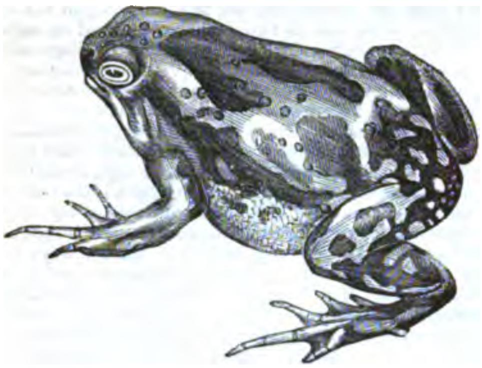
Marsh Frog (*Rana palustris*). Two-thirds natural size. Europe.

Ceratophrys granosa. Two-thirds natural size. America.

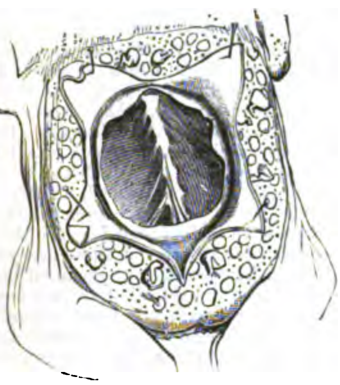


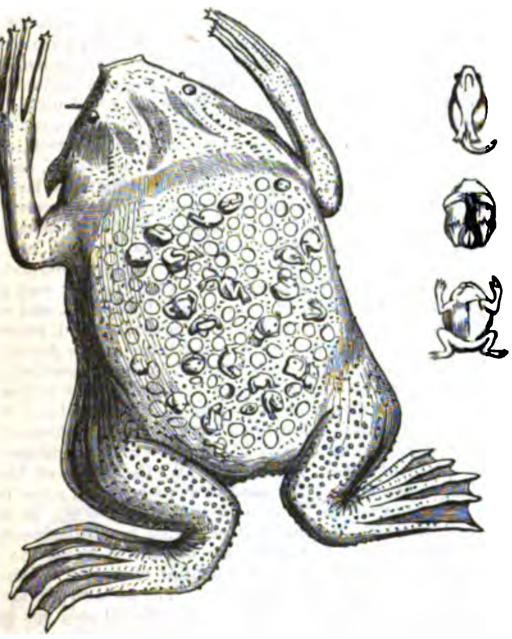
Common Toad (*Bufo vulgaris*). Half natural size. Europe. With an under view of the foot.

Hyla bicolor. Half natural size. South America.



Engystoma marmoratum. India.





Pipa monstrosa, Laurenti (*Asterodactylus*, Wagler), Surinam Toad, female, reduced. The upper figure shows the disposition of the cells, and their situation in the skin, which is turned back, and the muscle seen below. The small separate figures are Tadpoles, in different stages of development.

Oxyrhynchus bicolor. South America.

Messrs Duméril and Bibron ('Erpétologie') make the Bufoniform Family of the ***Anourous Amphibia*** (***Anoures Phanéroglosses***) consist of the following genera :—

Dendrobates, Wagl. (***Hylaplesia***, Boie, Tschudi.) Example, ***Dendrobates tinctorius.*** (Cayenne.)

Rhinoderma Dum. and Bibr. Example, ***Rhinoderma Darwinii.*** (Chile.)

Atelopus, Dum. and Bibr. Example, ***Atelopus flavescens.*** (Guyana.)

Bufo, Laur. Example, ***Bufo vulgaris***, the Common Toad. (Europe, Japan.) Messrs. Duméril and Bibron record 18 species of this genus.

Phryniscus, Wieg. (***Chaunus***, Tschudi.) Example, ***Phryniscus nigricans***, Wieg. (Montevideo.)

Brachycephalus, Fitzing. (***Ephippifer***, Coct.) Example, ***Brachycephalus ephippium***, Fitzing. (Brazil, Guyana.)

Hylædactylus, Tschud. Example, ***Hylædactylus baleatus.*** (Java.)

Plectropus, Dum. and Bibr. Example, ***Plectropus pictus.*** (Manilla.)

Engystoma, Fitzing. (***Microps***, Wagl.; ***Stenocephalus***, Tschudi.) Example, ***Engystoma ovale.*** (Surinam, Buenos Ayres.)

Uperodon, Dum. and Bibr. Example, ***Uperodon marmoratus.*** (Montavalle, Indian Peninsula.)

Breviceps, Merrem (***Engystoma***, part, Fitzing.; ***Systoma***, Wagl., Tschudi). Example, ***Breviceps gibbosus.*** (South Africa, near the Cape of Good Hope.)

Rhinophrynus, Dum. and Bibr. Example, ***Rhinophrynus dorsalis.*** (Mexico.)

Geographical Distribution of the Family.—**Messrs. Duméril and Bibron state that the number of species of the Bufoniform Family known to them (1841) was 35, a much less number than that of the Raniform Family, which includes 51, and less still than the Hyliform, or Tree-Frog Family, which comprises 64.**

Nevertheless, observe these excellent herpetologists, species of this family exist in all the five parts of the world, where they are distributed in a manner not less unequal than the Raniform and Hyliform species, and always with a greater proportion for America, whilst the smallest portion of them belong to Europe, which has not even a single species peculiar to itself; for the two there found, the Common Toad and the Green Toad (*Bufo viridis*, Laur.), also inhabit Africa and Asia, which produce moreover, the one *Bufo pantherinus* and *Breviceps gibbosus*, the other *Plectropus pictus*, *Engystoma ornatum*, *Hylædactylus baleatus*, *Uperodon marmoratum*, and *Bufones cruentatus*, *scaber*, *biporcatus*, *isos*, and *asper*.

Oceania, which after America is, they observe, best furnished with Hyliform species, and where two of the Raniform Family are found, has not hitherto yielded more than a single Bufoniform species, namely, *Phryniscus Australis*.

America, besides six species of *Bufo*, namely, *strumosus*, *melanotis*, *musicus*, *Americanus*, *margaritifer*, *d'Orbignyi*, and *Leschenaultii*, furnishes *Dendrobates tinctorius*, *obscurus*, and *pictus*; *Rhinoderma Darwinii*; *Atelopus flavescens*; *Phryniscus nigricans*; *Brachycephalus ephippium*; and *Engystomata ovale*, *Carolinense*, *rugosum*, and *microps*.

Mr. Darwin, speaking of the Fauna of the Galapagos Archipelago, says: "Of snakes there are several species, but all harmless. Of toads and frogs there are none. I was surprised at this, considering how well the temperate and damp woods in the elevated parts appeared adapted to their habits. It recalled to my mind the singular statement made by Bory St. Vincent, namely, that none of this family are to be found on the volcanic islands in the great oceans. There certainly appears to be some foundation for this observation, which is the more remarkable when compared with the case of lizards, which are generally among the earliest colonists of the smallest islet. It may be asked whether this is not owing to the different facilities of transport through salt-water of the eggs of the latter, protected by a calcareous coat, and of the slimy spawn of the former." ('Journal.')

Urodèles, or Tailed Amphibia.

Under this designation the following genera are included :—*Pleurodèles*, Waltè.; *Bradybates*, Tsch.; *Salamandra*, Linn.; *Pseudosalamandra*, Tsch.; *Ambystoma*, Tsch.; *Onychodactylus*, Tsch.; *Plethodon*, Tsch.; *Cylindrosoma*, Tsch.; *Œdipus*, Tsch.; *Salamandrina*, Fitz.; *Geotriton*, Bonap.; *Hemidactylium*, Tsch.; *Cynops*, Tsch.; *Hynobius*, Tsch.; *Pseudotriton*, Tsch.; *Triton*, Laur.; *Xiphonura*, Tsch.; *Megalobatrachus*, Tsch. (*Sieboldia*, Bonap.); *Andrias* (fossil) Tsch.; *Menopoma*, Harl.; *Siredon*, Wagl. (*Axolotl*); *Amphiuma*, Gard.; *Menobranchus*, Harl.; *Hypochton*, Merr. (*Proteus*); *Siren*; and many others.

Skeleton.—**The skull of the Terrestrial Salamander (*Lacerta Salamandra*, Linn.; *Salamandra terrestris*, Aldr. and Ray) is well described by Cuvier as being nearly cylindrical, widened in front in order to form the semicircular face, and behind for the two crucial branches resembling those of the frogs, and containing the internal ears. But though the composition of the head resembles that of the frogs in the back and under parts, it differs remarkably in other parts: there is no girdling bone (*os en ceinture*), and the only representation of the ethmoïd bone appears in a membranous state.**

Above, the cranium is divided nearly equally between the two frontal and the two parietal bones. The anterior part of the frontal bones is articulated forwards with the bones of the nose, and, laterally, with

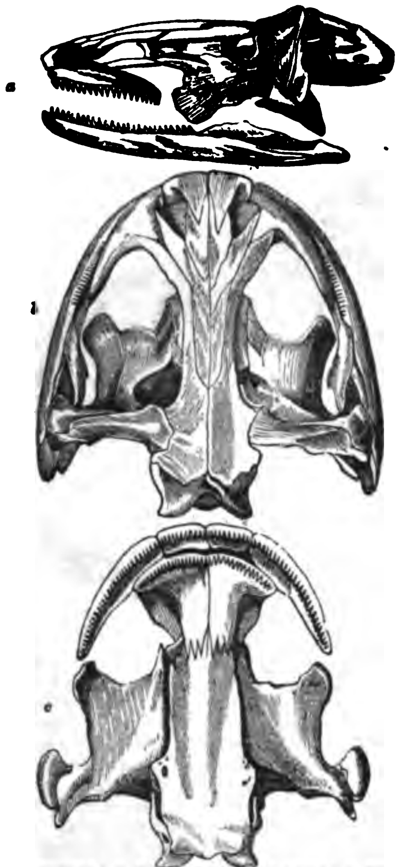
the anterior frontal bones. The apophyses rising from the intermaxillary bones are very large, which places the external osseous nostrils very far apart. The nasal bone is placed on the upper part of each of them, between the intermaxillary, the frontal, the anterior frontal, and the maxillary bones. The anterior frontal bone occupies the cheek in front of the anterior angle of the orbit, but does not descend into the cavity, the anterior wall of which is simply membranous. Cuvier believed that he saw a very small lachrymal bone at the external angle of the anterior frontal bone. The dental part of the upper maxillary bone is carried backwards as usual, but without forming a junction with either the pterygoïd or jugal bones. Cuvier found only two occipital bones, as in the other Batrachians, and each of them was intimately united with a part analogous to the os petrosum (*rocher*). A great round hole serves for the entry to the vestibule, and consequently to the fenestra ovalis. In the living animal it is closed by a cartilaginous plate, without any stem, and entirely hidden under the muscles. To this bone, which occupies the place of both the occipital, lateral, and petrous bones, are attached three others, the lower of which (the pterygoïd), with its triangular figure, brings to the mind of the observer the three branches of which it is formed in the frogs. Its anterior angle, as has been stated, does not reach the maxillary bone, and is only connected to it by a ligament; neither does the internal angle reach the sphenoïd bone: the external angle exists under the second of the three bones here noticed, namely, the intermediate bone—that to which belongs the facet for the articulation of the jaw. This bone, Cuvier remarks, is very difficult to define; and he further says that he shall perhaps be considered very rash if he names it the jugal bone, for, far from being placed horizontally, and going forwards to join the maxillary, it lies transversely on the posterior border of the pterygoïd bone; nevertheless, there is a ligament which unites it to the posterior point of the maxillary bone. The third and upper of these bones lies upon the preceding, and in the same direction; it is oblong and flat, and is attached by its internal extremity upon the lateral occipital bone, without reaching to the parietal. Supposing the jugal bone to be well named, this would be the tympanic bone; and, in fact, if the little plate which covers the fenestra ovalis had a handle (*manche*), it would pass behind the bone of which we speak, as in the frogs it passes behind the tympanic bone.

Below there is only a single sphenoïd bone, which is oblong. Two large triangular bones, which are manifestly analogous to those named vomers by Cuvier in the frogs, form the flooring of the nostrils below, and give off each a slender apophysis, which extends backwards under the sphenoïd parallel to its correspondent. It is to these bones and to their apophyses that the two longitudinal rows of the palatal teeth of the Salamanders adhere. Between the anterior part of these bones, behind the intermaxillaries, is a large oval space, which is filled by the membrane of the palate only; their posterior and dentary apophysis extends nearly as far backwards as the sphenoïd bone. Perhaps, observes Cuvier, it is divided at certain periods into two by a suture, and a palatine bone may then be distinguished, but he had not been able to perceive one. There is in the orbit, at its anterior wall, a great membranous space between the maxillary bone, the anterior frontal, and the vomer; and it is at the bottom of this space, and in a notch of the vomer, that the internal nostril is pierced on each side. The bottom of the orbit, on the side of the cranium, between the frontal and parietal bones on one side, and the vomer and sphenoïdal bones on the other, is occupied by an oblong bone in which the optic hole is pierced, and which can only answer to the orbital wing of the sphenoïdal bone. It is this part which is membranous in the frogs, and has no existence in the serpents, in which the parietal and frontal bones each supply it by halves; here it is elevated to the state of a particular bone. The two occipital condyles are very much separated from each other, and placed at the two sides of the occipital hole.

The cranium of the European Aquatic Salamanders differs in general from that of the Terrestrial in having the entire head more oblong, the external nostrils more approximated, the space between the vomers a simple small hole, the pterygoïd bone a mere plate, wide behind and pointed before, &c. They also differ among themselves.

The os hyoïdes is subject to changes in the Salamanders, as in the frog. In its larva state it has two hyoïdian branches springing from the occipital bones, uniting forwards under the lower jaw, and a cartilaginous branchial apparatus suspended at the point of union of those branches, and supporting four arches on each side, the first of which is attached to an intermediate stem, the three following to a second two-jointed stem, and these two pairs of stems to an unequal branch, as is more clearly manifested in the *Axolotl*. The adult Aquatic Salamanders preserve in the bony state the branches which still are attached below the fenestra ovalis, and terminate forward by a truncation under the middle of the lower jaw; but the anterior articulation of these branches is now become membranous. The unequal stem, in the bony state, supports on each side an osseous branch consisting of two joints, terminated by a cartilaginous point, and moreover, internally, another branch which is simple and reduced to a filament, which goes from the unequal stem to the second articulation of the external branch. In the Terrestrial Salamander, which can only pass a very short time in the larva state, all remains cartilaginous. The two suspensive branches or anterior horns are delicate and flat, and do not join the cranium; and the unequal stem with its two branches soldered on each side by their two ends, forms only a single chevron-shaped cartilage, each branch of which is pierced with a considerable gap. This remainder or vestige of the branchial apparatus does not prevent the co-existence of a larynx and the rudiment of a sternum; both indeed weak and membranous rather than cartilaginous. The shoulder of the Salamander is very curious on account of the close junction of its three bones into a single one, which has the glenoïd fosset at its anterior edge, sends towards the spine a square lobe slightly enlarged above, which is the omoplate, and towards the breast a rounded disk, slightly lobated, which is composed of the clavicle and coracoïd bone, where a suture which separates them may for a long time be observed, and where there always remains a small hole. The omoplate has its spinal edge augmented by a cartilaginous prolongation. The cleido-coracoïd is also surrounded with a great cartilaginous blade in form of a crescent, which crosses upon its congener under the breast; for the only vestige of a sternum remaining is a cartilaginous blade placed behind the two preceding, and which represents the xiphoïd. The atlas of the Salamander is articulated with the head by two concave facets, and with the second vertebra by the face of its body, which is also concave; for, contrary to the case of the frogs and lizards, all the anterior faces of the bodies of the vertebræ are convex in the Salamanders, and all the posterior faces concave; the upper part is flat. The articular apophyses are horizontal, and united on each side by a crest, which, joined to that of the other side, gives to the vertebra a sort of roof which is rectangular, but with its lateral borders a little re-entering. The posterior parts of a vertebra lie on the anterior parts of that which follows it. In lieu of spinous apophyses, there is only a slight appearance of a longitudinal ridge. The body of the vertebra, which is cylindrical and narrowed in its middle, adheres under the roof above noticed. The transverse apophyses also adhere under the lateral crests, are directed slightly backwards, and divided by a furrow on each of their faces, so that their extremity has as it were two tubercles for carrying those into which the base of the small rib is divided. These small ribs adjoin all the cervical, dorsal, and lumbar vertebræ, except the atlas, but are only two or three lines in length, and are far from surrounding the trunk or reaching the sternum. Among the Aquatic Salamanders, the *Triton Gesneri* has the crest of the dorsal vertebræ more elevated and sharp than the Terrestrial Salamander; this crest is also rather more developed in *Triton alpestris*, and even in *Triton punctatus* and *Triton palmatus*; but what, adds Cuvier, is very singular, it is precisely in *Triton cristatus* that this crest is most effaced, and the upper part of the vertebra nearly plain. The vertebræ of the tail (25 or 26 in number) in the Terrestrial Salamander have crests and transverse apophyses like those of the back; they become smaller and smaller, and, counting from the third caudal, there is under the body a transverse blade directed obliquely backwards, pierced with a hole at its base, which represents the chevron-bones of the lizards and the other long-tailed genera. Cuvier counted 33 caudal vertebræ in the *Triton alpestris* and *Triton cristatus*, 34 in *Triton Gesneri*, and 36 in *Triton punctatus*. They form, he observes, a tail flattened laterally, in consequence of the elevation of their upper and lower crests. The bones of the limbs are, says Cuvier in continuation, proportioned to the smallness of the members themselves. The humerus has, above, a round head; a little lower, forwards, there is a compressed and obtuse tuberosity; and backwards, a little lower still, another very pointed one. Its lower head is flattened from before backwards, and widened to suit the condyles, between which is an articular head, rounded for the fore-arm, and above, forwards, a small fosset. The Aquatic Salamander has this bone more widened above than the Terrestrial species. The fore-arm is composed of two separate bones. The radius has a round upper head, a narrowed body, and a compressed and widened lower head. The cubit is more equal in size, and its olecranon is very short and rounded. The carpus has 5 bones and 2 cartilages which occupy the place of bones, 7 pieces in all: the whole of these are flat, angular, disposed in a pavement-like order, and in some respects announce the structure to be seen in the *Icthyosaurus*. In the first rank are two, of which the smallest or radial is cartilaginous. The greatest belongs to the radius and ulna; between them on the second rank is a single one; then come, on the third rank, four for the metacarpals. The first remains cartilaginous. The metacarpals are short, flat, and narrowed in their middle. Cuvier found only one phalanx ossified on the first finger, two on the second and fourth, and three on the third. The variety of points by which the pelvis is attached to the spine is, he remarks, a very singular thing. He had individuals of the Terrestrial Salamander in which it was suspended from the 15th vertebra (counting in the atlas), and others in which it was suspended from the 16th; and he refers to a specimen (species undetermined) seen by M. Schultze, in which it was suspended on one side to the 16th vertebra, and on the other to the 17th. With regard to the Aquatic Salamanders, Cuvier found it constantly suspended to the 14th in *Triton palmatus* and *Triton alpestris*, to the 15th in *Triton punctatus* and *Triton Gesneri*, and to the 17th or 18th in *Triton cristatus*. He had an individual of the last-named species, in which it was suspended on one side to the 17th vertebra, and on the other to the 18th. The pelvis itself is quite differently formed from that of the frogs. The vertebra which supports it is like those which precede it, and has, like them, on each side a small rib, at the extremity of which the os ilii is suspended by a ligament. It is cylindrical, and widens a little on arriving at the cotyloïd cavity. The pubis and ischium are soldered

Vertebræ of *Sieboldia*.

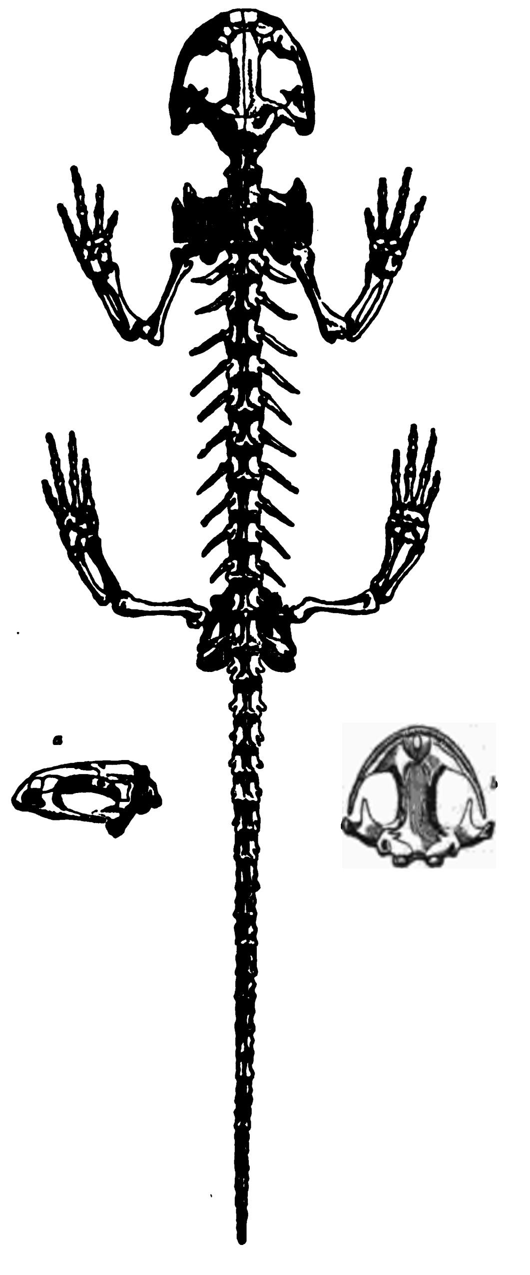


Skull of *Menopoma*; *a*, in profile; *b*, from above; *c*, from below.

Skull of *Sieboldia*, seen from below.

together, and form, with those of the other side, from which they are distinct, a large disk, concave above, flat below, cut square in front and at the anterior parts of the sides, notched laterally and narrowed behind the cotyloïd fossæ, and terminated backwards in a concave arch.

Fore-hand of *Sieboldia*.



Skeleton of Terrestrial Salamander. *a*, Skull in profile; *b*, from below.

The pubis remains cartilaginous much longer than the ischium, with which it is united by a suture which makes a cross with the symphysis, and in front of this symphysis is a cartilage in the form of a Y in the muscles, which recalls to the observer the marsupial bones of

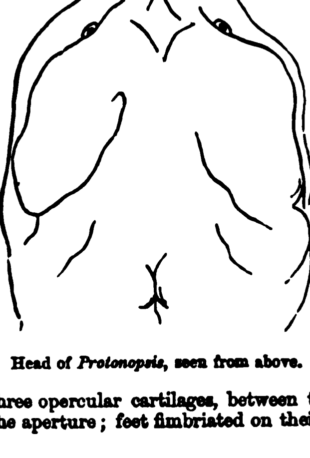
Opossums. The upper head of the femur is oval; at the internal face of the neck, there is a very pointed apophysis, occupying the place of a trochanter: the lower head is widened and flattened from before backwards. There are two bones in the leg. The tibia, which is very stout upwards, has in front a ridge, which detaches itself from the upper part of the bone in the form of a slender stem, resembling the vestige of a fibula discernible in various Rodents, but this does not prevent the development of a true fibula as large as the tibia, and which descends a little lower. There are 9 tarsal bones, all flat and disposed in a pavement-like order: the lower rank has 5 for the five metatarsal bones; the four others consist of one small (the tibial) at the internal border, one great (the fibular) at the external border, an oblong one between them, placed obliquely and answering to the tibia and fibula, and one square in the middle of all the others. Cuvier found but one phalanx on the first finger, two on the second, three on the third and fourth, and two on the last.

Reproduction of Parts.—The power of reproducing excised or injured parts has been observed in no family among the reptiles more carefully than in the *Tailed Amphibia*. Plateretti, Spallanzani, Murray, and others have recorded their observations with respect to this power; and Bonnet particularly has given most accurate descriptions and figures of his careful experiments. The arms or thighs of Tritons amputated sometimes on one side, sometimes on the other, or both on the same side, were constantly reproduced, and the toes were again gradually formed and endowed with motion. The tail, too, cut off at various points, was renewed, pushing out by little and little from the amputated base. In one case the same limb was reproduced four times consecutively in the same animal. Bonnet found that this reproduction was favoured by heat and retarded by cold. He observed that the parts of excised limbs were often reproduced with remarkable alterations, either of defect or excess; the deficiency or exuberance of certain parts taking upon themselves very singular forms. In many species of Tritons the long bones of the limbs detached from their principal articulation, and remaining suspended by some points which still caused them to adhere to the flesh, were found completely consolidated in a few days. The most extraordinary observation was that consequent on the total extirpation of the eye, which was entirely reproduced and perfectly organised at the end of a year. Dufay has recorded their faculty of remaining frozen up in ice for a long period without perishing.

Their tenacity of life was strongly shown in an experiment made by M. Duméril. Three-fourths of the head of a *Triton marmoratus* was removed with a pair of scissors. The mutilated animal was placed by itself at the bottom of a large glass vessel in fresh water about half an inch deep, and which was carefully renewed at least once a-day. The animal, although deprived of the four principal senses, without nostrils, without eyes and ears, and without a tongue, continued to live and move slowly. Its only communication with externals was carried on by touch alone. M. Duméril relates that it was evidently conscious of existence, and walked slowly and cautiously. It raised the stump of its neck towards the surface of the water, and during the first days was seen making efforts to breathe. In less than three months reproduction and cicatrisation had so done their work that there remained no aperture for the lungs, or for food. At the end of three months, M. Duméril was compelled to leave it to the care of another during an absence, and it died, in all probability, as he observes, from want of attention on the part of the person who undertook the care of it. This specimen is now preserved in the Paris Museum, and exhibits, as M. Duméril remarks, the singular fact of an animal having lived without a head; and a proof of the possibility and necessity, even in the Batrachians, of a sort of respiration by means of the skin. In this animal M. Duméril states that respiration was certainly thus carried on for three months, although the stump of the amputated part presented a cicatrice, the smooth surface of which proved, even when examined by a magnifying glass, that there was a complete obturation of the œsophagus and larynx.

Dr. Von Siebold has also recorded his observations on the reproduction of wounded or lost parts in the *Triton niger*.

The following are some of the more remarkable genera belonging to the *Tailed Amphibia*:—



Head of *Protonopsis*, seen from above.

Protonopsis.

Head flat, broad; two concentric rows of teeth (the inner row palatine) in the upper jaw, and a single row only in the lower jaw; tongue free in front; operculum situated about half way between the posterior edge of the rictus of the mouth and the fore-leg; three opercular cartilages, between the posterior, two of which form the aperture; feet fimbriated on their outer edge; toes four on the anterior feet, and five on the posterior; of the latter the fourth and fifth are webbed and without claws.

This is the *Abranchus* * and *Menopoma* of Harlan; *Protonopsis* of Barton; *Cryptobranchus* of Leukardt and Fitzinger; *Salamandrops* of Wagler.

There are two species known, the *Protonopsis horrida* and *P. fusca*. The first species is well known. Its length is about two feet; head broad and flattened; mouth wide; nostrils projecting; body thick and stout; tail compressed vertically, and nearly as long as the body; legs stout and short; colour slaty with dark spots on the body; a dark line runs through the eyes.

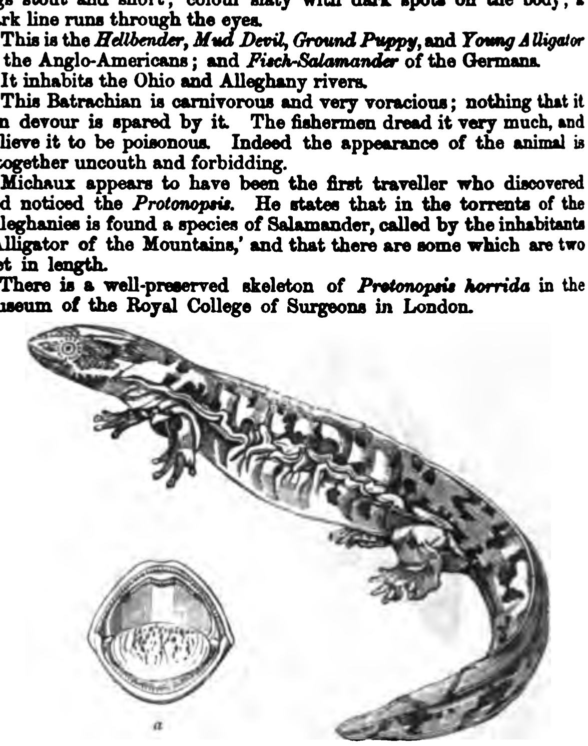
This is the *Hellbender*, *Mud Devil*, *Ground Puppy*, and *Young Alligator* of the Anglo-Americans; and *Fisch-Salamander* of the Germans.

It inhabits the Ohio and Alleghany rivers.

This Batrachian is carnivorous and very voracious; nothing that it can devour is spared by it. The fishermen dread it very much, and believe it to be poisonous. Indeed the appearance of the animal is altogether uncouth and forbidding.

Michaux appears to have been the first traveller who discovered and noticed the *Protonopsis*. He states that in the torrents of the Alleghanies is found a species of Salamander, called by the inhabitants 'Alligator of the Mountains,' and that there are some which are two feet in length.

There is a well-preserved skeleton of *Protonopsis horrida* in the museum of the Royal College of Surgeons in London.



Protonopsis Alleghaniensis.
a, Mouth open, showing the arrangement of the teeth.

Sieboldia.

Head large, trigono-ovate; rostrum produced, vertex convex; forehead concave; nostrils, in the anterior margin of the maxilla, approximate; eyes very small, hardly distinguishable; no parotids; tongue not distinct; palatine teeth numerous; a crest on the anterior margin of the vomers; posterior feet with cutaneous appendages; toes small, free, with depressed cutaneous lateral lobes; tail rather round at the base, very much depressed in the middle and behind, head thickly covered with glands; body depressed, with transverse folds and a long thick cutaneous appendage on each side.

Figures of the skull, showing the teeth, of the skeleton of the fore-hand, and of some of the vertebræ, are given on the preceding page.

This is the genus *Megalobatrachus* of Tschudi; but the Prince of Canino's name, *Sieboldia*, has the right of priority. The genus belongs to the sub-family *Andriadina* of the Prince's *Salamandridæ*.

Sieboldia maxima is the *Salamandria maxima* of Schlegel ('Fauna Japon.,' vii., tab. vi., vii., viii.), and was found by Dr. Von Siebold in a lake on a basaltic mountain in Japan. He brought away a male and a female; but the former devoured the latter during the passage. The gill-aperture slit always remains open in *Protonopsis*, but in this great newt the slits are closed. This animal is the nearest living analogue of *Andrias Scheuchzeri*, the celebrated *Homo Diluvii Testis* of Scheuchzer.

Triton.

Head rounded, convex; vertex somewhat flattened; tongue small, semi-globular, slightly free at each side, free and pointed behind; palatine teeth numerous, disposed in two rows; body granulous; no parotids; tail compressed, as long as the body; glandular pores behind and over the eyes, and a longitudinal row of distant and similar pores along each side. Toes four on the anterior and five on the posterior feet. Crests of the back and tail (in the male) separate.

Example, *Triton cristatus*.

The colour is blackish, orange-coloured beneath, sprinkled with round black spots; sides dotted with white; upper lip overhanging the lower, but not having a distinct lobe; body warty or tuberculated; tail rather smooth, compressed, sharp, trenchant above and below. Length six inches.

Male (in the spring) with an acute toothed dorsal crest; tail with

* Afterwards changed to *Menopoma* by Dr. Harlan, *Abranchus* having been pre-occupied by Van Hasselt to designate a genus of mollusks.

a longitudinal white stripe. In winter without a crest, and much resembling the female.

Female.—No crest; lower edge of the tail orange.

Young.—Olive-brown with a sulphureous dorsal line; abdomen orange, spotted with black; lower edge of the tail orange-red.

This is the *Lacerta palustris* of Linnæus; *Salamandra aquatica* of Ray; *Salamandra cristata* of Schneider, Daudin, &c.; *Triton palustris* of Fleming; *Salamandra platycauda* of Rusconi; *Molge* of Merrett; *Molge palustris* of Merrem; *Grosse Wasser-Salamander* and *Sumpf-Salamander* of Bechstein; *Warty Lizard* of Pennant; *Common Warty Newt* and *Great Water-Newt* of the British.

It is distributed over the whole of Europe, and is found in western and northern Asia.

Habits.—The ponds and ditches of this country abound with this the largest British Newt, and a most voracious animal it is. Aquatic

Triton cristatus, male, in the spring season, seen from above.

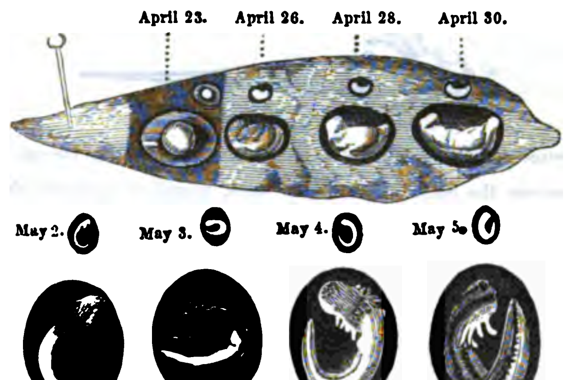
Triton cristatus, female, in the act of compressing a turned leaf upon her included egg. The leaves folded back represent those in which eggs have already been thus laid. (Rusconi.)

insects, and indeed any small living animals which come in its way, are unsparingly devoured. It is a great destroyer of tadpoles, and the smaller Water-Newt (*Lissotriton punctatus*) frequently falls a victim to its ferocity and voracity. Mr. Bell has taken them more than once in the act of swallowing an individual of the smaller species, which was so large as to occasion great difficulty and delay in the act of deglutition. In swimming, the legs are turned backwards to lessen resistance, and the animal is propelled principally by the tail. Every one has observed the Newts, or Efts, as they are called in many places, floating motionless at the surface of the water, with their limbs extended at right angles with the body, and their toes spread out. Their progression at the bottom of the water, and on land, is performed creepingly with their small and weak feet.

Generation.—For our knowledge of this subject we are chiefly indebted to the observations of Rusconi. Mr. Bell, in his work on 'British Reptiles,' has confirmed most of Rusconi's observations, and also added some of his own.

Rusconi enters into minute details of the actions of the male from the time of its first pursuit of the female to the period of fecundation, for which we refer the reader to the work itself. ('Amours des Salamandres Aquatiques, et Developement du Têtard de ces Salamandres depuis l'Œuf jusqu' à l'Animal Parfait,' Milan, 1821.) Prior to the time of depositing her eggs, the female remains immoveable; at last she moves, and slowly goes in search of a plant proper for receiving her eggs, choosing almost always, when present, the *Polygonum Persicaria.* She first approaches her head to the edges of a leaf, and turns it with her snout in such a way that the lower surface of the leaf, which was towards the bottom, is turned towards her breast: then with her fore-paws she passes the turned leaf beneath her belly, seizes it with her hind-paws, and conducts it beneath the vent, folding it at the same time, and forming with it an angle the opening of which is directed towards the tail. The egg in escaping from the vent would thus pass through the middle of the angle formed by the leaf, but the salamander stops it in its fall by her hind-feet, shuts up this angle with them, and thus forms in the leaf a fold in which the egg is held. Still on the removal of the feet the egg would fall to the bottom of the water; but the careful parent, before she quits the leaf, folds it so firmly with her hind-feet that the gluten with which the envelope of the egg is surrounded spreads from the pressure on the two internal surfaces of the leaf, and prevents the folds from opening. When several eggs have been laid in this manner, in different leaves, the female remains quiet until another male comes to caress her. Rusconi did not ascertain how long the period of laying continued; but he found eggs as early as the middle of April and as late as the middle of July.

The following figures, given by the same author, exhibit the several stages of the evolution of the egg which was kept on its proper leaf: these stages are denoted by the dates of the days on which the drawings were made. Thus, the figure marked 23rd April shows the egg of its natural size, and the figure below it the same magnified.

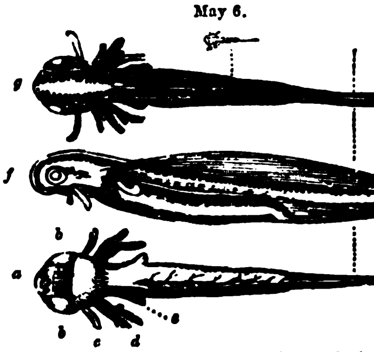


The temperature of the water during the period of Rusconi's observations varied from 22° to 27° Centigrade (71·6° to 80·6° Fahr.) The globule in the centre of the ovum is white with a yellow tint, and is environed with a glairy matter, to which it is not attached, so that it can move freely in every direction. Its envelope is membranous, of glassy transparence, and covered with a very clear viscid matter: the specific gravity of this matter appears to be less than that of the globule. In three days the globule had undergone the change exhibited at April 26. Under the microscope may be observed in the embryo the commencement of the parts which are to become the head, the belly, and the tail. The globule at first becomes enlarged, then elongated, and its previously smooth surface presents some small eminences. If it has not been fecundated, or has lost its prolific power, it enlarges, nevertheless, during the first days, as in ordinary cases, but afterwards changes so as to resemble a vesicle half filled with water: when this appearance comes on, the egg has lost its vitality.

On the 28th of April (fifth day) the embryo has grown so long that it becomes bent in order to accommodate itself to the circumscribed envelope. Now the head, abdomen, and tail are easily distinguishable, and near the head (the larger extremity) small elevations (the rudiments of gills and fore-feet) are perceptible. These parts become more apparent by the 30th, when in the concave side of the embryo and towards the head a small furrow is seen which separates the head from the abdomen, and the rudiments of a spine are distinctly visible along its convex border.

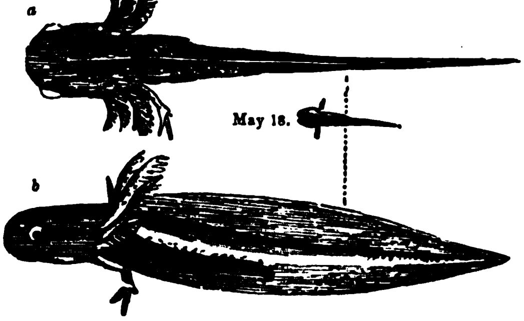
By the 2nd of May the position of the embryo is changed, and the tail has already assumed its oar-like form. The embryo begins to move, and its heart may be seen to beat; colour, too, begins to be present. This appears to be a critical state of the embryo; for almost half of those of which the development was watched by Rusconi, died at this period or soon after. 3rd May. On one side of the head, and before the two elevations which are the rudiments of the fore-feet, filaments to the number of four on each side may be observed. 4th May. The changes of position become frequent. In that here presented the embryo shows the lower part of its head and trunk, which is white inclining to green. On the chest between the gills of the two sides, where the pulsations of the heart are seen, small irregular blackish spots are observable. Before the two claspers are seen also other blackish spots, forming the junction of the two bands which run along the back, as shown in the preceding figure. The circulation of the blood, which is simple, and performed by a single curved vessel, is seen in the gills, which are of a glassy transparence, and consist only of a single filament without leaflets as yet. 5th May. Traces of the eyes may now be just seen; and the rudiments of the two leaflets are perceptible on the two longest gills. 6th May. The upper small figure shows the young Salamander, seen from above, and of the natural size, just escaped from the envelope. Before its escape, the embryo as it enlarges gradually dilates the envelope, which at last it tears, and so forces its way out. As yet the eyes are scarcely defined, though they form two prominences on the sides of the head, and its mouth is so slightly traced that attentive observation is required to detect it; for it is indicated only by a slight transverse depression beneath the head, and between the two prominences formed by the eyes, and in the middle of the space between the anterior border of the head and the origin of the neck. Its fore-feet begin to separate like buds from the gills, which last are gradually furnished with small leaflets.

May 6.



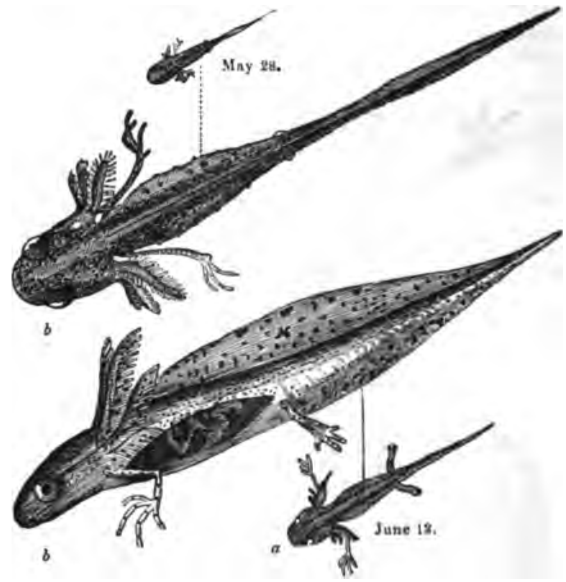
Stages of development of *Triton cristatus* after exclusion from the egg.

a shows the Salamander in this stage, magnified and seen from below; *bb* are the two prominences formed by the globes of the eyes, and between them is the slight depression which afterwards becomes the mouth; *c*, the hook of the right side; *d*, the gills of the same side; *e*, rudiment of fore-feet of the same side; *f* represents the same seen in profile, and *g* the same seen from above.



Further stages of development of *Triton cristatus*.

The middle and small figure above shews the natural size of the Salamander-Tadpole on the 18th of May, twelve days after its exclusion from the egg. By this time the fore-feet have become lengthened, and are divided at their extremity like a bicuspid tooth; these two tubercles elongate, and are converted into two toes. Now the eyes are disclosed; the pupil black, the white speckled with various colours. The yellow back of the little animal has become green, and the gills are now furnished with leaflets, in which red blood circulates. The transverse depression between the eyes above noticed has become a very large mouth, whose extremities extend on the sides of the head to the eyes. The head, hitherto narrow behind, has become much enlarged near the origin of the gills. The two hooks by which the animal anchored itself have disappeared, and the opaque body has become so transparent that the action of the heart and the form and disposition of the abdominal viscera may be observed in the living animal. With this advance in organisation the sluggishness of the animal has vanished, and its habits are now manifested. It may be seen near the surface, hiding beneath leaves or swimming with rapidity. If, while it floats at rest, a small aquatic insect should pass before it near the surface, it pursues it deliberately, and as soon as it approaches within reach, darts upon it and swallows the prey. Here then we have the little Salamander in the enjoyment of active animal life.



Further stages of development of *Triton cristatus*.

a, shows the young Salamander at this stage, natural size, seen from above; and *b*, the same magnified, seen from above and in profile.

By the 28th of May the Salamander has put on the form above given in the upper figures, seen from above. About this time the hind-feet begin to appear, and the fore-feet are well developed; these last are, as will be seen, long in proportion to the trunk. The following are the principal points manifested under the microscope in this stage:—1, two small eminences or excrescences, extending from the axillæ to the abdomen; 2, the parietes of the abdomen take the colour of the insects on which the animal feeds; 3, the changes of colour from yellow to green, during the growth of the tadpole, are purely accidental, and commence immediately on the escape of the animal from the egg; 4, the inner toes first push forth, and this holds good also with regard to the hind-feet; 5, the amylaceous bone of the organ of hearing is now formed, and may be seen through the skull and skin; 6, at this period, and even sooner, the animal begins to expel air from the mouth. The two lower cuts show the same salamander on the 12th June; the small figure represents it of the natural size and as seen from above, and the larger figure magnified and in profile. Now the hind-feet have almost attained their development, though the fifth toe is wanting. The lungs extend about half-way down the trunk, and are visible through the parietes of the abdomen. The longest gills, which were furnished with only 13 or 14 leaflets 13 or 14 days previously, have now nearly 20.

Last stage of the tadpole of *Triton cristatus*.

On the 18th of July the young Salamander, as represented above, had arrived at the maturity of its tadpole state, and it is represented watching a small mollusk to ascertain whether it is living and fit for prey. Rusconi found that on this day the gills appeared rather shorter than on the day before. On the next day the leaflets at the extremities of the gills were obliterated, and the gill-stem itself was shortened. On the 27th of July the Salamander had lost even the smallest trace either of gills or of branchial apertures. It respired atmospheric air only, and having arrived at its perfect state, made strong efforts to escape from the vessel in which it had undergone its metamorphosis.

In its complete state this species habitually lives in the water, and is seldom to be found on land unless the pond which has been its abode is dried up, and the animal finds itself obliged to walk in search of another.

The development of the Common Smooth Newt (*Lissotriton punctatus*, Bell; *Triton punctatus*, Auct.; *Triton palustris*, Laur.; *Salamandra punctata*, Daud.; *Molge punctata*, Merr.; *Salamandra exigua*, Rusc.; and *Brown Lizard* of Pennant) was also observed by Rusconi; but it did not require particular notice, being very similar to that of *Triton cristatus*. *Triton punctatus*, however, showed itself much the more brisk animal of the two; and the lashings of the tail of the male in his approaches to the female were much more rapid.

Lissotriton punctatus, seen from above. *a*, Male, the toes of whose hind-feet are furnished in the breeding season with a black-spotted membrane, in the act of lashing his tail; *b*, female.

Salamandra.

Head thick; eyes large; gape of the mouth ample; tongue broad; palatine teeth arranged in two long series; parotids large; body sprinkled with many small glands; toes free; tail rather smooth.

Example, *Salamandra maculosa*, Laur.

This species is black with yellow spots, and has numerous prominent warty excrescences on the sides; tongue very large; palatine teeth spatuliform; toes smooth.

This is the *Salamandra* of Gesner; *Salamandra terrestris* of Aldrovandus, Ray, and others; *Salamandre de Terre* of the French; and *Gefleckte Erd-Salamander* of the Germans.

It inhabits Central Europe and the mountainous parts of the south of Europe.

The Land Salamander, unlike the Tritons, is ovoviviparous, though the young at first inhabit the water and undergo metamorphoses till they arrive at the mature state which fits them for living upon land, where they haunt cool and moist places, being not unfrequently found about fallen timber or old walls. Their food principally consists of insects, worms, and small molluscous animals. In the winter they retire to some hollow tree or hole in an old wall, or even in the ground, where they coil themselves up, and remain in a torpid state till the spring again calls them forth.

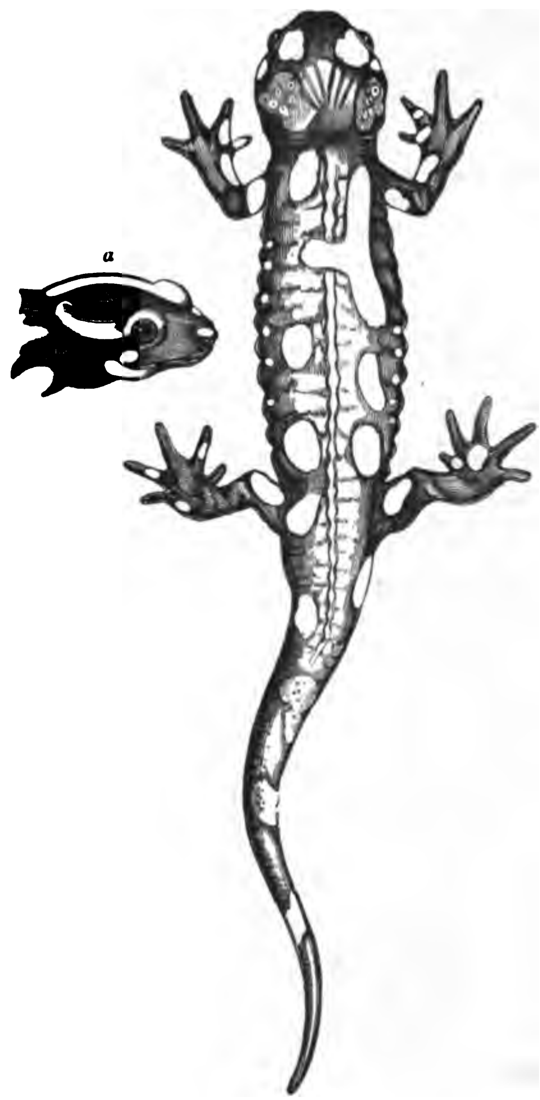
The body of the Salamander is largely covered with warty glands. These secrete a milky fluid of a glutinous and acrid nature like that of the toad, which, if not capable of affecting the larger and more highly-organised animals, appears to be a destructive agent to some of those which are less highly organised. Thus Laurenti provoked two gray lizards to bite a Salamander, which at first attempted to escape from them, but being still persecuted ejected some of this fluid into their mouths; one of the lizards died instantly, and the other fell into convulsions for two minutes, and then expired. Some of this juice was introduced into the mouth of another lizard; it became convulsed, was paralytic on the whole of one side, and soon died.

This is the only foundation for the long-cherished notion that the Salamander was one of the most venomous of animals. Nicander, in his 'Alexipharmaca,' gives an appalling picture of the symptoms produced by its bite. The Romans looked on it with horror, as most destructive; and considered it as deadly a part of the poisoner's laboratory as aconite or hemlock. Hence came a proverb that he who was bitten by a Salamander had need of as many physicians as the animal had spots; and another still more hopeless: "If a Salamander bites you, put on your shroud."

Not only was its bite considered fatal and the administration of the animal itself taken internally believed to be deadly, but anything that its saliva had touched was said to become poisonous. Thus, if it crept over an apple-tree, it was supposed to poison all the fruit with its saliva; and even herbs on which the fluid fell were believed to affect those who tasted them with vomiting. These fables had taken such strong hold, that it was thought worthy of record in the 'Acta Acad. Nat. Cur.' that a man had eaten a Salamander, which his wife had put into his food in the hope of becoming a widow, without suffering any inconvenience.

But the grand absurdity of all was the belief that the Salamander was incombustible; that it not only resisted the action of fire, but extinguished it; and, when it saw the flame, charged it as an enemy which it well knew how to vanquish.

Aristotle, whose Salamandra (σαλαμάνδρα) this appears to be, has been quoted as giving his sanction to this belief, and indeed he cites it as a proof that there are animals over which flame has no power: "the Salamandra, as they say, when it goes through fire, extinguishes it." ('Hist. An.,' v. 19.) Now this is evidently only a reference to report; and it is not improbable that a copious secretion of the fluid above noticed might, in a rapid and short passage, so damp the fire that the animal might get through comparatively unhurt. Ælian (ii. 31) says not only that it will live in the flames, but that it attacks fire like an enemy. Nicander, Dioscorides, and Pliny all add their authority; and the latter not only relates that they extinguish fire by their touch, but that they are without-sex and produce nothing. He dwells on their poison as being of the worst description, and is profuse in his catalogue of remedies. ('Hist. Nat.,' xxix. 4.) But even so late as 1789 there was an attempt to revive these wondrous tales. A French consul at Rhodes relates that, while sitting in his chamber there, he heard a loud cry in his kitchen, whither he ran and found his cook in a horrible fright, who informed him that he had seen the devil in the fire. M. Pothonier then states that he looked into a bright fire, and there saw a little animal with open mouth and palpitating throat. He took the tongs and endeavoured to secure it. At his first attempt the animal, which he says had been motionless up to that time (two or three minutes), ran into a corner of the chimney, having lost the tip of its tail in escaping, and buried itself in a heap of hot ashes. In his second attempt the consul was successful drew



Salamandra maculosa, seen from above. *a*, profile of head.

the animal out, which he describes as a kind of small lizard, plunged it into spirit of wine, and gave it to Buffon. This appears to be very circumstantial, and M. Pothonier, whose head was evidently filled with preconceived opinions, may be acquitted of any intention to deceive.

That the skin of an animal which could resist the action of fire should be considered proof against that element is not to be wondered at. We accordingly find that a cloth said to be made of the skins of salamanders was incombustible, as is noticed by Marco Polo, who however was shrewd enough to observe that these fire-proof cloths were really made of a mineral substance (asbestos, no doubt, which the old writers termed Salamander's Wool). Such most probably was the Salamander-Cloth sent by the Tartar king to the Roman pontiff, in which the Holy Napkin (*Sudarium Domini*) is preserved.

Among the other fables may be noticed the belief that the saliva of the Salamander was depilatory—having the power to remove hair, and substitute bald places for luxuriant tresses. Martial has an epigram, of which this notion forms the point (lib. ii., ep. lxvi).

Its heart, worn as an amulet, was considered to be a prophylactic against fire, and it was used in medicine to eradicate leprosy.

It could hardly be expected that the alchymists would neglect animals of which such wonders were rife; and we accordingly find that the power of transmuting quicksilver into gold was attributed to them. To this end the wretched reptiles were placed in a vessel on the coals, and quicksilver introduced through an iron tube was poured upon them. This experiment was supposed to be accompanied with danger to the life of the operater. Those who would further dwell on the legends connected with this subject may consult Funk's work, 'De Salamandræ Terrestris Vita, Evolutione, et Formatione.'

In the catalogue of the specimens of *Amphibia* in the British Museum the following arrangement is adopted. The catalogue of the first suborder, the *Anourous Amphibia*, is not yet published (June, 1853).

Order I. BATRACHIA.

Suborder I. SALIENTIA (including the Frogs and Toads). (Arrangement not yet published.)

Suborder II. GRADIENTIA.

Fam. I. SALAMANDRIDÆ.

Name.	Locality.
Salamandra nigra	Europe.
„ *maculosa*	„
Pleurodeles Waltl	„
Triton Poiretii	North Africa.
„ *cristatus*	Europe.
„ *marmoratus*	„
„ *alpestris*	„
Notophthalmus miniatus	North America, East Coast.
„ *viridescens*	„ „
Euproctus platycephalus	Corsica and Sardinia.
Cynops pyrrhogaster	Japan.
Taricha torosa	California.
„ *lugubris*	North America.
Bradybates ventricosus	Spain.
Lophinus punctatus	Europe.
„ *palmatus*	„
Ommatotriton vittatus	Syria.
Seiranota perspicillata	Europe.

Fam. II. MOLGIDÆ.

Name.	Locality.
Hynobius nebulosus	Japan.
Molge striata	„

Fam. III. PLETHODONTIDÆ.

Name.	Locality.
Onychodactylus Japonicus	Japan.
Heterotriton ingens	North America, East Coast.
Xiphonura Jeffersoniana	„ „
Ambystoma Carolinæ	„ „
„ *tigrinum*	„ „
„ *talpoideum*	„ „
„ *opacum*	„ „
„ *punctulatum*	„ West Coast.
„ *macrodactylum*	„ „
„ *mavortium*	„ „
„ *episcopus*	„ East Coast.
„ *erythronotum*	„ „
„ *Haldemani* (?)	„ „
„ *frontale* (?)	„ „
Plethodon glutinosum	„ „
„ *granulatum*	„ „
Desmognathus niger	„ „
„ *fuscus*	„ „
„ *auriculatus*	„ „
Hemidactylum scutatum	„ „
Batrachoseps attenuatus	„ West Coast.
„ *quadridigitatus*	„ East Coast.
Spelerpes longicauda	„ „
Spelerpes cirrigera	North America, East Coast.
„ *bilineata*	„ „
„ *gutto-lineata*	„ „
„ *rubra*	„ „
„ *montana*	„ „
„ *salmonea*	„ „
„ *porphyritica*	„ „
„ *Bellii*	Mexico.
Geotriton fuscus	Italy.
Œdipus variegatus	North America, West Coast.
Ensatina Eschscholtzii	„ „
Axolotl	Mexico.
„ *maculata*	„

Order II. PSEUDOSAURIA.

Fam. I. PROTONOPSIDÆ.

Name.	Locality.
Sieboldia maxima	Japan.
Protonopsis horrida	North America, East Coast.
„ *fusca*	„ „

Fam. II. AMPHIUMIDÆ.

Name.	Locality.
Amphiuma means	North America, East Coast.
Muranopsis tridactyla	„ „

Order III. PSEUDOPHIDIA.

Fam. I. CÆCILIIDÆ.

Name.	Locality.
Cæcilia gracilis	Tropical America.
„ *tentaculata*	„
„ *compressicauda*	„
„ *rostrata*	„
„ *oxyura*	Malabar.
„ *squalostoma*	West Africa.
Siphonops interrupta	Tropical America.
„ *Mexicana*	„
Icthyophis glutinosus	Ceylon.
Rhimatrema bivittatum	Tropical America.

Order IV. PSEUDOICTHYAS.

Fam. I. LEPIDOSIRENIDÆ.

Name.	Locality.
Lepidosiren paradoxa	Tropical America.
Protopterus annectens	West Africa.
„ *rhinocryptis*	„

Order V. MEANTIA.

Fam. I. PROTEIDÆ.

Name.	Locality.
Proteus anguinus	Europe.
Necturus maculosus	North America, East Coast.
„ *lateralis*	„ „

Fam. II. SIRENIDÆ.

Name.	Locality.
Siren Lacertina	Carolina.
„ *intermedia*	Texas.
Pseudobranchus striatus	North America, East Coast.

FOSSIL AMPHIBIA.

Fossil Anourous Amphibia.—Fossil Frogs have been found in the Coal-formation of the Rhine (*Papier-Kohl*) in company with the fishes *Leuciscus macrurus* and *L. papyraceus*. Two species have been described, and there are many examples in the museum at Bonn. In this country specimens are to be found in the collections of the Earl of Enniskillen and Sir Philip Egerton, Bart.

Palæophrynos Gesneri. (Tschudi.)

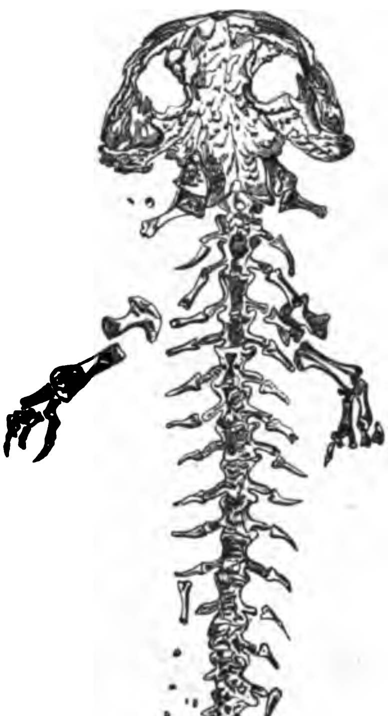
Fossil Toads.—Here may be noticed the fossil specimens from the Œningen Beds—*Bombinator Œningensis*, Agass. (*Pelophilus Agassizii*, Tschudi), and *Palæophrynos Gesneri*, Tschudi. (See 'Classification der Batrachier' of J. J. Tschudi, pp. 84, 89, tab. 1, ff. 2, 3.)

Fossil Salamandridæ.—Few fossils have awakened more curiosity than the *Homo Diluvii Testis* of Scheuchzer, who was unwearied in collecting organic remains, which he considered irrefragable evidence of the general deluge. At length he obtained from the Œningen Beds (Miocene Period of Lyell) a fossil which he viewed with transport as the unequivocal remains of Man himself. A short description of this specimen was published by him in the 'Philosophical Transactions' for 1726. He again brought forward this piece of 'good fortune'—(in his rapture he writes the last two words in Greek—) in his 'Physica Sacra,' where he tells us that previously he had only possessed two dorsal vertebræ. Of the humanity of his prize he certainly entertained no doubt. In his rapturous vision he saw in the fossil not only one part of the human skeleton, but many parts. No fancy could possibly lead astray in a case where there were appearances of bones, and flesh, and even the softer parts of flesh, impressed on the solid stone. Here indeed was a rarity above all rarities. He gives no bad figure of the fossil in tab. xlix. of the work last quoted. When we look at that figure, it is difficult to conceive how such remains could have appeared to a physician, who must have had some acquaintance with osteology, to be those of man; and we can only account for it by the blindness which an excited imagination and a determined adherence to theory can produce. The iteration and determination of Scheuchzer had its effect, and naturalists adopted his opinions. Gesner (1758) appears to have been the first who threw deserved doubt on the alleged nature of the fossil; for though he quotes it as an anthropolite, he nevertheless, having become possessed of a similar specimen, offers his conjecture that it was a fossil fish (*Silurus glanis*, Linn.), and the obsequious naturalists were now as ready to follow him as they had been eager to run after Scheuchzer.

Gesner's specimen does not appear to have been engraved, nor another which was said to be in the convent of Augustins at Œningen; but a third specimen, more complete than Scheuchzer's, came into the possession of Dr. Ammann of Zürich, and is now in the British Museum. A figure of this was published by Karg, in the 'Memoirs of the Society of Naturalists of Suabia.'

Cuvier well observes that a comparison of the specimen with the skeleton of Man must at once have destroyed the idea that it was anthropolite; and it would be a waste of space to repeat here the details of that comparison which Cuvier so well follows out, and to which we refer. ('Ossemens Fossiles,' tom. v., pt. 2, p. 433, ed. 1824.)

Karg, after figuring Dr. Ammann's specimen, expressly stated that he had no doubt that the fossil was a *Silurus*, an opinion which Jäger refuted by placing by the side of the figure of the fossil, one of the skeleton of *Silurus glanis*. Cuvier disposes of this opinion with the same success as attends his former demonstration.



Anterior part of *Andrias Scheuchzeri*, Tschudi, seen from above. (Cuvier.)

The rounded head and great orbits of the fossil struck Cuvier as strongly resembling the head of a frog or a salamander; and he states that, as soon as he beheld Karg's figure, he perceived in the vestiges of the hind-feet and the tail evidence in favour of the last-named genus.

Cuvier, being at Haarlem in 1811, obtained permission to work upon the stone which contained the pretended anthropolite of Scheuchzer, for the purpose of uncovering any bones which might be still hidden there. During the operation, the figure of the skeleton of a salamander was placed before the operators; and Cuvier relates the pleasure which they felt, as they saw, while the chisel chipped away pieces of the stone, the bones which the figure had already announced.

But by far the finest head of *Andrias Scheuchzeri* is figured by Tschudi, in his work above quoted, tab. 3; and many most interesting details are given in tab. 4 and tab. 5. These show how nearly allied this gigantic Fossil Newt was to *Sieboldia maxima*.

Salamandra ogygia, Goldf., is found in the Braunkohle (Tertiary), where also *Triton Noachicus*, Goldf., occurs. *Triton palustris* (?) *fossilis* of Karg is from the Œningen Slate.

Under the generic title *Salamandroides*, Professor Jäger described a fossil reptile from the German Keuper, giving it the specific name of *giganteus*. This fossil now appears to be identical with *Mastodonsaurus* and *Phytosaurus*. Professor Owen therefore proposes to designate this gigantic genus of extinct Batrachians—for to that order he has satisfactorily shown that the form belongs—by the name of *Labyrinthodon* (from the extraordinary structure of its teeth), in his paper 'On the Teeth of Species of the Genus *Labyrinthodon* (*Mastodonsaurus*, *Salamandroides* and *Phytosaurus* (?) of Jäger) from the German Keuper and the Sandstone of Warwick and Leamington.'

Andrias Scheuchzeri, Tschudi, seen from above. (Cuvier.)

The following description of the teeth of this animal, from the 'Proceedings of the Geological Society,' will afford some idea of the peculiarity of its structure:—

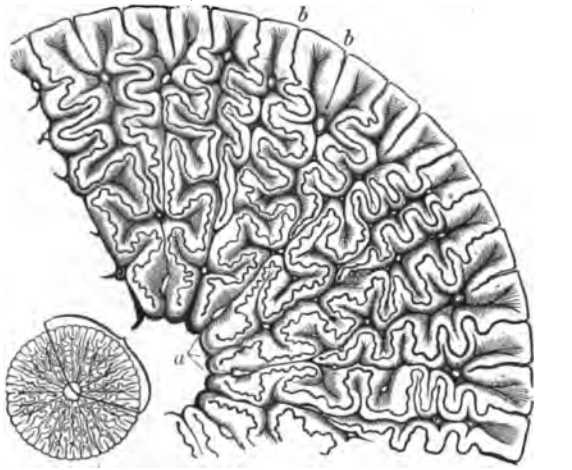
"The plan and principle of the structure of the tooth of the *Labyrinthodon* are the same as those of the tooth of the *Ichthyosaurus*, but they are carried out to the highest degree of complication. The converging vertical folds of the external cement are continued close to the centre of the tooth, and instead of being straight simple lamellæ, they present a series of irregular folds, increasing in complexity as they proceed inwards, and resembling the labyrinthic anfractuosities of the surface of the brain; each converging fold is slightly dilated at its termination close to the pulp-cavity. The ordinary laws of dental structure are however strictly adhered to, and every space intercepted by a convolution of the folds of the cement is occupied by corresponding processes of the dentine. These characters were presented by a transverse section of a fragment of a tooth of the *Labyrinthodon Jägeri* from the German Keuper, which included about the middle third part of a tooth, and Mr. Owen considers that the entire length of the tooth might be 3¼ inches, and the breadth at the basis 1½ inch.

"The external longitudinal grooves, which correspond to the inflected folds of the cement, extend upwards from the base of the tooth to about three-fourths of its height, decreasing in number as the tooth diminishes in thickness, and disappearing about half an inch from the summit of the tooth. Each fold of cement penetrates less deeply as the groove approaches its termination; and Mr. Owen conceives that the structure of the upper part of the tooth may be more simple than that of the lower, but he has not yet been able to extend his investigations to it.

"The dentine consists of a slender, central, conical column, or 'modiolus,' hollow for a certain distance from its base, and radiating outwards from its circumference a series of vertical plates, which divide into two, once or twice, before they terminate at the periphery of the tooth. Each of these diverging and dichotomizing vertical plates gives off throughout its course narrower vertical plates, which stand at nearly right angles to the main plate, in relation to which they are generally opposite, but sometimes alternate. Many of the secondary plates which are given off near the centre of the tooth also divide into two before they terminate. They partake of all the undulations which characterise the inflected folds of the cement.

"The central pulp-cavity is reduced to a line, about the upper third of the tooth; but fissures radiate from it, corresponding in number with the radiating plates of the dentine. One of these fissures is continued along the middle of each plate, dividing where it divides, and penetrating each bifurcation and process; the main fissures extend to within a line or half a line of the periphery of the tooth; the terminations of these, as well as the fissures of the lateral processes, suddenly dilating into subcircular, oval, or pyriform spaces. All these spaces constitute centres of radiation of the fine calcigerous tubes, which, with their uniting clear substance, constitute the dentine. The number of these calcigerous tubes, which are the centres of minor ramifications, defies all calculation. Their diameter is the $\frac{1}{7000}$th of a line, with interspaces equal to 7 diameters of their cavities."

By the permission of Professor Owen we are enabled to give a section of this highly complicated tooth, from his elaborate 'Odontography' (pl. 64, A.), in which the subject is treated with minute detail (part ii., p. 203, &c.).



Transverse Section of Tooth of *Labyrinthodon Jägeri* (Owen); *Mastodonsaurus Jägeri* (Meyer); natural size, and a segment magnified. *a*, pulp-cavity, from which the processes of pulp and dentine radiate; *b*, cement.

In connection with this subject we may call the reader's attention to some facts of considerable interest, which have lately been studied with much care and success, and have become of such importance as to constitute a distinct branch of inquiry under the name of *Ichnology* (Ἰχνος, a footstep, and λόγος, a discourse).

This department of geological investigation is conversant with the phenomena of footsteps impressed by animals on the strata of the earth.

In 1828 Mr. Duncan's account of tracks and footmarks of animals impressed on sandstone in the quarry of Corn-Cockle Muir, Dumfriesshire, appeared in the 'Transactions of the Royal Society of Edinburgh.' Dr. Buckland caused a living *Emys* and *Testudo Græca* to walk on soft sand, clay, and paste or unbaked pie-crust. He found the correspondence of the footsteps of the latter with the fossil footsteps sufficiently close, allowing for difference of species, to render it highly probable that the fossil footsteps were impressed by *Testudo Græca*.

In Saxony, at the village of Hessberg, near Hildburghausen, fossil footsteps were, a few years ago, discovered in several quarries of gray Quartzose Sandstone alternating with beds of Red-Sandstone, nearly of the age of the Red-Sandstone of Corn-Cockle Muir. Dr. Hohnbaum and Professor Kaup state that those impressions of feet are partly concave and partly in relief; the depressions are described as being upon the upper surfaces of the Sandstone slabs, but the footmarks in relief are only upon the lower surfaces, and cover the depressions. In short, the footmarks in relief are natural casts formed in the subjacent footsteps as in moulds. On one slab, 6 feet long by 5 feet wide, many footsteps of more than one animal and of various sizes occur. The larger impressions, which seem to be those of the hind-foot, are generally 8 inches in length and 5 in width, and one was 12 inches long.

The name of *Chirotherium* was proposed by Professor Kaup as the provisional name for the great unknown animal that impressed the larger footsteps, from a supposed resemblance in the marks of both the fore- and hind-feet to the impress made by a human hand; and he thought that they might have been derived from some quadruped allied to the *Marsupialia*. Dr. Siekler, in a letter to Blumenbach (1834), gave a further account of these footsteps. Fragments of bones were found in the quarries where the footsteps had been impressed, but those fragments were destroyed.

The existence of footprints of this kind soon became more extensively known. In his address to the Geological Society, in 1840, Dr. Buckland says:—"Further discoveries of the footsteps of *Chirotherium* and five or six smaller reptiles in the New Red-Sandstone of Cheshire, Warwickshire, and Salop, have been brought before us by Sir P. Egerton, Mr. J. Taylor, jun., Mr. Strickland, and Dr. Ward. Mr. Cunningham, in a sequel to his paper on the footmarks at Storeton, has described impressions on the same slabs with them, derived from drops of rain that fell upon thin laminæ of clay interposed between the beds of sand. The clay impressed with these prints of rain-drops acted as a mould, which transferred the form of every drop to the lower surface of the next bed of sand deposited upon it, so that entire surfaces of several strata in the same quarry are respectively covered with moulds and casts of drops of rain that fell whilst the strata were in process of formation. On the surface of one stratum at Storeton, impressed with large footmarks of a *Chirotherium*, the depth of the holes formed by the rain-drops on different parts of the same footstep has varied with the unequal amount of pressure on the clay and sand, by the salient cushions and retiring hollows of the creature's foot; and from the constancy of this phenomenon upon an entire series of footmarks in a long continuous track, we know that this rain fell after the animal had passed. The equable size of the casts of large drops that cover the entire surface of the slab, except in the parts impressed by the cushions of the feet, record the falling of a shower of heavy drops on the day in which this huge animal had marched along the ancient strand. Hemispherical impressions of small drops, upon another stratum, show it to have been exposed to only a sprinkling of gentle rain that fell at a moment of calm. In one small slab of New Red-Sandstone found by Dr. Ward near Shrewsbury, we have a combination of proofs as to meteoric, hydrostatic, and locomotive phenomena, which occurred at a time incalculably remote, in the atmosphere, the water, and the movements of animals; and from which we infer, with the certainty of cumulative circumstantial evidence, the direction of the wind, the depth and course of the water, and the quarter towards which the animals were passing: the latter is indicated by the direction of the footsteps which form their tracks; the size and curvatures of the ripple-marks on the sand, now converted to sandstone, show the depth and direction of the current; the oblique impressions of the rain-drops register the point from which the wind was blowing at or about the time when the animals were passing."

Soon after this address was delivered, Professor Owen proved the existence of a gigantic Batrachian at the period when the New Red-Sandstone was formed, and described three species of *Labyrinthodon*. He concluded that these creatures produced the foot-prints that had been observed, and maintained the following positions:—

1st. Proof from the skeleton that *Labyrinthodon* had hind extremities much larger than the anterior extremities.

2nd. That the foot-prints of *Chirotherium* are at least as much like those of certain Toads as those of any other animals.

3rd. That the size of the known species of *Labyrinthodon* corresponds with the size of the foot-prints of the different species of *Chirotherium*; e.g. *Labyrinthodon Jägeri*, with the foot-print of *Chirotherium Hercules* (Egerton); *Labyrinthodon pachygnathus*, with the foot-marks of the common *Chirotherium*; and *Labyrinthodon leptognathus* with the impressions of the smaller Batrachian figured in the memoir by Sir Roderick Murchison and Mr. Strickland.

4th. *Labyrinthodon* occurs in the New Red-Sandstone strata to which Chirotherian impressions are peculiar. And

Lastly, no remains of animals that could have left such impressions as those of the *Chirotherium* have been found in these strata, except the remains of the *Labyrinthodon*.

Labyrinthodon pachygnathus.

Fore and hind-foot of the same.

It is true that the structure of the foot is still wanting, and that a more connected and complete skeleton is required for demonstration; but the circumstantial evidence above stated is strong enough to produce the conviction that Chirotherian and Labyrinthodontic foot-impressions are identical; and that *Mastodonsaurus*, *Salamandroïdes*, *Phytosaurus*, *Chirotherium*, and *Labyrinthodon* are one and the same genus, which ought for the future to be designated by the last-mentioned name. We owe this evidence principally to the use of the microscope in skilful and judicious hands; and it is impossible not to be struck with the wonderful applicability of that instrument to the largest of created bodies as well as to the smallest, when we look at the results of Professor Owen's discovery of the highly-organised dental structure in *Labyrinthodon*, an extinct animal of a low grade, where it could hardly have been expected to occur.

The reading of Professor Owen's memoir was accompanied by the exhibition of a diagram representing a restoration of two species of *Labyrinthodon*. By the Professor's kindness, we have been enabled to give a greatly reduced copy of one of them. [See the preceding column.] The bones which appear within the outline are those which were known when the paper was read. The animal is represented as impressing its footsteps on a shore of sand, now New Red-Sandstone. There is reason for believing that this Batrachian was not smooth externally, but was protected, on certain parts at least, by bony scutella.

Specimens of the foot-prints may be seen in the British Museum and in that of the Royal College of Surgeons in London.

AMPHIBOLE, a mineral belonging to the group of silicates of magnesia, lime, iron, and manganese. [AUGITE.]

AMPHIBOLI'TE, a name sometimes given to the simple mineral more commonly called *Hornblende*, and which was introduced by Haüy, the mineralogist, who uselessly changed many names. He called Hornblende *Amphibole*, because it is easily mistaken for Augite, another simple mineral closely allied to it in composition, from ἀμφίβολος, equivocal.

AMPHIDESMA, a genus of Marine Bivalve Shells, which are found in the sand on the sea-coast of tropical climates. The shells are oval or rounded, sometimes rather twisted and slightly gaping behind. They have two hinge teeth in each valve, and often distinct compressed lateral ones. The elastic cartilage is placed in a small triangular cavity just behind the hinge teeth. The animals of these shells are unknown; but they are supposed to have long syphons, like the Tellens, as the shells have a broad deep inflation on the back edge of the submarginal scar, formed by the attachment of the muscles which retract these syphons, as in the Tellens, from which genus it simply differs in the position of its cartilage.

Lamarck gave the name of *Amphidesma* to this genus, because he observed that it had a ligament and a cartilage, which he regarded as peculiar to this genus, he having, like the rest of the zoologists before the appearance of the Conchological Observations in the 'Zoological Journal,' considered what is usually called the ligament of bivalves as only one substance. It is however two substances, of very different structure and use; the outer, or ligament, being inelastic, and only employed to keep the two valves together, is formed of fibres extending from the edge of one valve to the other; but the cartilage is elastic, and formed of perpendicular fibres, like the prismatic crystalline-structured shell, its use being to separate the valves from one another when the muscles which keep them closed are relaxed. When the valves are closed, this part is compressed by their edge. For this purpose it is sometimes, as in the shell under consideration, placed in a small triangular cavity close to the hinge, when the shell is said to have an internal cartilage, the ligament being still in its usual place. In other shells it is placed, along with the ligament, on the margin of the valves, and is pressed, when the valves are closed, against the ligament itself, which forms its outer wall. The resistance which the ligament offers is the means of opening the shell. The cartilage has opaline reflections, and the cartilages of some large shells, as the mother-of-pearl shells, are sold by the jewellers under the name of Peacock-Stone, or Black Opals. They are not so much used now as formerly, but they are still much sought after on the Continent, especially in Portugal.

AMPHI'DETUS, a genus of *Echinidæ*, found in the Crag of Suffolk.

AMPHIGENE, a mineral abundant in the lava of Vesuvius, consisting of silica, alumina, and potash. [LEUCITE.]

AMPHI'ON (Pander), a genus of Fossil Crustacea (*Trilobites*), four species of which have been described, from Tyrone and Waterford, by Colonel Portlock.

AMPHIOXUS. [BRANCHIOSTOMATA.]

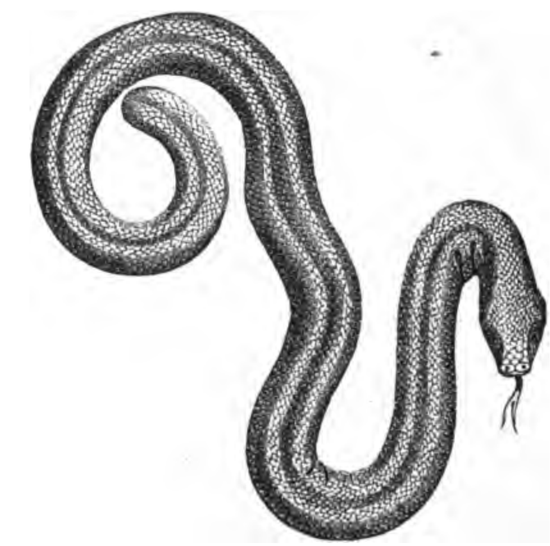
AMPHIROA. [ACALEPHÆ.]

AMPHISBÆNA (from ἀμφίσβαινα, which signifies 'an animal that can walk in both directions'), a genus of Serpents, distinguished by their bodies having nearly the same uniform thickness from the head to the extremity of the tail, by their small mouths and extremely diminutive eyes, their remarkably short tails, and the numerous rings of small square scales which completely surround this organ and the body. A range of small pores runs in front of the vent, which is situated nearly at the end of the tail; the jaws alone are provided with a single row of small conical teeth, the palate being without any; and even those of the jaws are few and distant from one another. They are moreover destitute of fangs, and are consequently harmless and inoffensive, living for the most part upon ants and other small insects, and inhabiting ant-hills and burrows which they themselves construct under ground. The nature of their food does not require these animals to possess the power of dilating the mouth and gullet to the extraordinary extent that is observed in the boas, pythons, and other serpents in general, which live for the most part upon animals proportionally much larger than themselves, and in order to admit the huge mouthful have the upper and under jaws both equally moveable upon the cranium. In the *Amphisbœna*, on the contrary, the upper jaw is fixed to the skull and intermaxillary bones, as in birds and mammals, so that the head remains constantly in the same plane with the body—a form which permits the animal to move equally well either backwards or forwards, and which has acquired for it the name by which it is distinguished. [*See* BOIDÆ, cols. 548, 549.]

The head of the *Amphisbœna* is so small, and the tail so thick and short, that it is difficult at first sight to distinguish one from the other, and this circumstance, united to the animal's habit of proceeding either backwards or forwards as the occasion may require, has given rise to the popular belief very generally spread throughout Brazil and other parts of South America, the native countries of this genus, that it possesses two heads, one at each extremity, and that it is impossible to destroy the animal by simple cutting, as the two heads mutually seek one another in case of such a serious accident, and soon re-unite as if nothing had happened. Ignorance is the parent of superstition and absurdity, and one wonder naturally produces twenty. It is not therefore surprising that, among an ignorant and credulous people, the singularity of the *Amphisbœna's* form and habits should have given rise to this and a multitude of other gross fictions. "Another snake," says Stedman, in his 'History of Surinam,' "which I also observed here, is about 3 feet long, and annulated with different colours; it is called *Amphisbœna*, from the supposition of its having two heads; and the truth is, that from its cylindrical form the head and tail so much resemble each other that the error is almost pardonable; besides which, the eyes are nearly imperceptible. This is the snake which, being supposed blind, and vulgarly said to be fed by the large ants already described, is in this country honoured with the name of King of the Emmets. The flesh of the *Amphisbœna*, dried and reduced to a fine powder, is confidently administered as a sovereign and infallible remedy in all cases of dislocation and broken bones; it being very naturally inferred that an animal which has the power of healing an entire amputation in his own case, should at least be able to cure a simple fracture in the case of another." Two centuries have scarcely passed since opinions equally credulous and absurd were universally prevalent among the most enlightened nations of Europe, when grave and learned physicians administered the bezoar or rhinoceros' horn with as much confidence as the simple Brazilian at the present does the powdered flesh of the *Amphisbœna*.

The genus *Amphisbœna*, as at present defined, contains only American species, which are confined to Brazil, Surinam, and other tropical parts of the Continent. Of these the following are the principal:—

1. The *A. fuliginosa*, the first and still the best-known species of the whole genus, is, like all the other Amphisbænas, confined to the hotter regions of South America, and does not inhabit Ceylon or any other part of the East Indies, as Linnæus and Lacépède have erroneously supposed, and asserted on the authority of Seba. The general colour of this serpent is a deep brown, varied with shades of white, more or less intense according to the difference of the individual and the season of casting the old and acquiring the new external skin. It



Amphisbæna fuliginosa (*Clothonia Johnii*).

grows to the length of 18 inches or 2 feet, of which, however, the tail measures only 1 inch or 15 lines. The body is surrounded by upwards of 200 rings, and the tail by 25 or 30 the eyes are covered and almost concealed by a membrane, which, added to their naturally diminutive size, has given rise to the popular opinion that the animal was entirely deprived of sight; an opinion extended with no better reason to the Common Blind-Worm (*Anguis fragilis*). It lives upon worms and insects, particularly ants, in the mounds of which it usually conceals itself. The antipathy which most people entertain against serpents in general has given rise to a belief common among travellers, that this species is venomous, but without the slightest foundation in reality, as it is entirely destitute of fangs, and its teeth in other respects so small as to be incapable of inflicting a wound.

2. *A. alba*, so called from its colour, which is that of uniform pale straw without any marks or spots. The head of this species is short and thick, and its mouth small. The body usually measures from 1 foot 6 inches to 1 foot 9 or 10 inches, and is surrounded by 223 rings; the tail is from 1¼ to 3 inches in length, and is surrounded by 16 or 18 rings. The thickness of the body seldom exceeds that of a man's fore-finger, and is uniform throughout its whole length; that of the former species, on the contrary, equals the thickness of the wrist of a child of 10 or 12 years old. The *A. alba* inhabits the same localities and lives in the same manner as the *A. fuliginosa*, from which indeed it differs only in size, colour, the proportionate length of the tail and body, and in having the mouth provided with a greater number of teeth, all, however, equally small and weak.

3. *A. cæca*, a species mentioned by Baron Cuvier in the second edition of the 'Règne Animal,' but without any detailed description. It inhabits the island of Martinique, and is said to be entirely deprived of sight, at least M. Cuvier was unable to discern any trace of eyes. He supposes it, nevertheless, to be identical with the *Amphisbæna vermicularis* of Spix, which that naturalist describes as having eyes scarcely perceptible.

AMPHITHE'RIUM (Blainville). This Fossil Mammal, from Stonesfield, is now termed *Thylacotherium* by Owen.

AMPHIUMA, a singular genus of Amphibian Reptiles, first noticed by Dr. Garden in 1771, in a letter to Linnæus. The remarkable and anomalous order *Amphibia*, to which this genus belongs, is more extensively spread throughout the New World, and exhibits a far greater diversity of organic modification in the western hemisphere, than in all the rest of the earth together. It is here alone that the *Menopomæ*, the *Amphiumæ*, the *Axolotls*, the *Menobranchi*, and the *Sirens*, are to be found. These singular animals abound in all the lakes and stagnant waters, and astonish the observer equally by the variety as by the novelty of their forms. [AMPHIBIA.]

Amphiuma tridactylum.

The external form of the *Amphiuma* is very similar to that of the common eel, but the whole anatomy and physiology of the animal approximates it more nearly to the Common Water-Newt (*Triton marmorata*) than to any other known species. From this creature indeed it differs principally in the extreme length of its body and the diminutive size of its extremities, which rather resemble small tentaculi than actual legs. The only two known species inhabit the stagnant pools and ditches in the neighbourhood of New Orleans, and those in Florida, Georgia, and South Carolina. They bury themselves in the mud at the bottom of the ditches, particularly on the approach of winter, and vast numbers of them are sometimes found in draining and clearing ponds, at the depth of 3 or 4 feet from the surface. They are also capable of existing on land, but as their food in all probability exists only in the water, they never voluntarily abandon that element. The two known species, *A. didactyla* and *A. tridactyla*, differ principally in the number of their toes, the one having only two, the other three on each foot.

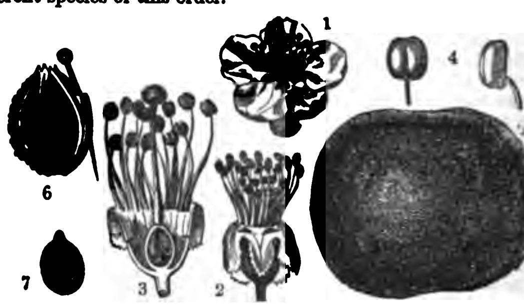
AMPHODELITE, a mineral allied to *Scapolite*, from which it differs in possessing magnesia instead of lime. It is composed of silica, alumina, and magnesia. [SCAPOLITE.]

AMPLEXUS (Sowerby), a fossil genus of *Madrephylliæa*, remarkable for the simplicity of its structure and the variability of its general figure. It occurs in the Mountain Limestone and Devonian Limestone.

AMPULLA'RIA, a genus of Fresh-Water Spiral Univalve Shells, which are found in the rivers and ponds of India, Africa, and South America. They are of a globular or rather depressed form, are covered with a thick olive or black periostraca, and often banded. Their mouth is ovate, with the lips complete all round, and often slightly thickened or reflexed. The animals are somewhat similar to the Common Pond-Snail (*Paludina*), but they have the front of the head nicked and furnished with two slight conical horn-like processes; and they have long slender tentacles, with the eyes placed on small pedicles at their outer base: these horns and the tentacles often contract into a spiral form. But the great peculiarity of these animals is, that, unlike all other molluscous animals with comb-like gills, they have a large bag, which opens beneath, placed on the side of the respiratory cavity, which they probably can fill with water; and it is this structure which most likely gives them the power of living for a long time out of water, specimens having been brought from Egypt to Paris alive, by only packing them in a little sawdust. Their operculum is formed of concentric rings with the nucleus nearly in the centre; in the species which come from India, this part is generally shelly, but in those of America and Africa it is always horny. The Indian species lay globular pale-green eggs about the size of small peas, which are placed in clusters on sticks and other things in the ditches; the eggs when dry form most beautiful objects. Some of the African species are reversed, or have the whorls of the shell turned from the right to the left, and these have been separated into a genus, under the name of *Lanistes*, on this account. It has been generally supposed by the geologist, that all the species of this genus are purely fresh-water, but the large Egyptian species, *A. ovata*, discovered by Olivier in Egypt, lives in Lake Mareotis, where the water is salt; therefore there is no proof that some of the fossil species are not marine.

AMPYX (Dalman), a genus of Fossil Crustacea (*Trilobites*), four species of which have been described by Colonel Portlock, from Tyrone.

AMYGDA'LEÆ (*Drupaceæ* of Lindley), a sub-order of the natural order *Rosaceæ* [ROSACEÆ], among which it is known by its bearing the kind of fruit called a drupe, by the stamens being numerous and arising from the orifice of a tubular calyx, and by the leaves and other parts of the plant yielding hydrocyanic acid. Owing to the last circumstance, the species are all more or less poisonous, especially in those parts where the prussic acid is concentrated, as the leaves of the common laurel, the skin of the kernel of the almond, &c. On the other hand, those parts in which the prussic acid exists either in very minute quantity, or not at all, as the succulent fruit, and sometimes the kernel, are harmless, and are often valuable articles of food. It is on this account that, while the general character of the foliage is either unwholesome or suspicious, the fruit of many of them is much cultivated. The peach, the nectarine, the plum, the cherry, the almond, the apricot, prune, damson, and bullace are produced by different species of this order.



Amygdaleæ.

1. An expanded flower. 2. The same with the corolla removed. 3. The same cut through. 4. Anthers. 5. Drupe. 6. Stone. 7. Embryo.

The bark of *Amygdaleæ* yields a gum which is similar in its properties to gum arabic; and an astringent substance which gives some of the species so much efficacy in fevers, that their bark has been compared for utility to Peruvian Bark.

AMYGDALOID, the name of a variety of the Trap-Rocks, when in a uniform base there are imbedded round or almond-shaped bodies, consisting of agate, calcareous spar, or zeolites, like almonds in a cake: the term is derived from the Greek ἀμυγδαλοειδής, resembling an almond.

AMY'GDALUS, a genus of plants, the type of the sub-order *Amygdaleæ*, comprehending the almond, and the peach and nectarine, besides a few bushes, the chief interest of which arises from their gay appearance.

A. communis, the Common Almond, is a native of Barbary, whence it had not been transferred into Italy in the time of Cato; it has, however, been so long cultivated all over the south of Europe and the temperate parts of Asia as to have become, as it were, naturalised in the whole of the Old World from Madrid to Canton. In this country, it is only grown for the sake of its beautiful vernal flowers; but in the countries that have a long and hot summer, it is the fruit for which it is esteemed. This, which is produced in very large quantities, is partly exported into northern countries, and partly pressed for oil, or consumed for various domestic purposes. Although botanists distinguish only one species of eatable almond, yet there are many varieties, of which the principal are the Bitter Almond and the Sweet Almond; of each of which the French and Italians have several sub-varieties distinguished by the hardness or softness of their shell, and the form or size of the kernel. These have all been introduced into England, but none of them are capable of ripening their fruit in the neighbourhood of London, except in unusually fine hot summers, preceded by mild and uninterrupted springs.

A. Persica, the Peach, once called the Persian Apple, because it was introduced from that country into Europe, has for ages been an object of careful cultivation for the sake of its delicious fruit, and has almost naturalised itself in America. In the country round about Buenos Ayres it is one of the most conspicuous trees, and bears abundant and delicious fruit. In our gardens many varieties are known, which are classed under the two heads of peaches and nectarines according as their fruit is smooth or downy; of the varieties there are few that are not worthy of cultivation, but the best are, perhaps, the Red Magdalen Peach, the Noblesse Peach, the Royal George Peach, and the Smith's Newington or Tawny Nectarine. For a late crop of peaches, the Têton de Venus may be recommended; but not the Catherine, nor indeed any of the thick-skinned October peaches, which, however excellent in the south of Europe, seldom ripen, and never acquire their natural flavour in this country. For preserving, the Blood-Red Peach, or Sanguinole, the flesh of which is of the deepest crimson, is worth a place in a garden.

AMYRI'DACEÆ, *Amyrids*, a natural order of plants consisting of tropical trees or shrubs, the leaves, bark, and fruit of which abound in fragrant resin. It is known among the Polypetalous Dicotyledonous orders by its hypogynous stamens, which are twice as numerous as the petals, by the large disk in which the ovarium is inserted, by its one-seeded fleshy fruit, covered all over with resinous glands, and generally dotted leaves.

The species are natives of tropical India, Africa, and America.

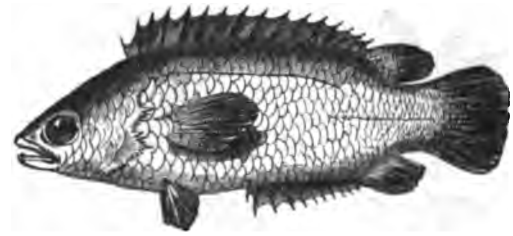
This order is remarkable for yielding various fragrant resins as Myrrh, Frankincense, and other products. The Frankincense of India is the produce of a species of *Boswellia*. Olibanum is yielded by *Boswellia serrata*. Myrrh is obtained on the Abyssinian coast from the *Balsamodendron myrrha*. *B. Opobalsamum* yields the Balm of Mecca. Bdellium is produced in Africa by *B. Africanum*. American Elemi comes from *Icica Icicariba*. Resin of Courina from *I. ambrosiaca*. The Gum Elemi of commerce is said to be yielded by several species of *Amyris*. (Lindley, *Vegetable Kingdom*.)

A'NABAS (from ἀναβαίνω, to ascend), the name given by Cuvier to a genus of Acanthopterygious Osseous Fishes, remarkable for the power possessed by the species of living for some time out of water, and making their way on land. This power depends on a structure characteristic of the family of which it is the type, part of the pharangeals being labyrinthiform; that is to say, divided into a number of irregular lamellæ, more or less numerous, forming cavities and little cells capable of retaining a certain quantity of water. This apparatus is so protected, that when the animals are out of their native element the evaporation of the contained water takes place very slowly, and the gills are kept moist, by means of which remarkable provision the fishes of this family are enabled to leave the rivers and marshes where they usually reside, and to travel over land for considerable distances, creeping among the herbage or along the ground. Although this fact has been but recently known to modern naturalists, the ancients appear to have been well acquainted with it, and Theophrastus has recorded the existence in India of certain little fishes which leave the rivers for a time, and again return to them: he doubtless alludes to the *Anabas* and its allies.

The genus *Anabas*, of which there is but one species, the *Anabas scandens* (*Perca scandens* of Daldorf, *Anthias testudineus* of Bloch), is distinguished by a well-marked character, the borders of its opercle, subopercle, and interopercle being denticulated, whilst the preopercle is not so, nor even distinctly marginated. The head is round and broad; the muzzle is very short and obtuse, the eye placed very near its extremity. The mouth is small, and large scales cover the head. The body is oblong, compressed centrally and behind. The lateral line is interrupted at its posterior third, recommencing a little lower. The tail is somewhat rounded. The whole body is covered with large scales. There is a single dorsal and an anal fin, nearly equal in height, and in both the spinous rays prevail.

In colour it appears to vary, being brown or bluish-black or dark green, paler beneath and having violet fins. In form the individuals are constant, and reach the length of 6 inches.

This fish inhabits all parts of India and the Indian Archipelago, living in marshes and feeding on aquatic insects, and Dr. Cantor observed it at Chusan. Respecting its habits there has been much discussion. In 1797 a Danish gentleman, M. Daldorf, communicated an account of its habits to the Linnæan Society of London, in which he stated that he had observed it in the act of ascending palm-trees near marshes, and had taken it at a height of no less than 5 feet above the surface of the water, effecting its movements of ascent by means of its fins and tail and the spines of its opercles, in a similar manner to that by which it progressed along the ground. Another Danish observer, M. John, published a similar statement, adding that it is called in Tranquebar by a name which signifies Tree-Climber. Other naturalists, who have equally observed it in its native countries, such



Anabas scandens.

Head of *Anabas scandens*, laid open to show the peculiar pharyngeal apparatus.

as Reinwardt, Leschenault, and Hamilton Buchanan, whilst they record its habit of creeping on the ground and living a long time out of water, deny or omit all mention of its power to ascend trees.

To the same family with *Anabas* belong the genera *Helostoma*, *Polyacanthus*, *Colisa*, *Macropodus*, *Osphromenus*, *Trichopus*, and *Spirobranchus*, of which the habits are as yet very imperfectly known, though the peculiarities of their anatomy warrant us in supposing that they have a similar power of living out of water.

(*Linnæan Transactions*, vol. iii.; and Cuvier and Valenciennes, *Hist. Nat. des Poissons*, tom. vii.)

ANABATHRA, a Fossil Tree, from Allenbank, Berwickshire, is thus named by Mr. Witham, and figured in 'Foss. Veg.' t. 8 and t. 10.

A'NABLEPS (from ἀναβλέπω, to look up), a genus of Malacopterygious Osseous Fishes, remarkable for the curious structure of their eyes, which, in consequence of the division of the iris and cornea by transverse ligaments, have two pupils, and appear as if double, whilst there is only one crystalline humour, one vitreous humour, and one retina. There is no other example known of such a modification of structure among the *Vertebrata*. This peculiarity of the *Anableps* has given rise to several stories of four-eyed fish, with exaggerated accounts of their habits. The *Anableps tetrophthalmus* inhabits the rivers of Guyana and Surinam. Its body is cylindrical, and covered with strong scales; its head is flattened, and snout blunt. The upper jaw projects beyond the lower.

ANACARDIA'CEÆ, *Anacards* or the *Cashew Tribe*, is a natural order of plants, consisting exclusively of woody plants, abounding in an acrid resin, which is easily discovered by bruising the leaves, but which is not indicated by its being collected in transparent receptacles in the leaves, as is most commonly the case. They are polypetalous dicotyledons, with perigynous stamens, a simple one-seeded superior fruit, and alternate leaves without stipules.

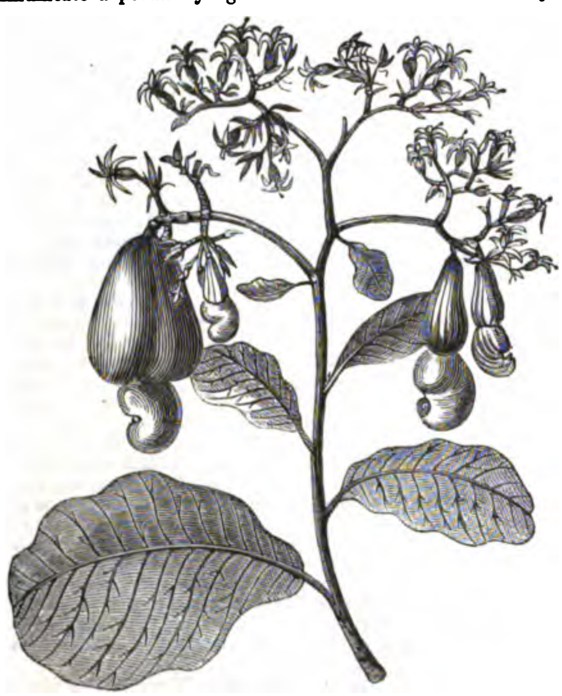
Their juice is often used as a kind of varnish, for which it is well adapted in consequence of its turning hard and black when dry. It is, however, often dangerous to use, because of the extreme acridity of the fumes, which are apt to produce severe inflammation in many constitutions. The best-known genera of the order are, in the first place, *Rhus*, or the Sumach, of which so many species are cultivated in our gardens; and the *Pistacias*, the nuts of which are served at desserts, and their juice is commonly sold in the shops under the name of Mastich and Scio Turpentine. Besides these, there are the Chilian *Duvauas*, which resemble myrtles, the *Mango*, the fruit of which is so delicious in tropical countries, and the Cashew or Acajou Nut, *Anacardium*, from which the order takes its name.

The last, *Anacardium occidentale*, is a small tree found all over the West Indies, where it is much cultivated for the sake of its bunches of fragrant rosy flowers, as well as of its fruit. Its stem, if wounded, yields abundantly a milk, which, when inspissated, becomes intensely black and hard, besides which, it secretes a gum not inferior to gum arabic. The nut is a kidney-shaped body, seated on a large fleshy protuberance, and being, in fact, the extremely dilated disk or receptacle; the latter is sometimes red, sometimes white. The nuts contain, in abundance, beneath the outer shell, the black caustic oil of the order, which, when volatilised by heat, as happens in the process of roasting, is apt to produce erysipelas and other disagreeable affections in the face of persons standing over the fumes; the kernel is a well-known wholesome article of food. In the West Indies it is used as an ingredient in puddings, is eaten raw, and is roasted for the

Duvaua dependens.

1. Male flower. 2. Hermaphrodite do. 3. Back of do.
4. Fruit. 5. Section of do. All slightly magnified.

purpose of mixing with Madeira wine, to which it is thought to communicate a peculiarly agreeable flavour. In this country the



Cashew Nut (*Anacardium occidentale*).

Cashew Nut never flowers, and can only be cultivated as a tender stove-plant.

The *Spondias*, or Hog Plum, which is the type of the order *Spondiaceæ*, is referred by Lindley to this order. [SPONDIACEÆ; RHUS.]

ANAGA'LLIS, a genus of plants of the natural order *Primulaceæ*. among which it is known by its flat or wheel-shaped corollas and by its capsule opening into two halves, of which the upper fits the under like the lid of a box. A very common species is the Pimpernel, or Poor Man's Weather-Glass, so called because its flowers generally open at eight in the morning and close in the afternoon, and also refuse to expand in rainy weather. It is a little trailing plant with brick-red flowers, very abundant in corn-fields; it was once thought useful in cases of madness, especially such as arose from the bite of rabid animals, but it is in no esteem at the present day. There is a purple variety called by Sir J. E. Smith *A. cærulea*. A far more beautiful species is the *Anagallis tenella* (Bog Pimpernel), which grows in the drier parts of marshes, along with *Pinguicula* and *Drosera;* it has delicate flesh-coloured flowers, in the centre of which grows a cone of stamens covered all over with glittering transparent hairs; these and its peculiarly neat appearance, entitle it to be called the queen of British wildflowers. Some botanists regard it as a distinct genus, and describe it under the name of *Irasekia*. One or two foreign species, with large blossoms, are cultivated in greenhouses.

ANALCIME, also called *Cubicite* and *Sarcolite*, is a mineral belonging to the group of hydrous silicates of alumina. It contains according to analyses by Rose and Connell, the following constituents:—

	Rose.	Connell.
Silica	55·12	55·07
Alumina	22·99	22·23
Soda	13·53	13·71
Water	8·27	8·22
	99·91	99·23

It is found crystallised, the primary form being a cube. The cleavage is parallel to the face of the cube, but is obtained with difficulty. It has an uneven undulating fracture. It scratches glass, but not readily. It is brittle, and is of a white colour with a shade of red. The streak is white, and it has a vitreous but not brilliant colour. It is either transparent, translucent, or opaque. The specific gravity is 2·068. It melts into a clear glassy globule by the blow-pipe on charcoal. It gelatinises in hydrochloric acid. It is principally found in the Basaltic and Amygdaloidal rocks of Scotland, Ireland, the Tyrol, and other countries.

ANAMIRTA, a genus of plants belonging to the natural order *Menispermaceæ*, including some of the species of the old genus *Cocculus*. [COCCULUS.]

ANAMORPHO'SIS. (Botany.) [METAMORPHOSIS OF ORGANS.]

ANANASSA, a genus of plants belonging to the natural order *Bromeliaceæ*, found wild in the woods of South America, and now commonly cultivated in the gardens of rich Europeans. It is distinguished from the *Bromelia*, to which it was once referred, by its succulent fruit collected in a compact head.

Of *Ananassa sativa*, the Common Pine-Apple, a great number of varieties are known, of which the Moscow and Common Queen, the Black Jamaica, and the Antigua Queen are the best for summer use, the Enville and the Trinidad the largest, the Black Jamaica the best for winter use, and the Blood-Red the worst for any purpose or season.

The fruit is a mass of flowers, the calyxes and bracts of which are fleshy and grow firmly together into a single head; it is the points of these parts that together form what gardeners call the pips, that is to say, the rhomboidal spaces into which the surface is divided. When wild, Pine-Apples bear seeds like other plants; but in a state of cultivation, generally owing to the succulence of all the parts, no seeds are produced, and consequently the plants can only be multiplied by suckers, or by their branches, which gardeners call the gills and crown. The latter, which surmounts the fruit, is in reality the end of the branch round which the flowers are arranged, and if it has any tendency to ramification, as sometimes happens, it becomes what is called double.

The Pine-Apple was undoubtedly unknown before the discovery of America; its incomparable flavour soon however caused it to be introduced into Africa and Asia, where, in a suitable climate, it multiplied so rapidly as to acquire as firm a footing in those countries as their aboriginal plants. In Asia it has even improved so much in quality, that the Birmese Pines, which have never yet reached England, are said to be the finest in the world. With this exception it is believed that we already possess the best varieties that exist; and it is undoubted that, except in the kingdom of Birma, the most delicious specimens of the fruit are produced in England. Within a recent period Pine-Apples have been imported largely into England from the West India Islands, where the cultivation has in consequence been more carefully attended to, the quality greatly improved, and this branch of commerce largely extended. [PINE-APPLE, in ARTS AND SC. DIV.]

ANANCHY'TES (Lamarck), a fossil genus of *Echinodermata*, found abundantly in the Chalk.

ANA'RRHICAS, a genus of Acanthopterygious Osseous Fishes, established by Linnæus, and retained by subsequent ichthyologists. They are very nearly allied to the Blennies, so that Cuvier remarked they might be regarded as Blennies without ventral fins. They have round smooth blunt heads; elongated bodies, covered by minute scales; a single long dorsal fin, and an extended anal fin, both separated from the caudal; no ventrals; the mouth armed with formidable teeth of two kinds, conical incisors and flat grinders. One species, the Wolf-Fish, Sea-Cat, or Cat-Fish (*Anarrhicas lupus* of Linnæus), is common in the northern seas, and in Britain is frequently taken on the east coast of Scotland and the Orkneys, though rare on the English shores. Its range extends to Greenland. It grows to the length of 6 feet, and is a ferocious and formidable animal, destroying the nets of fishermen; when caught it defends itself to its last gasp, inflicting severe wounds by means of its powerful teeth and jaws. It lives chiefly on crustacea and testaceous mollusca, and, like most fish which subsist on such food, its flesh is excellent eating, though, from the ugly appearance of the animal, usually rejected. It finds its way however to the Edinburgh market, where, by naturalists especially, whose knowledge of its good qualities enables them to vanquish their prejudices against its aspect, it is much esteemed. The Cat-Fish is of a light gray colour marked with seven or eight broad vertical bands of bluish gray. When old it becomes darker. Its skin is covered with slime. (Yarrell's *British Fishes*.)

ANAS, the Duck, a genus of birds under which Linnæus included a great number of species now separated into several genera by recent naturalists. [DUCKS.]

ANASTATICA, a genus of plants belonging to the natural order *Cruciferæ*. One species, *A. hierochuntina*, is the Rose of Jericho. [JERICHO, ROSE OF.]

ANASTO'MOSIS, from ἀνὰ, through, and στόμα, a mouth, signifies the communication of blood-vessels with each other by the opening of the one with the other. The blood-vessels are the tubes by which the different parts of the body are supplied with nourishment. If the blood-vessels destined to nourish a part be obstructed, so that it cannot receive a due supply of blood, that part must necessarily die, or, as it is technically termed, mortify. But the blood-vessels are soft compressible tubes, liable by innumerable circumstances to have their sides brought so closely into contact as to prevent the flow of a single particle of blood through them. In order to prevent the consequences that would result to the system from the operation of causes thus tending to impede the circulation, provision is made for the freest possible communication between the main trunks of the blood-vessels and their branches, and between one branch and another. All the branches which form such communications are called *anastomosing* branches, and this union of branch with branch is termed *Anastomosis*.

ANATASE, in Mineralogy, a variety of Titanic Acid. [TITANIUM.]

ANATHERUM, a genus of Grasses, belonging to the group of which species yield fragrant volatile oils. *A. muricatum* is the *Vetian* of the French and the *Khus* of the Hindoos. Its fragrant roots are employed in making tatties, covers for palanquins, &c. It is administered medicinally, and has stimulating and diaphoretic qualities. *A. nardus* is also, on account of the volatile oil it contains, called Ginger-Grass, or Koobel.

ANA'TIDÆ (Leach), the Duck kind, a group formed by Dr. Leach to include his genera formed from the great genus *Anas* of Linnæus. [DUCKS.]

ANA'TOMY, from a Greek term (ἀνατομή), which literally signifies 'the separation of a thing into parts by cutting;' the term Anatomy is used to signify particularly, dissection, or knowledge acquired by dissection. Anatomy is at once an art and a science; an art, inasmuch as the pursuit of it requires skilful manipulation; and a science, inasmuch as certain general principles are deducible from it. The object of anatomy is to ascertain the structure of organised bodies. Of the two great kingdoms of nature, the inorganic and the organic, it comprehends the whole range of the latter. Like the organised kingdom itself, it forms two divisions, the one including the structure of plants—Vegetable Anatomy; the other the structure of animals—Animal Anatomy. Animal Anatomy is divided into comparative and human: Comparative Anatomy includes an account of the structure of all classes of animals, excepting that of man; Human Anatomy is restricted to an account of the structure of man only. Human Anatomy is subdivided into descriptive, general, and pathological. *Descriptive Anatomy* comprehends a description of all the various parts or organs of the human body, together with an account of their situation, connections, and relations, as these circumstances exist in the natural and sound, or, as it is technically termed, the normal, condition of the body. The human stomach, for example, is composed of a number of membranes, which are united in a particular manner; a number of blood-vessels which are derived from particular arterial trunks; a number of nerves which proceed from a particular portion of the brain and spinal cord; a number of absorbent vessels, and so on; moreover, this organ is always placed in a particular cavity of the body, and is always found to have certain specific connections or relations with other organs. The anatomy of the human stomach comprehends an account of all the particulars of this kind, which are uniformly found to concur in all human bodies in which the conformation is regular or natural; and so of every other organ of the body: and because such an exposition of the structure of the various organs includes a description of all the circumstances that relate to their organisation, it is called Descriptive Anatomy.

After the study of the human body in this mode has been carried to a certain extent, with a certain degree of success, it necessarily gives origin to a second division of the science, that termed *General Anatomy*. It is found, that many of the circumstances which belong to any one organ, belong at the same time to several organs; and that thus several individual circumstances are common to many organs. Of the membranes, for example, of which it has been stated that the stomach is composed, some are common to it and to the intestines, to the bladder, to the heart, to the air-passages, and so on. In like manner with respect to any one of these membranes, when its structure is carefully examined, it is found that in many points its organisation is exactly similar to that of all other membranes. This view extended leads to further important and interesting results. All the arteries of the body, whatever their situation, size, or office, are found to be composed essentially of the same substances, disposed in nearly the same order and form. All the veins have, in like manner, a structure essentially the same. All the absorbent vessels, all vessels of every kind, all the bones, muscles, and nerves, the whole external covering of the body or the skin, widely as these various structures differ from each other, present no material difference as far as regards the organisation of each particular class. Hence various organs of the body are disposed into what are called common systems, and these common systems are said to consist of common substances or *tissues*. All the vessels, for example, are collected and arranged under one common class, called the vascular system: in like manner, all the bones are collected and arranged under another class, called the osseous system; all the muscles under another, called the muscular system; all the nerves under another, called the nervous system, and so on. The material that enters into the composition of each of these systems consists of a substance of a peculiar nature; but as this substance is more or less generally diffused over the whole body, entering as a constituent element into the various organs, it is termed a common substance, or tissue. What is termed the common cellular or areolar tissue, for example, is the substance which enters most commonly into the compositition of the organs of the body; the muscular tissue is the substance of which the muscles are composed; the nervous tissue is the substance of which the nerves are composed: and thus, the structure of the body, analysed in this mode, innumerable and complex as the substances appear to be of which it consists, is ultimately reduced to a very few simple materials, by the combination and modification of which all the different animal substances are produced.

General Anatomy also includes the study of certain fluids from which the membranes or textures are formed. The following is a list of the fluids and textures, given by Dr. Sharpey in Quain's 'Elements of Anatomy:'—

The Blood, Chyle, and Lymph.
Epidermis Tissue (including Epithelium, Cuticle, Nails, and Hairs).
Pigment.
Adipose Tissue.
Cellular Tissue.
Fibrous Tissue.
Elastic Tissue.
Cartilage, and its varieties.
Bone or Osseous Tissue.
Muscular Tissue.
Nervous Tissue.
Blood-Vessels.
Serous and Synovial Membranes.
Mucous Membranes.
Skin.
Secreting Glands.

These textures and fluids will be treated of under their respective heads.

Descriptive and general anatomy, then, include an account of the structure of the body as it exists in the state of health. But there is no organ of the body, and no tissue which enters into its composition, which is not subject to disease; in consequence of disease, the regular or natural structure of the component substances of the body becomes changed in a great variety of modes. That part of anatomy which displays these diseased or morbid changes, and which describes all the circumstances relating to them, is called *Pathological* or *Morbid Anatomy*. We may say, then, that Descriptive Anatomy comprehends an account of all the parts or organs of the body as they exist in the state of health; General Anatomy comprehends an account of all the separate substances of which those organs are composed, not as these substances exist combined in organs, but as they form distinct and peculiar substances; Pathological Anatomy comprehends an account of all the changes of structure produced by disease, whether in individual organs, or in the primitive or common substances of which these organs are composed.

The term *Anatomy*, as we have seen, is chiefly applied to the science which determines the nature and relations of the various organs of the human body. A general term is here used in a restricted sense. On the other hand, when we would express the extension of the science of anatomy to the whole animal creation, we employ the general term with the addition of the word *Comparative*. This anomaly has doubtless proceeded from the circumstance that, till within a very recent period, the study of animal structure was almost exclusively confined to the human subject; and that even zoologists were contented with inquiring into the functions of animals, instead of determining the character of the organs which were connected with those functions. By the term *Comparative Anatomy* is understood the science which conveys a knowledge of the differences in the structure and organisation of the whole animal kingdom in all its classes, orders, and species.

It is evident that a science possessing such an extensive range must be exceedingly imperfect; especially when it is borne in mind that scarcely half a century has elapsed since the first attempts were made to simplify, by systematising, its almost infinite details. It has however made sufficient progress, not only to have furnished the most important aids to the study of human anatomy and physiology, but to have supplied a secure and broad foundation for all zoological knowledge, both as regards existing and extinct races. As the basis of modern zoology, comparative anatomy presents a subject of the highest interest, and the most successful methods of classification have been produced mainly by its aid. [ANIMAL KINGDOM.]

ANBURY and CLUB-ROOT, a sort of Galls produced by insects on the roots of cabbages, turnips, hollyhocks, and other species of cultivated plants, and popularly, but incorrectly, supposed to arise from peculiarities of soil, or from growing the same crop successively on the same field, or to be owing to variations of seasons. Nothing can be more simple than the disproof of all these theoretical notions. If we take some of the cabbages or turnips, whose roots are infected with anbury, and keep them in garden-pots covered over with close gauze, in a short time, if the plants be kept growing, the little weevils, evolved from the grubs in the interior of the roots, will make their appearance, ready to multiply their species, by depositing their eggs, as their parents had done, on the first turnip or cabbage they can find. The weevil thus arising continues to be no less, but often more, destructive than the grub had proved to be in feeding on the roots; for it thrusts its beak (rostrum) into the seed-leaf of the turnip, and greatly injures the crop. When the turnip is advanced to the rough leaf, these insects either die, as most insects do, when they have laid their eggs, or betake themselves to some other plant, such as clover, which is suited to their taste.

It will be therefore evident, that no peculiar rotation of crops, nor peculiar manure for dressing the soil, can be of any avail in preventing anbury, or in stopping its progress when the insects have obtained a lodgement within the roots. The destruction of the adult insects before they have laid their eggs, is the only remedy, though in the case of so small a species it is peculiarly difficult to effect.

ANCHOVY (*Engraulus*, Cuvier), a genus of Abdominal Malacopterygious Fishes, separated by Baron Cuvier from the *Clupeæ*, or Herrings of Linnæus, from which they are distinguished by the superior number of their branchiostegous rays, amounting to twelve or upwards, by the gape of the mouth extending behind the eyes, and by the straight and prolonged form of the superior maxillary bones, which form a small muzzle, projecting considerably beyond the mouth. The genus, as at present constituted, consists of six or seven species, all of diminutive size, and with the exception of the Common Anchovy (*E. encrasicholus*), and a nearly allied species distinguished from it by M. Cuvier (*E. meletta*), all inhabitants of the tropical seas of India and America. Whether these latter agree with the European species in the savour and other qualities of the flesh, for which it is so highly esteemed, is a doubtful question; at all events we are not aware that the fishing of the native species has ever been attempted either in America or India.

The Common Anchovy is a small fish, not much longer than the middle finger, of a bluish-brown colour on the back, and silvery-white on the belly. The anal-fin is remarkably short, and the dorsal situated immediately above the ventral; these characters will serve readily to distinguish it from the sprat and other kindred species, with which it might otherwise be confounded, and which are, in fact, not unfrequently imposed upon the public for the real anchovy. It abounds in the Mediterranean along the shores of Spain, Italy, and Greece; in the Atlantic it is found along the coasts of Portugal and France, and occasionally has been taken off the shores of England and Holland. Considerable fisheries of Anchovies are established along the coasts of Provence and Catalonia; but the most productive of all is off Gorgona, a small island west of Leghorn. The latter fishery is carried on only during the months of May, June, and July, at which period the anchovies quit the deep seas and approach the shores for the purpose of depositing their roe; it is then only that they are found in the Mediterranean, which they enter in enormous shoals, by the straits of Gibraltar, at the commencement of the breeding season, and leave it, after fulfilling this duty, to retire again to the depths of the Atlantic. They are fished for only during the night, and are attracted round the boats by means of charcoal fires which are kept burning in the sterns.

After being caught, the heads, gills, and entrails are separated from the bodies, which are salted and arranged in small barrels, varying from 5 to 20 pounds in weight: this is the only preparation which they undergo previous to being sent to market; and if proper means be taken to exclude the air they will in this state keep for a considerable period. If, when the barrels are open, the fish are found to be small and firm, round-backed, with a silvery-white skin and red flesh, and a plump compact form, they are probably the true anchovy; if, on the contrary, they taper very much towards the tail, are of a dark brown colour without, and have flabby pale-coloured flesh, they will probably turn out to be the Sardine (*E. maletta*), another Mediterranean species frequently mixed with real anchovies, or even sold separately as the genuine fish.

No condiment is more generally known and esteemed than anchovy sauce. It was also in use among the Romans, and was one of the kinds of sauce called Garum, which appears to have formed an indispensable article of seasoning in their most expensive and luxurious dishes.

ANCHOVY PEAR. [GRIAS.]

ANCHU'SA, a genus of plants belonging to the natural order *Boraginaceæ*, and to the sub-tribe *Anchuseæ*. The calyx is 5-fid; the corolla funnel-shaped, with a straight tube, the throat being closed by prominent obtuse scales; the stamens are included, and subsessile; the fruit a nut, which is depressed. The species are chiefly inhabitants of the temperate parts of the earth, either on the mountains of tropical regions or the temperate zone. They are all of them rough plants, and are known, as well as the species of *Lycopsis* and *Echium*, by the common name of Bugloss. Some of the species have been used in medicine, while others are employed in the arts for dyeing. Two are inhabitants of Great Britain.

A. officinalis, Common Alkanet or Bugloss, has lanceolate hispid leaves, unilateral crowded spikes, ovate-lanceolate bracts, the segments of the calyx bluntish, hairy on both sides, the scales of the corolla hairy. The flowers are a deep purple. It is an inhabitant of Great Britain, on waste ground, but is a rare plant. In the south of France, Germany, and Switzerland it is everywhere common, in uncultivated places, on old walls, and by the road-side. The young plant is sometimes boiled and eaten. The roots contain a considerable quantity of gum, and when boiled yield a demulcent drink, which was once in repute as a medicine.

A. sempervirens, Evergreen Bugloss, has ovate leaves, with lower leaves on long stalks, the peduncles axillary, each bearing two dense spikes with an intermediate flower, the segments of the calyx hairy on the outside only, the bracts minute lanceolate, scales of the corolla downy, flowers blue, salver-shaped. This plant is found on waste ground, near ruins, in Great Britain, but is rare.

A. tinctoria, Dyers' Bugloss or Alkanet, has diffuse stems, oblong hispid leaves, bracts longer than the calyx, the segments of the corolla shorter than the stamens. The corolla has a deep blood-coloured tube, with the limb deep blue. The root is woody, descending, and of a dark blood-red colour. This plant is a native of Peloponnesus, the island of Cyprus, and the deserts about Alexandria. It is cultivated in the south of France for the sake of the root, which yields a fine red colour to oils, wax, all unctuous substances, and to spirits of wine. Its chief use is in colouring lip-salves, ointments, &c. It is however sometimes employed for staining wood and dyeing cotton. It is also used for colouring many of the beverages sold under the name of port wine, and the corks used for the bottles in which this fluid is sold.

A. angustifolia, Narrow-Leaved Bugloss, has linear lanceolate hispid leaves, ovate-lanceolate bracts, 5-fid calyx, with blunt teeth. The tube of the corolla is pale purple, the limb deep blue. In gardens it attains a height of two feet, but when wild it is not more than a foot high. It grows in Italy, Germany, and Switzerland, by road-sides, amongst rubbish, and on the borders of ploughed fields.

In the cultivation of the species of this genus but little care is required, as they will grow in almost any soil, and are easily increased by seed. The *A. Capensis*, Cape Bugloss, requires the treatment of a greenhouse plant. Many of them are pretty annuals for the garden, as *A. paniculata*, *A. Barrelière*, &c.

ANCILLA or ANCILLA'RIA, are the names given by Lamarck to a genus of Spiral Univalve Marine Shells, allied to the Olives. Like them they are covered with a hard shining coat, destitute of any periostraca, and are immured in the large foot of the animal, so that the middle of the back of the shell can be alone discovered. They chiefly differ from the Olives in the suture of the whorl, being callous and not furnished with a groove, formed by a thread-like filament placed at the end of the mantle, which is wanting in this genus: they are also furnished with a small ovate operculum. The species are numerous, and are chiefly confined to tropical climates; some have a small tooth, like the Unicorn Shell (*Monoceros*), placed at the end of a groove crossing the front of the shell. The best-known species is the Ivory Shell, which with a few others differ from the rest of the genus in having the front of its axis deeply pierced.

ANCYLO'CERAS (D'Orbigny). This Fossil genus of M. D'Orbigny includes several species of *Hamites* (Phillips), from the Speeton Clay and Lower Greensand.

A'NCYLUS is the name of the shell which is usually called the Fresh-Water Limpet. They are small pellucid conical shells, with slightly-recurved tips. The cavity is simple, and marked with a horse-shoe-shaped muscular scar near the margin, which is interrupted on the middle of the left side over the respiratory holes, as in the genus *Syphonaria*. This animal, like the Pond-Snail (*Limnea*), has two compressed triangular tentacles, with the eyes sessile on the outer base; and a respiratory cavity placed on the middle of the back, with an aperture closed by a valve opening in the middle of the left side.

This genus is very nearly allied to the Pond-Snail, from which it chiefly differs in the simple conical form of its body and shell; and some species, as *Ancylus*, are allied to it by having the apex bent on one side, as if making an approach to the spiral form. It has been placed in several orders, but there is little doubt that its true situation is with the lung-breathing mollusca. They are found in Europe, America, and the West Indies, attached to stones and plants, and they will live a considerable time out of the water. They are easily known from the *Syphonariæ*, which are the only shells they can be confounded with, by their being sinistral, very thin, and covered with a hairy periostraca.

ANDALUSITE, a Mineral consisting of

Silica	39·09
Alumina	58·56
Protoxide of Manganese	0·53
Lime	0·21
Water	0·99
	99·38

It occurs crystallised; its primary form being a right rhombic prism. It has an uneven conchoidal fracture. Its colour varies from a flesh-red to a brownish and grayish-red. It has a vitreous lustre. It occurs both transparent and opaque. The specific gravity is 3·104. This mineral is found in Spain, France, and North America. The above analysis is from an American specimen.

ANE'MONE (ἀνεμώνη) is a genus of plants belonging to the natural order *Ranunculaceæ*. It consists of lowly herbs, usually perennials, with white, or purple, or scarlet, or even yellow blossoms, in which there is no distinct calyx, and which are succeeded by a cluster of grains, each terminated by a long silky feathery tail. As the species generally grow on open plains or in high exposed situations, their feathery grains produce a singular shining appearance when waved by the breeze, whence their name, and which literally signifies Wind-Flower, their English appellation.

The Anemones possess, in common with other *Ranunculaceæ*, an acrid property. The leaves of *A. pulsatilla* will raise blisters on the skin; if chewed, they produce irritation of the throat and tongue; and their roots, as well as those of *A. pratensis*, a nearly related species, produce nausea and vomiting if administered in very small doses, on which account they have been strongly recommended by some medical men in various complaints. The following are the most remarkable species:—

1. *A. pulsatilla*, or Pasque Flower, grows wild upon exposed downs in various parts of England, as on the Gogmagog Hills near Cambridge, the heath at Newmarket, and on open chalky pastures. It has large purple flowers and finely-cut hairy leaves.

2. *A. nemorosa*, the Wood Anemone, is found abundantly in woods all over England, covering the ground with its neat white flowers under the shelter of bushes as early as March and April. It is a perennial plant with knobby roots, and a short stem having one or two smooth, bright-green, deeply-cut leaves. It is poisonous to cattle.

3. *A. pavonina*, the Peacock Anemone, a native of the vineyards in Provence, about Nice, and in other parts of the south of Europe. This is not very uncommon in gardens, where it is usually, but improperly, named *A. stellata*. It is known by its scarlet or scarlet and white flowers, which are usually double, and have their divisions very sharp-pointed. It is one of the handsomest of the cultivated species.

4. *A. coronaria*, the Common Garden Anemone. Found in a wild state in moist meadows in the south of France, Italy, and Greece, and different parts of Asia Minor; Dr. Russell speaks of it as abundant near Aleppo. In these places it is seen only in a single state, but even then sporting into a variety of colours, the principal of which are white, scarlet, and purple in different shades.

5. *A. stellata* is a native of various parts of Germany, France, and the Levant, and is also often seen in our gardens, where it is called *A. hortensis*. It differs from the last in having smaller and narrower petals, very rarely double flowers, a greater tendency to purple in their colours, and much broader leaves. It is not so liable to vary as the last species.

ANEMONIES, SEA. [ACTINIADÆ.]

ANGEL-FISH. [SQUALIDÆ.]

ANGE'LICA, a genus of plants belonging to the natural order *Umbelliferæ*. It comprehends several species, the principal part of which are to be met with in botanic gardens; and one that was formerly very much cultivated as an esculent plant. This, the *Angelica archangelica*, or *Archangelica officinalis*, is a native of the banks of rivers and of wet ditches in all the northern parts of Europe; in this country it grows abundantly on the banks of the Thames below Woolwich, and in several other places. It is a biennial plant, with a large fleshy aromatic root, blackish externally, but white within; and a stout furrowed branched stem as high as a man. Its leaves are of a clear bright green, shining, and divided into a very large number of heart-shaped finely-serrated lobes. The flowers are white, and disposed in round very compact umbels; they are succeeded by large broad-winged grains of a pale yellowish-brown colour. Each partial umbel is surrounded at its base by 7 or 8 pointed undivided bracts.

For the sake of its agreeable aromatic odour, this plant is much cultivated on the Continent. Its blanched stems, candied with sugar, form a very agreeable sweetmeat, possessing tonic and stomachic qualities. Its roots contain a pungent, aromatic, stimulating principle.

A very common wild species, the *Angelica sylvestris*, or Wild Angelica, which is found all over the meadows near the Thames above London, possesses similar properties.

Angelica archangelica, a diminished figure.
1. A partial umbel of the natural size. 2. A separate flower.
3. The back of one of the partial umbels, showing the bracts.

ANGLARITE, a name for the native blue phosphate of iron. [IRON.]

ANGLESITE, in Mineralogy, a name for the native sulphate of lead.

ANHYDRITE, the Mineralogical name for the native anhydrous sulphate of lime. It is found at Halle in the Tyrol, Bex in Switzerland, and in the Salt-Mines of Upper Austria and Salzburg. A specimen from Sulz yielded—

Sulphuric acid	56
Lime	42
Silica	2

It occurs both massive and crystallised. The crystals have the form of a right rhombic prism. The cleavage is very distinct, and parallel to the terminal planes and their two diagonals, indistinct parallel to the lateral planes. The fracture is uneven. The colour is white, bluish, violet, or reddish. The streak is grayish-white. The lustre is vitreous and pearly on the cleavage surfaces. It is transparent and translucent. It has a double refraction. The specific gravity is from 2·5 to 2·9. Its hardness 3·0 to 3·5. The massive varieties are amorphous, nodular, or reniform.

ANIMAL FLOWERS. [ACTINIADÆ.]

ANIMAL HEAT. [HEAT, ANIMAL.]

ANIMAL KINGDOM. All natural objects are referred by naturalists to three great divisions, called the *Kingdoms of Nature*. These are respectively called after the objects they include, the *Mineral Kingdom*, *Vegetable Kingdom*, and *Animal Kingdom*. Although at first sight nothing would appear easier than defining these great groups, in such a manner as to afford an easy means of distinction, it is nevertheless one of considerable difficulty. The difficulty, however, does not lie in the typical object of each kingdom, as a rock, an oak-tree, and a man, but in applying the definition to those objects which lie as it were on the limits of each kingdom. The line is perhaps better drawn between minerals, and plants and animals, than between the latter two. It is usual to speak of minerals as forming the *Inorganic Kingdom* or portion of Nature, whilst plants and animals constitute the *Organic Kingdom*. The great distinctive character of the Organic Kingdom, is the fact of their parts originating in and being formed out of cells which give to them many characters by which they are distinguished from minerals. Thus they are unsymmetrical, whilst minerals are symmetrical; they grow irregularly, whilst minerals increase in definite crystalline forms. Each portion of a mineral, however small, consists of the same elements, whilst any part of a plant or animal may be differently composed to another part. The line in fact is nowhere difficult to be drawn, where the presence or absence of cells can be determined.

The distinctions between animals and plants present greater difficulties, and perhaps no mere structural or formal difference can be found. Looked at from one point of view, plants and animals form a great organic unity, connected together by their common modes of cellular growth and functions; and when thus regarded, there seems to be no necessity for drawing an absolute line of distinction between one and the other. Naturalists have however regarded them as distinct, and the study of the two classes of objects have constituted the sciences of Botany and Zoology. Rude definitions of various kinds have been laid down to guide the systematist in his classification of the objects belonging to each. Aristotle was one of the first who sought a distinction, and in stating that an animal possessed a mouth whilst a plant had no such organ, he gave perhaps the simplest and most generally applicable definition that exists. But Aristotle had not the microscope to direct his inquiries, and by the aid of this instrument beings can be made apparent to which other distinctions must be applied before they can be arranged in one kingdom or another. Professor Kölliker describes an animalcule, the *Actinophrys sol* of Ehrenberg ('Microscopical Journal,' Nos. i. and ii.), in which, though no mouth is found, the function of digestion is carried on by an indentation of its skin, temporarily formed for that purpose. Linnæus, with no better success, gave the following definition: "Minerals grow, plants grow and live, animals grow, live, and feel." To apply this definition, we must define life and feeling, and this cannot be done in such a way as to effect the object of the naturalist. Cuvier thought the possession of a stomach a sufficient distinction for the animal kingdom, but the nature of a stomach must first be understood, and here we have no absolute structural character to guide us. It was at one time a favourite distinction that animals have the power of motion, and that plants are fixed, but we know now that many plants move, whilst many animals are fixed. One of the most recent and philosophical of physiological writers says: "A plant is an organised being, whose vital powers are directed solely to the performance of formative operations, by which its fabric is not merely built up in the first instance, but is continually receiving additions during the term of its existence; and any movements which it may exhibit are destined solely for the furtherance of these operations, and must be regarded as originating in physical or vital forces. On the other hand an animal is an organised being, whose vital powers are not merely directed to the construction and maintenance of its corporeal fabric, but are also subservient to the operations of the conscious mind, which involve a continual disintegration of the structures that minister to them; on the repair of which, rather than on the extension of the fabric, after it has attained its full development, the formative energy is chiefly expended; and of the movements which it may exhibit, though a part are still to be regarded as directly dependent (like those of plants) on causes inherent in its material organisation, there is another part, small though it may often be, in which the consciousness and spontaneity of the individual are necessarily concerned, and which must therefore be distinguished as originating in psychical causes." (Carpenter, 'Principles of Physiology.')

In this way the naturalist and physiologist have tried to contend with the difficulty. Within the last few years chemistry has invaded the domain of the anatomist, and supplied him with materials for determining the problem of the difference of animal and vegetable life. The substances found in animals and plants are found in a great measure to be formed of four elements, carbon, hydrogen, oxygen, and nitrogen. At one time nitrogen was supposed to distinguish animal from vegetable substances. It is now known, not only that plants contain nitrogen, but that they supply this and the three other elements to the animal system. It is found that these four elements are always present in the *protoplasm nucleus, cytoblast*, or *primordial utricle*, from which the cells of all plants and animals are first formed. So that they are universally necessary in plants and animals, and have hence been called *Organic Elements*. Three compounds of three of these elements, carbon, hydrogen, and oxygen, and called cellulose, sugar, and starch, were at one time thought to be peculiar to plants. It is now known that cellulose is present in many animals, and that sugar is very generally present in certain animal textures and fluids. Starch yet remains to be found in the animal kingdom, and its presence in doubtful structures is still regarded as evidence of their vegetable nature.

It is clear however that no single character is sufficient to mark the line between these two kingdoms, and that the collective functions performed by animals and plants, accordingly as they are more or less prominent in organised beings, guide the opinions of naturalists. The structural characters of typical animals are so evidently different from the corresponding forms of plants, that we need not dwell on them here; but a view of the functions which animals and plants perform dependently on one another, will give the best possible notion of their antagonistic nature. One of the great functions performed by the animal kingdom is that of *Respiration*. During this process the oxygen of the atmosphere is brought in contact with carbon in the blood of the animal, and the result is a union of the carbon and oxygen, and the formation of carbonic acid gas, which is being constantly thrown off from the structure of the animal—from the whole surface of the body in the lowest animals, from the gills of those that live in water, and from the lungs of those that live in air. It thus consumes oxygen and gives off carbonic acid. The great function of plants is antagonistic to this. They take from the air carbonic acid gas; it is a part of their food. In the tissues of the plant the carbonic acid is decomposed. Its elements are separated; the carbon is retained in the plant, and the oxygen is set free. It thus consumes carbonic acid and gives off oxygen. As far as we at present know there are no exceptions to this law. On tracing the supply of the carbon which is contained in the animal system, and which combines with the oxygen, we find that it is derived by the animal from the plant. The food of the whole animal kingdom is derived from the vegetable kingdom; and the other three elements, as well as the carbon, which are found in the animal, are thus obtained. The animal, in like manner, throws off its nitrogen in the form of excretions, more especially those of the kidneys, which, on decomposing, yield ammonia, a compound of nitrogen and hydrogen; and it is from this substance that plants principally derive their nitrogen. Thus, whilst the animal derives the constituent of its body from the vegetable kingdom, the plant derives its elements from the mineral kingdom. The animal takes up starch, sugar, and protein, from the plant, but the plant takes up carbonic acid and ammonia in their mineral form. The tissues of the plant are engaged in converting mineral into organic substances, whilst the tissues of the animal are engaged in converting organic substances into mineral.

In their relation to the great physical forces, heat and light, we see the same antagonism between plants and animals. Light and heat are essential to the growth of plants. The productions found in their tissues are but the expression of the amount of heat and light they have as it were appropriated. Many of the substances thus formed are taken into the system of animals as food; and whilst in the system of the animal, the heat and the light are again set free in the form of the peculiar vital animal forces.

It is then by regarding the Animal and Vegetable worlds as exhibiting a combination of antagonistic and dependent forces in the great circle of nature, that we shall best form an idea of the real differences that exist between these two kingdoms of nature. Having said this much with regard to the nature of the Animal Kingdom, we shall now proceed to consider some of the methods which have been employed by naturalists to arrange the various members of which it is composed into groups, for the purpose of exhibiting the relation of one animal to another, and of facilitating the study of the whole.

In a crude shape, zoology, or the arrangement of animals, must have been one of the earliest sciences that forced itself upon the attention of the human mind. The very necessity for finding names for the more obvious divisions of living beings must soon have produced a classification into the natural groups of Quadrupeds, Birds, Fishes, and Insects; and certain subordinate sections, as, for instance, the distinction between herbivorous and carnivorous beasts, granivorous and carnivorous birds, harmless and poisonous reptiles, must have followed as a matter of course.

We have in the Bible, and in the engraven and pictorial Egyptian records, the earliest evidence of the attention which had been paid to Natural History in general. The 'navy of Tarshish' contributed to the wisdom of him who not only "spake of the trees, from the cedar of Lebanon even unto the hyssop that springeth out of the wall," but "also of beasts, and of fowl, and of creeping things, and of fishes" (1 Kings iv. 10); to say nothing of numerous other passages showing the progress that zoological knowledge had already made.

The Egyptian records bear testimony to a familiarity not only with the forms of a multitude of wild animals, but with their habits and geographical distribution.

Although it must be admitted that Herodotus was behind the science of his day in physical knowledge, he who, despising the sneers of the half-learned at his wonderful stories, will bring to the perusal of his works a fair share of scientific acquirement, will find many instances of zoological information which have been taken for the mere tales of this excellent traveller and historian, but which modern investigation has confirmed. But it is to Aristotle, justly termed the father of natural history, that we owe the first dawnings of system founded on the only sure basis—the organisation or physiological character of animals.

Aristotle's method was founded on a division of organs, which may be arranged, first, with reference to natural groups (*κατὰ γένος* or *κατ' εἶδος*), Birds or Fishes, for instance, which depend on a similar structure of parts; secondly, according to their excess and defect (*καθ' ὑπεροχὴν καὶ ἔλλειψιν*), as, for example, a division of Birds into those with long bills and those with short bills; those having crests and those having none; thirdly, according to their analogies (*κατ' ἀναλογίαν*); take, for instance, the comparison of a hoof with a claw, the wing of a bird with the fore-foot of a quadruped, a feather with a scale; and, fourthly, according to their situation (*κατὰ θέσιν*); take, for example, animals which have pectoral mammæ: man, apes, and elephants; and animals which have abdominal mammæ: dogs and cats.

The writers who succeeded Aristotle, and mostly copied from his ample stores were: Ælian, Pliny, Athenæus, Albertus Magnus, Belon, Gesner, Aldrovandus, and Johnston. Although some of them recorded new facts they did nothing to supply any further arrangement of the animal kingdom.

To our countryman Ray we are principally indebted for the first clear zoological method. That great naturalist, for originality and comprehensive philosophical discernment, may, without hesitation, be placed next after Aristotle himself.

The brilliant style of Buffon fixed the attention of the civilised world upon the subject which his eloquence at once rendered captivating. A more severe writer might have done greater things for natural history as a science, but Buffon at once secured a willing audience, and made all Europe his class. To him above all others may be conceded the merit of making the subject decidedly popular at once and for ever. The way was thus prepared for Linnæus.

In the last edition of the 'Systema Naturæ,' revised by its great author, the Animal Kingdom is thus arranged:—

Heart bilocular, with two auricles. Blood warm, red.	Viviparous..........	*Mammalia.*
	Oviparous..........	*Birds.*
Heart unilocular, with one auricle. Blood cold, red.	Arbitrary lungs....	*Amphibia.*
	External gills......	*Fishes.*
Heart unilocular, with one auricle. Circulating fluid (*sanies*) cold, white.	With antennæ.....	*Insects.*
	With tentacula....	*Vermes.*

I. *Mammalia.*

Heart bilocular, with two auricles. Blood warm, red. Lungs respiring reciprocally. Jaws incumbent, covered: teeth inserted in most. Penis intrans viviparas, lactiferas. Senses: Tongue, Nostrils, Eyes, Ears, Papillæ. Covering: Hairs, very sparing in the aquatics. Props (Fulcra): Four feet, except in those which are merely aquatic, in which the posterior feet are conjoined in the fin of the tail. A tail in most.

II. *Birds.*

Heart bilocular, with two auricles. Blood warm, red. Lungs respiring reciprocally. Jaws incumbent, naked, exserted, toothless. Penis subintrans absque scroto oviparas crusta calcarea. Senses: Tongue, Nostrils, Eyes, Ears without auricles. Covering: Incumbent imbricated feathers. Props: Two feet, two wings. Rump heart-shaped.

III. *Amphibia.*

Heart unilocular, with one auricle. Blood cold, red. Lungs breathing arbitrarily. Jaws incumbent. Penes bini. Eggs generally membranaceous. Senses: Tongue, Nostrils, Eyes, Ears. Covering: Cutaceous, naked. Props: Various, null in some.

IV. *Fishes.*

Heart unilocular, with one auricle. Blood cold, red. Gills external, compressed. Jaws incumbent. Penes nulli. Eggs without albumen. Senses: Tongue, Nostrils (?), Eyes (not ears). Covering: Imbricated scales. Props: Natatorial fins.

V. *Insects.*

Heart unilocular. Sanies cold. Spiracles, lateral body pores. Jaws lateral. Penes intrantes. Senses: Tongue, Eyes, Antennæ on a head without a brain (neither ears nor nostrils). Covering: Cataphracta, sustaining an osseous cutis. Props: Feet, Wings in some.

VI. *Vermes.*

Heart unilocular, with one ventricle. Sanies cold. Spiracles obscure. Jaws multifarious. Penes varii Hermaphroditis Androgynia. Senses: Tentacles (no head, hardly eyes, neither ears nor nostrils.) Covering: Calcareous, or null except spines. Props: Neither feet nor fins.

This table concludes with the following summary, which will be best given in the original form:—

"Vivarium Naturæ sic alit VI plicis formæ Animalia.

"*Mammalia* pilosa, in Terra gradiuntur, loquentia. *Aves* plumosæ, in aëre volitant, cantantes. *Amphibia* tunicata, in calore, serpunt, sibilantia. *Pisces* squamati, in aqua natant, popyzantes. *Insecta* cataphracta, in sicco exsiliunt, tinnitantia. *Vermes* excoriati, in humido panduntur, obmutescentes."

It is impossible to enter into the details of the arrangement of Linnæus, without being struck with the comprehensive views of the author, when the imperfect light that existed at the time is considered.

The subject was now taken up by able hands; and Pallas, especially in his anatomy of the *Glires*, made a great advance in Comparative Anatomy. Among the most active and enlightened labourers in this department, our own John Hunter stands pre-eminent in England and Blumenbach in Germany.

But the time was now come when a new light was to arise; and George Cuvier, guided by his dissections, became the great leader of his day. The 'Anatomie Comparée,' the 'Ossemens Fossiles,' and, finally, the 'Règne Animal,' were the results of his acute and comprehensive demonstrations. In his hands Comparative Anatomy became a new power among the dynamics of natural history, and by its aid he rebuilt the extinct fossil forms that before his time lay scattered over the face of our earth in wild and apparently inextricable disorder.

Well does this extraordinary man enunciate the valuable truth, that since Natural History has taken Nature for the basis of its distributions, its relationship with Anatomy has become more intimate. "One of these sciences," says he, "cannot take a single step without the other profiting by it. The approximations which the first establishes often indicate to the other the researches that ought to be made." And again, with equal truth he declares, that "the natural history of an animal is the knowledge of the whole animal. Its internal structure is to it as much as its external form, and perhaps more."

That Cuvier practised what he preached is evident from his own record of his mode of proceeding in constructing his system:—

"I examined," says he, "one by one, all the species which I could procure; I associated those which did not differ from each other, except in size, colour, or the number of some parts of little importance, and on these materials founded what I have called a sub-genus.

"Whenever I could, I dissected at least one species of each sub-genus; and if those to which the scalpel could not be applied be excepted, there exist in my book very few groups of this degree, of the organs of which I cannot produce at least some considerable portion."

As in this work the various articles on the Animal Kingdom will be generally given subordinate to the great divisions indicated by Cuvier, we have added in the following page his arrangement in a tabular form.

The following are the distinguishing characters of the great divisions of this arrangement:—

Vertebrate Animals (*Animalia vertebrata.*)—They have all red blood, a muscular heart, a mouth furnished with two jaws placed one either before or above the other, distinct organs of sight, hearing, smell, and taste, situated in the cavities of the face; never more than four limbs, the sexes always separated, and a very similar distribution of the medullary masses and of the principal branches of the nervous system. On examining each of the parts of this great series of animals more closely, there may always be detected some analogy even in those species which are most remote from one another; and the gradations of one single plan may be traced from man to the last of fishes.

In the second form there is no skeleton, the muscles are attached only to the skin, which constitutes a soft contractile envelope, in which in many species are formed stony plates called shells, the production and position of which are analogous to that of the mucous body; the nervous system is contained within this general envelope together with the viscera, and is composed of several scattered masses, connected by nervous filaments, and of which the principal placed over the œsophagus bears the name of brain. Of the four senses, the organs of those of taste and vision only can be distinguished, the latter of which are even frequently wanting. A single family alone presents organs of hearing. There is always, however, a complete system of circulation, and particular organs for respiration. Those of digestion and of the secretions are little less complicated than in the vertebrated animals. We will distinguish the animals of this second form by the appellation of

Molluscous Animals (*Animalia Mollusca.*)—Although the general plan of their organisation is not so uniform, as regards the external configuration of the parts as that of the vertebrates, there is always an equal degree of resemblance between them in the essential structure and the functions.

The third form is that observed in insects, worms, &c. Their nervous system consists of two long cords running longitudinally through the abdomen, dilated at intervals into knots or ganglions. The first of these knots placed over the œsophagus, and called brain, is scarcely any larger than those which are along the abdomen, with which it communicates by filaments that encircle the œsophagus like a collar. The envelope of their trunk is divided by transverse folds into a certain number of rings, of which the teguments are sometimes hard, sometimes soft, but to the interior of which the muscles are always attached. The trunk often bears on its sides articulated limbs, but is frequently unfurnished with them. We will bestow on these animals the term

Articulate Animals (*Animalia Articulata.*)—It is among these that the passage is observed from the circulation in closed vessels to nutrition by imbibition, and the corresponding transition from respiration in circumscribed organs to that effected by tracheæ or air-vessels distributed through the body. The organs of taste and vision are the most distinct in them, a single family alone presenting that of hearing. Their jaws, when they have any, are always lateral.

Lastly, the fourth form, which embraces all those animals known under the name of *Zoophytes*, may be designated

Radiate Animals (*Animalia Radiata.*)—In all the preceding, the organs of sense and motion are arranged symmetrically on the two sides of an axis. There is a posterior and an anterior dissimilar face. In this last division, they are disposed as rays round a centre; and this is the case even when they consist of but two series, for then the two faces are alike. They approximate to the homogeneity of plants, having no very distinct nervous system, nor organs of particular senses: there can scarcely be perceived in some of them the vestiges of a circulation; their respiratory organs are almost always on the surface of the body; the greater number have only a sac without issue for the whole intestine; and the lowest families present only a sort of homogeneous are covered and hidden by a kind of flocky down, like tow, which springs upon the sides, and from which issue groups of strong spines, that pierce, in part, the flocky covering, and bundles of flexuous bristles, glittering like gold, and changing into all the colours of the rainbow. Cuvier says, and without exaggeration, that they do not yield in beauty either to the plumage of the humming-birds or to the most brilliant precious stones. Lower down is a tubercle, out of which come spines, in three groups, and of three different sizes, and finally a fleshy cone. There are 40 of these tubercles on each side, and between the first two are two small fleshy tentacles. There are 15 pairs of scales, which are wide and sometimes puffed up, on the back, and 15 small branchial crests on each side.

Prickly Sea-Mouse (*Aphrodita aculeata*).
a, ventral view; *b*, dorsal and lateral view.

Some of the *Halithææ* (*Halithées Hermiones*, Sav.) have no flocky down upon the back, and such is *Aphrodita Hystrix* (genus *Hermione*, De Blainv.).

The genus *Polynöe*, Sav. (*Eumolpe*, Oken), is another subdivision. This genus has flocky covering on the back; the tentacles are 5 in number, and their proboscis is furnished with horny and strong jaws. *Polynöe lævis* is an example.

Then there are the genera *Sigalion* and *Acoëtes* of Messrs. Audouin and Milne-Edwards.

The first of these is more elongated in form than the other *Aphroditæ*; it has cirrhi on all the feet. Such is *Sigalion Mathildæ*.

The second has cirrhi, which alternate with the elytra (as the two rows of membranous scales which cover the back are somewhat oddly called, the term being already applied to the horny external wings of coleopterous insects), in great length; their jaws are stronger and better toothed. There is a large species at the Antilles which inhabits a sheath or pipe of the consistence of leather.

Here Cuvier places his *Chætopterus*, which has a mouth devoid of jaws and proboscis, furnished above with a lip, to which are attached two very small tentacula. Then comes a disk with nine pairs of feet, then a pair of long bristly bundles, like two wings. The branchiæ, in the form of plates, are attached rather below than above, and are placed along the middle of the body.

Example, *Chætopterus pergamentaceus*. This is 8 or 10 inches long, and inhabits a pipe of the substance of parchment, in the seas of the West India Islands.

The nervous system is more highly developed in the Dorsibranchiate Annelides than in the other orders. It consists of a double chain of ganglia, but the latter are larger generally, and the cephalic more fully developed, to accord with their organs of special sense. There are also observable nerves and ganglia destined to supply the digestive and respiratory organs.

Although the *Dorsibranchiata* are so highly developed, they nevertheless many of them retain the power of regenerating portions of their body which may be broken off; and in certain species which divide spontaneously a whole animal is formed from parts that are separated. In this respect they are related to the lower vermiform animals included in the *Entozoa*. [ENTOZOA.]

The *Tubicolæ* are characterised by having their branchiæ in the form of plumes, or of small arborisations, attached to the head or on the anterior part of the body; and nearly all inhabit tubes.

Of those which inhabit tubes, some form a calcareous homogeneous one, resulting probably from their transudation, like the shells of the mollusca, but they do not adhere to it by means of muscles; others construct a tube by agglutinating grains of sand, fragments of shells, or particles of sand, by means of a membrane which they doubtless secrete also; there are others again whose tube is entirely membranous or horny. ('Règne Animal.')

To the first category belongs the genus *Serpula*. The species of this genus are the *Tuyaux de Mer* of the French, and their twisting calcareous tubes cover stones, shells, and other submarine bodies. The section of these tubes is sometimes round and sometimes angular, according to the species.

Cuvier describes the animal as having a body composed of a great number of segments; its anterior part enlarged into a disk, armed on each side with many bundles of stiff bristle-like appendages, and on each side of the mouth a plume of branchiæ in the form of a fan, ordinarily tinted with vivid colours. At the base of each plume is a fleshy filament; and one of the two, that to the right or left indifferently, is always prolonged and dilated at its extremity into a disk of different configuration, which serves as an operculum, and closes the aperture of the tube when the animal retires within it. Cuvier further observes that as the most common species has this disk in the form of a funnel, some naturalists have mistaken it for a proboscis; but it is not pierced; and the other species have it more or less of a club-shape.

The number of species of *Serpula* (Lam.), admitted into the last edition of 'Animaux sans Vertèbres,' is 60 recent and fossil; and M. Milne-Edwards adds many more at the end of the genus; but he observes that very little is known of the specific differences presented by these animals, and that many of the living and all of the fossil species are characterised in a very doubtful manner. The fossils are said to be found in the Tertiary, Green-Sand, Chalk (environs of Münster and Maastricht), Lias, and Oolite beds, &c. Mr. Lea describes a species, *Serpula ornata*, from the Tertiary of Alabama (Claiborne Beds).

Dr. Fitton records 14 named species and two uncertain species from the strata below the chalk, ranging from the Upper Green-Sand to the Kimmeridge Clay.

Sir Roderick Murchison notices *Serpulites* and *Spirorbis* in the Silurian rocks, *Serpulites longissimus* in the upper Ludlow Rock, and *Spirorbis tenuis* in the lower Ludlow Rock, and in the Wenlock Limestone. He also records the presence of *Serpula* (*Serpula omphalotdes*, Goldf.) in the Devonian Rocks of Russia.

Example, *Serpula contortuplicata*. The tubes of this *Serpula* are round, twisted, and about three lines in diameter. Its operculum is funnel-shaped, and its branchiæ are often of a beautiful red, or variegated with yellow and violet. It quickly covers vases, bottles, or other objects thrown into the sea.

Locality.—The Mediterranean and European Seas.

Serpula contortuplicata.

In other species, as for instance of the genus *Galeolaria*, Lam., the operculum is flat and beset with points.

Cuvier notices another species from the Antilles (*Serpula gigantea*, Pallas), which lives among the madrepores, and whose tube is often surrounded by their masses. Its branchiæ are rolled into a spiral form when they re-enter; and its operculum is armed with two small branched horns, like the antlers of a stag. This species is the *Terebella bicornis*, 'Abbild. Berl. Schr.' ix. iii. 4; *Actinia*, or Animal Flower, Home, 'Lect. on Comp. Anat.' ii. pl. 1. Upon this spiral rolling up of the branchiæ Savigny established his subdivision of *Cymospire Serpulæ*, from which M. de Blainville afterwards established a genus.

The genus *Spirorbis*, Lam., consists of those *Serpulæ* whose branchial filaments are much less numerous, only three or four on each side; their tube is rolled up into a tolerably regular spiral, and they are ordinarily very small.

Sabella.—The species of this genus have the same body and the same fan-shaped branchiæ as the *Serpulæ;* but their two fleshy filaments adhering to the branchiæ each terminate in a point, and do not form an operculum; they are even sometimes absent. The tube of the *Sabellæ* appears, most frequently, to be composed of grains of sand, of clay, or very fine mud, and is rarely calcareous. The known species are rather large, and Cuvier notices their branchial plumes as being of admirable delicacy and brilliancy.

Example, *Sabella protula*, Cuv. (*Protula Rudolphii*, Risso). This beautiful and large species, with a calcareous tube like that of the *Serpulæ*, has the branchiæ of a rich orange.

Terebella.—The species like the greater part of the *Sabellæ*, inhabit a factitious tube; but it is composed of grains of sand and fragments of shells; their body, moreover, has much fewer rings, and their head is differently ornamented. Numerous filiform tentacles, susceptible of much extension, surround their mouth, and on their neck are arborescent branchiæ, not fan-shaped.

Example, *Terebella conchilega*.

Amphitrite.—Cuvier remarks that the species of this genus are easily known by straw-like processes ranged in a pectinated form, or in that of a crown, in one or more rows, where they probably serve for defence, or perhaps as means of creeping or collecting the materials for their tube. Around the mouth are very numerous tentacles, and on the commencement of the back on each side are branchiæ in the form of a comb.

Cuvier's genus *Amphitrite* comprehends the *Pectinariæ* of Lamarck, the *Amphictènes* of Savigny, the *Chrysodons* of Oken, the *Cistenes* of Leach, the *Sabellariæ* of Lamarck, the *Hermelles* of Savigny, and the genus *Pherusa* of De Blainville.

Siphostoma (Otto).—The species of this genus, which Cuvier suspects should be referred to this order, have on each articulation above a bundle of fine bristles; below, a simple bristle; and, at the anterior extremity, two packets of strong and golden-coloured bristles. Under these bristles is the mouth, preceded by a sucker surrounded by many soft filaments, which Cuvier thinks may be branchiæ, and accompanied by two fleshy tentacles. The knotted medullary cord may be seen through the skin of the belly. The *Siphostomata* live burrowed in the sand.

Examples, *Siphostoma diplochaitos*, Oken; *S. uncinata* Aud. et Edw. 'Littoral de France, Annel.' pl. ix., f. 1.

The close connection between the *Tubicolæ* and the *Dorsibranchiatæ* is seen in the fact that the young of these orders pass through precisely the same stage before arriving at maturity. It is only during the last stages of change that the embryoes of *Tubicolæ* manifest their ultimate destination by the unequal development of certain of their segments, some of which become almost abortive, whilst others are disproportionately developed.

The *Terricolæ* have a cylindrical body tapering at both ends. The segments of their bodies are not well marked, and the head is not distinct from the trunk. They have neither eyes, mandibles, cirrhi, nor tuberculous feet. This order includes two principal groups, one of which only is terrestrial, whilst the other is aquatic. To the former belong the Common Earth-Worm (*Lumbricus terrestris*), whilst in the latter is included the Lob or Lug-Worm (*Arenicola*). As the Earth-Worm is so well-known we shall refer to its structure and habits to illustrate the order.

Cuvier remarks that the *Lumbrici* ought to be subdivided; and Savigny has, in effect, subdivided the Earth-Worms into the genera *Enterion*, *Hypogæon*, and *Clitellio*. Messrs. Audouin and Milne-Edwards distinguish also the genus *Trophonia*.

Of these *Enterion* has upon each ring four pairs of small bristle-like processes, eight in all.

Clitellio is stated to have two bristle-like processes only on each ring.

Hypogæon has, besides the other bristle-like processes, one on the back of each ring. (This form is noticed as being American only.)

Trophonia has on each ring four bundles of short bristle-like processes, and at the anterior extremity a great number of long and brilliant bristle-like processes which surround the mouth.

Savigny described upwards of twenty species, which he considers to be distinct, and to have been confounded previously under the name of *Lumbricus terrestris*. M. Morren, in his 'Treatise on the Natural History and Anatomy of the *Lumbricus terrestris*,' appears to be doubtful with regard to the number of species described by Savigny and others, and inclines to the opinion that they are merely varieties. M. Milne-Edwards (edit. of Lamarck's 'Animaux sans Vertèbres,' 1838,) considers the characters on which Savigny relied as distinctions for dividing the group into the three genera as of little importance.

Externally the Earth-Worm (*Lumbricus terrestris*, Linnæus) presents a body composed of numerous narrow rings closely approximated to each other; at about one-third of their length may be seen, particularly at the season of reproduction the clitellum, which becomes at that time a highly important agent. The colour of the body is reddish or bluish, and of a shining aspect, and the animal has the power of secreting a viscous substance, which forms a sort of protecting sheath to its body, and greatly facilitates its progress through the earth. The animal is eyeless, and unprovided with either tentacle, branchiæ, or cirrhi.

Respiratory System.—The generally received opinion is that the blood of the Earth-Worm is aërated by means of lateral series of small pyriform vesicles, analogous to the breathing sacs of the Leech, and opening externally by very minute pores.

Digestive System.—The mouth consists of two lips without tentacles or armature of any description; but the upper lip is elongated and proboscidiform. The œsophagus, which is a wide membranous canal, is continued straight down for half an inch, and ends in a dilated bag or reservoir, to which succeeds a muscular stomach or gizzard, disposed in the form of a ring. The intestine is constricted at each segment of the animal by a series of ligaments or partitions, connecting it to the parietes of the body, and swells out the intermediate spaces, when distended by the particles of earth.

Nervous System.—The nervous system of the Earth-Worm consists of a double row of small ganglions close to each other.

Generative System.—Allotriandrous, or with male organs so disposed as to fecundate the ova of a different individual. (Owen.) It has been doubted whether these animals are oviparous, ovoviviparous, or viviparous. The fact is, that after fecundation by another individual, the ova, which are contained in the ovary, are set free in the cavity of the body by the bursting of the ovary, and are gradually propelled to a cavity near the anus. In this spot they undergo the usual changes, and they may or may not emerge from the parent before the egg-membrane is broken.

Organs of Progression.—Earth-Worms creep at a good pace by means of muscular contraction and dilatation acting on the rings, which carry on their under-side the bristle-like processes above mentioned: these last operate as feet. The power of elongation is considerable, and the anterior part of the animal acts as a sort of awl in penetrating the earth.

Habits, &c.—The Earth-Worm, as far as relates to its appearance above the surface of the ground, may be considered almost a nocturnal animal. In the night-season and at early morning hundreds may be seen, though not one, unless they are disturbed either by moving the ground or pouring liquids into their holes, is to be found moving about in the day. The power of reproducing parts after mutilation is very great in this animal and the whole of the order.

Utility to Man.—The worm-casts, which so much annoy the gardener by deforming his smooth-shaven lawns, are of no small importance to the agriculturist; and this despised creature is not only of great service in loosening the earth and rendering it permeable by air and water, but is also a most active and powerful agent in adding to the depth of the soil, and in covering comparatively barren tracts with a superficial layer of vegetable mould. In a paper 'On the Formation of Mould,' read before the Geological Society of London, by Charles Darwin, Esq., F.G.S., the author commenced by remarking on two of the most striking characters by which the superficial layer of earth, or, as it is commonly called, vegetable mould, is distinguished. These are, its nearly homogeneous nature, although overlying different kinds of subsoil, and the uniform fineness of its particles. The latter fact may be well observed in any gravelly country, where, although in a ploughed field, a large proportion of the soil consists of small stones, yet in old pasture-land not a single pebble will be found within some inches of the surface. The author's attention was called to this subject by Mr. Wedgwood, of Maer Hall, in Staffordshire, who showed him several fields, some of which, a few years before, had been covered with lime, and others with burnt marl and cinders. These substances, in every case, are now buried to the depth of some inches beneath the turf. Three fields were examined with care: the first consisted of good pasture-land, which had been limed, without having been ploughed, about 12½ years before; the turf was about half an inch thick; and 2½ inches beneath it was a layer or row of small aggregated lumps of the lime, forming, at an equal depth, a well-marked white line. The soil beneath this was of a gravelly nature, and differed very considerably from the mould nearer the surface. About three years since cinders were likewise spread on this field: these are now buried at the depth of an inch, forming a line of black spots parallel to and above the white layer of lime. Some other cinders, which had been scattered in another part of the same field, were either still lying on the surface or entangled in the roots of the grass. The second field examined was remarkable only from the cinders being now buried in a layer, nearly an inch thick, 3 inches beneath the surface. This layer was in parts so continuous, that the superficial mould was only attached to the subsoil of red clay by the longer roots of the grass.

The history of the third field is more complete. Previously to 15 years since it was waste land; but at that time it was drained, harrowed, ploughed, and well covered with burnt marl and cinders. It has not since been disturbed, and now supports a tolerably good pasture. The section here was turf half an inch, mould 2½ inches, a layer 1½ inch thick, composed of fragments of burnt marl (conspicuous from their bright red colour, and some of considerable size, namely, 1 inch by ½ an inch broad, and a ½ inch thick), of cinders, and a few quartz pebbles mingled with earth; lastly, about 4½ inches beneath the surface was the original black peaty soil. Thus beneath a layer (nearly 4 inches thick) of fine particles of earth, mixed with some vegetable matter, those substances now occurred, which, 15 years before, had been spread on the surface. Mr. Darwin stated that the appearance in all cases was as if the fragments had, as the farmers believe, worked themselves down. It does not however appear at all possible that either the powdered lime or the fragments of burnt marl and the pebbles could sink through compact earth to some inches beneath the surface, and still remain in a continuous layer; nor is it probable that the decay of the grass, although adding to the surface some of the constituent parts of the mould, should separate in so short a time the fine from the coarse earth, and accumulate the former on those objects which so lately were strewed on the surface. Mr. Darwin also remarked that near towns, in fields which did not appear to have been ploughed, he had often been surprised by finding pieces of pottery and bones some inches below the turf. On the mountains of Chile he had been perplexed by noticing marine shells, covered by earth, in situations where rain could not have washed it on them.

The explanation of these circumstances, which occurred to Mr. Wedgwood, although it may at first appear trivial, the author does not doubt is the correct one, namely, that the whole is due to the digestive process by which the Common Earth-Worm is supported. On carefully examining between the blades of grass in the fields above described, the author found that there was scarcely a space of two inches square without a little heap of the cylindrical castings of worms. It is well known that worms swallow earthy matter, and that, having separated the serviceable portion, they eject at the mouth of their burrows the remainder in little intestine-shaped heaps. The worm is unable to swallow coarse particles; and as it would naturally avoid pure lime, the fine earth lying beneath either the cinders and burnt marl, or the powdered lime, would, by a slow process, be removed and thrown up to the surface. This supposition is not imaginary, for in the field in which cinders had been spread out only half a year before, Mr. Darwin actually saw the castings of the worms heaped on the smaller fragments. Nor is the agency so trivial as it at first might be thought, the great number of Earth-Worms (as every one must be aware who has ever dug in a grass-field) making up for the insignificant quantity of work which each performs.

On the above hypothesis, the great advantage of old pasture-land, which farmers are always particularly unwilling to break up, is explained; for the worms must require a considerable length of time to prepare a thick stratum of mould, by thoroughly mingling the original constituent parts of the soil, as well as the manures added by man. In the peaty field, in 15 years, about 3½ inches had been well digested. It is probable however that the process is continued, though at a slow rate, to a much greater depth; for as often as a worm is compelled by dry weather or any other cause to descend deep, it must bring to the surface, when it empties the contents of its body, a few particles of earth. The author concluded by remarking, that it is probable that every particle of earth in old pasture-land has passed through the intestines of worms, and hence that in some senses the term 'animal mould' would be more appropriate than 'vegetable mould.' The agriculturist, in ploughing the ground, follows a method strictly natural; and he only imitates in a rude manner, without being able either to bury pebbles or to sift the fine from the coarse soil, the work which Nature is daily performing by the agency of the Earth-Worm.

The most common species of *Arenicola* is the *A. Piscatorum*, or Lug-Worm, which is commonly employed on the coasts of this country as a bait by fishermen.

The genus *Nais*, of Linnæus, includes a number of small Annelides, not well made out. They live in holes which they perforate in the mud at the bottom of the water, from which they protrude the upper portion of their body, which they are incessantly moving.

The *Suctoriæ* are characterised by the body of the animals being destitute of bristles for locomotion, completely apodous, without soft appendages, and furnished with a prehensile cavity in the form of a sucker at each extremity. The head is not distinct, but generally provided with eyes and jaws.

The principal family of this order is the *Hirudinidæ*, which comprehends not only the Leeches properly so called, which live by sucking the blood of various animals, but also includes many other worms which derive their nourishment in a totally different way, and present corresponding differences in organisation. The affinities between the leeches and some of the Setiferous Annelidans, as various species of *Nereis*, *Lumbricus*, *Planaria*, &c., are so close that they hardly admit of being arranged in separate orders, and others of the Leech tribe may even be confounded with some species of *Lerneæ* or *Epizoa*.

The ancients appear to have only known the most common species of Leeches. Aristotle makes no mention of them, and they do not appear to have been used in medicine in the time of Hippocrates. Pliny describes them very clearly under the name of *Hirudines* and *Sanguisugæ*, and distinguishes two species. The Sea-Leech is distinctly mentioned by Belon, Rondelet, and by all the writers on natural history since the revival of letters. More recently Linnæus increased our knowledge of the number of species, of which he describes eight in the 12th edition of the 'Systema Naturæ.' Müller afterwards discovered five or six others, so that Gmelin, in his edition of the 'Systema Naturæ,' enumerated fourteen species. Since then, Shaw, Leach, Dutrochet, Savigny, Milne-Edwards, and others, have found many more, and the introduction of new zoological methods has caused a necessity for arranging these various species in different genera, of which we shall enumerate some of those which are best known.

The True Leeches are all destitute of branchiæ or special organs of respiration; and this function has been supposed to be effected by means of the skin generally, but M. Milne-Edwards has recently stated (as was before observed by Cuvier) that "there exists in these *Annelidæ* a series of small membranous sacs, each of which communicates externally by a minute orifice situated on the ventral aspect of the body: these sacs derive from the numerous vessels which ramify upon their parietes a considerable quantity of blood; water penetrates into these organs, and seems to subserve a true respiratory purpose." But though the species of the family *Hirudinidæ* are not provided with distinct branchiæ, these organs are found in a genus which is generally associated with the True Leeches, and which we shall place first in the following list of genera:—

1. *Branchellion*, Savigny, *Branchiobdella*, De Blainville, *Polydora*, Oken. These names have been given to a worm closely resembling a leech in external structure (it being furnished with two suckers), which is found parasitic on the Torpedo in the Mediterranean and other seas. The *Hirudo branchiata*, Menzies, a species observed on the tortoise which is found in the Pacific Ocean, has also been placed in this genus, though Cuvier says that it ought not to be associated with it.

Hirudinidæ proper.

Section I.—*Anterior Sucker separated from the Body by a distinct Strangulation or Neck.*

2. *Albione*, Sav., *Pontobdella*, Leach and Blain., characterised by the body being bristled over with tubercles. Species all marine; seven have been enumerated; two of them are very common in our seas:—1, *Albione verrucosa*, *Hirudo muricata*, Linnæus; 2, *Pontobdella spinulosa*, Leach: both of these worms attach themselves to fish, particularly skates; and the latter species is commonly known to fishermen by the name of the Skate-Sucker.

3. *Hæmocharis*, Sav.; *Ichthyobdella*, Blain. In this genus there are eight eyes, the body is narrow, and the jaws scarcely visible. The only known species is the *Hæmocharis Piscium*, *Hirudo Piscium*, Linn., which lives in fresh waters, where it attaches itself to fish, particularly *Cyprini*.

Section II.—*Anterior Sucker very slightly separated from the Body.*

4. *Geobdella*, Blain., *Trochetia*, Dutrochet, is distinguished by having an enlargement round the orifices of the genital organs. We only know one small species of this genus, the *Geobdella Trochetii*, which inhabits our waters, and which frequently comes on land to pursue the *Lumbrici*, or Earth-Worms.

5. *Pseudobdella*, Blain., has the mouth merely provided with folds of skin, and is destitute of teeth. Only one species is well known, the *Pseudobdella nigra*, *Hirudo nigra*, Linn., the Common Black Leech.

6. *Hæmopis*, Sav., *Hypobdella*, Blain., has the mouth furnished with a few obtuse teeth. Three species are enumerated; the best known is the *Hæmopis sanguisorba*, Sav., *Hirudo sanguisuga*, Linn., the Common Horse-Leech, which is much larger than the Medicinal Leech, and wholly of a greenish-black colour. The Horse-Leech has been reported to inflict dangerous wounds by some observers, while others say that it never attacks vertebrate animals. M. De Blainville thinks that this discrepancy has arisen from this species having been confounded with the foregoing, the Black Leech, which cannot penetrate the skin of vertebrate animals for want of teeth. Both these leeches greedily attack the common earth-worm.

7. *Sanguisuga*, Sav., *Jatrobdella*, Blain. The anterior sucker has its upper lip divided into several segments. Its aperture is transverse, and it contains three jaws, each of which is armed on its edge with two ranges of very fine teeth, which enable these leeches to penetrate through the skin without making any dangerous wound. This genus contains the true Medicinal Leeches, eight species of which have been enumerated: the most common is the *Sanguisuga medicinalis*, *Hirudo medicinalis*, Linn., which is a native of all our stagnant fresh waters.

8. *Bdella*, Sav., has eight eyes and is destitute of teeth: one species is found in the Nile—the *Bdella Nilotica*.

9. *Nephelis*, Sav., *Erpobdella*, Blain., has eight eyes, and the mouth is furnished internally with only three folds of skin. Several species of this genus are enumerated; the most common is the *Nephelis tessilata*, Sav., *Hirudo vulgaris*, Linn. This species has often been confounded with the medicinal and other leeches; it is commonly found in fresh waters, and, like all the other species of this genus, never leaves the water, and is injured by the contact of the air; so that if taken out of the water it quickly dies.

Section III.—*Anterior Sucker wanting.*

10. *Clepsina*, Sav., *Glossopora*, Johnson, *Glossobdella*, Blain. This genus has a widened body and only a posterior sucker; the mouth is in the form of a proboscis. Cuvier thinks it doubtful whether the species of this genus should be arranged with the Leech Family; they

consist of little worms which never leave the water, and live fixed to the stem of aquatic plants, from which they perhaps derive their nourishment: they never swim, but crawl along.

Besides the genera which we have enumerated, several parasitic worms, which live always fixed to the same part of some animal, have been enumerated among the *Hirudinidæ*, and have been arranged by Blainville in the genus *Epibdella*. He also places several other species, which are without distinct articulations, in the genus *Malacobdella*. There still remain several doubtful species of Leech, and some have been confounded with true *Planariæ*, which differ from Leeches in having no sucker at either end. [*See* SUPPLEMENT.]

To this order also is referred the genus *Gordius* of Linnæus, but recent researches have rendered it highly probable that their relations are rather with the *Entozoa*. [ENTOZOA.]

(Williams, *Report of the Structure of Annelida*, 'Brit. Ass. Trans.,' 1851; Owen, *Lectures on Comparative Anatomy;* Cuvier, *Règne Animal;* Carpenter, *Principles of Physiology;* Milne-Edwards, *Elémens de Zoologie*.)

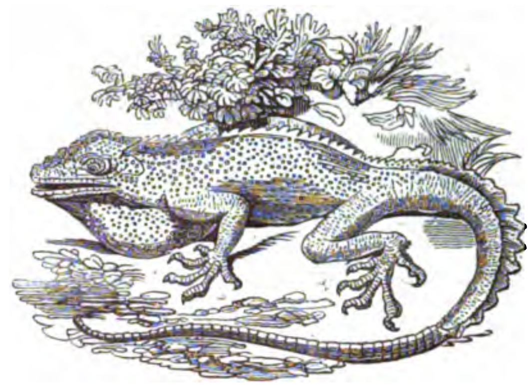
ANOA, a species of Ruminating Animals, so very imperfectly known, that zoologists are undetermined whether to consider it as an antelope or a species of buffalo. This uncertainty arises from the fact, that though the animal has been noticed for many years, only a few fragments of skulls and horns have been hitherto brought to Europe, and even these too imperfect to acquaint us with the zoological characters of the animal. Judging, however, from these materials, the Anoa would really appear to be a species in many respects intermediate between the buffaloes and antelopes, as at present defined; agreeing with the former in the form of its horns, and with the latter in their position.

Horns of *Anoa*.

ANOLIS (*Anolius*, Cuvier), a genus of Saurian Reptiles, belonging to that section of the *Iguanias* which Cuvier distinguishes by having teeth in the palate of the mouth as well as in the maxillary bones. They are readily distinguished from the Iguanas, properly so called, the Basilisks, and other genera of this division, by the peculiar form of the antepenultimate phalanx of the toes, which is flattened beneath, and furnished with a kind of pad or cushion, grooved or striated transversely, and serving to make the animals adhere more firmly to those substances which they grasp in walking. In this particular point of their structure the Anolis approach the Geckoes, but it does not enable them to exercise the singular power of walking with the legs uppermost, like flies on a ceiling, which some of these reptiles possess. The toes, however, are much longer and better separated than those of the Geckoes, and the claws, instead of being short and flattened, are long, crooked, and sharp-pointed. The body and tail are long and slender, as are also the legs, particularly those behind, which are rather longer than the fore-legs. Each foot has five toes. The whole body and tail, both above and below, are covered irregularly with small round scales, which give the skin a granulated appearance like that of a fine shagreen.

The Anolis are entirely an American genus, and seem, in many respects, to supply in the New World the place which the Chameleons occupy in the Old. The colours of their skins change with the same or even greater rapidity, especially on the loose skin of the throat, which is constantly distended when these animals are actuated by strong passions, either of fear, anger, or love, and in this state they assume an endless succession of ever-varying hues. They differ from the Chameleons, however, in their more slender and graceful proportions, and in the great activity of their movements, displaying all the restlessness and celerity of the common green lizard of Europe. They frequent woody and stony situations indifferently, climb and leap with such swiftness and facility that their motion has been compared to the flight of a bird; and, when overheated or fatigued by their exertions, will stop, open their mouths, and pant like a tired dog. They are extremely timid and harmless, and feed for the most part upon flies and other small insects. There are two small sub-genera, distinguished from one another by the presence or absence of the carinated crest on the upper surface of the tail. The first of these divisions, comprehending those which have this crest, consists of a number of species definitely characterised by M. Cuvier, but formerly confounded under the denominations of *Lacerta principalis* and *Lacerta bimaculata*. The principal species are the following:—

1. *Anolius velifer*, of Baron Cuvier, is of a beautiful dark ashy-blue colour, and perhaps the largest of the whole genus, the body measuring a foot in length, and the tail being about a foot and a half. The crest extends along the top of the tail for half its length from the origin, and is supported by from 12 to 15 rays. The loose skin beneath the throat extends from the chin even to the belly, and when not distended forms a longitudinal fold along the whole under-surface of the animal. The food, from the observation of Baron Cuvier, would appear, at least occasionally, to consist of berries and other vegetable substances. It inhabits Jamaica and the Antilles generally, preferring the woods to the open country, and lodging in decayed trees or small crevices in the



Anolius velifer.

ground, where the female likewise deposits her eggs. It is incessantly in motion, and when pleased frequently emits a low but acute chirp; though harmless and extremely timid, it possesses a considerable share of curiosity, and allows itself to be readily caught in little rush snares, which children in the West Indies amuse themselves by placing in its haunts, alluring it from its concealment by imitating its voice.

2. *Anolius bimaculata*, of Sparrmann, is little more than half the size of the former species, but with the same general form and habits, and with a similar crest upon the first half of the tail. The general colour is a greenish blue, clear on the top of the head and neck, but mixed with dark brown on the body, tail, and extremities, and marked with numerous small black spots on the head and sides, and two large ones on the shoulders, from which it derives its specific name. It is found in North America, from Pennsylvania to the shores of the Gulf of Mexico, and in the Antilles.

The second subdivision of the genus *Anolius* consists of species without a carinated crest on the tail, but in no other respect differing from those already described. Of these the principal are:—

3. *Anolius equestris*, of Merrem, of which the tail, more flattened on the sides than in the following species, still retains a slight indication of the crest which distinguishes those of the former division. The body of this species measures about a foot in length, and the tail is nearly a foot and a half.

Anolius equestris.

4. *Anolius Cepedii*, of Merrem, is a pretty little species, found likewise in the Antilles, about half the size of the last, of a green colour, with a short muzzle spotted with brown, and, except in the absence of the crest on the tail, very similar to the *Anolius bimaculata*.

5. *Anolius lineatus*, of Daudin, resembles the last species in its pure bright green colour, but it is rather larger, and is marked along each flank with two parallel lines of oblong black spots, the upper of which passes over the arms and thighs, and the under between the shoulders and hips. It inhabits different parts of South America.

6. *Anolius bullaris*, of Merrem, first described by Catesby in his 'Natural History of Carolina,' under the name of the Green Lizard, is a very beautiful species, of a greenish gold colour, particularly distinguished by a black band on the temples, and the elongated and flattened form of its muzzle.

ANONA'CEÆ, *Anonads*, the *Custard-Apple-Tribe*, a natural order of plants consisting of tropical or subtropical trees and bushes, that usually abound in a powerful aromatic secretion, which renders the flowers of some highly fragrant, the leaves of others a grateful perfume, and the dried fruits of many so highly aromatic as to vie with the spices of commerce; among these last is the Æthiopian Pepper of the shops, which is yielded by the fruit of *Uvaria aromatica*. Of others of this order, the fruit is succulent and abounds in a delicate juice, which renders it a pleasant article of food. Under the name of Sour Sop, Sweet Sop, and Custard-Apple, many kinds are cultivated in the West Indies and South America. Finally, the bark of some separates readily into fibres which make excellent cordage: a large tree called in Brazil Pindaiba, and by botanists *Xylopia sericea*, is advantageously employed for this purpose.

The natural order *Anonaceæ* is known from all other Dicotyledonous orders by its flowers having the calyx and sepals arranged in threes, a number of carpella occupying the centre, as in a ranunculus, and by the curious circumstance of their albumen, which here constitutes the bulk of the seed, being what is called ruminated, that is, perforated in all directions by twisting and crossing passages, like the nutmeg.

The Sweet Sop (*Anona squamosa*) is often only a small bush, growing in all the West India Islands, where it bears a greenish fruit covered with scales, and having the appearance of a young pine-cone. Its skin is half an inch thick, and contains an abundance of thick, sweet, luscious pulp. In many parts of the Indian Archipelago it is a favourite fruit.

Sweet Sop (*Anona squamosa*).

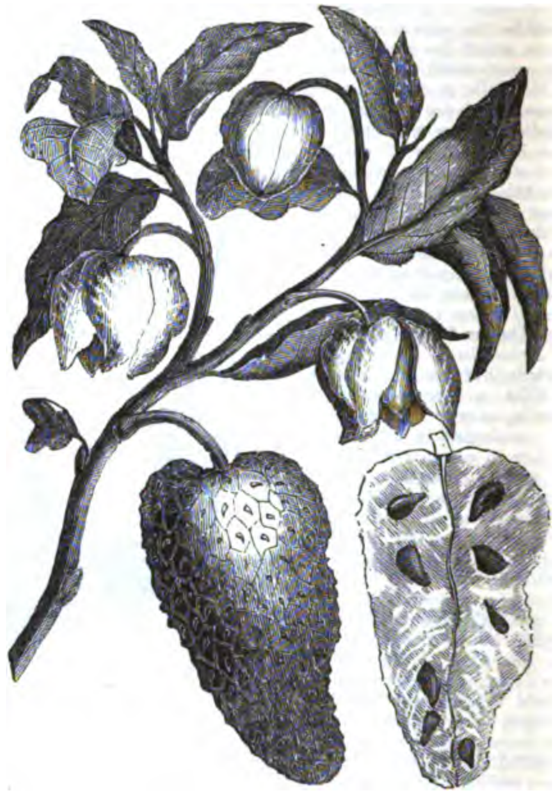
1, A calyx opened, the petals having fallen away, showing the arrangement of the stamens and carpels in the inside of the flower; 2, a stamen; 3, a seed; 4, the same cut in half, to show the ruminated albumen; 5, the embryo; 6, a ripe fruit, much less than the natural size (the projections on its surface are the points of the carpella which grow together into one fleshy mass, as in the raspberry); 7, a view of the same fruit cut in half.

The Custard-Apple (*Anona reticulata*) is an inferior kind, resembling the foregoing, but forming a larger tree, and having a much larger dark-brown fruit, the surface of which is netted all over. The bulb is yellowish or reddish, and of about the consistence of custard.

The Sour Sop (*Anona muricata*) forms in the West Indies a picturesque small tree, resembling a large bay-tree. The flowers are yellow, and have an unpleasant odour. The fruit is often as heavy as 2 lb., or even 3 lb.; it is covered all over with weak prickles; its skin is yellowish-green, and very thin; its pulp is more like pith, is as white as milk, and is sweet mixed with a most agreeable acid.

The Cherimoyer (*Anona Cherimolia*), is easily known from the preceding by its leaves not being shining and bright green, but hoary, with short down, and very blunt. It forms a small tree about 12 or 14 feet high, and is exceedingly valued in Peru, where it is cultivated on account of the excellence of its fruit. The flowers are very fragrant. The fruit heart-shaped, grayish-brown or black, when ripe, with a scaly rind; it is white, sweet, and rich.

A. sylvatica is called *Araticu do Mato* in Brazil. Its wood is used for light turnery, and its fruit is good for the dessert. The root of *A. palustris* is used for making corks in Brazil.



Fruit of Sour Sop (*Anona muricata*).

Sour Sop (*Anona muricata*).

ANOPLOTHE'RIUM (from ἀ privative, ὅπλον, and θήρ, that is, a beast without offensive arms or tusks), in Fossil Zoology, a genus of extinct Pachydermatous Quadrupeds, discovered and characterised by Baron Cuvier. The bones of these singular inhabitants of a former world, occur in great quantities, mixed with those of the *Palæotherium*, another extinct genus of the same order, likewise described by M. Cuvier, in the gypsum-strata or plaster-quarries in the neighbourhood of

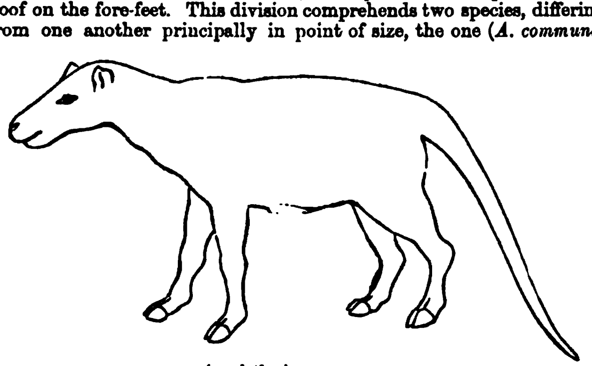
Paris, and they are occasionally, though more rarely, met with in the neighbourhood of Orleans and Genoa. Remains also of this genus have been found in the fresh-water deposits at the Seafield quarries in the Isle of Wight.

The first character in which the *Anoplotheria* differ essentially from all other Pachydermata, whether extinct or recent, is found in the number and arrangement of their teeth, which consist of 6 incisors, 2 canines, and 14 molars in each jaw, making in the whole 44 teeth. These, as in the human subject, are arranged in a continued and uninterrupted series, without any vacancies between the molars or incisors and the canines, a circumstance peculiar to this genus of animals among the Pachydermata, and which, besides man, it shares only with the shrews and hedgehogs—Mammalia in all other respects widely different. The canines moreover are perfectly similar in form and appearance to the incisors, and might easily be mistaken for lateral teeth of this description, did not their situation in the jaw, beyond the maxillary suture, prove their real nature. The four posterior molars resemble those of the Rhinoceros and Palæotheria; that is to say, they are quadrangular in the upper jaw, and marked in the lower with a double or triple crescent of enamel, which penetrates their substance and shows itself on the crowns in the form of salient ridges.

This formation of the organs of mastication, intimately connected as these organs necessarily are with the food and alimentary canal, demonstrate most unequivocally that these animals fed upon vegetable substances, and that, in all probability, they differed but little in this respect from the Tapirs and Rhinoceroses at present existing.

The second important character of the *Anoplotheria* which must have exercised a very decided influence upon their habits, arises from the conformation of the extremities. These, as in Ruminating Animals, were terminated by two toes, enveloped in small hoofs, sometimes without accessory or false hoofs behind, as in the Camels and Llamas, sometimes with one or even two small lateral toes of this description, as in the Peccaries; but the bones of the metacarpus and metatarsus respectively corresponding to these two toes were not united into a single canon, as they invariably are among the Ruminantia, and this is in reality the principal difference between the extremities of the latter animals and those of the *Anoplotheria*. The structure of the carpus and tarsus is precisely the same in both genera; the scaphoïd and cuboïd bones, which are soldered together into a single piece in all the other Ruminantia, being separate in the Camels and Llamas, as they invariably are in the *Anoplotheria* and other Pachydermata. These analogies prove that the *Anoplotherium*, which its teeth have already shown to have been essentially a Pachydermatous quadruped, approached in many of its characters to the Ruminantia of the existing creation, partaking on the one hand of the characters of the Camels and Llamas, and on the other of those of the Rhinoceroses and Peccaries. In the less prominent details of organisation however, the different species of *Anoplotheria* present peculiarities which have induced Baron Cuvier to distribute them in three sub-genera. In all, the prolongation of the nasal bones clearly shows that the *Anoplotheria* were not furnished with trunks like the Elephants, Tapirs, and Palæotheria; and their head altogether, judging from the form of the skull, appears to be intermediate between that of the Horse and that of the Camel. The first subdivision comprehends those species which M. Cuvier calls—

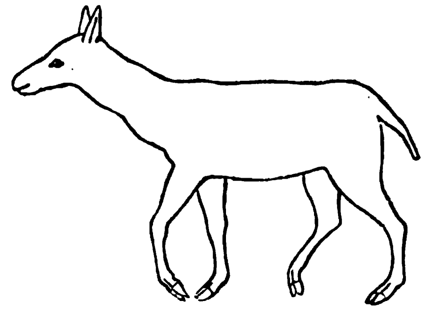
Anoplotheria proper. They are distinguished by having all the lower molars marked by double or triple crescents in a longitudinal direction, without salient tubercles; and by a third or supernumerary hoof on the fore-feet. This division comprehends two species, differing from one another principally in point of size, the one (*A. commune*)



Anoplotherium commune.

being about the size of the ass, and the other (*A. secundarium*) about that of the hog. Both these species have been found in the Isle of Wight. These animals were low on the limbs, probably like the Tapirs, but their long and powerful tail, equalling the body itself in length, made them still more essentially aquatic animals. The great size of their members, the depressed and heavy proportions of their bodies, and their long tails compressed horizontally at the base, must have given them much of the external form of the otter; but they resorted to the lakes and marshes of the antediluvian world, not for the purpose of preying upon other animals, but in search of aquatic plants, whilst the depressed form of their tails shows that they must have swum and plunged with as much ease and facility as either the Tapir or Hippopotamus. Like these animals their ears were probably short and erect, and their bodies sparingly covered with hair, as in all the existing Pachydermata.

The sub-genus *Xiphodon* differs from that just described in having the inferior molars tuberculous, and being without the additional or false hoof on the fore feet. It contains but a single species (*A. gracile*), which, judging from the length and smallness of its limbs, and the elevation of the tarsus, must have presented in every respect a complete contrast to the *A. commune*, exhibiting the light form and graceful proportions of the gazelle. Its course must necessarily have been rapid, and probably unembarrassed by a long tail; and, instead of resorting habitually to the rivers and ponds, like the former species, it must have been confined to the dry land, and, probably like the gazelles and antelopes, fed upon dry aromatic herbs, and was provided with long moveable ears to warn it of the approach of danger.



Anoplotherium gracile.

The third sub-genus, *Dichobunes*, contains three species, all established from the observation of detached bones, and of the actual forms of which it is consequently impossible to give a correct idea. They differed from the species contained in the two former subdivisions, principally by having a small additional or false hoof both on the fore- and hind-feet; and this character is so well marked in all the sub-genera of M. Cuvier, that, besides other considerations, it would suffice, among existing animals, to distinguish three separate genera, and perhaps should do so in the present instance. The *Dichobunes* were all of small stature: the largest of the three known species (*A. leporinum*) was about the size of a hare; the other two (*A. murinum* and *A. obliquum*) about that of the guinea-pig, were in all probability the smallest of hoofed quadrupeds. M. Cuvier supposes them to have been the hares and rabbits of the preadamite world, but their whole structure seems to approximate them more correctly to the musks of the present time, and they probably differed little from these animals either in form or habits. Another species of this genus was discovered by Mr. Pratt, in the Eocene deposits at Binstead in the Isle of Wight, and has been described by Professor Owen under the name of *D. cervinum*.

(Cuvier, *Ossemens Fossiles*; Owen, *British Fossil Mammals*.)

ANOPLURA, a family of Insects, including the *Aptera* of Linnæus, and the various forms of *Pediculus* [PEDICULUS] and Parasitic Insects of other authors. The researches which were commenced on this family by Dr. Leach have been carried on by Mr. Denny, and resulted in the discovery of a vast number of new forms. The result is that it has been found that every animal is infested with, or, for some wise purpose is accompanied by, one or more creatures belonging to this family, having a peculiar form in each species. Nearly 500 different forms of these curious insects, all formed on the type of the common human louse, have been described by Mr. Denny, in the catalogue of the specimens which at present exist in the British Museum. In most cases but one species of the parasite exist on one species of animal, but there are instances, as in the eagles and gulls, in which a species of the bird is attacked by five species of *Anoplura*. The best series of illustrations of these insects which exist are contained in Denny's 'Anoplura Britannica,' published in 1842.

ANORTHITE, a mineral found at Monte Somma, and, according to the analysis of Rose, containing:—

Silica	44·9
Alumina	34·46
Lime	15·68
Magnesia	5·25
Oxide of Iron	0·74

It occurs crystallised, and has the primary form of a doubly oblique prism. The colour and streak are white. The lustre is vitreous, inclining to pearly on the cleavage surfaces. It is translucent and transparent. The specific gravity is 2·65.

ANSER, the Goose, a genus of birds which M. Brisson separated from the genus *Anas* of Linnæus. Brisson has been followed in this by Baron Cuvier, Vieillot, Lesson, Drapiez, and Fleming; while Latham adheres to Linnæus, and Temminck confines *Anser* to a section of *Anas*. [DUCKS.]

ANT (*Formica*), a well-known genus of insects, which has attracted attention from the earliest ages, on account of the singular economy and extraordinary industry manifested by the different species. In the present article we shall confine ourselves to a brief but methodical outline of their natural history. In tracing the history of most insects, it is best, perhaps, to begin with the eggs; but in the case of the ant, the laying and hatching of the eggs could not be well understood without an acquaintance with their singular manner of pairing, with which, therefore, we shall begin.

Pairing of Ants.—It may be necessary to premise here, that, similar to bees, a community of ants, whatever the species may be, consists of males, which have always four wings; of females, much larger in size than the males, which only possess wings during the pairing season; and of a sort of barren females, which have been variously termed neuters, workers, or nurse-ants, and which, so far as we know, have never been observed to have wings in any stage of their existence.

If an ant-hill be examined any time after midsummer up to the close of autumn, there may be seen, mixed with the wingless workers, a number of both males and females furnished with white glistening wings. These however are neither kings nor queens in the state, at least so far as freedom of action is concerned, for they are not allowed to move without a guard of workers to prevent their leaving the boundaries, and if one straggles away unawares, it is for the most part dragged back by the vigilant sentinels, three or four of whom may, in such cases, be seen hauling along a single deserter by the wings and limbs. The workers, so far from ever facilitating the exit, much less the departure of the winged ones, more particularly the females, guard them most assiduously in order to prevent it; and are only forced to acquiesce in it when the winged ones become too numerous either to be guarded or fed. There seems indeed to be a uniform disposition in the winged ones to desert their native colony: and as they never return after pairing, it would soon become depopulated in the absence of females. The actual pairing does not seem to take place within the ant-hill, and we have observed scouts posted all around, ready to discover and carry back to the colony as many fertile females as they could meet with. Nay, we are quite certain that whole colonies have been thus dispersed; and when they did not find fertile females near their encampment, they have gone farther and farther till they found them, and, if they had gone very far, never returned, but commenced a number of new establishments, according to their convenience. It is probable that, soon after pairing, the males die, as do the males of bees and other insects; for, as the workers never bring any of them back, nor take any notice of them after leaving the ant-hill, they must perish, being entirely defenceless, and destitute both of a sting and of mandibles to provide for their subsistence. The subsequent proceedings of the females are very different, and of curious interest. It was supposed by the ancients that all ants, at a certain age, acquired wings; but it was reserved for the younger Huber, in particular, by means of his artificial formicaries, to trace the development of the wings in the female from the first commencement, till he saw them stripped off and laid aside like cast clothes.

This curious process, which was first hinted at by Gould in his interesting account of 'English Ants,' we have repeatedly witnessed —the females extending their wings, bringing them over their heads, crossing them in every direction, and throwing them from side to side, till at length they are disjointed from the body and fall off.

Foundation of Colonies.—Some of the females are, after pairing, usually captured by the working ants, and conducted back to the parent community; and others are laid hold of by straggling parties of from two to a dozen workers, who do not return to the parent community, but commence small colonies on their own account. This explains the common occurrence of a great number of small colonies being formed in the immediate vicinity of each other, while sometimes the parent community is thereby quite broken up, and the hill deserted. This happens frequently in the case of the Red Ant (*Myrmica rubra*) and the Ash-Coloured Ant (*Formica fusca*), both very common species in fields and gardens. In the case of the Yellow Ant (*F. flava*) again, and the Wood-Ant (*F. rufa*), this rarely occurs, the parent community often remaining in the same spot for years together.

When a female, after pairing, does not chance to fall in with any scouting parties of workers, she proceeds without their assistance to found a colony herself in the same manner as is always done by the females of the social wasps and humble-bees every spring. We have repeatedly verified this fact, both by confining a single female after pairing, and witnessing her proceedings, and by discovering in the fields single females occupied in laying the foundations of a future city for their progeny. We have met with these single females when they have just begun to form the first cell for the reception of their eggs; when the eggs have just been laid; when the eggs have been hatched; and also when a few workers had been reared to assist in the common labours.

Contrary to what takes place in most insects, the eggs of ants are not, when laid, glued to any fixed place, but are found in parcels of half a dozen or more loosely attached, so that they can be removed at pleasure during the hatching. It has been shown in the 'Penny Magazine' (vol. i., p. 60), by a series of minute observations, that the female earwig moves her eggs with the utmost care from a place which she judges too dry, to one which is sufficiently moist; and in the same way the female ant, when she founds a colony without assistance, or the nurse-ants in a community, change the situation of the eggs according to the state of the weather or of the day and night—a circumstance first observed by Dr. King in the reign of King Charles II. Heat being indispensable to their successful hatching, the eggs are carefully placed during the day near the surface of the ant-hill, but so sheltered from the direct influence of the sun as to prevent the too rapid evaporation of their moisture. During the night, or in cold weather, the eggs are not placed so high, to prevent the escape of the heat which they naturally possess. The attention to the state of temperature occupies much of the assiduity of the female and the nurse-ants.

When the eggs are at length hatched (and during this process we have already seen that they enlarge in size), the young grubs are similarly treated with respect to temperature, but greater care is now taken to preserve them from too great heat, which might prove more injurious than before hatching.

The grubs are fed by the nurse-ants when any of these are in the colony, and by the mother when she is alone, by a liquid disgorged from the stomach, as is done in a similar way by wasps, humble-bees, pigeons, and canary birds. It consequently requires no little industry on the part of a solitary female to procure for herself sufficient food to supply nutriment for a brood of perhaps a dozen or twenty grubs, which are insatiably voracious.

When the grubs are full grown they spin for themselves cocoons of a membranous texture, and of a brownish-white colour, not unlike barleycorns in appearance, and indeed mistaken for these by early observers—a mistake which led to the unfounded notion that ants store up corn for winter provision, though, from their always becoming torpid in the winter, they could have no need of this; and even were this not so, they never feed on corn, and would probably starve rather than taste it. The authority of Scripture, which has been supposed to countenance the popular notion, is shown by the Rev. Dr. Harris, Messrs. Kirby and Spence, and others, to have no foundation in the sacred text.

The cocoons are treated precisely like the eggs and the grubs with regard to exposure to heat; and the anxiety of the nurse-ants to shelter them from the direct rays of the sun is taken advantage of on the Continent to collect the cocoons (popularly and erroneously called ants'-eggs) in quantity as food for nightingales and larks. The cocoons of the Wood-Ant are the only species chosen; and in most of the towns in Germany one or more individuals make a living during summer by the business.

In the case of moths, ichneumons, and other insects which spin themselves up in cocoons, the included insect, when the time of its change arrives, is enabled to make its own way through the envelope; but though it would appear, from some observations made by Swammerdam, that ants may, when forced thereto, effect their own disengagement, this is not the usual process. It is the nurse-ants that cut a passage for them with their mandibles, as was first minutely described by Baron de Geer and the younger Huber.

Labours of the Working Ants.—We have already seen that workers or nurse-ants have to labour assiduously in placing the eggs, the grubs, and the cocoons in due degrees of temperature; that they have to feed the grubs by a liquid disgorged from the stomach, and have to disengage the insect at its period of change from the envelope of the cocoon. They have also to perform the task of forming streets, galleries, and chambers for the habitation and protection of the colony, and they exhibit in the work such perseverance and skill as must excite the admiration of every observer. Many of their processes, indeed, it is not a little difficult to account for and explain, though these have been very carefully investigated, particularly by the younger Huber, in whose work, and in the 'Library of Entertaining Knowledge —Insect Architecture' (p. 254 *et seq.*), may be found copious details of the mining, masonry, and carpentry of various species. We shall here give an instance of each of those operations.

Mining.—There is an interesting species called the Sanguinary Ant (*F. sanguinaria*, Latreille), reported to have been seen near London, but which is certainly very rare, if it is found in England. In the summer of 1832 we discovered several colonies of this ant on the brow of the heath above Godesberg, on the Rhine; and being desirous of taking a number of them alive to England for the purpose of observing their singular manners, we waited till the beginning of October, when they had ceased to work, and had retired for the winter to their galleries underground. After uncovering the thick coping of dry heath-twigs and grass-stems which was placed over the subterranean city of the colony so as to defend it from rain and cold, we found several covert-ways dug into the clay, wide enough to allow two or three ants to walk abreast; but not an individual now made its appearance, though some weeks previously we had observed thousands in all the bustle of industry; and we began to fear the whole had migrated elsewhere. Being anxious, however, to see the interior structure, we dug in the direction of the covert-ways to the depth of about six or nine inches, when we came upon a number of chambers communicating with each other by galleries, and from an inch to two or three inches in extent, in each of which a number of ants were lying along the floor in a half torpid state, being so sluggish that they could not be brought to run with their usual agility even when irritated.

The point which we wish to call attention to here is, that the whole of the apartments which we laid open, amounting to a dozen or more —and there were probably as many more to which we did not penetrate—must have been dug out of the solid clay by the jaws (*mandibula*) of these little miners. We deemed it singular that we could see none of the rubbish lying about, which must have been cleared away from the interior; and we can only account for this by supposing the colony long established, and the rubbish battered into the grass by the weather.

In other instances of mining, such as in the case of the Turf-Ant (*F. cæspitum*), the clay taken from the interior is built up on the outside, using the herbage for buttresses to support the walls thus formed. In the case of the Sanguinary Ants, however, we observed nothing of this kind, and do not think they ever employ any exterior masonry.

Masonry.—The most common of our English ants which employ masonry is the Yellow Ant (*F. flava*), whose hills are so usually found built up in old pastures, a foot or more in height, and from 6 inches to 2 feet in diameter. For the materials of their building they are wholly indebted to the soil below, which they quarry out with great assiduity; but as they have no means of tempering the clay when it is dry, they are always forced to execute their principal works in rainy weather. "I was," says Dr. J. R. Johnson, "in the habit of visiting, almost daily, for a month, an extensive nest of Red Ants, of which a large flat stone formed the roof. During my visits for the first three weeks, scarcely a drop of rain had fallen, and the nest seemed considerably injured by the continual falling in of loose earth, which these little creatures with amazing industry removed, whenever it happened any of the avenues were blocked up. No attempt was ever made towards reparation; but what was my surprise, on visiting my little friends after a two days' heavy rain, to find that the repairs were already completed, and that the upper surface of their habitation presented as smooth a surface as if a trowel had been passed over it; yet all their work they had industriously effected by kneading with the rain-water the loose earth into a sort of paste. From the nest being situated in the midst of an extensive heath, where there could be no supply of water, and from its remaining unrepaired during the dry weather, it amounts to a full conviction that ants employ no other cement than water in the construction of their varied habitations.

"I have often been surprised at the ingenuity of these little creatures, in availing themselves of contiguous blades of grass, stalks of corn, &c., when they wish to enlarge the boundaries of their abode. As these are usually met with in the erect position, they are admirably calculated for pillars; they therefore coat them over with a fine paste of earth, giving them, by additional layers, the solidity they judge necessary for the work on which they are engaged; they then leave them to be consolidated by the wind, and afterwards spring a number of arches, from pillar to pillar, and thus form an extensive saloon. Should they be at any time in want of small apartments, they have only to prepare a quantity of moistened earth, and by placing this between the pillars, and carrying it up to the roof, leaving here and there an aperture for entrance, their object is completely attained."

It is remarkable that the greater part of these masonic labours are performed during the night, or at least in gloomy weather.

Carpentry.—The coping which we have already described as placed over the subterranean abode of the Sanguinary Ants, and which is still more remarkable in the colonies of the Wood-Ant (*F. rufa*), cannot be referred to any sort of carpentry, for the small sticks and straws of which it is composed are not cut into fitting lengths, but collected in the vicinity of the hill and laid on it after the manner of thatch. The term carpentry, however, will apply most justly to those species which form excavations in the interior of trees, of which the following is an instance observed in 1832.

We had brought into our garden in the beginning of June, a large piece of a willow tree, which had been very curiously worked out by the species usually called the Emmet (*F. fuliginosa*, Latreille). The tree indeed from which it had been taken, appeared to have been destroyed in a great measure from the extensive excavations of these little carpenters. Yet the portion of the tree alluded to seemed to be singularly strong, when the great number of the cells and their peculiar structure was taken into consideration. The walls of these cells were literally as thin as writing-paper, though not quite so smooth and even, and they were seldom quite parallel, but arranged, some perpendicularly, and others slanting in various directions, worked out, it would appear, upon no previous design, but beginning at any given point, and only limited in extent by the worker discovering his approach to one adjacent. The tact with which they chisel away the wood with their jaws, so as to come so near the next cell without actually cutting into it, cannot well be accounted for on any of the common principles of human mechanism. It cannot be the result of vision, from the worker-out looking along the level of the plane, as one of our carpenters would do, and thence working so as not to cut through it; for the wall has, in most instances, though not in all, no free edge along which such a level could be taken by the eye. Hearing might assist them however, supposing workers to be engaged in chiselling on each side of the partition, but it would appear to be more from touch, or rather that modification of it denominated tact, which enables them to feel, as it were, when they have nearly penetrated the wall, and which consequently warns them to stop.

It is not a little remarkable, that all the wood which is worked out by these ants is tinged of a black colour, giving all their streets and lanes somewhat the appearance of having suffered from fire or of being smoked. M. Huber the younger did not succeed in ascertaining the cause of this black colour. We should conjecture it to arise from iron contained in the saliva of the ants acting on the gallic acid of the wood, in a similar way as the same wood becomes black when cut with a knife. The fine glossy black of the ants themselves may originate from the same chemical principle, and this is rendered more probable from the excavations made by other species, such as the Dusky Ant (*F. fusca*, Latreille), not being tinged with this black colour. Neither are the excavations of the latter so regular in the form of the cells; and the delicately thin partitions do not occur. We have seen several colonies of the Yellow Ant (*F. flava*, Latreille) established in trees, though their usual habits lead them to prefer a hedge-bank, the dry ridge of a field, or a small knoll on a common. In none of these however had the workers much trouble in making their excavations, the trees being in every instance far gone with the dry rot, and the chambers were consequently as easy to construct as in a knoll of sand. In the instance of the Black Carpenter-Ant (*F. fuliginosa*), on the other hand, the wood of the tree selected for their colony is always hard and tough, the easiness of working it being apparently considered a disadvantage rather than a recommendation. We have usually seen these colonies, therefore, in growing trees, the oak seeming to be preferred to all others; the honeycomb-like work does not seem to stop the vegetation, the tree continuing to put forth leaves and shoots as before it was excavated for the use of the colony. In the instance which gives rise to these remarks, the willow tree was indeed dilapidated and shorn of its leaves and branches, yet was it untouched with dry rot, and the wood was hard and tough.

Food of Ants.—Some species of ants are carnivorous and will eat insects, fruits, and almost anything eaten by other animals; but honey is the most universal favourite among all the species, particularly the excretion of the various species of Aphides, called Honey-Dew. It is on this account that, wherever Aphides abound, we are always certain to meet with ants carefully attending their motions and greedily drinking the honey-dew, which becomes so injurious to plants when it increases in quantity so as to obstruct the pores of the leaves. It is stated by Huber and some other authors, that during winter the ants imprison some Aphides in their cells, or, at all events, take advantage of individuals of the Grass Aphis (*Aphis graminum*) in the vicinity of their hills to obtain honey-dew. We strongly suspect there must be some fallacy in this statement; for among numerous colonies which we have carefully examined during winter, we always found the whole population torpid or nearly so, and not inclined to touch even honey when we offered it to them. In the case of the Sanguinary Ants in Germany already mentioned, we have seen that they had become torpid as early as October, when the weather was still fine and far from being cold. We are therefore of opinion that the statement will be found as void of accurate foundation as that which represents ants as storing up corn for the winter.

Migrations.—We have already seen, under the head of pairing, one principle in operation for spreading around a parent ant-hill a number of young colonies. This indeed may be considered the main principle of migration; but besides this, the whole of a populous ant-hill which has been established for several years will, from some cause beyond our means of tracing, though most probably on account of more convenient forage, at once desert their homes and march to a new station. Among the Yellow Ants, the Emmets, and the Wood Ants or Pismires, this is by no means common; but it is an every-day occurrence among the Red Ants, the Ash-Coloured Ants, the Turf-Ants, and others whose colonies never become very populous, and are consequently both more easily moved and more easily provided with lodging.

"Immense swarms of ants," to use the words of Dr. Roget, "are occasionally met with, and some have been recorded of such prodigious density and magnitude as to darken the air like a thick cloud, and to cover the ground to a considerable extent where they settled." Mr. Gleditsch describes, in the 'History of the Berlin Academy,' for 1749, shoals of a small black ant which appeared in Germany, and formed high columns in the air, rising to a vast height, and agitated with a curious intestine motion, somewhat resembling the aurora borealis. A similar flight of ants is spoken of by Mr. Acolutte, a clergyman of Breslau, which resembled columns of smoke, and which fell on the churches and the tops of the houses, where the ants could be gathered by handfuls. In the German 'Ephemerides,' Dr. Charles Rayger gives an account of a large swarm which crossed over the town of Posen, and was directing its course towards the Danube. The whole town was strewed with ants, so that it was impossible to walk without trampling on 30 or 40 at every step. And Mr. Dorthes, in the 'Journal de Physique' for 1790, relates the appearance of a similar phenomenon at Montpellier. The shoals moved about in different directions, having a singular intestine motion in each column, and also a general motion of rotation. About sunset all fell to the ground, and, on examining the ants, they were found to belong to the *Formica nigra* of Linnæus.

Wars and Expeditions to capture Slaves.—In the same way as the bees and the wasps of different hives manifest inveterate hostility when they meet, ants also of the same or of different species assail one another when they meet during their foraging excursions. Besides the individual skirmishes which thence occasionally arise, pitched battles are sometimes fought between the whole or nearly the whole force of populous adjacent colonies. We have never ourselves witnessed any very extensives battles of this kind, such as Huber describes, in which thousands of combatants were engaged, but we have seen as many as 50 of the Wood-Ants fighting most pertinaciously within the area of a few inches on what were supposed to be the boundaries of their several territories. Their bite is so sharp, and the acrid acid which they infuse is so deleterious, that many are thus disabled or killed outright. Huber witnessed on such occasions very extensive carnage.

Besides these skirmishes and battles which occur among all the species, there are whole communities of warrior-ants, as was first discovered by Huber, whose history is so extraordinary as almost to exceed belief. The details indeed have hitherto been credited chiefly, if not solely, on the well-known veracity of Huber; but in the autumn of 1832 we had an opportunity of verifying them both in the Black Forest and in Switzerland, with respect to the species which he terms the Amazon Ant (*F. rufescens*, Latreille), and on the Rhine with respect to the Sanguinary Ant.

Both of these species make war on the ants of a different species from themselves, particularly the Dusky Ant (*F. fusca*), not for the purpose merely of gratifying a propensity to combat, but to make slaves of the vanquished to do the drudgery of the conquerors at home. The manner in which they proceed in this affair manifests, so far as we can judge, deep design, such as might be ascribed to the counsels of a cunning diplomatist. They do not capture the adult ants and carry them into slavery, but make booty of the eggs and cocoons, which, after the contest is decided—and the warriors are always conquerors—are carried off to the Amazonian citadel, and being hatched there, the poor slaves are most probably not aware but that it is their native colony. Huber repeatedly witnessed such expeditions for the purpose of capturing slaves; but though we were not so fortunate, we witnessed, in a great number of instances, the slaves at work for their warlike captors.

The Amazons have not hitherto been found in Britain, and we were unsuccessful in our attempt to bring over from the Black Forest a nest of live ones with their slaves which we had placed in a box for the purpose.

ANT-BEAR, the name commonly given to the ***Myrmecophaga jubata*** by the English at Demerara. [ANT-EATER.]

ANT-EATER (***Myrmecophaga***, Linnæus), a genus of ***Edentata***, distinguished by their total want of teeth and their hairy covering. The latter circumstance separates them from the Pangolins (***Manis***), or Scaly Ant-Eaters of Africa and Asia, which they resemble closely in other respects, as well in their general anatomy as in their food and habits. These two genera form a small but very distinct family of Cuvier's order ***Edentata***, differing from the common animals comprised in that singular group, as well as from all other known mammalia, by their entire deprivation of the organs of mastication, and acquiring an additional interest by the light which their osteological conformation throws upon the structure and organisation of the ***Megatherium***, ***Megalonyx***, and ***Mylodon***, those extraordinary animals whose fossil remains have attracted so much of the attention, not only of the professed naturalist, but likewise of the public at large. The osteology of the skulls and trunks of these extinct animals presents the closest analogies with that of the corresponding parts in the Sloths; so the whole construction of their extremities appears to have been formed after the same model as that of the corresponding organs of the Ant-Eaters. The head of these latter animals, indeed, is altogether different from that of the Sloths: not only does it want the organs of mastication, of which they are deficient only in the incisors, but the bones of the face, which in them are short and round like those of apes and monkeys, are prolonged in the Ant-Eaters, particularly in the Great Ant-Eater (*M. jubata*), to double the length of the skull. This singular conformation arises from the form of the maxillary or jaw-bones, and those of the nose, which form together a kind of long tube, very small in proportion to its length, and almost cylindrical. This prolongation of the muzzle is not carried to so great an extent in either of the other two known species of Ant-Eaters; but even there the construction here described differs only in degree, and presents, on a more contracted scale, all the characteristics of the ***Myrmecophaga jubata***.

It is in the construction of the anterior extremities however that these animals offer the greatest singularities, and become most important in their relations to the fossil species. The phalanges or joints of the toes, particularly the last, which bear the claws, are formed in such a manner as to permit them to be bent inwards only, as in the Sloths; and for this purpose they are provided with very powerful ligaments, which keep them, in a state of repose, bent in along the sole of the foot, and never permit the hand to be completely opened, but only half extended, as we sometimes see in gouty or rheumatic people. The toes themselves are of very unequal size, and even differ in number in different species. The Great Ant-Bear and Tamandua have four on the anterior and five on the posterior extremities, whilst the smallest species, called, from that circumstance, ***M. didactyla***, has only two on the fore feet and four on the hind. The toes themselves, as in the Sloths, are united closely together as far as the claws, and are consequently incapable of any separate or individual motion, but the disadvantages arising from this circumstance are more than counterbalanced by the increased strength which it produces, and the consequent adaptation of the organ to the peculiar purposes of these animals' economy. The claws are all large and powerful, especially that of the middle toe, of which the dimensions are quite enormous. Nor do the Ant-Eaters, in walking, tread flatly upon the sole of the foot like the generality of mammalia: on the contrary, they rest entirely upon its outer edge, which is provided with a large callous pad for that purpose, whilst their toes being bent inwards along the palms, the sharp points of their powerful claws are preserved from being injured by the friction of the hard ground. In other respects the Ant-Eaters are remarkable for their long cylindrical tongues, covered with a glutinous saliva, by means of which they entrap and devour the insects upon which they live, and from which they derive their names, both among naturalists and common observers—***Myrmecophaga*** literally signifying Ant-Eater. This tongue is protractile, and capable of being extended to a surprising distance beyond the snout; it is nearly twice the length of the whole head and muzzle together, and when not extended is kept doubled up in the mouth with the point directed backwards. The eyes are particularly small, the ears short and round, the legs robust and amazingly powerful, but so unfavourably formed for locomotion, that the pace of these animals is almost as tardy as that of the sloths themselves, their greatest exertions not enabling them to surpass the ordinary walk of a man. The tail is always long: in the great species lax and thickly covered with very long flowing hair, in the other two, strongly prehensile, and naked underneath. These species consequently climb trees and reside principally among their branches, feeding upon the wild bees and termites which inhabit the same situations. The Great Ant-Bear, on the contrary, never quits the surface of the earth, and confines its depredations entirely to the numerous species of large ants which inhabit its native regions, and furnish him at all times with an abundant and easily-procured nutriment. The whole genus is confined to South America, and contains three distinct and well-defined species.

1. The Great Ant-Eater (***M. jubata***, Linn.), called Tamandua by the Portuguese, and Ant-Bear by the English and Spaniards, is a large animal which measures, when full grown, four feet and a half from the extremity of the snout to the origin of the tail. The tail itself is 3 feet 3 inches in length, reckoning to the extremity of the hair, or measured only along the stump, 2 feet 4 inches; the head, 13½ inches from the snout to the base of the ear, and 10½ inches to the anterior angle of the eye; its circumference immediately before the eyes, where it is the thickest, is 14 inches, but from this part it gradually diminishes to the end of the muzzle, where it measures only 5¼ inches. The height of the animal at the shoulder is 3 feet 3 inches, and at the croup only 2 feet 10 inches, because, being

Great Ant-Eater (*M. jubata*).

perfectly plantigrade, it necessarily stands lower on the hind legs than before, as may be observed in the common bear, the badger, and other species which partake of the plantigrade formation of the extremities. The ear is short and round, being an inch and a quarter broad at the base, and only an inch in length; the eye is remarkably small, deeply sunk in the head, and with a naked eyelid; the head and snout, as already observed, are prolonged to a remarkable degree; they are in form almost cylindrical, and end in a small truncated muzzle, having the nostrils and mouth placed at its extreme end; the latter is so small that its whole width scarcely exceeds an inch, and the jaws are of equal length. The tongue is almost cylindrical, fleshy, extremely flexible, and capable of being protruded to the distance of 16 or 18 inches. The toes of the anterior extremities, four in number, are of unequal length, the innermost being the smallest and weakest of all; the second measures 2¼ inches in length, and is provided with a powerful crooked claw nearly 2 inches long, sharp-pointed, and trenchant on its under surface; the third, which is the largest of all, has a similar claw 2¼ inches in length; and the fourth, or exterior toe, is provided with a smaller and weaker claw, like that of the innermost. All these claws, when in a state of repose, are kept bent inwards, and only extended, or rather half-extended (for the animal cannot open the fingers farther), when used for defence, or for breaking through the hard external crust of the ant-hills.

The prevailing colour on the head, face, and cheeks of the Ant-Bear is a mixture of gray and brown; that on the upper parts of the body and tail is a deep brown, mixed with silvery-white. A broad black band, bordered on each side with a similar one of a white or light grayish-brown colour, commences on the chest, and passes obliquely over each shoulder, diminishing gradually as it approaches the loins, where it ends in a point. The sides, arms, and thighs are silvery-gray, with a slight mixture of brown, marked with two deep black spots, one on the carpus, and the other on the toes; the hind-legs are almost perfectly black, and the breast and belly of a deep brown, almost equally obscure.

The habits of the Great Ant-Bear are slothful and solitary; the greater part of his life is consumed in sleeping, notwithstanding which he is never fat, and rarely even in good condition. When about to sleep, he lies upon one side, conceals his long snout in the fur of the breast, locks the hind and fore claws into one another, so as to cover the head and belly, and turns his long bushy tail over the whole body in such a manner as to protect it from the too powerful rays of the sun. The female bears but a single young one at a birth, which attaches itself to her back, and is carried about with her wherever she goes, rarely quitting her, even for a year after it has acquired sufficient strength to walk and provide for itself. This unprolific constitution, and the tardy growth of the young, account for the comparative rarity of these animals, which are said to be seldom seen, even in their native regions. The female has only two mammæ, situated on the breast, like those of apes, monkeys, and bats.

In its natural state the Ant-Bear lives exclusively upon ants, to procure which it opens their hills with its powerful crooked claws, and at the moment that the insects, according to their nature, flock from all quarters to defend their dwellings, draws over them his long flexible tongue, covered with glutinous saliva, to which they consequently adhere; and so quickly does he repeat this operation, that we are assured he will thus project his tongue and draw it in again covered with insects twice in a second. He never actually introduces it into the holes or breaches which he makes in the hills themselves, but only draws it lightly over the swarms of insects which issue forth alarmed by his attack. "It seems almost incredible," says Azara, "that so robust and powerful an animal can procure sufficient sustenance from ants alone; but this circumstance has nothing strange in it for those who are acquainted with the tropical parts of America, and who have seen the enormous multitudes of these insects, which swarm in all parts of the country, to that degree that their hills often almost touch one another for miles together." The same author informs us, that domestic Ant-Bears were occasionally kept by different persons in Paraguay, and that they had even been sent alive to Spain, being fed upon bread and milk, mixed with morsels of flesh minced very small. Like all animals which live upon insects, they are capable of sustaining a total deprivation of nourishment for an almost incredible time.

The Great Ant-Bear is found in all the warm and tropical parts of South America, from Colombia to Paraguay, and from the shores of the Atlantic to the foot of the Andes. His favourite resorts are the low swampy savannahs, along the banks of rivers and stagnant ponds, also frequenting the humid forests, but never climbing trees, as falsely reported by Buffon, on the authority of Laborde. His pace is slow, heavy, and vacillating; his head is carried low, as if he smelled the ground at every step, whilst his long shaggy tail, drooping behind him, sweeps the ground on either side, and readily indicates his path to the hunter; though, when hard pressed, he increases his pace to a kind of slow gallop, yet his greatest velocity never half equals the ordinary running of a man. So great is his stupidity, that those who encounter him in the woods or plains may drive him before them by merely pushing him with a stick, so long at least as he is not compelled to proceed beyond a moderate gallop; but if pressed too hard, or urged to extremity, he turns obstinate, sits up on his hind-quarters like a bear, and defends himself with his powerful claws. Like that animal, his usual and indeed only mode of assault is by seizing his adversary with his fore-paws, wrapping his arms round him, and endeavouring by this means to squeeze him to death. His great strength and powerful muscles would easily enable him to accomplish his purpose in this respect, even against the largest animals of his native forests, were it but guided by ordinary intelligence, or accompanied with a common degree of activity. But in

these qualities there are few animals indeed which do not greatly surpass the Ant-Bear; so that the different stories handed down by writers on natural history from one another, and copied, without question, into the histories and descriptions of this animal, may be regarded as pure fictions. For this statement we have the express authority of Don Felix d'Azara, an excellent observer and credible writer, from whose 'Natural History of the Quadrupeds of Paraguay' we have derived the greater portion of the preceding account of the habits and economy of this extraordinary animal. The flesh of the Ant-Eater is esteemed a delicacy by the Indians and negro slaves, and, though black, and of a strong musky flavour, is sometimes even met with at the tables of Europeans.

2. The Tamandua (*M. Tamandua*, Cuvier), is an animal much inferior to the Great Ant-Bear in point of size, being scarcely so large as a good-sized cat, whilst the other exceeds the largest greyhound in length, though, from the shortness of its legs, it is much inferior in height. The head of the Tamandua is not so disproportionately long and small as that of the Great Ant-Bear. It is however of the same general cylindrical form, and equally truncated at the extremity, having the nostrils and mouth situated in the same position, and equally minute, when compared with the size of the animal. Its whole length, from the extremity of the muzzle to the root of the ear, is 5 inches, and to the anterior angle of the eye, 3 inches; the body, from the muzzle to the origin of the tail, measures 2 feet 2 inches, the tail itself being 1 foot 4¼ inches more; the height at the shoulder is 1 foot 3 inches, and at the croup an inch lower; the length of the ear is 1¼ inch, its greatest breadth an inch, and the greatest circumference of the head—that, namely, taken immediately in front of the ears—8¼ inches. The conformation of the extremities, and the number of the toes both before and behind, are in every respect the same as in the Great Ant-Eater; but the Tamandua differs from this animal particularly in the prehensile power of its tail, which makes it essentially an arboreal quadruped, and altogether changes the most striking traits of its habits and economy. The hair over the entire body also is of a very different texture; instead of being long, harsh, and shaggy, as in the Great Ant-Bear, it is short, shining, and of a consistence something between the qualities of silk and wool; standing out from the body like the latter, and of the same uniform length in every part. The colours of this species, however, are by no means so uniform and invariable as those of the species already described; on the contrary, they differ more in the Tamandua, according to the individual, than perhaps in any other known animal in a state of nature. Accordingly many eminent naturalists are disposed to consider them as forming distinct species, rather than mere varieties of the same; and it is not improbable that, when we come to be better acquainted with this animal in its native woods, their opinion may be at least partly confirmed.

Tamandua (*M. Tamandua*).

The eyes of the Tamandua are minute; the ears small and round; the body long and cylindrical; the legs short and robust; the tail round and attenuated, covered with very short hair throughout its greater part, but naked underneath towards the point, and strongly prehensile. There are several varieties of the Tamandua, chiefly distinguished by differences of colour.

The Tamandua is an inhabitant of the thick primeval forests of tropical America; it is never found on the ground, but resides exclusively in trees, where it lives upon termites, honey, and even, according to the report of Azara, bees, which in those countries form their hives among the loftiest branches of the forest, and, having no sting, are more readily despoiled of their honey than their congeners of our own climate. When about to sleep it hides its muzzle in the fur of its breast, falls on its belly, and letting its fore-feet hang down on each side, wraps the whole tightly round with its tail. The female, as in the case of the Great Ant-Eater, has but two pectoral mammæ, and produces but a single cub at a birth, which she carries about with her, on her shoulders, for the first three or four months. The young are at first exceedingly deformed and ugly, and of a uniform straw-colour.

This animal has a strong disagreeable odour, which is so powerful that it may be perceived at a very great distance, particularly when the animal is irritated. Tamandua is the name by which it is known to the Portuguese of Brazil; the French call it Fourmillier and the English the Little Ant-Bear.

3. The Little or Two-Toed Ant-Eater (*M. didactyla*, Linn.) is easily distinguished from the other two species, not only by its size, which does not exceed that of the common European squirrel, but likewise by the number of its toes, four on the posterior and only two on the anterior extremities. The form and general proportions of its body resemble those of the Tamandua, only on a very reduced scale. Its whole length, from the snout to the origin of the tail, is but 6 inches, that of the head not quite 2 inches, and of the tail 7½ inches. This organ is consequently rather longer than the body; it is thick at the root, and covered with short fur, but tapers suddenly towards the point, where it is naked and strongly prehensile. The muzzle is not so long, in proportion, as in the other two species; the tongue also is shorter, and has a flatter form; the mouth opens farther back in the jaws, and has a much larger gape, the eye being situated close to its posterior angle; the ears are short, rather drooping, and concealed among the long fur which covers the head and cheeks; the legs are short and stout, and the hair very fine and soft to the touch, three-quarters of an inch in length on the body, but much shorter on the head, legs, and tail. The general colour is that of straw, more or less tinged with maroon on the shoulders, and particularly along the median line of the back, which usually exhibits a deep line of this shade. This species is said to have four mammæ, two pectoral, as in those already described, and two others on the abdomen. It is reported, nevertheless, to have but a single cub at a birth, which it conceals in the hollow of some decayed tree. The native countries of the Little Ant-Eater are Guyana and Brazil, beyond which it appears not to extend farther towards the south, since Azara is not only unacquainted with it, but imagines from Buffon's and Daubenton's descriptions that it must be the young of his Tamandua. The habits and manners of this little animal are thus described by Von Sack, in his 'Narrative of a Voyage to Surinam':—

Little Ant-Eater (*M. didactyla*).

"I have had," says he, "two Little Ant-Eaters or Fourmilliers, which were not larger than a squirrel: one was of a bright yellow colour, with a brown stripe on the back; the other was a silvery-gray and darker on the back; the hair of each was very soft and silky, a little crisped; the head was small and round, the nose long, gradually bending downwards to a point; it had no teeth, but a very long round tongue; the eyes were very small, round, and black; the legs rather short; the fore-feet had only two claws on each, the exterior being much larger and stronger than the interior, which exactly filled the curve or hollow of the large one; the hind-feet had four claws of a moderate size; the tail was prehensile, longer than the body, thick at the base and tapering to the end, which, for some inches on the under side, was bare. This little animal in Surinam is called Kissing-Hand, as the inhabitants pretend that it will never eat, at least when caught, but that it only licks its paws, in the same manner as the bear; that all trials to make it eat have proved in vain, and that it soon dies in confinement. When I got the first, I sent to the forest for a nest of ants, and, during the interim, I put into its cage some eggs, honey, milk, and meat; but it refused to touch any of them. At length the ants' nest arrived, but the animal did not pay the slightest attention to it either. By the shape of its fore-paws, which resemble nippers, and differ very much from those of all the other different species of ant-eaters, I thought that this little creature might perhaps live on the nymphæ of wasps, &c.; I therefore brought it a wasps' nest, and then it pulled out with its nippers the nymphæ from the nest, and began to eat them with the greatest eagerness, sitting in the posture of a squirrel. I showed this phenomenon to many of the inhabitants, who all assured me that it was the first time they had ever known that species of animal to take any nourishment. The ants with which I tried it were the large white termites, upon which fowls are fed here.

"As the natural history of this pretty little animal is not much known, I thought of trying if they would breed in a cage; but when I returned from my excursion into the country, I found them both dead, perhaps occasioned by the trouble given to procure the wasps' nests for them, though they are here very plentiful: wherefore I can give no further description of them than that they slept all the day long curled together, and fastened by their prehensile tails to one of the perches of the cage. When touched they erected themselves on their hind-legs, and struck with the fore-paws at the object which disturbed them, like the hammer of a clock striking the bell, with both paws at the same time, and with a great deal of strength. They never attempted to run away, but were always ready for defence, when attacked. As soon as evening came they awoke, and with the greatest activity walked on the wire of the cage, though they never jumped, nor did I ever hear their voice."

ANTAGONIST MUSCLE (from ἀντί, against, and ἀγωνίζομαι, to strive), a muscle the action of which is opposed to that of some other muscle. Muscles are the instruments by which, in the animal body, motion is effected. The object of each muscle is to produce some specific motion. Among the various motions which are needed in the animal economy, it necessarily happens that some are directly opposite to others, and the muscles which accomplish these directly opposite movements are said to be with relation to each other Antagonists.

ANTELOPE. [Antilopeæ.]

ANTENNÆ, horn-like members placed on the head, and peculiar to Insects and Crustaceous Animals. Their functions are not well understood, and have given rise to several different opinions among naturalists. The term is derived from the Latin *ante*, 'before.' In insects they are uniformly two in number; but in crabs and lobsters there are more than two. They are connected with the head, always near the eyes, by means of a ball (*bulbus*) and socket (*torulus*). They are composed of minute cylinders or rings successively added to each other, to the number of 30 in some butterflies, and thus forming a tube which incloses nerves for sensation, muscles for moving, as well as air-pipes and cells.

The form of the antennæ is exceedingly various, some being simple and some feathered, clubbed, comb-shaped, in endless diversity. In moths, the female is distinguished from the male by the antennæ being more simple. In some moths and beetles the antennæ are very long compared with the length of the body, whereas in the house-fly, and some other two-winged flies, they are very short. Their length does not depend on the number of joints, for they may be long when composed of only three or four pieces, and short when composed of ten or more pieces.

With respect to the functions of the antennæ, it is the most common opinion, sanctioned by such authorities as Linnæus and Bergmann, that they are organs of touch, and are on that account often termed feelers; "but," as M. Straus-Dürckheim justly remarks, "this conjecture is founded upon facts imperfectly investigated, if not altogether false. I have made numerous researches on this subject, and I have never been able to satisfy myself that insects examine objects by feeling them with their antennæ. On the contrary, I have rarely observed these animals touch anything with these organs, and when this did happen, it appeared to be only by accident, and not at all from design. Many insects, besides, have their antennæ so short, that they would be obliged to stand erect upon their heads in order to come at the bodies which they might thus wish to explore, and for this their feet are certainly much better adapted.

"Since," continues M. Straus-Dürckheim, "almost all Articulated Animals possessing a solid skin (*peau*) have antennæ, which are furnished with nerves of an extraordinary thickness in proportion to their own size, there cannot remain a doubt that they are organs of some sense, and that too a very acute one.

"I have said that insects are proved, by observation, to be furnished with an organ of hearing. The solidity of the envelope of antennæ renders these organs well adapted to undergo the same vibrations as the air, in the same manner as the strings of an Æolian harp vibrate and emit various sounds according as they are differently struck by the air. In this view, however, we might infer that nature would have made antennæ in the form of rods, consisting of a single piece, in order that they might be more susceptible of vibrations; but it ought to be considered, that these organs would, by such a conformation, have been much exposed to breaking, while, in consequence of their jointed form, they have the advantage of regulating the degree of vibration at pleasure, as may indeed be observed when insects listen with attention; I mean, that the joints of the antennæ perform the same functions as the chain of small bones in the chamber of the human ear, inasmuch as they form a similar chain, and transmit the vibrations of the air to the auditory pulp."

Professor Bonsdorff of Abo in Finland, and other naturalists, though opposed to the views of Linnæus and Bergmann, have adopted the same opinion, and regard the antennæ as organs of hearing.

There is one other subject connected with the antennæ which requires notice. The younger Huber has attributed to ants the use of certain signs made with these organs, which he terms 'antennal language,' understood not only among ants themselves, but also among the aphides, on which they depend for the excretion popularly termed honey-dew. The motions of the antennæ, however, to which he refers in proof of his views, do not, so far as we can judge, authorise us to conclude that they are used in the way of language, any more than to theorise in the same way upon the bills of nestling birds which are opened to receive food, or their wings which are opened and vibrated rapidly while they receive it. That there is nothing peculiar in this alleged antennal language, so far as the aphides are concerned, any one who chooses may prove by taking a pin or a camel-hair pencil and gently touching the aphis, when it will eject the honey-dew as readily as in consequence of being touched with the antennæ of an ant. This we deem to be quite fatal to M. Huber's conclusions.

(*Insect Miscellanies*, vol. iv., in the *Library of Entertaining Knowledge.*)

ANTENNULARIA, a genus of Sertularian Zoophytes. [SERTULARIADÆ.]

A'NTHEMIS is the genus of plants which includes the useful herb Chamomile. It belongs to the order *Compositæ*, and is distinguished by having the scales that surround its flower-heads membranous at the border, like those of a *Chrysanthemum*, from which genus it, in fact, differs chiefly in the receptacle of the flowers being furnished with little chaffy projections.

Anthemis nobilis, or Chamomile, is frequent in a wild state on many of the commons near London, where it adds a peculiar richness of colour and fragrance to the turf. It is a dwarf plant, with finely-cut leaves; its flower-heads are white in the ray, but deep yellow in the disk. All the parts are intensely bitter, but especially the little yellow flowers of the disk: for this reason the wild blossoms are far more efficacious than those of the cultivated sort, in which there is scarcely any disk, the flowers of the ray having almost entirely usurped their place. Besides the bitter principle for which Chamomile is so celebrated, it has been found by chemists to contain camphor and tannin, and also a volatile oil of a beautiful blue colour.

There is another wild plant, called *Anthemis Cotula*, or Mayweed, which must not be confounded with Chamomile, to which it bears great resemblance: it may be distinguished by its being an erect branching plant, with an exceedingly disagreeable and powerful odour.

Anthemis tinctoria is used in France by the dyers for the sake of a brilliant yellow tint, which is obtained from it.

ANTHER, in Botany, the upper part of the stamen which contains the pollen-cells, the function of which is to aid in the development of the embryo in the ovule. [STAMEN.]

ANTHERI'DIA, in Botany, organs found in many of the tribes of Cryptogamic or Flowerless Plants. They have been observed in the Characeæ, Horse-Tails, Ferns, Mosses, and Algæ, and are supposed to represent the anthers in Phanerogamic or Flowering Plants. In the cells of which they are composed certain moving filaments are observed, which have received the name of *Phytozoa* or *Spermatozoids*. Many of these phytozoa move by cilia attached to their surface. For the nature of their functions, development, and forms, see REPRODUCTION, VEGETABLE.

ANTHOLI'THES (Brongniart). Some Fossil Plants thus designated occur in the Coal-formations of Shropshire and Northumberland.

ANTHO'PHYLLUM (Schweigger), a Fossil genus of *Madrephylliœa*. [MADREPHYLLIŒA.]

ANTHO'SIDERITE, in Mineralogy, an impure silicate of iron.

ANTHOSPE'RMEÆ (from ἄνθος, flower, and σπέρμα, seed), a tribe of plants resembling *Anthospermum* (the Amber-Tree), belonging to the natural order *Cinchonaceæ*. It consists of the genera *Coprosma*, *Phyllis*, *Galopina*, *Ambraria*, and *Anthospermum*. They possess diœcious or hermaphrodite flowers; a rotate corolla; styles separating to the base, ending in an elongated hispid or plumose stigma; the fruit consists of 2 indehiscent 1-seeded mericarps, or nuts; the albumen of the seed is fleshy. The species are small herbs or shrubs, with opposite or verticillate leaves, and small 1-3-toothed stipules, which are adnate to both sides of the petioles.

None of the species are used in the arts or medicine; the tribe is however interesting as forming a link between the opposite-leaved *Cinchonaceæ* and the verticillate *Rubiaceæ*. Although most of the *Anthospermeæ* have opposite leaves, yet several species of *Anthospermum* itself, as *A. Bergiainum* and *A. Æthiopicum*, have their leaves subverticillate. In *Phyllis* the leaves occur in whorls of three or four. This genus has but a single species, known by the common name of Bastard Hare's-Ear. It may be cultivated, with other species of the tribe, in a mixture of loam, peat, and sand.

ANTHOXA'NTHUM, a genus of Grasses, one species of which (*A. odoratum*) is well known to farmers under the name of the Sweet Vernal Grass. It is a small annual plant, bearing its flowers in short heads, which are not very compact, and broader at the bottom than the top. The flowerets of which it is composed are a pale yellowish-green; each consists of two sharp-pointed smooth glumes, within which are two other dark-brown hairy paleæ, each having an awn at its back; the stamens are only two in number. This grass is of little importance for its nutritive qualities, but it is much esteemed for the sweet smell of its leaves, which causes much of the well-known fragrance of new-mown hay.

A'NTHRACITE, a black, light, mineral substance, resembling coal; so named from ἄνθραξ, charcoal. It is also called Blind-Coal, because it burns without flame; and Glance-Coal, from the German word *glanz* (lustre), because it has often a shining surface like graphite or blacklead, as it is improperly called, the substance of which pencils are made, and to which it is very closely allied in composition. In some systems of mineralogy it is divided into massive, slaty, and columnar anthracite; but these are mere accidental varieties of structure, and are all of the same chemical composition, when the

Sweet Vernal Grass (*Anthoxanthum odoratum*).
a, a flower-head magnified. *b*, a floweret more magnified.

pure anthracite is separated from the matrix, or from the foreign matter with which it is mechanically mixed. Its specific gravity is about 1400, water being 1000; it is slowly combustible, but without flame, and contains from 70 to 90 per cent. of carbon. Naphtha may be considered as one extremity of the mineral carbonaceous substances, and anthracite as the other; and from the highly-inflammable fluid naphtha we have numerous varieties of mineral tar, or petroleum, bitumen, asphaltum, cannel-coal, caking-coal, slaty-coal, &c., all diminishing in inflammability, until at last we come to the blind-coal, or anthracite. If asphaltum, or indurated mineral pitch, be subjected to distillation, at a certain stage of the process, when it has lost a part of the bitumen which it contains, it resembles caking Newcastle coal; continuing the distillation, it passes into a substance which is identical with anthracite, both in appearance and composition. The following is an analysis of Welsh anthracite :—

Carbon	92·56
Hydrogen	3·33
Oxygen and Nitrogen	2·53
Ash	1·58
	100·00

It is undoubtedly of vegetable origin in common with all coal. [COAL; COAL PLANTS.]

ANTHRACOTHE'RIUM (Cuvier), a Fossil genus of Pachyderm Mammals, of which many species occur in Tertiary deposits, especially in the Gypséous and Lignitic strata of Paris and Tuscany.

ANTHRI'SCUS, a genus of plants belonging to the natural order *Umbelliferæ* and the tribe *Scandicineæ*. It is known by possessing little or no calyx, with heart-shaped petals bent down at the point; a fruit narrowed below the short beak, and without any ridges. The beak has five ridges.

A. sylvestris, Wild Chervil, is known by its terminal stalked umbels, and its linear glabrous fruit with a short beak. It is a common weed in hedges and banks throughout Europe.

A. Cerefolium (*Scandix Cerefolium*), the Garden Chervil, is probably an escape from cultivation in England. It is common enough in waste places. [SCANDIX.]

A. vulgaris has the umbels lateral and stalked, and an ovate hispid point. The leaves are slightly hairy. It is common in the waste places of Great Britain. (Babington's *Manual of British Botany*.)

ANTHROPHYLLITE, a mineral, containing, according to an analysis by Gmelin :—

Silica	56
Protoxide of Iron	13
Magnesia	22
Protoxide of Manganese	4
Lime	2
Alumina	3

It occurs in crystalline masses with a fibrous columnar structure. The cleavage is parallel to the lateral planes of a rhombic prism and to both its diagonals. The colour varies from a brown to a yellowish-brown. It has a white streak and an uneven fracture. The specific gravity is from 3·0 to 3·3. The lustre is pearly, and inclining to metallic. It is translucent and transparent on the edges. It is found at Kongsberg and Modum in Norway, in the United States, and in other places.

ANTHRO'POLITES, the name given to Human Fossil Remains. Although at one time it was thought that human remains were often found fossilised, the investigations of modern anatomists have shown that in most of these cases the supposition has been false. Daubenton first demonstrated that some bones which had long been regarded in Paris as the remains of a gigantic human being belonged to a lower tribe of beings. The researches of Cuvier gave a clue by which all cases might be tested, and most of the earlier instances brought forward have been referred to their correct types.

Human fossil bones have, however, been discovered in the Belgian bone-caverns, with bears, rodents, &c., and are figured by Dr. Schmerling, in his interesting work on the bones found in a cavern near Liège.

Dr. Buckland ('Bridgewater Treatise') remarks that frequent discoveries have been made of human bones and rude works of art in natural caverns, sometimes inclosed in stalactite, at other times in beds of earthy materials, which are interspersed with bones of extinct species of quadrupeds. These cases, he thinks, may be explained by the common practice of mankind in all ages to bury their dead in such convenient repositories. "The accidental circumstance," continues Dr. Buckland, "that many caverns contained the bones of extinct species of other animals, dispersed through the same soil in which human bodies may, at any subsequent period, have been buried, affords no proof of the time when these remains of men were introduced. Many of the caverns have been inhabited by savage tribes, who, for convenience of occupation, have repeatedly disturbed portions of soil in which their predecessors may have been buried. Such disturbances will explain the occasional admixture of fragments of human skeletons and the bones of modern quadrupeds with those of extinct species introduced at more early periods and by natural causes. Several accounts have been published within the last few years of human remains discovered in the caverns of France and in the province of Liège, which are described as being of the same antiquity with the bones of hyænas and other extinct quadrupeds that accompany them. Most of these may probably admit of explanation by reference to the causes just enumerated. In the case of caverns which form the channels of subterranean rivers, or which are subject to occasional inundations, another cause of the admixture of human bones with the remains of animals of more ancient date may be found in the movements occasioned by running water."

The same learned author observes that the most remarkable and only recorded case of human skeletons imbedded in a solid limestone rock is that on the shore of Guadaloupe, adding that there is however no reason to consider these bones to be of high antiquity, as the rock in which they occur is of very recent formation, and is composed of agglutinated fragments of shells and corals which inhabit the adjacent water. Such kind of stone is frequently formed in a few years from sand-banks composed of similar materials, on the shores of tropical seas. ('Bridgewater Treatise,' vol. i.) One of these skeletons, described by Mr. König ('Phil. Trans.,' 1814) is in the British Museum. See further as to the rock in which the skeletons are imbedded, 'Linn. Trans.,' 1818, vol. xii.

Dr. Lund published, some years ago, the discovery of human remains with those of *Megatherium*, &c.; and he was of opinion that the former were of the same epoch as those of the latter. The cranium had the peculiar shape which distinguishes the ancient Peruvian. [*See* SUPPLEMENT.]

ANTHUS (Bechstein), the Pipit, a genus of birds separated by Dr. Bechstein from the Linnæan genus *Alauda*, a separation followed by Temminck, Cuvier, Lesson, and Selby, and justly; for though the Pipits have a long hind claw, and are usually coloured, like the larks, their bill is more slender, in consequence of which they never, like them, feed on grain. In the form of the head, in the movement of the tail, and their mode of life, they resemble the Wagtails (*Motacilla*) on the one hand, and on the other the Blue-Breast (*Sylvia Suecica*).

Adhering, then, to the distinction of Bechstein, we characterise the Pipits by the bill being straight, slender, somewhat awl-shaped towards the point, having the base of the upper mandible keeled, the tips lightly bent downwards, and notched. The nostrils, situated at the sides of the base of the bill, are oval, and partly concealed by a membrane: feet, with the shank (*tarsus*) generally exceeding the middle toe in length; toes, three before and one behind, and with the outer toe adhering to the middle one as far as the first joint; the hind claw rather long. The wings have the first quill very short; the third and fourth the longest in each wing.

A. pratensis, the Meadow-Pipit, known also by the names Titlark, Titling, Common Titlark, and Moss-Cheeper, is a common British bird, occurring on the coasts as well as the interior of the country, and frequenting wet meadows, moors, commons, and pasture-land. It usually builds its nest on a grassy bank or beside a tuft or turf. It is to this species that the young of the cuckoo are most frequently consigned.

A. arboreus, the Tree-Pipit, Meadow-Lark, or Short-Heeled Field-Lark, is a larger bird than the last. It is only a summer visitant in the British Islands, arriving at the end of April, and departing in September. Its song is superior to that of the last. It frequently perches on trees. It builds its nest on the ground.

A. obscurus, Dusky or Shore-Pipit, Rock-Pipit, Rock-Lark, Sea-Lark, Dusky Lark, is larger than the last species, has duller tints, and is entirely confined to the sea-shore.

A. Spinoletta, Red-Breasted Pipit, has been observed by Mr. Macgillivray in the neighbourhood of Edinburgh.

A. Richardi, Richard's Pipit, was first described as a British species by Mr. Vigors. (Macgillivray, *British Birds*.)

ANTIARIS is the botanical name of the half-fabulous Upas-Tree, of which so many idle stories were propagated some years since by travellers. It was said to be a large tree, growing in the island of Java, in the midst of a desert caused by its own pestiferous qualities; its exhalations were reported to be so unwholesome, that not only did they cause death to all animals which approached the tree, but even destroyed vegetation for a considerable distance round it; and, finally, the juice which flowed from its stem, when wounded, was said to be the most deadly of poisons. To approach the Upas-Tree, even for the momentary purpose of wounding its stem and carrying away the juice, was stated to be so dangerous, that none but criminals under sentence of death could be found to undertake the task. As is usual in such cases, this fable is founded upon certain natural phenomena which occur in Java. There is such a tree as the Upas, and its juice, if mixed with the blood in the body of any animal, is speedily fatal; and there is also a tract of land in the same island on which neither animal nor plant can exist. But the two circumstances have no relation to each other: the poisoned tract is a small valley completely surrounded by a steep embankment, like the crater of a volcano, and is continually emitting from its surface carbonic acid gas, which is alike fatal to animals and plants; on the other hand, the poisonous Upas-Tree is not an inhabitant of the valley, for nothing can live there, but it flourishes in the woods, in the midst of other trees which are unharmed by its vicinity.

The Upas is a species of the genus *Antiaris*, which belongs to the natural order *Artocarpeæ*, a group of plants all of which abound in a milky juice, and many of which are poisonous. (ARTOCARPEÆ.) *A. toxicaria* is the true Upas. It is not unlike *A. macrophylla*, which has been found on the north coast of Australia.

Antiaris macrophylla.

1, A head of male flowers in the involucrum; 2, the same divided perpendicularly; 3, a couple of the male flowers; 4, pistil; 5, the same divided perpendicularly; 6, a fruit.

ANTICLI'NAL, a term in Geology which expresses the fact that, from a given line, the strata dip in opposite directions.

ANTIGORITE, in Mineralogy, a silicate of lime and magnesia, a variety of Bronzite. [BRONZITE.]

ANTILOPEÆ, in Zoology, a family of Ruminating Mammals, belonging to the Hollow-Horned group, and distinguished by the following characters. The horns conical, bent back, cylindrical, or compressed, and ringed at the base. The knee (or wrist) in the middle of the fore-leg. The occipital plane of the skull forms an obtuse angle with the frontal plane. Core of the horns thin, consisting of dense bone, often with a clear sinus at the base within. Teats two or four. Feet-pits in hind-feet and generally also in the fore ones.

Perhaps the most general character belonging to the Antelopes consists in the form of the horns being round and annulated, or at least never exhibiting the prominent angles and ridges which distinguish those of the Sheep and Goats. In their particular forms and curvatures, however, they vary in almost every different species, as among domestic sheep they do even in different varieties of the same species. Sometimes they form a single bend forwards or backwards, sometimes they are what is commonly called lyrated, or bent first backwards and then point forwards, in such a manner as, when opposed to one another, to assume the figure of an ancient lyre, the brachia or sides of which instrument were frequently made of the horns of the *Dorcas* or Common Gazelle, as appears from the engravings of antique gems still preserved. In many of the smaller species the bony core, or process of the os frontis which is inserted into the hollow sheath of the horn itself, is almost solid, or at least the osseous substance of it is penetrated only by very minute pores.

The possession of 'lachrymal sinuses,' or as they are vernacularly called with reference to the stag and fallow-deer, 'tear-pits,' is another circumstance which distinguishes the greater number of the Antelopes, but which, like all their other characters, is far from being general. Many zoologists suppose these organs to communicate with the nostrils, so as to enable the animals to breathe freely during their long and rapid flights when pursued or frightened. Some even suppose them to be subservient to the sense of smell, and to serve for detecting the noxious qualities of the numerous poisonous plants which grow in the deserts, or spring up among the rank vegetation of tropical climates. It is certainly true that all these animals possess a most delicate sense of smell, and that no known quadrupeds can surpass, and very few equal them in the course. It has been supposed that these organs are used when the animal drinks. The anatomy of the parts demonstrates that no internal communication exists between the lachrymal sinus and the nose, or indeed any other organ. The sinus itself is simply composed of a sac or fold of the skin, of greater or less extent according to the species, but always capable of being opened or shut at the will of the animal, and furnished at the bottom with a gland which secretes an oily viscous substance of the colour and consistence of ear-wax, but which hardens and turns black upon exposure to the air. The precise function of these organs is uncertain; all that we know with certainty at present is, that many of the Antelopes which are most commonly brought to Europe and preserved in menageries, such as the common Indian Antelope and the Gazelle, make continual use of this organ when any strange substance is presented to their notice, particularly if it be odoriferous, and appear to derive great pleasure from protruding the lachrymal sinus and rubbing its interior surface against the odorous body.

It has been already hinted that the Antelopes are not the only ruminants which possess suborbital sinuses: in fact, these organs are more universally found in the deer kind than in the present family; but, on the other hand, as these are the only animals belonging to the hollow-horned family which exhibit this character, it thus becomes sufficiently appropriate, and, as far as it goes, serves readily to distinguish the Antelopes from the Goats and Sheep, with which they are most liable to be confounded. In this respect, as well as in the absence of horns in the females of many species, they form an intermediate link between the rest of the hollow-horned ruminants and the cervine or solid-horned family: so nearly indeed do some species of Antelopes approach to the deer kind in general, and so perfectly similar are they in all their most prominent and essential characters, the horns alone excepted, that it is often next to impossible to distinguish the hornless females of the one genus from those of the other.

Besides the suborbital sinus, a few species of Antelopes possess a different gland, which runs lengthwise between it and the mouth, in a direction for the most part parallel to the plane of the chaffron or face and nose, and secretes a dark oily substance; it is, however, entirely external, and has no internal opening like the lachrymal sinus, nor are its uses better known than those of that organ. The former fact, if it can be relied upon, proves at least that it is a separate organ, and not a mere modification of the lachrymal sinus; and, consequently, it may be fairly presumed that its function, whatever it may be, is likewise different. Another character, but much more generally found to distinguish the Antelopes than even the suborbital sinus itself, is derived from the inguinal pores, which are sacs or deep folds of the skin, situated in the groin, opening inwards, and secreting a glutinous substance similar to that of the glands already mentioned.

In the form of the upper lip, an important character among animals which seek their food on the ground, and in which the lips and tongue constitute the only organs of touch and prehension, the Antelopes are as variable and inconstant as in the other characters already described. In some species it forms a broad naked muzzle, as in the ox; in others it is hairy and attenuated, like that of the goat; and finally, it sometimes assumes an intermediate form, and presents a modification of both these characters. The females are furnished with either two or four teats, forming a small udder; they usually bring forth but one at a birth, in a few instances two, and the period of gestation differs from five to eight months according to the species.

The hair of the Antelopes is generally short and smooth, and of an equal length over every part of the body; some however have manes along the neck and on the shoulders, composed of long bristly hair, either growing upright or reversed towards the head as in the Oryx; and a very few species, like the Gnu, are furnished with a beard on the chin and throat. The ears are commonly long, narrow, and pointed, smooth on the outside, and filled internally with long white hair growing in five longitudinal lines, with four naked black spaces between, and forming the appearance which, in describing these animals, is usually denominated *striated*. The tails are generally short, round, and tufted at the extremity, and many species are furnished with little tufts of long black hair, called *scopæ*, or knee-brushes, upon the upper part of the anterior canons, immediately below the carpal joint.

Generally speaking, the Antelopes are gregarious, and unite in large herds, either permanently or at particular seasons of the year, but only for the purpose of migrating in search of more abundant and grateful pasturage; some species, however, reside in pairs or small families, consisting of an old male and one or more females, with the young of the two foregoing seasons. They are always extremely cautious in guarding against surprise, placing sentinels in various directions about their feeding ground, to warn them of the approach of danger whilst grazing or reposing; and their vision and sense of smell are so acute, that it is only by using the greatest caution and circumspection that the hunter can bring them within range of the gun. The names by which the animals themselves are distinguished in all languages, ancient as well as modern, have a direct reference to this quickness of sight, and to the brilliancy of the large black eyes which form so conspicuous a feature in the Antelopes. Thus the word *Dorcas* (δορκάς), the Greek and Roman name of the Gazelle, or common Barbary Antelope, is derived from the verb δέρκομαι, 'to see.' The common English word Antelope, which zoologists have adopted as the generic name of the group, is a corrupt form of the term ἄνθολοψ, employed by Eustathius to designate an animal of this genus, and literally signifying 'bright eyes;' and, according to the learned Bochart, *Tabitha*, the name of the disciple raised to life at Joppa, is derived from *Tzebi*, the Hebrew name of the common Gazelle, and alludes likewise to the beauty of her eyes. Among the Greeks and Romans also, as we learn from Agathias, and others, *Dorcas, Dorcalis*, and *Damalis*, all names of different Antelopes, were common names of women likewise, bestowed without doubt on account of the remarkable beauty of their eyes; and Prosper Alpinus, and more recent travellers, inform us that *Aine el Czazel*, 'You have the eyes of an antelope,' is the greatest compliment which at the present day an oriental admirer can pay to his mistress.

The Bushmen of the Cape often destroy vast numbers of the antelopes with which their country abounds, by poisoning the springs and reservoirs to which they are known to resort, nor is the flesh ever known to be injured by this mode of slaughter; they also shoot them with poisoned arrows, but in this case the parts immediately around the wound must be cut out before the rest of the body imbibes the poison, which would otherwise penetrate it, and render it unfit for food.

Africa may be considered as the head-quarters of the Antelopes. Australia and Madagascar are, as far as we at present know, completely destitute of Antelopes, as indeed they appear to be of all indigenous ruminants. The precise nature of the habitat frequented by these animals has nothing of a uniform character, but, as might naturally be expected from the different modifications of organic structure observable throughout the genus, differs according to the particular species. Some frequent the dry sandy deserts, and feed upon the stunted acacias and bulbous plants which spring up even in the most arid situations, where the stony nature of the ground gives a certain degree of adherence to the soil; some prefer the open stony plains, the steppes of Central Asia and karroos of Southern Africa, where the grass, though parched, is still sufficient for their subsistence; some again inhabit the steep rocky mountains, and leap from cliff to cliff with the ease and security of a wild goat, whilst others are found only in the thick and almost impenetrable forests of tropical countries.

Although what are popularly called Antelopes were at one time all referred to the genus *Antilope*, their number has so greatly increased as to render it necessary to distribute the various species under different genera. As by far the most extensive and available collection of these animals for the British student is contained in the British Museum, we shall follow in this article the arrangement given of these animals by Dr. J. E. Gray in the 'Catalogue of the Specimens of Mammalia' in that collection, published in 1852.

The family *Antilopeæ* is divided into two great divisions, the *Antelopes of the Fields*, and the *Antelopes of the Desert*. These divisions are recognised by a peculiarity of the nostrils, easily perceived. In the Antelopes of the Fields the nostrils are bald or free from hairs, whilst in the Antelopes of the Desert these organs are bearded within or covered with bristles. There are other distinctions, but these are the most obvious, and readily recognised.

ANTELOPES OF THE FIELDS.

These are again divided into three groups:—

1. *The True Antelopes*, which have a light elegant body; slender

limbs; small hoofs; a short or moderate tail, covered with elongated hairs at the base; lyrate or conical horns, placed over the eyebrows.

2. *The Cervine Antelopes* approaching the deer in character. They have rather a heavy large body; strong slender limbs; a long tail, cylindrical at the base, with the hair longer at the end, often forming a compressed ridge. The muffle is like that of the Cervine Ruminants.

3. *The Goat-like Antelopes*, which have a heavy body; strong legs; large hoofs and false hoofs; very short tail, flat and hairy above; recurved conical horns.

1. *True Antelopes.*

Saiga.

The horns are short, strong, lyrate, annulated, and of a white colour; the nose is compressed, very high, rounded, the nostrils very close together; the crumen distinct; the fur soft; the skull has the nose-opening very large, and extended back over the eyes.

1. *Saiga Tartarica* (*Antilope Colus*, H. Smith), the Saiga and Colus, is the only species of True Antelope which inhabits any part of Europe. The size of the Saiga is about equal to that of the fallow deer, the length being four feet; but the form of the body more nearly resembles that of the sheep, being round and heavy, with a large head and short slender limbs, and the whole proportions of the animal want the usual grace and elegance which commonly characterise the antelope tribes. The nose is large, swollen, and cartilaginous, like that of the elk; it is marked above by deep transverse furrows or wrinkles, and, from its great size and protuberance, compels the animal to go backwards whilst feeding. The nostrils are large and open; the ears of a moderate size; the tail from three to four inches in length; and the lachrymal sinuses much smaller than in the Indian Antelope. The hair is uniformly long and flowing over the whole body, of a grayish yellow colour in summer, and grayish white in winter on the upper parts, and white beneath at all seasons; the knees are furnished with small brushes. The horns of the male are longer than the head, they are semi-transparent and of a light yellow colour, which causes them to be much sought after by the Russians and Chinese for the purpose of making combs, lanterns, and other articles of domestic economy; their form is intermediate between that of the spiral-horned and lyrated groups, being distinctly twisted upon their axis, though without exhibiting the complete spiral threads which characterise the horns of the Indian Antelope.

The Saiga is mentioned by Strabo (vii., 312. ed. Casaub.) under the name of *colus* (κόλος). The Polish name of the animal, *Sulak*, appears to bear some resemblance to the name in Strabo. The Tartars call it *Akkak* and the Turks *Akim*, which come so near to the Hebrew word *Akko*, translated 'wild goat' in our English version of the Scriptures, that we cannot help suspecting that the sacred writers alluded to this animal. In autumn the Saigas unite into large flocks, composed sometimes of many thousand individuals, and migrate southward in search of a milder climate and more abundant pasturage; they return northward in small families about the commencement or middle of spring, and generally keep about the vicinity of lakes and rivers, as they drink a great deal, and, as we are credibly assured, by sucking the water through their large open nostrils. This last fact is also stated by Strabo. They like to feed upon acrid, saline, and aromatic plants, and grow very fat during the summer season; but their flesh acquires a disagreeable taste from the nature of their food, and must be allowed to cool after cooking before it is fit to be eaten. The females are gravid about six months, from the end of November to the end of May; they drop their kids soon after they return northward in the spring, and commonly produce one, rarely two, at a birth. They inhabit the open steppes and deserts from the Danube to the Irtish eastward, and as far north as 54° of N. latitude; and are found in Poland, Moldavia, about the Caucasus, and the Caspian Sea, in Siberia, and in Northern Persia. Their eye-sight is said to be defective from the reflection of the dry arid plains upon which they mostly reside; and, though amazingly swift for a short distance, they are soon exhausted, and easily run down. They are hunted principally for the sake of their horns and skins, the latter of which, particularly those of the kids, are much valued for the manufacture of gloves. The hunters must always take care to approach them against the wind, as their sense of smell is remarkably acute. With all these precautions it is often impossible to get within shot of these animals, as, like many other gregarious species of antelope, they take care, whilst feeding or reposing, to place sentinels in different directions round their encampment to warn them of the approach of danger.

Pantholops.

The horns are elongate, lyrate; the nose (of the males?) has a dilated pouch on each side; the crumen is distinct; the hair close, erect, and spreading; the nose-opening in the skull is large.

2. *Pantholops Hodgsonii* (*Antilope Hodgsoni*, Abel), the Chiru, is believed to be the Unicorn of the Bhotias, and supposed by Colonel Smith to be the animal which Ælian describes under the name of *Kemas*, (see also Homer, 'Iliad,' x. 361.) an opinion founded upon very slight and not easily tenable grounds. The whole length of this animal, from the muzzle to the root of the tail, is about 5 feet, its height 3 feet; the tail is 8 inches long; the head, from the nose to the root of the horns, 9 inches; the ears 4 inches, and the horns measured along the curves, upwards of 2 feet. The horns grow upright from the skull, are strongly compressed on the sides, bent slightly backwards at first, and afterwards point gradually forwards, thus assuming a lyrate form, but less stongly marked than in the common gazelle; they are surrounded, to within 6 inches of the points, with from 15 to 20 annuli, forming prominent knobs in front, but more obscure on the sides and rear; the last 6 inches are smooth and round, and the points rather attenuated. The legs are long and slender; but the symmetry of the head is destroyed by two large fleshy tumours about half the size of a hen's egg, which grow close to the outer margins of the nostrils, as well as by a profusion of bristly hair which surrounds the mouth and nose. The body is furnished with two different kinds of hair, a long external coat of the usual quality, and a short interior one of fine close wool. The prevalent colour of the latter is uniform grayish blue, and the outer coat is likewise of the same colour at the base, but it is tipped with reddish fawn, and thus gives the whole of the upper parts a tawny hue, through which the lower tinge is but faintly visible. The belly and interior of the limbs are white, the nose and face black, and a dark brown band passes down the front of each leg.

The Chiru, according to the information obtained by Mr. Hodgson, inhabits the elevated plains of Tibet, but never approaches the mountains, and is altogether unknown on the Indian side of the great Himalayan chain. It is gregarious, residing in herds of many hundreds on the open plains, extremely shy and difficult to approach, posting sentinels in all directions where the herd feeds or reposes, and flying with astonishing velocity on the first alarm or intimation of danger. When brought to bay, however, the males defend themselves with courage, and in confinement are sometimes mischievous, and should be always approached with a considerable degree of caution. They are very jealous and pugnacious, and in their contests often break off one of their long horns—hence the belief in their being Unicorns. Like most other Ruminants, they are extremely fond of salt, and during the summer months unite in large herds to visit the beds of this mineral, which abound throughout Tibet, advancing under the guidance of an experienced leader, and as usual posting sentinels to prevent surprise.

Procapra.

The horns are lyrate, strong, and black; the tail is tapering; the nose simple, as in the sheep; the muffle and crumen absent; the feet with small feet-pits; the post-corneal sinus large; no inguinal pores; the hair elongated, especially above the head and neck; the knees not tufted; the females are hornless; the teats two; the male has rather a large nose-hole; no suborbital pits, but very large slits; the intermaxillary bones short.

3. *Procapra gutturosa* (*Antilope gutturosa*, Pallas), the Dzeren, the Hoang Yang, Whang Yang, or Yellow Goat of the Chinese, is nearly 4½ feet in length, and 2 feet 6 inches high at the shoulder; the body also is large and corpulent, and the legs shorter than is common to the Antelopes in general; the horns are black, lyrated, and marked to within a short distance of their points with prominent transverse rings; the suborbital sinuses are small; the larynx large and salient, forming, particularly in the old bucks, a prominent lump on the throat; upon the prepuce of the same sex there is likewise situated a bag about the size of a hen's egg, which contains a waxy substance similar to that produced in the analogous organ of the musk animal, but without any kind of odour; the tail is short, and the knees furnished with small bunches of hair, but scarcely sufficiently long and distinct to merit the name of brushes; the summer coat is of a grayish fawn-colour above, and white beneath; that of winter almost entirely white, being tinged but slightly with a grayish yellow shade on the back and sides. The females resemble the males in colour, but are rather of smaller size, and without horns; they want the sac on the abdomen, and have two teats.

The Dzerens inhabit the dry arid deserts of Central Asia, Tibet, China, and Southern Siberia, particularly the great desert of Gobi; and prefer the most sandy and stony plains, feeding upon such scanty herbage as these localities supply, and avoiding water, to which they appear to entertain a marked aversion. They are remarkably swift, take prodigious leaps, and when frightened will occasionally pass over 20 or 25 feet at a single bound. In spring and summer they form small families which live apart from one another, but in the beginning of winter they unite into large flocks, always under the guidance of an experienced old buck. They never run, even when pursued, in a confused crowd, but form single files, and follow closely in the footsteps of their leader. They rarely emit any voice. When taken they are easily tamed, and appear to have rather a predilection for the domestic state, often mixing with flocks of sheep, and approaching human habitations during the severity of the winter season. Their flesh is tender and well tasted, and they are a favourite object of chase with the Moguls and Tartars. The gestation of the females continues from December till the middle of June, and they produce but a single kid at a birth, which grows slowly, and is long in arriving at maturity. During the first year the young males have neither horns nor any appearance of the protuberance on the throat from which the specific name of *gutturosa* is derived; but these organs are gradually more and more developed in proportion as the animal advances in age, till at last, in very old animals, the laryngal protuberance attains the dimensions of 5 inches in length by 3 inches in breadth, and assumes the appearance of a large and deformed goitre. The females differ from the males by the absence of this protuberance as well as by the want of horns. Gmelin denies the antipathy to water which Messerschmid attributes to this species, and affirms that when pursued the Dzerens do not hesitate to throw themselves into the first river they meet with, and that they swim remarkably well. The physical nature of the arid sandy plains which they frequent, in preference to all other situations, may probably have given rise to this presumed antipathy to an element which they seldom encounter, as well as to the marked antipathy to woody localities likewise attributed to them, trees and rivers being equally unknown in the indigenous habitats of these animals.

4. ***Procapra picticauda***, the Ragoa, or Goa, is an animal described by Mr. Hodgson as an inhabitant of Tibet. It has brown hair with rufous tips; the inside of the ears and limbs white; and tail black. It is perhaps the last species in its summer coat.

Gazella.

The horns black, strong, lyrate; the face conical, tapering; the nose is simple; the females have smaller horns; the fur is short, close-pressed; the skull has a suborbital fissure, and a moderate or very slight fossa suddenly pressed in before the orbit.

5. ***Gazella Dorcas*** (*Antilope Dorcas*, Pallas), the Gazelle, the Algazel, the Corinne, is 3 feet 6 inches in length, 1 foot 9½ inches high at the shoulder, and 1 foot 10½ inches at the croup; the head is 6 inches long, the horns 9½, the ears 4⅜, and the tail, with its terminating tuft, 8 inches. The horns of the old male are surrounded by 13 or 14 prominent rings, complete and close together at the base, more distant, oblique, and interrupted behind, towards the points, the last inch or inch and a half alone being smooth and free from annuli; they rise almost immediately above the orbits, are black, almost cylindrical, at first bent gently backwards, and finally forwards; in the females they are much smaller, seldom exceeding the ears in length, surrounded at the base with a few obscure wrinkles, smooth and polished throughout the rest of their extent, straight to near the tips, and pointing inwards. This is the character of the *Corinne* of Buffon, which is now considered by the best zoologists to be nothing more than the female of this species, and not itself a distinct species, as was formerly supposed. The ears of the Gazelle are long, narrow,

Group of Gazelles.

The Gazelle (*Gazella Dorcas*).

and pointed; the eyes large, mild, and black; and the tail round, furnished on its upper surface only with an upright ridge of stiff black hair, and terminated by a little tuft of the same colour; the size of the body is about equal to that of the roebuck, but the legs are considerably longer, and the whole form lighter and more elegant; the face and cheeks are reddish fawn-colour, and the nose has a broad mark of a dark-brown colour, approaching to black; on each side of the face, passing over the eyes from the horns down to the nose, there is a broad white stripe, and beneath this, from the anterior canthus of the eye, a narrower dark stripe, parallel to it and separating it from the fawn-colour of the cheeks; the hind part of the head, the back of the ears, neck, shoulders, back, sides, and croup, are fulvous, of different shades according to the age of the individual; all the under parts are white, and this colour is separated from the fulvous of the sides by a broad dark-brown longitudinal band on the flanks; the knees are furnished with brushes of dark hair, and the ears are filled internally with long white hair arranged in three longitudinal striæ.

The Gazelle is found in Egypt, Barbary, and some say also in Asia Minor; but it is very questionable whether the animal of the Levant does not really belong to a different species. It lives in large troops upon the borders of the Tell, or cultivated country, and the Sahara, or desert. When pursued it flies to some distance, then stops to gaze a moment at the hunters, and again renews its flight. The flock, when attacked collectively, disperse in all directions, but soon unite; and when brought to bay defend themselves with courage and obstinacy, uniting in a close circle, with the females and fawns in the centre, and presenting their horns at all points to their enemies; yet, notwithstanding their courage, they are the common prey of the lion and panther, and are hunted with great perseverance by the Arabs and Beduins of the desert. When taken young, they are easily domesticated, and soon become familiar. This animal is frequently cut upon the monuments of Egypt and Nubia.

The Kevel of Buffon, the Flat-Horned Antelope of Pennant, the *Antilope Kevella* of Pallas, have been described from young specimens of this species. The Ariel (*Antilope Arabica*, Hemprich, *A. Cuvieri* of Ogilby, and *A. leptoceros* of F. Cuvier), seems to be a variety only.

Ariel Gazelle (*Antilope Arabica*).

6. *G. Isabella*, the Isabella Gazelle, has been separated by Dr. J. E. Gray rom the last species. He remarks that it may be easily known

from the foregoing by the softness and fineness of the skin, and the lower side-streak being of the same colour as the back, and by having no dark edge to the anal disk. It is a native of Egypt and Kordofan.

7. *G. subgutturosa* (*Antilope subgutturosa*, Guldenstädt), the Ahu and Jairou, is of a pale brown colour, the upper part of the sides with a broad rather paler streak, the face-streak indistinct; the lower part of the sides, belly, hinder side of fore and front side of hinder limbs, and anal disk, white; the streak on the haunches dark brown; the end of the tail black. It inhabits all the central parts of Asia, Persia, Daüria, the country around Lake Baïkal, and from the eastern limits of Great Bucharia to the shores of the Hellespont. It associates with its own species in extensive flocks, frequents the open uncovered plains and naked hills of moderate elevation, and feeds principally upon the *Absinthium Ponticum*. The flesh is much esteemed, and of an agreeable taste.

8. *G. Sœmmeringii* (*Antilope Sœmmeringii*, Cretzschmar), the Abyssinian Mohr discovered by Cretzschmar in Abyssinia, is

The Abyssinian Mohr (*G. Sœmmeringii*).

considerably larger than the species of *Gazella* hitherto described. The horns are irregularly lyrated, bending boldly outwards towards the points, and then suddenly turning inwards towards one another, with a very sharp and well-defined curve; annulated with 15 or 16 prominent and complete rings, which reach from the base to the inward curvature within about 2¼ inches of the points. The colour of all the upper parts of the body, the neck, shoulders, back, croup, sides and outward faces of the fore arms and thighs, is a beautiful clear isabel or yellowish-dun, the hair being extremely short, and appearing almost as if it had been clipped or shorn. It does not lie close and smooth upon the hide, nor does it all follow the same direction, as in the generality of animals, but is disposed in innumerable small waves, pointing in different directions as if it had been regularly shaded and parted on each side, and appearing glossy or glazed along their ridges with a shining dun shade, more or less intense according to the light in which it is observed. All the under parts of the body are of the most pure and brilliant white, and a large disk of the same colour surrounds the tail, and passes over the rump and croup. The white of the belly also is separated from the yellowish dun of the sides, immediately, without being shaded off. The tail is small and slender, nearly naked at the root, and furnished at the extremity with a tuft of mixed brown and gray hairs. The outsides of the legs are very pale fawn-colour, the insides white, and the knee-brushes white and fawn mixed. The ears are pretty long and brown, with a narrow black border surrounding their outer edge. The face is dark brown in some specimens, and pure black in others, uniform towards the end of the nose, but curiously mixed with wavy red on the forehead; on each side of this a broad white band passes from the root of the horns over the eyes to the nose, and there is an indication of a small black one from the anterior angle of the eye to the corner of the mouth, separating this white band from the cheeks and sides of the lower jaw, which are uniform fawn-colour. The horns of the female have nearly the same curvature as those of the male, and are fully as long, but they are much more slender, and have not such prominent annuli. This is the only external difference observable between the sexes. This antelope frequents hills of moderate ascent and elevation in the eastern provinces of Abyssinia, and is said to live in pairs, and not to unite into large flocks like the Gazelle and Kevel.

9. *G. Mohr* (*Antilope Mhorr*, Bennett), the Mohr or Mhorr, is 4 feet 2 inches long from the nose to the origin of the tail, 2 feet 6 inches high at the shoulder, and 2 feet 8 inches at the croup; the length of the head from the nose to the root of the horn is 7 inches; that of the horn 9½ inches on the curve, and 7½ in a straight line; and that of the tail 7 inches without the terminal tuft. The hair of the body is sleek and of moderate length; on the head and face it is very short and close, except about the root of the horns, where it is slightly tufted; the hair of the limbs is also short, except the tufts below the knees, which are long, and consist of a mixture of dark brown and grey hairs. The horns are thick at the base, and annulated with 11

The Mohr (*G. Mohr*).

or 12 prominent and complete rings, which occupy about two-thirds of their entire length; they are round, smooth, and attenuated towards the tips, which point directly forwards, and are but moderately sharp. The ears are narrow, erect, and pointed; the eyes large, dark, and lively; and the tail long, naked at the base, and furnished at the extremity with a tuft of long black hair. The colour of all the upper parts of the body, of the neck, back, shoulders, sides, fore-arms and thighs, as well as of the whole throat except a square spot on the larynx, is a deep brownish-red; and a narrow stripe of the same colour is continued down the outer face of the legs, both anterior and posterior, from the shoulders and thighs respectively to the hoofs and pasterns: the belly, buttocks, posterior face of the thighs and inner face of the extremities are pure white, as well as the spot on the larynx above referred to; and this colour, after spreading round the entire region of the tail, is continued forwards on the hip in a pointed stripe on each side, about half way between the croup and the knee-joint, and reaching nearly over the whole hip. It contrasts strongly with the surrounding colour, and has a very singular effect. There is no dark band on the flanks, the light colours of the under parts being abruptly separated from the darker shade above without any blending or intermediate colour. The head and cheeks are light fawn-colour, intermixed, in front of the horns, with dark brown and gray hairs, and marked below the opening of the suborbital sinuses with a small dark spot, representing the black band which passes in some other species of the last division from the anterior canthus of the eye to the corner of the mouth: the whole line of the nose and chaffron are likewise dark brown, mixed with gray in old specimens, and the back of the ears is fawn-coloured, tipped with black.

It is a native of Western Africa. The species is not found in the empire of Marocco, but individuals are occasionally brought from the opposite confines of the desert; the animal is much sought after by the Arabs on account of producing the bezoar-stones so highly valued in eastern medicine. These stones are commonly called in Marocco, Baid-el-Mhorr, or Mhorr's Eggs.

The Nanguer (*Antilope dama*, Pallas) was originally described and figured by Buffon from materials brought by Adanson from Senegal; since that time the animal has not been seen by any naturalist, and as the description of Buffon is imperfect, doubt may be entertained whether it be not in reality the young of the Mohr.

10. *G. ruficollis* (*Antilope ruficollis*, H. Smith), the Andra, is a beautiful species of Eastern Africa, discovered on the barren wastes of Nubia by Rüppel, and in Senaar and Dongola by Hemprich and Ehrenberg. The whole length of this species is 5 feet 4 inches, its height at the shoulder 3 feet; the length of the head is 8 inches, that of the horns 12½ inches, and that of the tail 9 inches. The horns are precisely similar to those of the Mohr already described, as are likewise the general form and proportions of the body. This species is gregarious, and resides in flocks on the desert between Nubia, Dongola, and Kordofan.

11. *G. rufifrons*, the Korin, is of a bay-brown colour, the sides above

paler, with a broad dark streak below; the chest, belly, inside of the legs, back edge of tarsus, and underside of feet and anal-disk, white; the face bright bay, with a broad white side-streak. Dr. Gray says, "The Kevel figured by M. F. Cuvier well represents this species. The Corine of the same author, also from Senegal, well represents the young animal." The Corine and Kevel of Buffon belong to *G. Dorcas*.

Tragops

Has short, black, lyrate horns; a tapering face; ovine nose; no muffle or crumen; the fur short, pressed down; the sides without any dark streak; the knees tufted; the feet with large feet-pits; the inguinal pits distinct. The female has slender horns and two teats.

12. *Tragops Bennettii* (*Antilope quadricornis*, Blainville), the Chikara, Ravine-Deer, Goat Antelope, Kalsiepie, or Black-Tail, is of a bay-brown colour, and has the end of the nose and tail black; the face streaked; chest, belly, and inside of limbs, white; the feet are black or brown.

The Kalsiepie, or Black-Tail, so called by the Mahrattas on account of the deep black colour of the tail, and distinguished by the name of the Goat Antelope by the Europeans, is found on the rocky hills of the Deccan, and, according to the report of Colonel Sykes, differs from many other antelopes in not being gregarious, there being rarely more than three or four found together in the same company, and not unfrequently a solitary individual.

Antidorcas

Has lyrate, short, black horns; a tapering face; a simple nose; the crumen moderate, distinct. On the back it has an extensive white fold or streak; the hair is pressed close; the knees are not tufted. The female has small horns, but the number of its teats are not known.

13. *A. Euchore* (*Antilope Euchore*, Forster), the Tsebe, or Spring-Boc, Prong-Boc, or Showy Goat, is perhaps the most graceful in its proportions, and beautifully varied in its colours, of all the antelope tribe. Imagination cannot conceive a quadruped more light and airy in form, more delicate in its proportions, or whose movements are executed with more natural ease and grace, than the Spring-Boc, or, as the English colonists now universally denominate it, Spring-Buck. In point of size it is nearly a third larger than the Dorcas. The horns of the Spring-Buck are rather irregularly lyrated, like those of the species last described; they are round, black, annulated very regularly till within a short distance of the points, spreading first backwards and widely outwards, and finally turning inwards, and with an almost imperceptible twist on their own axis backwards. The hair is long on the upper parts of the body, particularly on the back and croup, but smooth, sleek, and shining: it is of a beautiful light cinnamon-colour on the shoulders, neck, back, sides, and thighs; and of a pure snowy white on the breast, belly, and inner sides of the limbs, these two colours being separated on the flanks by a broad longitudinal band of a deep vinous-red colour, larger and more distinct than in any other species of Antelope. The whole head, face, cheeks, and chin are white, with a broad brown band on each side from the eyes to the corners of the mouth, and a mark of the same colour on the centre of the face, commencing in a narrow point on the muzzle, and enlarging as it proceeds upwards till it joins the reddish fawn-colour of the body on the crown of the head. The eyes are large, lively, and of a brown colour; the ears long, small, and cylindrical at the root, then widening in the middle, and ending in an attenuated point. The neck is long, slender, and slightly compressed on the sides; the hoofs are small, black, and triangular; the legs remarkably long and slender; and the tail small, round, and naked, except a ridge of stiff black hair which fringes it along the upper surface, and forms a small tuft at the extremity. But the most remarkable and distinctive character of this species consists in two longitudinal foldings or duplications of the skin on the croup, which commence above the loins, or about the middle of the back, and run in a straight line from thence to the tail. The interior of these folds is lined with long hair of 9 or 10 inches in length, and of the most brilliant and snowy whiteness; they are likewise under the complete command of the animal's volition, and are opened and shut at pleasure. When closed, which they always are when the animal is at rest, their lips form a narrow line along the top of the loins and croup, which, being covered by the long cinnamon-red hair of the back and hips, is scarcely distinguishable, or only as a narrow white streak; but when the animal leaps or runs, these folds are expanded, and form a broad circular mark of the purest white, which extends over the whole croup and hips, and produces a most remarkable and pleasing effect.

The Spring-Buck is so called from its remarkable habit of jumping almost perpendicularly upwards, apparently without any other motive than for its own amusement. It resides, in almost innumerable flocks, on the dry arid plains and karroos of the interior of South Africa, seldom approaching the inhabited districts of the colony, unless in seasons of peculiar drought, when the pools and pastures of the interior are dried and burnt up by the excessive heat, and these animals are compelled to migrate in search of a more abundant supply. On these occasions they are said to unite into flocks which often consist of from 10,000 to 50,000 individuals, spreading over the face of the whole country like a swarm of locusts, devouring every vegetable substance that they meet with, and scarcely deviating from their direct path to avoid the men and dogs which endeavour to turn them into another direction. These vast flocks, according to Mr. R. G. Cumming, will continue streaming along in an unbroken compact phalanx for two or more hours. This migration is called at the Cape a *Trak Bokken*. So great are their numbers in these migrations that those which happen to get into the rear of the troop are lean and half-starved before the migration is concluded, from the advanced ranks cropping the scanty pastures almost bare, and thus leaving them nearly destitute of food; but when the journey is concluded, and the troop begins to retrace its steps northward, those which formed the van during the advance are necessarily in the rear returning, soon lose their plump condition, and are in their turn subjected to want and starvation. During these migrations they are closely followed by lions, panthers, hyænas, and wild dogs, which destroy great numbers of them. There is perhaps no object in nature finer than a flock of these beautiful antelopes enlivening the dreary brown karroos of South Africa with their graceful motions; now leaping perpendicularly upwards to the height of six or seven feet, displaying at the same time the snowy-white marks on their croups, and anon flying over the desert with the speed of a whirlwind. It is only when disturbed or otherwise excited that they make those extraordinary springs from which they have derived their name; nor do they ever display the white mark on their rump except on these occasions. They are said to be particularly affected by the change of the weather, and are observed to leap more than usual before the setting in of the south wind, which, at the Cape of Good Hope, generally betokens stormy weather, and is always violent and tempestuous. When taken young, the Spring-Buck is easily tamed, and soon displays all the petulance and familiarity of the Common Goat, butting at every stranger that approaches it, and warding off stones or other objects thrown at it with its horns.

Æpyceros

Has black lyrate horns, elongate, wide-spreading, curved outwards from the base, then backwards and upwards at the tip; the face tapering; the nose simple; no tear-bag; the knees not tufted; the feet with a tuft of black hair near the pasterns; the female has two teats.

14. *Æ. melampus* (*Antilope melampus*, Lichtenstein), the Pallah, or Rooye-Buck, the Betjuan of the Kaffirs, is a magnificent species of South Africa, discovered by Professor Lichtenstein during his travels in Kaffraria, and since found in the Betchuana country on the elevated plains of Latakoo, by Trutell, Somerville, and Burchell. It is upwards of 4½ feet in length from the nose to the origin of the tail, and 3 feet high at the shoulder; the horns have an irregular lyrate tendency, bending first forwards and very much outwards, then with a large circular sweep inwards, and finally pointing forward again, approaching within three inches of one another at the tips, after being nearly a foot distant in the middle: they are about 20 inches long in adult animals, and surrounded for two-thirds of their length with irregular rings, often splitting into two, and forming prominent knobs on the front of the horn, but frequently obliterated, and always less strongly marked on the sides, which are slightly compressed. In the beautiful drawing of this animal given in Daniel's 'African Scenery,' the horns are represented with an unnatural angular bend, which has misled many describers, and caused even Colonel Smith to describe them as forming an obtuse angular bend, though he has himself given an accurate drawing of the pair which we have here described, and

The Pallah (*Æ. melampus*).

which certainly exhibit no appearance of the sudden angle attributed to them; which probably arose from the particular position in which Mr. Daniel's figure was drawn. The horns for a third of their length towards the points are black, smooth, and polished. The head, back, flanks, and outer surface of the legs and tail are of a deep rufous colour; the lips, eye-brows, interior of the ears, breast, belly, interior of the thighs and arms, and the region below the tail, white; the back is marked longitudinally by a band of deep shining black, which divides on the croup, and passes down along each hip in the form of a crescent, separating the pure white of the buttocks and interior of the thighs from the general rufous colour of the upper parts; the outside of the knee and heel are likewise marked by brilliant black spots, which contrast strongly with the general rust-colour of the extremities, and from which the animal derives its specific name of *melampus*. The ears are very long, particularly in the females, which are without horns, and of a smaller size than the males, but similar in other respects; the ears are covered on the outside with short red hair, bordered and tipped with black, and the knees are without brushes. We are as yet very imperfectly acquainted with the characters of this magnificent species of antelope, so that it is not without considerable doubt, and only on the authority of Colonel Smith, that we venture to include it in the present group.

The Pallah inhabits Kaffraria and the country of the Bachapins or Betchuanas, never descending farther south than the Koosges valley in the one direction and the Kamhanni Mountains in the other. They reside on the open plains in families of six or eight individuals, run with amazing swiftness, and occasionally leap like the Spring-Buck, which, according to Mr. Burchell, they much resemble in their general habits and manners. They are extremely numerous on the elevated plains in the neighbourhood of Latakoo, and constitute a favourite object of the chase with the natives, as their flesh, though deficient in fat, is well-tasted and wholesome. *Pallah* or *Phaala* is the Bachapin name of the animal; but the mixed Hottentots, who travel into that country from the Cape, distinguish it by the Dutch term *Rooye-Boc* or Red-Buck, on account of the prevailing colour of its hair.

Antilope

Has elongate, subspiral, erect, diverging horns; a tapering face; a simple nose; a large crumen; the male with a small suborbital fissure, and a very large suborbital pit; the tubercles and median grooves of the basi-occipital bone well developed.

15. *A. Bezoartica* (*A. cervicapra*, Pallas), the Sasin, or Common Antelope, is remarkable for the form and beauty of its horns, which compose a spiral of two or more turns, according to the age of the animal. This beautiful animal is, when full grown, about 4 feet in

The Sasin, or Common Antelope (*A. cervicapra*).

length, and 2½ feet high at the shoulder; the head, measured from the nose to the root of the horn, is 7 inches long, the ears 5½ inches, and the tail, without the hair, 6 inches. The legs are long and delicate; the body round, but light, and well formed; the head small; the eye large, lively, and expressive; the ears long and cylindrical, the suborbital sinus particularly developed, and in continual motion; and the horns forming a complete spiral of two or three turns, wrinkled at the base, distinctly annulated in the middle, and smooth for a couple of inches next the points. The females, and young males for the first three years of their age, are of a uniform tawny-brown on all the upper parts of the body, with a light silvery band passing longitudinally from the shoulder to the hips, about six inches below the spine, on either side; the breast, belly, and interior of the fore arms and thighs are white; as is likewise the under surface of the tail, which is rather broad, and furnished with a small tuft of black hairs at the extremity. After their third year, the males begin to assume the adult colours of their sex, and gradually darken on all the upper parts of the body, till they finally become almost entirely black above and white beneath; the nose, lips, and a large circle round each eye being likewise white, but the light bands of the sides completely obliterated. The hair is uniformly short and close over the whole head, body, and extremities, except on the knees, which are furnished with tufts of long bristles, forming small knee-brushes.

The Sasins are so swift that it is useless to slip greyhounds after them; as, unless taken by surprise, which their extreme precaution seldom allows, it is impossible to overtake them, and experience has convinced the Indian sportsmen that the dogs are more likely to be injured in the chase than the game. The bounds also which these animals occasionally take, either for their own amusement or over the long grass when pursued, are said to be almost inconceivable. Captain Williamson, in his splendid work on the 'Wild Sports of the East,' assures us that he has seen an old buck Antelope lead a herd of females over a net at least 11 feet high, and that they frequently vault to the height of 12 or 13 feet, and pass over 10 or 12 yards at a single bound. They reside on the open plains of India, where they can see to a great distance in every direction, live in large families of from 5 or 10 to 50 or 60 grown females to a single male, and when they feed, or lie down to ruminate, detach a number of the young bucks to a distance of 200 or 300 yards on every side to watch over the common safety. Nothing escapes the notice of these careful sentinels; every bush or tuft of grass that might be suspected to conceal an enemy is strictly and attentively examined, and on the first alarm the whole herd betakes itself to flight, following closely in the footsteps of the old buck, and is soon beyond the reach of pursuit. The venison is dry and unsavoury, and being held in small esteem, consequently holds out no inducement either to the occasional sportsman or to the professional Indian hunter. The species extends over every part of India, from the borders of Persia to the most eastern parts of which Europeans have any distinct knowledge. It is found on rocky open plains, avoids woody localities and the thick cover of the forest; nor is there any certainty of its existing beyond the limits of India, though many zoologists, from Ray to Hamilton Smith, are of opinion that it likewise inhabits some parts of Africa. The fakirs and dervishes polish the horns, and form them into a kind of offensive arms by uniting them at the base; these they wear at their girdles instead of swords and daggers, which their vows and religious character prevent them from using.

Tetracerus

Has the muffle large; the crumen large, longitudinal; four horns, the front pair very short, placed over the orbits, the hindmost, which are conical and straight on the back edge of frontal bone. The skull is like that of *Cephalophus*, with the nasal bones not expanded. The suborbital fossa large, shallow, occupying nearly the whole of the cheek. It has no knee-tufts; and the females are hornless.

16. *T. quadricornis* (*Antilope quadricornis*, Blainville), the Chousingha, is about 2 feet 9 inches in length from the muzzle to the root of the tail; the tail itself is 5 inches long, and the height at the shoulder about 1 foot 8 or 9 inches. The superior or common horns are about 3 inches long, smooth, black, pointed, erect, and moderately divergent, bending very slightly forwards, and without the least indication of annuli. The spurious or additional pair of horns are placed in front of these, immediately between the orbits, and consist of short, erect, blunt stumps, about three-quarters of an inch in length, 1½ inch in circumference at the base, and of the same smooth and black appearance as the real horns. The head is 7½ inches long, the ears 4¾ inches, erect and pointed; the general colour of the upper parts is uniform bright bay, and that of the under parts silvery white, more or less mixed with sandy-coloured hairs; the lips are bordered with black. The females differ from the males by the absence of horns, and likewise by being of a lighter colour, which character is conspicuous at a very early age, and continues throughout life.

This species, as well as *Tragops*, called Chikara by the Hindoos, is common in all the wooded parts of India, particularly in Bengal, Bahar, and Orissa; it is monogamous, and lives in pairs in the forests and thick jungle, being exceedingly wild and active, and rarely suffering a state of confinement unless taken young. During the rutting season the male becomes particularly mischievous, and it is then dangerous to approach him, as he butts at everything within his reach; the female produces two young at a birth, but the period of gestation has not been recorded. Baron Cuvier supposes, and apparently with reason, that the ancients were acquainted with this species, and that the Four-Horned Oryx of Ælian refers to the modern Chikara.

17. *T. Iodes*, the Rusty-Red Chousingha, is an Indian species described by B. H. Hodgson, Esq.

18. *T. paccervis*, the Full-Horned Chousingha, is another Indian species.

19. *T. subquadricornutus*, the Jungliburka, is distinguished by its front pair of horns being rudimentary and tubercular. It is a native of Bombay, and there are four specimens, two male and two female, in the collection of the British Museum.

Calotragus

Has the muffle large; the crumen arched, transverse; the horns subulate, elongate, erect; the hoofs triangular, flattish beneath, acute in front; the false hoofs small or none; the crown of the head smooth; the tail very short; the ears elongate; the knees not tufted; the females hornless; the teats four.

20. *C. campestris* (*Antilope Tragulus*, Lichtenstein), the Stein-Boc is one of the most graceful and elegant of the antelope tribe. Its

legs are longer and smaller in proportion to its bulk than in any other species; its body is compact and well made; its head small, pointed, and ending in a well-formed naked muzzle, and its tail reduced to a mere tubercle, scarcely perceptible among the long hair of the croup and buttocks. The whole length, from the muzzle to the root of the tail, is about 3 feet 4 or 5 inches; that of the head, from the muzzle to the base of the horns, 4 inches, and from the same point to the root of the ear 6 inches, the tail being 1½ inch long, and the horns 4 inches. The height at the shoulder is 1 foot 7 inches, and at the croup 1 foot 9 inches. The colouring of this species is altogether peculiar, and alone sufficient to distinguish it from all other ruminants. In general, it is a reddish fawn-colour on the upper parts of the body; but this seems to be glazed or as it were overlaid on the shoulders, back, sides, and hips, with a light dun or silvery-brown hue, arising from the hairs in these situations being tipped with that colour; the nose and legs are dark brown, the breast, belly, and interior of the fore arms and thighs white; the hair of the forehead is long and of a deep red colour, and a remarkable black line passes from the root of each horn backwards, uniting between the ears, and forming an obtuse angle equally as conspicuous in the hornless females as in the horned males, and affording an excellent criterion by which to distinguish the species. The horns of the male are small and round, furnished at the roots with a few faintly marked wrinkles; but smooth and polished throughout the greater part of their length, and ending in extremely sharp points, almost imperceptibly bending forwards. The ears are extremely large for the size of the animal, being nearly half as long again as the horns, and broad in proportion. But perhaps the most remarkable character of the species, and certainly that which most definitely distinguishes it from all the other ruminants with which it is at all likely to be confounded, though it has hitherto escaped the notice of observers, is the total absence of spurious hoofs, both on the fore and hind feet, a character which exists also in the Prong-Buck, and which, as far as we are aware, no other ruminating animals of the hollow-horned family possess.

The Stein-Boc resides in pairs on the stony plains and mountain valleys of South Africa, not however frequenting very elevated or rocky localities, as its colonial name of Stein-Boc, or Stone-Buck, would seem to imply. On the contrary, it prefers the dry open flats, covered here and there, it is true, with large rocks and boulder stones, but likewise interspersed with clumps of stunted bushes and underwood, which furnish it with cover. This is the general character of the South African plains in the neighbourhood of Cape Town, as well as of the gorges of the moderate hills and mountains, and it is in such situations that the Stein-Boc is most commonly found. This animal is, moreover, remarkably shy and timid, runs with extraordinary swiftness, and when pursued will frequently bound over a space of 12 or 15 feet at a single leap. When closely pressed, and without any further means or power of escape, it will hide its head in the first hole or corner it happens to meet with, and thus patiently resign itself to its fate. Though it cannot be called a rare animal at the Cape, it is nowhere particularly common, being much hunted on account of the delicacy of its flesh, which furnishes excellent venison, and great numbers of the young being destroyed by eagles and other birds of prey. Colonel Smith has described the young of the Stein-Boc as a different species, by the name of *A. rufescens*; and the *A. pallida*, or *A. pediotragus*, of Afzelius, appears to differ in no respect from the adult of the present animal, the really distinctive characters of which have been hitherto very imperfectly reported.

21. *C. melanotis* (*Antilope melanotis*, Lichtenstein), the Grys-Boc is a species closely allied to the Stein-Boc, but rather lower on the legs and more heavily made. The whole length of the body is nearly 3 feet, that of the head, from the muzzle to between the ears, 6 inches; the height at the shoulder is 1 foot 5½ inches, and at the croup 1 foot 7½ inches; the horns are 2½ inches long, and the ears 5 inches. The head, as in the Stein-Boc, contracts suddenly before the eyes, and ends in a pointed muzzle; the horns are situated immediately above the orbits, straight, upright, pointed, and shining, with two or three small annuli at the roots; the ears are long, wide, and open; and the tail, almost tuberculous, is concealed among the long hair which passes backwards over the hips. The hair of the body is universally long, particularly on the hind quarters; on the head and extremities it is, on the contrary, remarkably short. All the upper parts are of a deep crimson red colour, thinly but regularly intermixed with long coarse hairs of the purest white, giving the whole animal a hoary appearance, expressed by its colonial name of Grys-Boc, or Gray-Buck, and forming altogether a character not easily mistaken. The inferior parts are uniform light sandy-brown or red, the head and extremities fawn-colour; the muzzle, the openings of the lachrymal sinuses, and an obscure circle about the eyes, as well as a mark upon the occiput of some specimens, are black, as are likewise the backs of the ears, which are nearly naked, with a few very short gray hairs thinly scattered over them.

The habits of the Grys-Boc are in most respects similar to those of the Stein-Boc. It lives in pairs upon the plains, never unites into troops or flocks, and conceals itself in clumps of underwood, whence it is not easily driven, lying close like a hare in her form, and seldom moving till almost trodden on. It is common in most parts of the colony at the Cape, and being less swift than the Stein-Boc is more easily captured. Its venison is much esteemed, though, like the generality of antelopes, destitute of fat.

Scopophorus

Has the muffle small and bald; tear-bag (crumen) transverse; the horns subulate, elongate, acute, and slightly recurved at the tips; the knees largely tufted; the inguinal pores distinct and bearded; the ears of moderate size, with a naked spot on the outside of their base; the hoofs triangular, and false hoofs distinct.

22. *S. Ourebi* (*Antilope scoparia*, Schreber), the Ourebi, called Bleek-Boc, or Pale-Buck, by the Dutch colonists at the Cape, according to Professor Lichtenstein, is a much smaller species than the Nyl-Ghau, and differs from all the other species of the present section by the large brushes which, in common with many other antelopes, it has upon the upper end of the canons, immediately below the knees, and from which it was called by Schreber *A. scoparia*. It measures 3 feet 8 inches in length from the muzzle to the root of the tail; the length of the latter is 3¼ inches, that of the head is 7½ inches from the muzzle to the root of the horn; of the horns themselves 5½ inches; and of the ears 3¾ inches. The height at the shoulder is 1 foot 10 inches, at the croup nearly 2 feet, and the size of the animal, as well as its general form and proportions, are nearly those of the Roebuck, only that the head is longer and more slender. The horns are awl-shaped, sharp, slender, nearly straight, and bending almost imperceptibly to the front; they are surrounded at the base with a few obscure wrinkles, succeeded by five or six well-defined rings, but are smooth and black throughout the greater part of their length, and end in very sharp points. The general colour of the upper parts is a uniformly pale yellowish-brown, darker in some individuals than in others; all the under parts, as well as the chin, lips, and a longitudinal streak over the eyes in the form of eyebrows, are white, and this colour likewise spreads over the posterior surface of the hips. The tail is covered with long bushy hair of a jet black colour, forming a marked and prominent contrast with the white of the buttocks; the ears are edged with a narrow border of dark brown, and immediately beneath their opening at the root there is a remarkable bald or naked spot of an oval form on each side of the head.

The Ourebi inhabits the open plains of South Africa, and without being positively gregarious, is fond of the society of its own species. It is found chiefly in the eastern districts of the Cape Colony towards Kaffraria; and its flesh, though dry and destitute of fat, is esteemed one of the best venisons of the country. Great numbers of these animals are found on the plains about Zwartkops Bay. When feeding they straggle confusedly over the plain, and appear to be in company rather accidentally than by intention; when alarmed also they do not fly together, but each runs off by itself in whatever direction it thinks most secure from danger for the moment.

23. *S. montanus* (*Antilope montana*, Rüppell), the Gibari, is very like the former, but is of a gray-brown colour, and the temporal spot much larger, deeper, more distinct and bald, both when alive and in the skin. It was found in Abyssinia by Rüppell, and the late Earl of Derby received a specimen from Gambia.

Oreotragus

Has the muffle large; the crumen arched and transverse; the horns subulate, elongated; the hoofs squarish, high, compressed, much contracted, concave beneath; the false hoofs large, blunt; the crown of the head smooth; the tail very short; the hair thick, goat-like, spread out. The female is hornless, and has two teats.

24. *O. Saltatrix* (*Antilope Oreotragus*, Forster), the Kainsi or Klippspringer, is an Antelope which inhabits the most barren and inaccessible mountains of the Cape, and appears to supply in South Africa the place of the Chamois and Ibex. The entire length of this animal, from the muzzle to the root of the tail, is 3 feet 2 inches, its height 21 inches at the shoulder, and about an inch more at the croup; the horns are 3½ inches long, the ears 4¼ inches, and the tail 3 inches. The head is short and small, compressed on the sides, and suddenly contracted immediately in front of the orbits, ending in a small, round, naked, black muzzle; the lachrymal sinuses open by a moderately-sized circular aperture; the horns of the male are perfectly straight and smooth throughout the greater part of their length, having three or four small but distinct annuli surrounding their roots; the ears are large, open, and rounded at the points; the eyes large and dark; and the tail appearing externally only by a brush of hair which clothes it. There are neither inguinal pores nor knee-brushes, but in place of the latter the knees of some specimens exhibit a naked callous patch, probably occasioned by rubbing against the rocks. The general colour of the animal on all the upper parts of the body is a lively and pleasing mixture of yellow and green, resulting from each hair being individually surrounded by alternate rings of these two colours; the under parts of the body are light sandy-red, tinged with yellow: the interior of the ears is filled with long white hair, a narrow black border surrounds their edges, and the eyes are encircled by the same colour. The hair of the body is long, padded, and stands perpendicularly out from the hide; that of the head and extremities is shorter, and lies in the usual direction; in quality the latter also resembles the hair of common animals, but the texture of the hair which covers all the upper surface of the body and neck is altogether peculiar, being similar to that of the Prong-Buck already described. It is round and hollow internally, and so fragile

that it breaks with the slightest touch, crushing like straw when pressed between the fingers, and so deficient in elasticity that it never regains its original form. The tail is covered with a small bush of hair of the same description, but so short as to be scarcely perceptible among the long hair of the hips. The legs are more robust than in most other species of Antelope; and the hoofs, instead of being pointed and flat beneath, are perfectly round and cylindrical, being worn only at the tips, upon which alone the animal treads. This peculiarity of structure in the hoof, and the riged form of the pastern-joints, which are perfectly stiff, and in a straight line with the canons, account for the amazing agility which the Klippspringer displays in bounding among the most dangerous rocks and precipices.

The peculiar habitat of this species makes it impossible to hunt it with dogs, but it is easily shot as it exposes itself upon the naked rocks; and great numbers of the young are destroyed by eagles and other birds of prey which inhabit the same localities. In consequence of this the animal is by no means common, and is becoming every day more scarce in situations where it most abounded formerly. The excellence of its venison and the value of its hair, which is held in great estimation for stuffing saddles and mattresses, hold out a powerful inducement to its destruction.

Nesotragus

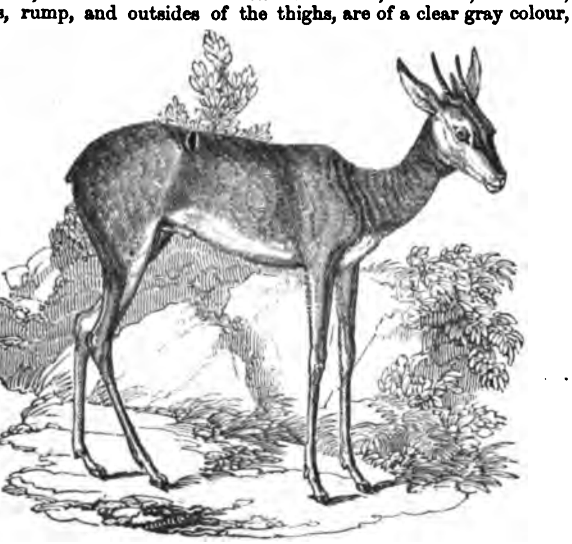
Has the muffle large and bald; the crumen large, deep, and arched; the face and forehead not crested; the ears large; the horns nearly straight, elongated, strong, many-ringed, incumbent, nearly parallel in the direction of the facial line; no false hoofs; the tail very short; the females hornless.

25. *N. moschatus* is the only species. It is an inhabitant of the island of Zanzibar. It was first described by Von Duben. Male and female specimens exist in the Stockholm Museum.

Neotragus

Has no muffle; the nose ovine; the nostrils close together; the crumen roundish; the horns short, conical, and recumbent; the tail very short; the crown crested; females hornless.

26. *N. Saltiana* (*Antilope Saltiana*, Blainville), the Madoqua. This is perhaps the smallest of all horned animals, being scarcely the size of a good English hare. It measures 2 feet in length from the nose to the root of the tail, and about 14 inches in height at the shoulder, the height at the croup being about an inch more. The length of the head from the nose to the ear is 5 inches, that of the horns 3 inches; the ears are 2¾ inches long, and the tail 1½ inch. The horns of the male are situated in the plane of the forehead; they are very sharp-pointed, almost insensibly bent outwards and forwards, provided on the inner anterior margin with a prominent sharp ridge, which runs from the base to within a quarter of an inch of the points, and annulated for about two-thirds of their length from the roots. The females are without horns, but have, in common with the males, a tuft of long stiff hair standing upright from the crown of the head, and forming a small crest, particularly remarkable in the females, from their not being furnished with horns; the hair on all other parts of the body is short, close, and smooth, except on the hind side of the hips and thighs, where it is rather longer, and radiates outwards and round the tail, its pure white colour contrasting agreeably with the colours of the croup and thighs; the face, forehead, and legs, as well as the tuft of long hair between the horns, are of a bright and deep red, as are likewise the backs of the ears; the neck, shoulders, flanks, rump, and outsides of the thighs, are of a clear gray colour,



The Madoqua (*N. Saltiana*).

like that of the American gray squirrels, each hair being annulated with alternate rings of black and white; the back, from the shoulders to the rump, is a deep reddish-brown; and the breast, belly, interior of the fore arms and thighs, and hinder surface of the hips, of the most pure unmixed white, forming altogether a variety, clearness, and brilliancy of colouring rarely met with among quadrupeds. The tail is very short, being in fact little more than a mere stump; the ears are round and nearly the length of the horns; the hoofs small, well-formed, and, like the horns, of a deep black colour; the forehead is perfectly flat, and the head is compressed suddenly below the eyes, and tapers to a small and attenuated snout; the legs are long in proportion to the weight of the body, and so small that they scarcely equal the little finger in thickness.

The Madoqua is found in all parts of Abyssinia, where it was originally noticed by Bruce, who discovered it in the country about the sources of the Abai, or eastern branch of the Nile. Mr. Salt afterwards procured specimens in the mountains of Tigré, and sent the horns and legs to the British Museum, where they were observed by De Blainville, and described under the specific name of *Antilope Saltiana*, in compliment to the distinguished traveller who procured them. More recently complete specimens have been brought to Europe by Rüppell, and Hemprich and Ehrenberg, and the species has been well described and beautifully figured both by these travellers and in the 'Darstellung Neuer oder Wenig-Bekannter Säugethiere' of Professor Lichtenstein. Little is known regarding the habits of this species. It is said to live in pairs in mountainous districts; and Pearce informs us that many of the Abyssinians object to eat its flesh, from a superstitious belief of its being often found in the society of monkeys and baboons.

Cephalophus

Has a large muffle: the tear-bag absent, but it is replaced by a naked glandular line formed of two series of pores on the side of the cheek; the crown crested, forming a tuft between the horns; the horns short, conical, placed far back on the hinder edge of the frontal bone, and inclined backwards. This genus contains several species.

27. *C. quadriscopa* (*Antilope quadriscopa*, Hamilton Smith), the Four-Tufted Antelope, is known only from Colonel Smith's description and figure of a male specimen formerly exhibited at Exeter Change. The individual from which Colonel Smith's description was taken was brought from Senegal.

28. *C. Grimmia* (*Antilope Grimmia*, Desmarest), the Impoon, Duyker, or Duyker-Boc, is of a yellowish-brown colour, and grayish in winter. The hair is yellowish, with black tips. The forehead yellowish-bay; the inside of the ears, chin, throat, abdomen, inside of fore and hind legs, and under side of tail, white; the feet, streak on the nose and up the legs, and upper part of the tail, black; the ears elongated, nearly as long as the head, acute; the horns black, elongated, slender; the base rugose, subangular in front; the skull small and short.

The Duyker-Boc, or Diving-Goat, so called by the Dutch of South Africa from its habit of plunging under the bushes in its passage through the woods, instead of leaping over them like the generality of other Antelopes, is a common animal in Kaffraria and in all parts of the Cape Colony which abound in forest and underwood, from the cover of which it seldom ventures, unless occasionally at night to steal into a neighbouring garden. It is found alone or in pairs, makes its way readily among the thickets and low bushes, and when pursued will from time to time stand up on its hind legs to look round it, then dive under the branches to reappear again at some distance; and thus alternately continuing its flight, and standing up at intervals to watch the motions of its pursuers. The peculiar nature of the humour secreted by the maxillary glands of this animal has given origin to a common saying among the Dutch colonists, that it carries the gall-bladder under the eyes. This species is most probably the animal of which the female was long since imperfectly described by Grimm, and which has been admitted into systematic catalogues under the name of *Antilope Grimmia*. The *A. Platous* of Colonel Smith likewise appears to be identical with, or at most a casual variety of the Duyker-Boc, the characters upon which the separation is made being by no means constant, and some of them even of doubtful authenticity. The *Capra sylvestris* (*Africana* of Grimm), is probably this species. *Fitomba* or *Philatomba* appears to be the Kaffrarian name for all the Bush Antelopes or species of *Cephalopi*.

29. *C. Campbelliæ* (*Antilope Campbelliæ*, Gray), the Black-Faced Philantomba. This species differs from the Duyker by being much darker and more distinctly grisled or dotted, and the under side being much whiter. It is possible that it is only a variety of that species.

30. *C. Burchellii* (*Antilope Burchellii*, Smith), Burchell's Bush-Boc. This species is easily known from the two former by its darker colour, and by the under sides and inside of the legs being nearly of the same colour as the back, and not white; and also by the shortness of the intermaxillary bones, and the width of the nose-hole. It inhabits the districts more or less covered with underwood in Kaffirland, and the country north of the Orange River. When interrupted or pursued by dogs, it springs with considerable activity over such bushes as may stand in its course, and endeavours to plunge into the closest bushes for concealment.

31. *C. Madoqua* (*Antilope Madoqua*, Rüppell), the Abyssinian Bush-Goat, is of a yellowish-brown colour, slightly punctulated with black; the neck is yellowish, the limbs blacker; the face-streak and feet black; the hair rather close-pressed, reddish-gray at the base;

upper part polished, yellow-brown, with dark tips; the forehead is reddish. This species inhabits Abyssinia, and is the Madoqua of Bruce.

32. *C. coronatus* (*Sylvicapra coronata*, Sundevall), the Red-Crowned Bush-Buck, is a species found in Western Africa, and is very distinct from the last, its colour being lighter, and the fur less rigid and close-pressed.

33. *C. sylvicultrix* (*Antilope sylvicultrix*, Afzelius), the White-Backed Bush-Buck, the Bush-Goat, and Bush-Antelope, is about 5 feet in length from the muzzle to the root of the tail, 3 feet high at the shoulder, and 3 feet 2 inches at the croup: the head, measured from the muzzle to the base of the horns, is upwards of 10 inches long, the horns and ears each 4 inches, and the tail with the hair half a foot. The circumference of the horns at the base is 3 inches, and their distance at the points 5 inches; they grow entirely in the direction of the forehead; are pointed, black, shining, nearly straight, with a slight inclination backwards, and diverging gradually towards the points. For about half an inch from the base they are finely marked with a number of small transverse striæ, then covered for about an inch with little depressions and inequalities, and smooth from thence to the points. The ears are situated rather close to the horns; they are about the same length as these organs, broad, open, rounded at the top, and nearly naked; the eye-lids are bordered with thick black lashes; the tail is bushy and pendent; the buttocks nearly naked; the limbs short and slender; the knees unprovided with brushes; and the female furnished with two teats. The hair is in general remarkably short, sleek, and shining, of a deep brown colour, rather paler on the neck and flanks, mixed with gray on the thighs, almost yellow on the throat, dun on the cheeks and sides of the jaws, clear brown on the face, nose, and backs of the ears, and chestnut-brown on the legs and feet. A tuft of long hair surrounds the base of the horns, and along the middle of the back is a longitudinal line of silvery gray which expands upon the croup, and is provided with hair considerably longer than that on the rest of the body. The tail is black, covered with moderately long hair, and without a terminal tuft.

The proportions of this species are heavy and ungainly, and bear a considerable resemblance to those of the Hog-Deer of India. The legs are short and slender, and appear disproportioned to the size of the body, which is large and heavy; the head, too, is thick and clumsy, though much attenuated towards the muzzle; the neck short and thick; the croup depressed; and the back very much arched. This species inhabits the west coast of Africa, about Sierra Leone, and the sources of the Pongas and Quia rivers. It frequents the thickets and underwood of the upland plains and moderate mountain declivities, keeping close to the cover during the day-time, and quitting it only at early dawn for the purpose of feeding in the neighbouring meadows. It is at this time that it is pursued by the hunters, who station themselves on the margin of the woods, and shoot it as it comes out to graze. It is a slow heavy runner, as might be anticipated from the size and corpulent make of its body, and the shortness of its legs. It affords excellent venison, and is much sought after on that account. It has long maxillary glands, but no appearance of lachrymal sinuses.

34. *C. Ogilbii* (*Antilope Ogilbii*, Waterhouse), the Black-Striped Bush-Buck, is of a pale bay-brown colour, with a deep black dorsal streak, pale beneath; the crown and haunches brighter bay; the neck, withers, and side of the dorsal line varied with deep brown hairs; the streak up the fore legs, upper part of hock, feet above the hoofs, and end of the tail, black. The horns are short, thick, conical, very rugose on the inner front edge of the base. This species is a native of Fernando Po, and was named by Mr. Waterhouse after Mr. Ogilby, the late secretary of the Zoological Society, and the author of the article 'Antelope' in the 'Penny Cyclopædia.'

35. *C. badius*, the Bay Bush-Buck, is very like the last species, but is of a darker bay colour; the legs are blackish; and the neck bright bay, and not blackish-bay as in *C. Ogilbii*. It is a native of Sierra Leone.

36. *C. dorsalis*, the Bay Bush-Goat, is of a dark-bay colour, with shoulders and legs darker. The hair is brown, a few hairs on the haunches tipped with white; the crown and nape, and a broad dorsal stripe, black; a spot over each eye, the lips, sides of chin, front of chest, under side of tail, and inside of the thighs, pale brown. It is a native of Sierra Leone.

37. *C. niger*, the Black Bush-Buck, is a native of the coast of Guinea, distinguished by its sooty-black colour.

38. *C. Natalensis* (*Antilope Natalensis*, A. Smith), the Natal Bush-Buck, or Rhoode-Boc, is of a bright red-bay colour, and has short conical horns. It inhabits the forests about Port Natal and the country to the eastward, living in the thick brushwood which fills up the intervals of the larger trees. It feeds on grass, the young shoots of trees, and the delicate twigs of smaller shrubs. It occupies the same position at Natal that the little Blue Antelope does at the Cape.

39. *C. rufilatus* (*Antilope Grimmia*, H. Smith), the Coquetoon, is of a deep reddish-bay colour; the legs, nape, streak on the nose to the crown, and broad streak on back, blackish-gray; the ears blackish; the crest and upper part of tail black; the cheeks rather paler; the inside of ears whitish; the horns conical, rather elongated, obscurely annulated, and slightly recurved. This is the Grimme of Buffon and F. Cuvier. It is a native of Western Africa.

40. *C. Maxwellii* (*Antilope Maxwellii*, H. Smith,) the Guevei, is of a gray-brown or sooty-black colour. It has a rather rigid fur, and the abdomen and front of the thighs white. It is the Guevei of Buffon, the Royal Antelope and Pigmy Antelope of Pennant and Shaw. It is a native of Senegal and Gambia.

41. *C. pygmæa*, (*Antilope perpusilla*, H. Smith), the Noumetzi, Cape Guevei, or Kleene-Boc, is about 1 foot high at the shoulder; the horns 1¼ inch long in the male, three-quarters of an inch in the female, and the tail about 2½ inches. The horns are small, erect, black, slightly inclined backwards and towards one another at the points, and very sharp, with seven or eight minute annuli at the base; the ears about the same length as the horns, perfectly round at the tips, and nearly

Kleene-Boc (*A. perpusilla*).

naked within; the head is long and pointed; the maxillary glands not parallel to the plane of the face, but nearly in the same line with the greater axis of the orbits, or rather in lines parallel to them; the forehead and nose are brown, bordered on each side by a narrow line of a sandy-red colour passing from the root of the horns down to the muzzle; the upper parts of the body are of a uniform dark slaty-brown colour; all the inferior parts, including the region under the chin, the breast, belly, interior of the fore arms and thighs, and under-surface of the tail, ashy-gray, inclining to white in some specimens, particularly in young individuals; the legs are reddish-brown; and the hoofs small, narrow, and pointed.

This species, called by the Dutch colonists of the Cape Kleene-Boc, Kleene Blauw-Boc, Blauw-Bokje, all signifying Little Goat or Little Blue Goat, inhabits South Africa, and lives singly or in pairs among the bushes. It is extremely active, and of a mild and timid disposition; but from the nature of the thick bushes in which it resides is not often seen even in those districts where it abounds most plentifully. It is said to exhibit considerable sagacity in eluding pursuit, and when domesticated soon becomes familiar, and learns to distinguish those about it, and to answer to its name. This species is also the *A. cærulea* of Colonel Smith and the *A. pygmæa* of M. Desmarest, who confounds it with the last species.

42. *C. melanorheus*, the Black-Rumped Guevei, is of a gray colour, with the rump and upper part of the back of a black colour. It is a native of Fernando Po.

43. *C. punctulatus*, the Grisled Guevei, is a native of Sierra Leone, and is of a dark fulvous-brown colour.

44. *C. Whitfieldii*, the White-Footed Guevei, is of a yellowish ash colour; the streak over the eyes, cheeks, throat, belly, inside of the limbs, and ring round the feet above the hoofs, ashy white. It is a native of Western Africa.

Nanotragus

Has very short conical horns; small rounded ears; slender legs; a subpectinate tail, and small triangular hoofs.

45. *N. perpusillus* (*Capra perpusilla*, Linnæus), the Royal Antelope, the Guinea Musk, and Pigmy Musk, is a native of Guinea. It is of a fulvous colour, and has the throat, belly, edge of the thigh, and tip of its tail, white.

Pelea

Has conical, erect, scarcely diverging horns, bent forward at the tips; the face narrow and elongated; the nose swollen; the muffle large, extended far behind the nostrils; the fur soft and woolly; the hoofs and false hoofs rather large; the inguinal pores distinct; the teats four.

46. *P. capreola* (*Antilope capreolus*, Lichtenstein), the Reh-Boc

or Peele, is nearly 5 feet in length, and 2½ feet high at the shoulder; the head is 6 inches long from the muzzle to the root of the horns; the ears and tail, without the hair, about the same length; and the horns of the old male from 9 to 12 inches. The head is long, and tapers gradually to the muzzle, which is small, round, and of a black colour; the horns are perfectly smooth and without any appearance of wrinkles or annuli for the two-thirds of their length next the points, but exhibit a few obscure wrinkles at the base; they are remarkably slender, long, straight, parallel, and so sharp at the points that the Hottentots and Bushmen use them in place of needles and bodkins; the ears also are long, very broad at the base, and attenuated towards the points; the tail long and bushy; the hair, or rather fur, is of a woolly quality, and of a uniform ash colour on the neck, shoulders, sides, croup, and thighs, and white or light gray on the breast, belly, and inner side of the arms and thighs. In young individuals it is beautifully frizzled or curled into distinct locks, and its colour is much clearer than in the adults, which have it straight, loose, and often tinged with a sandy-brown hue on the upper parts of the body. The hair of the legs in the young animal is likewise long and curly like that of a young lamb, but in aged specimens the legs are covered with short close hair of the common quality, and frequently with more or less of a dark brown colour. The hair of the head, face, and cheeks is always short, crisp, and close; it is brown on the nose, light fawn on the forehead and cheeks, and white about the margins of the lips and underneath the chin; the tail is slaty-gray above, and white below, and at the tip; and there is a conspicuous black spot at the angle of the mouth on each side. The hairs individually are obscurely annulated with alternate rings of a gray and light rufous-brown colour, the latter becoming more conspicuous as the animal advances in age, and communicating to the general colour of the fur the light rufous shade already mentioned.

The Reh-Boc or Rhee-Boc is of a lighter and more graceful form than the generality of the other antelopes included in the present section. The body is long and small, the neck particularly so, and the legs slender and well-proportioned. Its pace, consequently, is proportionally swift; it runs with great velocity, keeping close to the ground, and moving by long strides, and with a motion so rapid and uniform that it seems to glide rather than run. The Reh-Bocs live in small families of five or six individuals, consisting of an adult male and three or four females with their young. The males are pugnacious, and compel the young of their own sex to separate themselves from the family as soon as they become adult. Their general residence is on the sides of moderate hills, among stunted trees and underwood, or in the rocky glens and mountain-passes, in the vicinity of the little pools of water which remain after the winter-torrents have ceased to flow. Wherever such situations are found, the Rhee-Boc is not an uncommon animal in South Africa. Its flesh is dry and insipid, and esteemed less than that of any other of the numerous Cape Antelopes. The female produces but one at a birth, which grows rapidly, and, if caught at an early period, is readily domesticated.

Eleotragus

Has the horns conical, thick, diverging, bent back and then bent forwards at the tip; the face broad; the muffle rather large; the fur harsh, and that of the back more or less whorled; the hoofs and false hoofs rather large; the inguinal pores distinct; four teats.

47. *E. arundinaceus* (*Antilope Eleotragus*, Schreber), the Inghalla Riet-Boc, or Reed-Buck, so called from its habit of frequenting the reedy banks and beds of dry water-courses, is 4½ feet in length, and 2 feet 9 or 10 inches high at the shoulder. The head is 10 inches long from the muzzle to the base of the horns; the horns 10½ inches in a straight line, and 13 inches along the curves, and the tail 11 inches. The horns are round, annulated at the base, with prominent sharp rings and beautifully striated between, smooth and sharp at the points, and curved forwards with a bold and regular sweep, so as to form almost the segment of a circle. The ears are long and pointed, filled internally with a profusion of whitish hair, and beneath them, on each side of the head, there is a remarkable bald spot of an oval form and shining black colour, which is very characteristic of the species, and readily distinguishes it from all the other antelopes with which it is likely to be confounded. The hair over every part of the neck and body is long and rough, of a uniform dull ashy-gray colour, sometimes tinged with red on the upper parts, and silvery-gray on the throat, breast, belly, and interior of the fore arms and thighs. The tail is long and remarkably bushy, being covered with a profusion of long woolly hair, for the most part of a white or gray colour, with a narrow brown line running down the middle of the upper side. The females are in all respects similar to the males, excepting that they are without horns, and of rather smaller stature.

The Riet-Boc is not found in the immediate vicinity of the Cape, but farther in the interior of the country it is by no means uncommon, living in pairs or small families, and, as already observed, frequenting the reeds and rushy banks of mountain-streams which flow only during the winter season, and are dried up by the summer heats. Sometimes also it is found in woods along the banks of rivers, but always in the neighbourhood of water; and a variety, if not a distinct species, is even said to inhabit the plains. This is of a very deep reddish fawn-colour, and has been described by Afzelius and Hamilton Smith as a distinct species under the denomination of *A. fulvo-rufula*. Excepting in the redder shade of its colour, however, and the name of *Roode Rhee-Boc*, or Red Roe-Buck, by which it is said to be distinguished among the Dutch colonists at the Cape, it does not appear to

Rietboc (*E. arundinaceus*).

differ materially from the common variety, and the slight shades of variation which it does present, are most probably the effects of its difference of habitat and other accidental circumstances. The same may be said of the *A. Isabellina*, or Cream-Coloured Antelope of these authors, which does not appear to present any characters sufficiently marked or peculiar to be considered as indicative of a specific distinction.

48. *E. reduncus* (*Antilope redunca*, Pallas), the Wonto, or Nagor, known only from the description of Adanson and the figure of Buffon, is a species so nearly resembling the Riet-Boc that some naturalists have not hesitated to unite them. It is 4 feet long from the muzzle to the origin of the tail, 2 feet 4 inches high at the shoulder, and 2 feet 6 inches at the croup; the head is 9 inches long, the horns 5½ inches, and the ears 5 inches. The horns have one or two annuli at the base, but are smooth and shining throughout the remainder of their length; they are erect, parallel, and almost straight till within a short distance of the points, where they curve forwards. The colour was uniform fawn or pale red, without any white about the breast or belly, and the hair was long, rough, and undulating, and did not lie smooth or close to the body—characters which all tend to approximate the animal to the Riet-Boc, and more particularly to the variety which is said to inhabit the plains. It is found in the neighbourhood of Goree, on the west coast of Africa.

Dr. J. E. Gray refers the Bohor (*Antilope Bohor*, Rüppell) as a variety to this species. He says, "When in Frankfort I observed that the male *Antilope Bohor* from Abyssinia was rather larger than the male of *A. redunca* from Senegal, in the same collection, and the horns more slender; the female was darker and browner than the male: both sexes have more black in the carpus and tarsus than the specimen of *A. redunca* in the same museum."

The genus *Raphicerus*, of Colonel Hamilton Smith, appears to be a very doubtful one. Dr. J. E. Gray says that the author formed it "from two pairs of horns on part of the frontal bones in the College of Surgeons, which he called *Raphicerus acuticornis* and *R. subulata*." The figures are not sufficient to identify the species, and we now know that the horns differ greatly in individuals of the same species, and during the growth of the same specimen. *R. acuticornis* may be the horns of the Duyker-Boc (*Cephalopus Grimmia*).

2. *Cervine Antelopes.*

These Antelopes have rather a heavy body; an elongated tail, with short hair at the base, and a tuft of longer hair at the tip; the horns elongated and generally of a large size.

Adenota

Has a cervine muffle, cordate, and moderate; the nose hairy between and over the nostrils; the horns sublyrate, ringed, when young recurved; no tear-bag, or covered by a tuft of hair; the hair of the back whorled, and the hair of dorsal-line and back of head reversed; the tail elongated and hairy.

The only species of this genus is very like the species of *Eleotragus*, but has a smaller and more cervine muzzle and lyrated horns. It differs from the next genus in the form of the tail and absence of the mane, and from it and *Eleotragus* in having a tuft of hair in front of the orbit.

49. *A. Kob* (*Antilope adenota*, H. Smith), the Æquitoon, or Kob, is of

a pale brown colour. The end of the nose, the inside of the ears, the chest, belly, and inside of the legs and thighs, tip of tail, and end-band above the hoofs are white; the front of the fore and hind legs, and the end of ears and tail, black; the hair of dorsal-line reversed, with a whorl on the shoulder and loins. There has been a good deal

Æquitoon (*Adenota Kob*).

of confusion about this species. The figure that we have given was referred by Mr. Ogilby, in the 'Penny Cyclopædia,' to a new species which he named *Antilope Koba*. His description of the animal, however, refers to the *Antilope Sing-Sing* of Bennett, the *Kobus Sing-Sing* of the British Museum Catalogue. On this species Dr. Gray makes the following observations:—

"A fine pair has been at Knowsley some years. Thinking them new I described them as *A. annulipes*. Mr. Ogilby has called it the Nagor; but it is scarcely the Nagor of Buffon. An adult male noticed by Mr. Ogilby as the Kob is now in the museum of the Zoological Society. Its horns, like the male at Knowsley, are much worn down. They whistle like a stag. Buffon ('Hist. Nat.,' 12—219, 267, t. 32, pl.) figures a skull with horns brought from Senegal, by Adanson, under the name of Kob, which is also called the *Petit Vache Brune*. Erxleben gave this figure the name of *A. Kob*, and Pennant called it the Gambian Antelope ('Syn.' i. 39).

"The figure somewhat resembles the head of a half-grown male of this species, but the horns are longer and have more rings than the specimen in the British Museum; but I am inclined to agree with Mr. Ogilby in believing that it was intended for this species. In the Jardin des Plantes they called the Sing-Sing the Kob of Senegal. This may be a mistake for the Koba. I may remark that the horns of the Koba, in the same plate of Buffon, are represented with more rings than are mentioned in the description.

"Colonel Hamilton Smith describes two figures, a male and female specimen, which were alive in Exeter Change; and figures the male and its skull and horns under the name of *A. adenota*, which well agrees with this species, and has the peculiar distribution of its hair —hence its name: but he says, 'It has a long open suborbital slit, and small black brushes on the knees;' but this I suspect must be a mistake, as he himself observes that no lachrymal cavity was found in the skull. He might have mistaken the tuft of hair for the gland, at the distance at which he saw the specimens.

"He also ('G. A. K.' iv. 221) described a specimen which was in Exeter Change, which he regarded as the Gambian Antelope of Pennant, and calls it *A. forfex*. His characters agree in most particulars with this species, but he says, it had 'a long lachrymal sinus, and had small brushes on the knees.' If there was not some mistake in transcribing these descriptions, both these animals should be *Gazellas*, but I have never seen any which agreed with them.

"The young male in the British Museum shows the development of the horns of these animals. The upper rings of the growing horn falls off in large thick flakes as the horn increases in size beneath: this explains how the extent of the smooth tapering part of the horns increases in length as the horn grows; and how the number of rings are found to be nearly the same in the various ages and different individuals of the various species. Mr. Whitfield informs me that the scrotum is rarely developed or dependent externally in different kinds of antelopes before they have completed their first year."

50. *A. Lechée*, the Lechée. This animal is nearly as large as the Water-Buck. It is of a pale-brown colour. The orbit and lower part of the body is whitish; the front of the legs is dark brown; the horns are elongate and strongly knotted in front; the withers have a small roundish whorl of hair. It is a native of South Africa on the banks of the river Zouga, lat. 21°. There is a male specimen in the British Museum.

Kobus

Has the horns elongated, sublyrate, bent back, and then forward at the tip; the muffle cervine; no tear-bag or inguinal pores; the hair rough and elongated; the neck covered with longer diverging and drooping hair; the tail rather elongated, depressed, hairy on the sides and below. The females are hornless and have four teats.

51. *Kobus ellipsiprymnus* (*Antilope ellipsiprymna*, Ogilby), the Photomok, or Water-Buck. The following is Mr. Ogilby's description of this animal in the 'Penny Cyclopædia:'—The whole length of the animal from the muzzle to the root of the tail was 7 feet 3¼ inches; its height at the shoulder nearly 4 feet, and to the top of the horn upwards of 7 feet; the horns measured 30 inches upon the curves, the ears were upwards of 8 inches long, and the tail, with its terminal tuft, 1 foot 9 inches. The horns are very thick and heavy; they spread widely outwards, are nearly straight for the first half of their length, and then turn forwards with a gradual and uniform curvature. They are surrounded with 24 prominent annuli, forming large knobs in front and deeply striated between, but nearly obliterated behind; the last six inches are smooth, and the points blunt. Next to the character of the horns, this species is most readily to be distinguished by a ribbon of pure white, which passes over the croup and down each hip, uniting between the thighs, and forming a perfect ellipse, having the root of the tail in one of its foci, and contrasting most singularly with the dark rusty iron-gray of the surrounding parts. It is to this mark, which is so peculiarly characteristic of the species, that the name of *Ellipsiprymnus* refers. This animal is a native of South Africa, from whence it was originally brought by Mr. Steedman and exhibited with other specimens of South African animals in the Colosseum, Regent's Park. It has got the name of Water-Buck from its habit, when alarmed, of rushing into and crossing very rapid rivers. It lives in small herds on the banks of rivers, and has not been known to occur south of 26°. The flesh is not regarded as good for food, as it has a rank pungent smell, and disagreeable taste.

52. *K. Sing-Sing* (*Antilope Koba*, Ogilby), the Sing-Sing. This species differs in the tints of its colouring as well as the length of its hair at different seasons of the year. The following are the characters of the species. The colour is reddish or yellowish-gray brown, rather grayer on the shoulders; the nose, lips, hinder-parts of the thighs, under the neck from the ears to the gullet, a streak over the eye, and ring above the hoofs and false hoofs, white; the belly and legs, end of tail and legs, from shoulder to hock, black. The females are grayer and have the belly and upper part of the legs paler.

This animal is called Sing-Sing by all the negroes. They do not think that their flocks will be healthy or fruitful unless they have a Sing-Sing with them, just as a fancy is entertained by some persons in England for having a goat in a stable. The English on the Gambia call it a Jackass-Deer from its appearance, and it is called Koba and Kassimause by the negroes at Macarthy's Island. Its flesh is strong, and not pleasant eating. As far as can be judged by recollection and description, the adult specimen at Knowsley, the young male and adult female in the British Museum, the male and female at Frankfort, and the adult male in the Paris menageries, are the same species.

Buffon figured ('Hist. Nat.,' 210, 267, xii. t. 32, f. 2,) under the name *Koba*, a pair of horns which were in the library of St. Victor at Paris. He described them as larger and more curved above than those of the *Kob*, 18 inches long, and 5 inches in circumference at the base; and he refers them to an animal which Adanson says is called Koba in Senegal and the Great Brown Cow by the French colonists. Pallas refers these horns to *A. Pygarga*, and the figures and description agree in many particulars with the horns of that species, but they are rather longer and have more rings. Pennant ('Syn. Mam.' 38) gave the name of Senegal Antelope to Buffon's short account and figure, but has added to it the description and figure of the head of a skin which came from Amsterdam, and appears to be *A. Caama* of South Africa. Cuvier ('Dict. Sci. Nat.' ii. 235,) only translated Pennant's name to *A. Senegalensis*. Erxleben ('Syn.' 293) and Zimmermann ('Zool.' 345) have translated Pennant's description of his skin from Amsterdam of *A. Caama*, and called it *A. Koba*, referring to Buffon's description and Daubenton's figure. Fischer, Hamilton Smith, and M. Sundevall regard the Koba of Buffon the same as the Korrigum of Denham and Clapperton; but the horns of that species are considerably larger and much thicker at the base than those described by Daubenton, and the annulations of the horns are higher and more regular. It should be remarked that Buffon describes his horns as having 11 or 12 rings, but figures them as having 17 or 18. Mr. Ogilby ('Penny Cyclopædia' and 'Proceedings of Zoological Society') considers Buffon's Koba to be the Sing-Sing, from the length of the horns, and in the number, disposition, and form of the rings. His figure more nearly agrees with the horns of that species than of that of the *A. Pygarga*, to which Pallas first referred it; but the horns, according to Dr. Gray, are represented much more lyrated than any horns of the Sing-Sing; indeed, not one of the specimens which had come under his observation had had any inclination to assume that form; but as this is the only West-African species which in any way agrees with Buffon's figure, perhaps it is best to adopt Mr. Ogilby's suggestion. The name of Koba or Kob appears to be common to many species. Schinz erroneously considers *Damalis Senegalensis* (*Antilope adenota* and *A. forfex*, H. Smith), as synonyms of this species. (Gray, 'British Museum Catalogue,' Mammalia, Part III., p. 101.

Ægocerus

Has conical, elongate, recurved, rather compressed, ringed horns, arising immediately above the orbits; the nape with a linear, erect, reversed mane; the tear-bag covered with a tuft of hair. The female is horned, and has two teats.

53. *Æ. leucophæus* (*Antilope leucophæa*, Pallas), the Etaao or Blauw-Boc is 6 feet in length, and 3 feet 7 inches high at the shoulder; the

The Blauw-Boc (*Æ. leucophæus*).

head is 9 inches long from the muzzle to the base of the horns; these are 2 feet 2 inches, measured along the curves; the length of the ears is 8 inches; and that of the tail, with its terminating tuft, 1 foot. The horns are round, uniformly curved backwards, and marked with from 20 to 30 prominent and complete rings, the last six inches being smooth, and the points very fine and sharp. The hide of this animal is perfectly black, and it is this colour reflected through the ashy-gray hair that communicates the dark-blue shade which has given rise to the name of Blauw-Boc, or Blue-Buck, by which it has long been known among the Dutch at the Cape of Good Hope.

The Blauw-Boc lives in pairs or small families of five or six individuals on the open plains of South Africa, north of the Kurrichane. It is dangerous when wounded, and during the rutting season in particular is said to attack indiscriminately every animal that comes in its way. It is exceedingly swift. The flesh is eaten, but is not pleasant.

Antilope barbata, H. Smith, the Takhaitze, beautifully figured by Mr. Daniell in the 'African Scenery,' is a variety of this species, and differs from the Blauw-Boc by its long flowing mane, copious beard, and superior size. This animal inhabits the country in the vicinity of Latakoo, and is called Takhaitze by the Betchuanas. It is said to be so wild and ferocious that the natives are afraid to attack it openly with the assagai, or spear, as they do other game, but take it generally in pitfalls covered over with sticks and earth. It is commonly found in pairs upon the open plains, but when disturbed makes for the wooded heights, which are thickly covered with the common mimosa, upon which both this animal and the Giraffe delight to feed. The name Takhaitze signifies a fierce or wicked beast, and expresses the dread with which the resolution and prowess of this powerful animal inspire the Betchuanas, who seldom venture to approach it openly.

A. equina of Geoffroy is also a variety of this species.

Another probable variety is the Dacoi, or White-Mouth of the Mandingoes, the Kob or Koba of the Joliffs, the Vache Brune of the French in Senegal. Mr. Whitfield, who has brought several pairs of horns of this animal to England, says that the flesh is very good to eat.

54. *Æ. niger*, the Black-Buck, is black, with the face white, having a dark streak. The female and young are brown. This species is known from the description and specimens of Captain Harris, and also specimens in M. Sundevall's collection.

Oryx

Has elongate subulate horns, ringed at the base, straight or slightly arched, placed on a line with the face; the neck maned above and below; a subcervine nose, the nose only margining the nostrils; the hoofs narrow in front, and false hoofs large.

55. *O. Gazella* (*Antilope Oryx*, Pallas), the Kookaam or Gems-Boc. This is the Oryx of Cuvier, the Papan of Buffon, and the Egyptian Antelope of Pennant. It is a heavy stout animal, about 5 feet in length, and 3 feet 2 inches high at the shoulder; the length of the horns is from 2 feet to 2½, that of the ears 7 inches, and that of the tail 13 or 14 inches. The horns are almost perfectly straight, very little divergent, and situated in the plane of the forehead; they are

Gems-Boc (*Oryx Gazella*).

obscurely annulated for half their length, black, and blunt in the male, but very sharp-pointed in the female. The ears are large and pointed, and the tail pretty uniformly covered with long black hair, forming a large switch. The general colour of the body is dark rusty-iron gray on the upper parts, and white on the under, the two being separated on the flanks by a broad longitudinal band of dark brown or black; and the hair of the back and neck reversed. The head is white, and is marked with two transverse bands of deep black, rising from the root of the horns and passing down the face, then encircling the eye, and uniting under the lower jaw with those of the opposite side. From this point a black band passes down the throat upon the chest, where it divides into four, one pair of which pass along the flanks and divide the colours of the upper and under parts of the body, the other pair encircles the fore arms; the thighs are likewise black, whilst all the rest of the limbs is white, except a black mark on the canons. On the upper surface, the black line passes down the neck and back, and expands into a broad disk on the rump. These colours are all boldly separated from one another, and the harshness of their contrast produces a very singular effect upon the appearance of this animal.

The *Oryx* inhabits the karroos of South Africa. It is never found in the woods, but keeps on the open plains, and lives in pairs or small families of four or five individuals. It is extremely dangerous to approach when wounded, if not completely disabled, making vigorous use of its long powerful horns, and it is said being not unfrequently the first to commence the assault. We are even assured that the lion himself is afraid to attack this powerful and courageous animal, and that sometimes when, pressed by famine, he has ventured to do so, he has been beaten off with disgrace, or even paid for his temerity with his life. Captain Cumming says that it eats the bulb of the Water-Root, a Liliaceous plant.

56. *O. Beisa* (*Antilope Beisa*, Rüppell), the Beisa. Two specimens of this species exist in the Frankfort Museum, obtained in Abyssinia. They differ from the last species in having no bunch on the throat; the mane of the nape is small and indistinct, and they have no dark mark on the rump.

57. *O. Leucoryx* (*Antilope Leucoryx*, Pallas), the Oryx. This species, also referred to in various writers under the names of the Milk-white Antelope, the White Antelope, and the Algazel, is known to the Arabs by the name of Abu-hard, Jachmur, and Yazmur, and to the Persians as El-Walrugh-el-Bukraa. It is perhaps the most celebrated of all the Antelope genus, being the species which is generally supposed to have given rise to the fabulous Unicorn of the ancients. It is indeed, properly speaking, the *Oryx* of ancient writers, but many modern authors have followed the example of Pallas in bestowing that name upon the *Oryx Gazella* of Southern Africa, with which it is impossible that the ancients could have been acquainted, whilst the present species has received the name of *Leucoryx*, from an epithet bestowed upon it by Ælian on account of its white colour. The horns are at first directed in the plane of the forehead, and have a single gradual and moderate curvature throughout their whole course, forming, as it were, the segments of a very large circle; they are small in proportion to their great length, annulated about half way up, gradually attenuated, and very sharp at the points. The ears are long, erect, and pointed; and the tail is terminated by a very copiously furnished tuft of long hair of a mixed black and gray colour, which reaches below the hocks. The hair on the head, body, and extremities, is universally short, and lies smoothly along the hide, except upon the ridge of the back, where it is rather longer, and reversed, or turned towards the head in a direction contrary to that on the other parts of the body, and forming a short reversed mane from the middle of the back to the occiput. The head is

white, with a brown mark descending perpendicularly from each orbit, and expanding over the cheek, and a similar stripe passing down the centre of the face from the horns to the muzzle; the whole neck

The Oryx (*Oryx leucoryx*).

also, on the throat as well as on the upper part, is of a uniform rusty brown colour, but, with these exceptions, all the rest of the body, as well as the legs and tail, are milk-white.

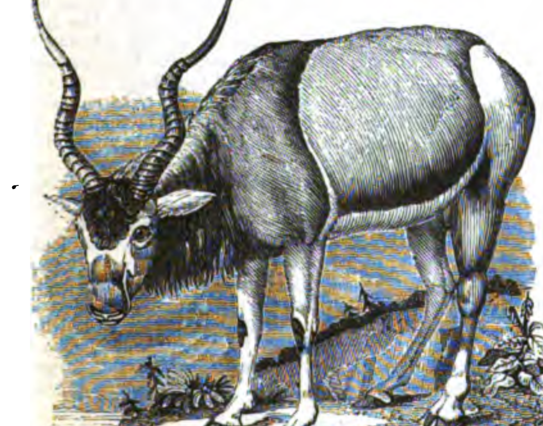
This species is frequently represented on the monuments of Egypt and Nubia, and particularly in the inner chamber of the great pyramid at Memphis, where a whole group of these animals is represented, some being driven or pushed forwards, and others led by the horns or by a cord about the neck, apparently by way of tribute from some subject or conquered nation. With one exception these representations are invariably in profile, so that only one horn is seen. The present species is gregarious, and lives in large herds in Senaar, Nubia, and Senegal, feeding principally upon different species of acacias.

Our engraving of this species is copied from one of M. F. Cuvier, who supposed it belonged to a different species from the present, and referred it to the *Antilope Gazella* of Pallas and the *Algazel* of Prosper Alpinus, both of which we now believe to be identical with *Oryx Leucoryx*.

Addax

Has slender, elongated, ringed, slightly spirally-twisted horns, sloping nearly in a line with the face; the forehead with long hair; the neck with a slight gular mane; the nose hairy, ovine; the hoofs semicircular, thin-edged; the tear-bag marked with a tuft of hair.

58. *A. nasomaculatus* (*Antilope Addax*, Lichtenstein), the Addax.



Addax (*Addax nasomaculatus*).

The Addax is mentioned by Pliny under the name of *Strepsiceros*, which, says he, the Africans call Addax (or it may be Addas, for the accusative *addacem* is the word used in the passage referred to, and it may be derived from either of these forms in the nominative). From the time of Pliny the only information which we had about this animal till a very recent period was derived from a figure and description of the skull and horns sent by our celebrated countryman Caius to his friend Gesner, and inserted in the great work of that early naturalist: the travellers, Rüppell, Hemprich, and Ehrenberg, re-discovered this species, and what is singular enough, under the ancient African name ascribed to it by Pliny, the Arabs still denominating it Akasch, Akas, or Addas, with the addition of the syllable *Abu* (father), which they bestow upon many other animals, as Abu-Hannis (Father John) for the Ibis, &c.

The length of the full-grown Addax is 6 feet from the muzzle to the root of the tail, and its height at the shoulder 3 feet; the horns, measured along the curves, are 3 feet long, the ears 6 inches, and the tail, with its terminating tuft, 1 foot. The animal is therefore about the size of a large ass, of which it has likewise much of the make and proportions, the heavy head, thick neck and legs, and switch tail. The horns are round, rather slender in proportion to their length, twisted outwards and describing two turns of a wide spiral, annulated to within five or six inches of the points, which are smooth and sharp; the form of the horns of the female does not differ from that of the male, but in the young they are almost straight. The ears are pretty long and proportionally broader than in most of the smaller antelopes; the tail reaches almost to the hock, and is terminated by a switch of long, coarse, gray hair. The whole head and neck, both above and below, are of a deep reddish-brown colour, except a transverse mark of pure white across the lower part of the forehead, between the orbits, which expands on the cheeks and half surrounds the eyes; a patch of black curly hair surrounds the root of the horns, and there is a scanty beard of the same colour on the larynx; all the rest of the animal, including the entire body from the neck backwards, as well as the legs and tail, are grayish-white; the hoofs are black, and remarkably broad, to enable the animal to pass more easily over the fine and loose sands of the deserts in which it resides.

These animals live in pairs on the sandy deserts of Central Africa and appear to extend over the greater part of the continent. Hemprich and Ehrenberg found them in Dongola; and a pair of horns were brought from Bornou by Denham and Clapperton, and deposited in the British Museum.

3. *Goatlike Antelopes.*

These Antelopes have a heavy body; strong legs; the hoofs and false hoofs large; the tail very short, flat, and hairy above; the horns conical and recurved.

Capricornis

Has short, strong, conical, inclined, recurved horns, arising behind the orbit; the nose cervine; the muffle moderate; the tear-bag and interdigital pores large.

59. *C. Sumatrensis* (*Antilope Sumatrensis*, Desmarest), the Cambing Outan, or Sumatran Antelope, first noticed by Mr. Marsden in his

The Cambing Outan (*C. Sumatrensis*).

'History of Sumatra,' is about 4½ feet in length, and 2 feet 3 inches high at the shoulder. The horns are 6 inches long, very thick at the base and much attenuated, slightly and uniformly curved backwards. The muzzle is distinct and well formed; the lachrymal sinuses open by a small circular aperture, and between them and the muzzle, on each side, is a long linear space, nearly two inches in length by a quarter of an inch broad, naked, and covered with a soft black integument, which represents the maxillary gland, and secretes a particular humour. The ears and tail are of moderate length, the hoofs very large, the limbs short and stout, and the whole form of the animal robust and powerful. The body is thickly covered with a coat of long hair, of a dark-brown colour, almost black, excepting along the nape of the neck, on the shoulders, and inside the ears, where it is white, and under the lower jaw, which is of a deep straw-colour. The white hairs of the neck and shoulders are much longer than on other parts of the body, and form a kind of flowing mane; the hair on the head and limbs, on the contrary, is much shorter than elsewhere, the knees are without brushes, and the tail, which is rather shorter than the ears, is covered throughout its whole extent with hair of moderate and equal length, and of the same dark-brown colour as that on the body.

The Cambing Outan, or Wild Goat, so called by the Malays, inhabits the hilly forests of Sumatra, and is described by Mr. Marsden as being of a wild character, extremely active and sure-footed, with much of the habits and character of the Common Goat and Ibex, of which it has the roving fearless eye and bold undaunted bearing.

60. *C. Bubalina* (*C. Thar*, Ogilby), the Thaar, Thar, Serow, or Imo, is of a gray, brown, blackish washed colour, with the crown and dorsal streak black; the nose, chin, inside of ears, lower part of mane and legs below the hocks, whitish. It is a native of Nepaul, and is principally known by the drawings and specimens presented by B. H. Hodgson, Esq., to the British Museum.

The Thar inhabits the central region of Nepaul, at an equal distance from the snows of the Himalayan range on the one hand, and the sultry heats of the low plains of India on the other. It is the most common of all the wild ruminants which are found in that country, and its chase is the favourite exercise and amusement of the hill tribes. Its flesh is indeed coarse, but there is plenty of it—and these rude people are easily satisfied on the score of quality, provided the quantity be sufficient. Its habits are wild and solitary; it is seldom found in herds, however small; the grown males especially live apart in the mountains, and never seek the society of their species except during the rutting season. As might be supposed from its heavy make and short stout limbs, it is a slow runner, and is soon brought to bay; but it leaps well, and makes its way over broken ground with greater ease than in open level situations. It is found from the eastern confines of Nepaul to the banks of the Sutlege, but abounds especially towards the east. The Thars differ from the Antelopes in being stout clambering animals, but they are not allied to the Ox-Tribe.

61. *C. crispa*, the Japanese Goat-Antelope, has a harsh crisp brown or brownish fur, with whitish sides, white cheeks, and legs black-brown. It is a native of Japan.

Nemorhedus

Has short, conical, inclined, recurved horns, arising from behind the orbits; the nose ovine, hairy; the fur short.

62. *N. Goral* (*Antilope Goral*, Hardwicke), the Goral, is of a gray-brown colour, minutely dotted with black; cheeks, chin, and upper part of throat, white.

The Goral was first described by General Hardwicke in the 'Linnæan Transactions.'

This animal inhabits the kingdom of Nepaul, and lives in large herds upon the elevated plains which crown the lower ridges of the Himalayan Mountains. It is wild and fleet, and when pursued flies to the rocky hills, where it easily escapes the hunter, and is indeed rarely taken except by stratagem. Its flesh is considered excellent venison. It is entirely confined to the cold upper regions of Nepaul, and is incapable of bearing the sultry heat of the plains of Hindustan.

Mazama

Has small, conical, round, nearly erect horns, slightly inclined backwards, and recurved at the tip, ringed at the base; the nose ovine, hairy; the fur double, the outer very long, hairy, and dependent, the under short and woolly.

63. *M. Americana*, the Mazame, or Spring-Buck. The colour of this creature is white; the horns and edge of the nostrils black. It is the Mountain Sheep-Antelope of Bennett, the Rocky-Mountain Sheep of Jameson. It inhabits the Rocky Mountains of North America.

Rupicapra

Has elongate slender round horns, nearly erect from above the orbit, and suddenly hooked backward at the tip; the nose ovine, hairy; the fur soft.

64. *R. Tragus* (*Antilope Rupicapra*, Pallas), the Chamois or Gems. It is the only animal of western Europe that partakes in any degree of the characters of the Antelopes. The horns are seldom more than 6 or 7 inches long, and are nearly parallel throughout their whole extent. The entire length of the body is about 3 feet 3 inches, that of the head to the root of the horns 6 inches, that of the ears 4 inches, of the tail 3½ inches, and the height at the shoulders rather better than 2 feet. The whole body is covered with long hair, hanging down over the sides, of a deep-brown colour in winter and brownish fawn-colour in summer, being in spring slightly mixed with gray: the head is of a very pale yellow or straw-colour, with a dark-brown band on each side passing from the root of the ears to the corners of the mouth, and encircling the eyes and base of the horns; the tail is short and black, and the edges of the hips and interior of the thighs and ears alone white. The face is straight, as in the goat; the ears small, erect, and pointed; and the chin without a beard. In old individuals, particularly during the severe colds of winter, the cheeks, chin, and throat turn white, and the breast and belly are at all times of a light silvery brown or yellow. Underneath the external covering there is a short thick coat of fine wool, which lies close to the skin, and protects the animal from the rigours of the cold mountain regions which it inhabits. The colours of both sexes are the same, but the females are rather smaller than the males, and have horns less abruptly hooked backwards. They go five months with young, and kid in March or April, producing one or very rarely two at a birth, which they suckle till the October following. The young are at first of a uniform deep yellowish-brown, with the lower jaw, sides of the head and throat, white; and the same dark bands through the eyes as in the adults only not extending so far back on the head.

The Chamois (*Rupicapra Tragus*).

The Chamois, like the Ibex, inhabits the loftiest chains of the primitive mountain ridges, and displays all the vivacity, restlessness, and agility of the common goat. It is extremely impatient of heat, and during summer is only to be found on the tops of the highest mountains, or in deep glens where the snow lies throughout the year: in winter, however, it descends to the lower ridges, and it is then only that the hunters can pursue it with any hope of success. Its senses of sight and smell are remarkably acute; it scents a man at a very great distance, and displays the greatest restlessness and alarm till it obtains a sight of the object of its terror, leaping upon the highest rocks at hand in order to command a more extensive prospect, and uttering a suppressed whistle or hissing sound, being all the time in a state of the greatest agitation; but no sooner does he appear in sight than it flies with the utmost speed, scaling rocks which few other animals could attempt, and, if not intercepted by stratagem, soon leaves its pursuers far behind. The usual and most successful mode of hunting the Chamois is therefore for a party of hunters to unite, and surround some mountain-glen which they are previously known to frequent for the purpose of lying on the fresh snow during the day-time; towards this point the hunters advance simultaneously, when the animals, of course scenting those which come down the wind, retire in an opposite direction and are intercepted by another party. The food of the Chamois consists of mountain herbs, flowers, and the tender shoots of trees and shrubs; it seldom drinks. Nothing can be more admirable than the agility with which it ascends and descends rocks apparently perpendicular. It does not descend at a single bound nor in a vertical direction, but by projecting itself obliquely or diagonally forwards, striking the face of the rock three or four times with its feet for the purpose of renewing its force, or directing it more steadily to the point it aims at; and in this manner it will descend a rock almost perpendicular of twenty or thirty feet in height, without the smallest projection upon which to rest its feet. This animal is extremely partial to salt, and many stones are met with in the Alps hollowed by the continual licking of the Chamois on account of the saltpetre with which they abound. The species is found in all the high mountain-chains of Europe and western Asia, in the Pyrenees, the Alps, the Carpathian and Grecian mountains, the chains of Caucasus and Taurus, and perhaps in other situations.

Antilocapra

Has erect horns arising directly over the orbit, and ending in a conical recurved tip; the nose ovine, hairy; the fur very close; the hairs stiff, coarse, flattened, wavy; the tail very short.

65. *A. Americana* (*Antilope furcifer*, H. Smith), the Cabrit, or Prong-Horn, called Cabree by the Canadian Voyageurs, and The Goat by the Fur-Traders. This animal measures 4 feet 4 inches from the nose to the root of the tail; its height is 3 feet at the shoulder, and the same

at the croup; the ears are upwards of 6 inches long, and the tail about 4½ inches. The horns rise perpendicularly from the skull, immediately above the orbits; they spread outwards, and are perfectly

The Prong-Horn (*A. Americana.*)

straight till within 2 or 3 inches of the points, where they curve suddenly backwards and inwards, forming a small hook, like those of the Chamois. The prong is situated upon their anterior face, and in adult animals about half-way up from the root; below it the horns are strongly compressed, rough and scabrous or pearly, like the antlers of deer; above it they are round, black, and polished. The prong itself is also very much compressed; it is little more than an inch in length, and points forwards, upwards, and a little outwards. The ears are long, narrow, and pointed; the tail short and bushy; the eye large and lively; the limbs long and slender; and the whole form and appearance of the animal peculiarly graceful and elegant. The head, ears, and legs are covered with short close hair of the common description, but that of the body is long and padded, and of a texture altogether different from that of other animals. It is tubular or hollow within like the feather of a bird, but so brittle and devoid of elasticity that it snaps with the smallest effort, and, when pressed between the finger and thumb, crushes like a reed and never regains its original form. It stands directly out at right angles to the hide, is about 2 inches long on the back, sides, and buttocks, but from the ears half-way down the neck it exceeds 6 inches in length, and forms an erect mane, equally conspicuous in both sexes. On the nape of the neck, shoulders, back, and hips, it is of a uniform fawn-colour for half an inch at the point, and light-blue with a tinge of rose-colour at the root; on the sides, chest, and belly, the latter colour prevails at the root, and the point is of a pure and shining white. The extremities are uniform light fawn-colour throughout, except on the interior of the fore arms and thighs, which are white. A broad disk of pure white also surrounds the tail, and passes over the croup, and the throat is likewise marked with two transverse bands of the same colour. This is the winter dress of the animal; but Dr. Richardson, who has well described it in his 'Fauna Boreali-Americana,' informs us that in summer when the new coat appears, it has at first the ordinary texture and appearance of common hair, and that it only assumes the appearances here described on the approach of the cold season.

The Prong-Horn inhabits all the western parts of North America from the 53° of north latitude to the plains of Mexico and California, that is, presuming this species to be the Mazama of Hernandez: it is particularly numerous on the banks of the southern branch of the Saskatchewan, and on the upper plains of the Columbia River, and a small herd annually visits the neighbourhood of the station called Carlton House, where some even linger throughout the winter. They are gregarious, frequent the open plains and hills of moderate height, never inhabit closely-wooded districts, and migrate from north to south according to the season. When the ground is clear, their speed surpasses that of most other animals, but a good horse easily outstrips them after a slight fall of snow. They are extremely curious, and the Indians, and even the wolves, as we are informed by Dr. Godman, know how to take advantage of their curiosity to get within reach of them, by crouching down, and moving forwards or stopping alternately. The antelopes wheel round and round the object of their attention, decreasing their distance at every turn, till at last they approach sufficiently near to be shot or captured. This habit renders them an easy prey, but as their flesh is not much esteemed by the Indians, they are only hunted in times of scarcity. The females produce one kid, and occasionally two kids, early in the month of June.

II. Antelopes of the Desert.

In this section the animals have a broad nose with the nostrils subvalvular, and lined with bristles within. Dr. J. E. Gray divides these into two groups, the *Equine Antelopes*, and the *Bovine Antelopes*.

1. *Equine Antelopes.*

These Antelopes have a broad, depressed, spongy, bristly muzzle, with large nostrils, covered with a large spongy valve.

Connochetes

Has the horns bent down, and outwards on the sides, broad at the base, bent up at the tip; the nose broad, dilated, spongy, bristly; the nostrils large, operculated; the tail elongate, bushy, hairy from the base; the hoofs compressed in front; the intermaxillary bones elongated; the nose-hole rather large; the frontal bone much produced behind. The female has four teats.

66. *C. Gnu* (*Antilope Gnu*, Gmelin), the Gnu or Kokoon, is about the size of a well-grown ass. The neck, body, and tail precisely resemble

The Gnu (*C. gnu*).

those of a small horse, and the pace also, which is a species of light gallop, is so perfectly similar, that a herd of Gnus, when seen at a distance flying over the plains of South Africa, might be readily mistaken for a troop of the wild zebras or quaggas which inhabit the same localities, if their dark and uniform colour did not distinguish them.

The Gnus live in extensive herds on the karroos of South Africa; they are naturally wild and difficult to approach, and when wounded will turn upon the hunter and pursue him in turn, dropping on their knees before making an attack, and then darting forwards with amazing force and velocity. When first alarmed they commence by flinging up their heels and capering like a restive horse, tossing their heads and tails, and butting at the mole-hills or other objects, but immediately after taking to flight, and traversing the desert with a speed which soon carries them beyond the reach of danger. They do not run in a confused crowd like sheep or oxen, but in single file following a leader, and have a pleasing appearance as they skim over the level plains. They are said to be subject to a cutaneous eruption at particular seasons of the year, which they sometimes communicate to domestic cattle, and which invariably ends in death.

The Kokoon (*A. taurina*, Burchell), is identical with the common Gnu, as may be seen by the specimen named Kokoon by Col. H. Smith, in the collection of the London Missionary Society.

67. *C. Gorgon* (*Catoblepas Gorgon*, H. Smith), the Gorgon, or Brindled Gnu, has a convex smooth face, covered with hair lying towards the nose; the chest not maned. It is of a black colour, varied, and striped with gray. It is the Bastard Wilde Beest of the Dutch at the Cape. It lives to the north of the Nu Gareep, or Black River, and though herds feed on its banks, yet it is not known to cross it. It occurs on the large plains north of the Orange River, and when alarmed each herd decamps in long regular files. The flesh is good to eat, and is much sought after. The Betchuanas use the skins for their cloaks and mantles.

2. *Bovine Antelopes.*

These Antelopes have the nose moderately broad, with a moderate or small bald moist muffle; the horns high on the frontal ridge; the grinders rather small, without supplemental lobes; the central cutting-teeth enlarged at the end.

Adelaphus.

Has the horns lyrate on the upper edge of the rather produced frontal bones, thick at the base, and suddenly curved at a nearly right angle; nose moderately broad, cervine; muffle moderate, bald, moist; tear-bag covered with a tuft of hair. The female has two teats.

68. *A. Bubalis* (*Antilope Bubalis*, Pallas), the Bubale, or Bekker-el-Wash, is about the size of the largest stag, and is particularly remarkable for the great length of its head, and its narrow, flat, and straight forehead and face.

The Bekker-el-Wash (*Alcelaphus Bubalis*).

This animal, called Bekker-el-Wash, or Wild Ox, by the Arabs, is common in every part of northern Africa, living in numerous herds on the confines of tho Tell or cultivated parts, and the Sahara or Desert, and also, according to Captain Lyon, upon the mountains south of Tripoli. Barbary seems to be the chief habitat of the species, but it sometimes happens that a few individuals find their way across the Desert to the banks of the Nile, where, however, they are seldom seen, and, as it is said, only when they stray from their native habitat. At the same time it is to be observed, that its representation occurs among the hieroglyphics of the temples of Upper Egypt. Dr. Shaw informs us that the Bubale is naturally of a familiar disposition, that the young calves frequently mix with domestic cattle, and soon learn to attach themselves to the herd without attempting to escape afterwards. They fight like the common bull, by lowering the head, and striking suddenly upwards with the horns, which are formidable weapons either for attack or defence.

69. *A. Caama* (*Antilope Caama*, Cuvier), the Lecama, or Harte-Beest. It is of a gray-brown colour; the dorsal line, streak on face, outer side of limbs, black; a large triangular spot on the haunches whitish. It inhabits the plains of South Africa, and is the most common of all the large antelopes in that country. It resides in large herds, and is a favourite object of pursuit with the natives and colonists. Its pace, when at full speed, resembles a heavy gallop, but is tolerably quick notwithstanding; and the animal has a habit of frequently stopping to gaze at its pursuers when it has got to any distance a-head of them. Its manners are sufficiently mild and tractable, but when put upon its defence it makes good use of its powerful horns, dropping on its knees before charging, and after advancing some distance in this position, darting suddenly forwards with great force against its adversary. The flesh is rather dry, but of a fine grain, more nearly resembling the beef of the ox than that of any other antelope, except perhaps the Eland, and it has a high game flavour which makes it universally esteemed. The female produces but a single calf, which she brings forth in September or April, and which, if taken young, is easily domesticated.

Damalis

Has diverging, sub-cylindrical, lyrate horns; the nose moderately broad, cervine, with a small bald moist muffle between and below the nostrils; an exposed tear-bag. The female has two teats.

70. *D. lunatus* (*Antilope lunata*, Burchell), the Sassaby, or Bastard Harte-Beest, is of a rufous glaucous colour, with the outer sides of the limbs dark. It inhabits the south of Africa, between Latikoo and the tropic of Capricorn. It lives in herds of six or ten, in the flat or wooded districts. The flesh is esteemed. When not disturbed it is confiding and curious, but when hunted it becomes vigilant and shy.

71. *D. Senegalensis*, the Korrigum, is of a reddish-gray colour; the front of the face, from nose to occiput, a small spot behind the eyes, a small streak above the angle of the mouth, streak on outside of limbs above the knees, and tuft of the tail, black. This animal is a native of West Africa, on the Gambia River and Macarthy's Island. It is called Yonga or Yongah by the Joliffs, and Tan-Rong by the Mandingoes. This species was formerly regarded by Dr. J. E. Gray as the *Koba* of Buffon, but he believes now that this animal is referable to the next species.

72. *D. Pygarga*, the Nunni, or Bonte-Boc, is of a simple red colour; the outer side of the limbs darker; the streak between the horns, face, and rump above the tail, white; the temple and upper part of throat whitish; the legs whitish, upper and lower part brown, varied. The female has the throat and under part of the body white. The terms *Kob* and *Koba* are applied to various kinds of antelopes by the negroes, and this is the species to which Dr. Gray believes the horns of the animal belong which accompany his description of the *Koba*.

73. *D. albifrons*, the Bless-Boc, is described by Burchell. "A half-grown specimen," says Dr. Gray, "of this species, when compared

Bless-Boc (*D. albifrons*).

with a similar specimen of *D. Pygarga* in the same paddock, was darker, with a pale spot between the horns, separated by a dark spot from the white on the face; the temple was white, with a white spot; the legs had a brown stripe down the outer side of the front, and the throat and rump brown, the latter without any white spot."

74. *D. Zebra*, the Doria. The skins, without head and feet, are alone known of this animal. The specific name is commemorative of Mrs. Ogilby, whose Christian name was Doria. In the 'Catalogue of the Zoological Society,' it is called the Gilded Antelope. It is a native of West Africa. The skins are of a bright golden-brown colour, with several black cross-bands, narrowing at the end.

We might here close our notice of the family of Antelopes, as we have come to the end of the species in a scientific point of view. But popularly there is another group of Ruminants, which are known under the name of Antelopes, and which were referred to the article 'Antelope,' in the 'Penny Cyclopædia.' This group is not large, but comprises some very interesting forms of the family of Ruminating Animals. It is called *Strepsiceræ*, from the peculiar form of the horns.

Strepsiceræ.

Horns subspiral, inclined backwards; the tear-bag distinct; the nostrils nearly together in front; the forehead flat; the males not bearded on the chin; the fur white, banded or spotted; the females have four teats and a small udder. These animals are distinguished among the Hollow-Horned Bovine Ruminants, by being marked with white stripes and spots. M. Agassiz has observed that the horns of the *Strepsiceræ* and the Sheep are twisted in contrary directions. Mr. Ogilby has observed that the right horn of the *Strepsiceræ* is twisted in the same direction as the left horn of the Sheep, and *vice versâ*. There are four genera of this family which may be thus divided:—

I. Limbs equal. (Natives of Africa.)
  a. Nose cervine. Neck, with a linear mane.
    1. *Strepsiceros.* Horns spiral, keeled.
    2. *Oreas.* Horns straight, with a spiral keel.
  b. Nose bovine. Neck, with long hair.
    3. *Tragelaphus.* Horns subtriangular, subspiral.
II. Hinder legs short. (Natives of Asia.)
    4. *Portax.* Horns short, subtriangular.

75. *Strepsiceros Kudu* (*Antilope Strepsiceros*, Pallas), the Eechlongole or Koodoo, is a magnificent animal of South Africa, and one of the largest of Antelopes, measuring upwards of 8 feet in length, and being 4 feet high at the shoulder. The horns of the male are particularly magnificent; they are nearly 4 feet long, and beautifully twisted into a wide-sweeping spiral of 2½ turns, surrounded by a prominent wreath which follows all their windings, and is gradually obliterated towards the points, which are rather blunt and directed

outwards. They are thick at the base, and marked for some distance up with irregular wrinkles, but not annulated, dark-brown at the bottom, black in the middle, and the extreme points white. They

The Koodoo (*Strepsiceros Kudu*).

spread boldly and widely outwards, and are usually carried couched on each side of the back, on account of their great weight. The whole make of this animal is heavy; the head large and terminated by a broad muzzle; the ears broad and slouching; the limbs thick and robust; and the whole external appearance more nearly resembling that of an ox than of an antelope. The ground-colour of the back and sides is a light fallow-brown, with a narrow white ribbon along the spine, and 8 or 10 similar bands descending from the back, and passing obliquely down the sides and hips; the belly and under parts are pale silvery brown. On the neck and withers is a thin spare mane of a brown colour, and the chin, throat, and breast are furnished with similar long hairs, forming a species of beard. The cheeks are marked with two or three round white spots, and a narrow gray line passes from the anterior angle of the eye down towards the muzzle. The tail is moderately long, and equally covered with short hair.

This magnificent animal inhabits the woody parts of Kaffraria, principally along the banks of rivers, to which it readily takes when pursued, and swims well. It lives in small families of four or five individuals. When taken young they are readily domesticated, and show no inclination to regain their original freedom. The females produce one young at a time. The large antelope called *Aggergeen* by Pearce, in his account of his 'Residence in Abyssinia,' has been supposed, but with little probability, to be the same as the Koodoo of South Africa.

76. *Oreas Canna*, (*Antilope Oreas*, Pallas,) the Impoofoo, Eland, Cape

The Eland (*O. Canna*).

Elk, Canna, or Bastard Eland, is considerably the largest of all the Antelopes, being the size of a good horse, and measuring 8 feet 2 inches in length, and full 5 feet in height at the shoulder. The horns of the male are 1½ foot in length, very thick and heavy, almost staight till within 3 inches of the tips, where they bend outwards, attenuated at the points, and surrounded throughout the greater part of their length with a thick spiral wreath, which passes twice completely round them, and finishes by becoming indistinct near the points. Those of the females are longer and smaller, and the spiral wreath is, in some specimens at least, scarcely to be seen. The head is long and pointed, the ears are large, the neck thick, compressed on the sides, as in the ox, and furnished underneath with a loose hanging skin or dewlap, fringed along the margin with a border of long hair. There is likewise a large protuberance of the size of a man's fist on the larynx; and it was probably from this organ, which is likewise found in the Elk of Europe, that the animal derived the name of Eland, by which it is universally known at the Cape. From the centre of the forehead to the root of the tail runs a short erect mane of dark brown hair, which is reversed on the neck, but directed backwards in the usual manner along the spine of the back. The length of the spinous processes of the interscapular vertebræ produces a considerable and sufficiently remarkable elevation of the shoulders; but there is no actual hump, as in the Camel or Indian Ox, though at first sight such a formation might be supposed to exist. The tail is upwards of 2 feet long, and terminated by a tuft of long black hair. The colour of the body is uniform reddish-fawn on the upper parts, and white on the under; the head and neck ashy-gray, but in some individuals the latter colour extends over all the upper parts of the body.

The Eland is a large heavy animal, which, when full grown, weighs from 7 to 9 cwts. and, contrary to the usual rule observed among Antelopes, is commonly extremely fat. Its flesh is consequently more prized than that of any other wild animal of South Africa, and the large muscles of the thighs, in particular, are held in the highest estimation when dried and cured, under which form they are denominated thigh-tongues. The character of this animal is very mild, and as it were predisposed to domestication; it is gregarious, and lives in large herds upon the open plains and low hills, the old males generally residing apart. Elands were formerly very common in the immediate neighbourhood of Cape Town, but were so much hunted, that they have long since ceased to frequent the inhabited districts, and are now rarely met with except in the more distant and retired parts of the colony. Being generally very fat and pursy, they do not run well, and are soon fatigued; it is even said that when hard run a red oily perspiration has been known to ooze out from the pores of their skin, and that they occasionally drop down from plethora. Like most other animals when hunted, they always run against the wind. As the carcass is weighty and consequently difficult to transport, the great object of the hunters, in the chase of the Eland, is to turn their game in such a direction as to drive it close to their own residence before killing it; and in fact the Cape farmers, from long practice and intimate knowledge of the animal's habits, very frequently succeed in accomplishing this masterpiece of South African field-sports. They are so gentle that a man on horseback may penetrate into the very middle of a herd, without alarming them, and pick out the fattest and best-conditioned, and as the old bulls are commonly chosen on account of their greater size and weight, it not unfrequently happens that the herd is left altogether without a male. There are several very fine specimens of this animal in the Zoological Gardens, Regent's Park, presented by the late Earl of Derby.

Mr. Livingstone says of this animal—"Our party was well supplied with Eland flesh during our passage through the desert; and it being superior to beef, and the animal as large as an ox, it seems strange it has not yet been introduced into England."

77. *O. Derbianus*, the Gingi Jonga, is a species found in Western Africa on the river Cassaman. It is of a pale reddish-brown colour, with the front of the face, the neck, the front part of the under-side, a spot on the front and upper part of the fore leg, and the dorsal streak, dark black.

Tragelaphus

Has horns conical, tapering, with only one spiral turn; tear-bag distinct; neck and throat with longer hair; nape and back with a more or less distinct mane; legs slender; hoofs and false hoofs small; females hornless.

78. *Tragelaphus Eurycerus* (*Antilope Eurycerus*, Ogilby), the Broad-Horned Antelope, has the head pale-brown; a broad band before the eyes, and two large spots on cheeks, chin, and front of upper-lip, white. The horns are elongated, thick, scarcely bent forward at the tip; the throat covered with long black hairs; the specimens of this species have come from the Bight of Biafra.

79. *T. Angasii*, the Inyala, a native of Natal, is distinguished from the last species by the slenderness of its horns, the smaller size of its head, and the dark colour and small size of the bands and spots on the head.

80. *T. scripta* (*Antilope scripta*, Pallas), the Guib, measures 4½ feet from the muzzle to the root of the tail; its height at the shoulder is 2 feet 6 inches, and at the croup 2 feet 8 inches; the horns are 8 inches long, the ears 5, and the tail 6 inches. The horns are straight, a little compressed and twisted spirally upon their axis, with two wreaths passing round them strongly marked at bottom, but obliterated within an inch or two of the points. The general colour is a reddish-fawn marked with white lines and spots. The head is unmixed fawn-colour with a dark mark on the forehead and face, white spots in front and beneath each eye, and another on the cheek, at some distance beneath the opening

of the ear; the sides of the upper lip and the whole space under the chin are likewise white. The neck is unmixed fawn, deep above and lighter beneath, with a white mark on the breast: the body likewise is deep fawn-colour, with a dorsal line of white and black hair intermixed, and rather longer than those on the rest of the body. From this dorsal line originate 8 or 10 narrow transverse ribbons of pure white, which pass obliquely down over the ribs and hips, and are crossed on the sides and flanks by one or sometimes two longitudinal bands of the same colour, running from the shoulder to the hips on each side, in a direction parallel to the dorsal line. All these markings are constant in the species, and equally common to both sexes: they are at regular distances from one another, and, as Buffon has observed, present the appearance of a set of small harness. A few small round white spots are frequently also scattered over the hips and thighs, as in the Bosch-Boc, and the interior of the fore arms, thighs, and legs are likewise of this colour, but the breast, belly, and under parts of the body in general are uniform fulvous brown.

The Guib inhabits the west coast of Africa, from Sierra Leone to the banks of the Senegal, from the latter of which localities it was first brought to Europe by Adanson the naturalist. It is said to associate with its own species, and to form extensive herds, which reside equally in the forests and on the open plains, particularly in the vicinity of Podor and Goree, where these animals are very numerous. Guib is their name in the Joliff language. The colours are sometimes subject to a slight variation as far as regards the number of longitudinal and transverse bands on the sides. Colonel Smith has considered this difference specific, and has bestowed the name of *A. phalerata* upon the variety with a single longitudinal line on the flanks, retaining the original name of *A. scripta* for the variety which is marked with two of these lines. This distinction, to say the least of it, is extremely doubtful, and the difference upon which it is founded is in all probability merely accidental.

81. *T. Decula*, the Decula, is of a gray-brown colour. The back has three or four indistinct cross-bands; an arched streak on the upper part of the side, a few spots forming an arch on the haunches; dorsal line, streak on nose, and front of fore legs, blackish. It was originally described by Rüppell, and is a native of Abyssinia.

82. *T. sylvatica* (*Antilope sylvatica*, Sparrmann), the Bosch-Boc, measures about 4 feet from the nose to the root of the tail, and is 2 feet 6 inches high at the shoulder. The horns are nearly 1 foot in length, thick at the base and gradually attenuated, but ending in rather blunt points; they are twisted on their own axis, but do not form the wide-spreading spiral curves so remarkable in those of the Koodoo: from the base, however, two sharp prominent wreaths, one on the outer and the other on the inner surface, wind spirally round them for the first two-thirds of their length, and are gradually obliterated towards the points, which are smooth and polished. The ears are large and rounded at the tops; the limbs robust but clean and well-formed; the tail of moderate length, and similar to that of the common Fallow-Deer. The male and female are of different colours; the ground-colour of the male is a dark sepia-brown above, and white beneath, the head and cheeks being light and sandy-red, and the extremities fulvous; that of the female reddish-fawn above and white beneath. Two pure white bands cross the throat, one at the junction of the head and neck, and the other at the union of the neck with the chest; the lips and chin are also white; round white spots mark the cheeks, and sometimes the nose in front of the eyes; similar spots are dispersed irregularly over the hips and thighs, to the amount of a dozen or more on each side, sometimes even forming interrupted lines. The hair is of moderate length, but it is smooth and lies close to the body; the backs of the ears are covered with short brown hair; the tail is black above and white underneath, and the pastern joints are marked behind with two oblong spots of the same colour. In very old males the legs become almost uniformly gray, and at all ages there is a white line running down their inner surface even to the very hoof. All these marks are equally found in the females, but not being so prominently contrasted, on account of the lighter ground-colour of this sex, they are not so conspicuous as in the males. There is frequently also a narrow white list along the back, but this is not a constant character in either sex, and is, for the most part, wanting in the females. The young males are of the same colour as the adults, but rather lighter, and the white spots on the hips and thighs more faintly marked.

The Bosch-Boc, or Bush-Goat, as its colonial name implies, resides in the woods, which it never quits but during the bright moonlight nights, or early in the morning, when it comes out to graze on the border of the forest, or to make incursions into the neighbouring gardens and corn-fields. Its voice resembles the barking of a dog, and its deceitful tone sometimes leads the benighted traveller into the most remote and lonely depths of the forest, in the vain search after some human habitation, which he is all the time leaving behind him. It is a slow runner, and easily caught when surprised in an open situation, but it keeps close to the woods, through which it penetrates with great ease, running with the horns couched backwards along the sides of the neck, to prevent them from impeding its course by striking against the branches, and having the neck and throat frequently denuded by rubbing against the underwood, as it forces its passage through the thick covers. The species is monogamous, the male and female being always found either alone, or accompanied by one or two kids, but never by adult individuals. It is common enough in Kaffraria, and in such parts of the Cape Colony as have sufficient forest to afford it a secure asylum; its flesh makes good venison, that of the breast being particularly esteemed.

83. *Portax Tragocamelus* (*Antilope picta*, Pallas), the Nil-Ghau or Nyl-Ghau, one of the largest and most magnificent Antelopes known, being upwards of 4 feet high at the shoulder, inhabits various parts of India, whence it has often been brought to England, where it lives and breeds, and is not an uncommon animal. The face of this species is long and narrow; the muzzle large and naked; the horns about 7 inches long, small, round, and black, rather distant at the base, nearly parallel throughout their whole length, pointed and slightly curved forwards; they are perfectly smooth and without annuli, but rather triangular at the base, and gradually rounded and attenuated towards the points. The lachrymal sinuses are large; the ears 7 inches in length, broad and rounded like those of an ox; the neck deep and compressed like that of the horse, not round and cylindrical as in the

The Nil-Ghau (*Portax Tragocamelus*).

Stag and most other Antelopes; and the tail broad, equally covered with hair on the sides and at the root, but terminated by a long black tuft, and descending to the houghs. The legs are small and well-formed, the anterior rather longer than the posterior; and the spinous processes of the dorsal vertebræ so much elevated between the shoulders as to give the animal the appearance of having a small hump. When at rest, the feet are gathered close under the body, and the tail turned in between the hind legs. The hair is uniformly short and close upon every part of the head, body, and limbs, excepting along the top of the neck and on the shoulders, where it is long, stiff, and upright, forming a thin erect mane which extends from between the ears half-way down the back, and on the middle of the throat, where there is a species of beard composed of stiff bristly hair. The general colour is a uniform slaty-blue on the upper parts in the male, and tawny-red in the female; on the under parts uniform white in both sexes. The limbs and face are almost brown, and the lips, chin, and under surface of the tail, white. There is a large white spot on the throat, and two smaller ones on the cheeks under the lachrymal sinuses; the pastern joints are marked in front with one spot, and in rear with two conspicuous spots of the same colour, which contrast strongly with the dark brown of the surrounding parts, and have suggested the specific name of *Antilope picta* which was given by Pallas to this animal.

The Nyl-Ghau resides in the dense forests of India, whence it occasionally makes excursions very early in the morning or during the night, to feed upon the corn-fields of the natives which happen to be situated in the vicinity of the jungle. It is a vicious animal, of very uncertain temper, and as it is both powerful and resolute, and frequently turns upon its pursuers, it is seldom made an object of chase except by the native princes, who employ elephants for this purpose, or inclose the game in nets. The usual method which the shikarrees, or professional hunters, employ for its capture is to shoot it from an elevated platform when it comes out at night or early in the morning to feed on the confines of the jungle; this being likewise their mode of destroying tigers, wild boars, and other beasts which they dare not attack openly. Even in confinement, and when domesticated from birth, the violent and changeable temper of the Nyl-Ghau cannot be trusted. Previous to making an attack, it drops upon the fore-knees, advancing in this position till within a proper distance, then darting suddenly forwards with the velocity of an arrow, and with a force which no ordinary animal can withstand. Yet, notwithstanding its vigour and resolution, it is the most common prey of the tiger, which the shikarrees often destroy in the very act of devouring the mangled remains of this animal; for, when these are discovered, the hunters always erect their platforms in a convenient situation in the neighbourhood of the carcass, knowing by experience that the tiger is sure to return on the following night to glut himself at leisure with the produce of his previous chase. The Nyl-Ghau has often bred in confinement, both in this country and in India. The period of gestation lasts eight months, and two young are most commonly produced at a birth. At first the young males are of the same reddish-brown colour as the females, and only assume the grayish-blue shade proper to their sex on arriving at maturity: their growth is, however, rapid, and they attain their adult size in the second or third year of their age.

ANTIMONOPHYLLITE. [ANTIMONY.]

ANTIMONY, a silver-white metal, slightly blue, and with a very brilliant lustre. Its hardness is as great as that of gold. It has a specific gravity of 6·7—6·8. It does not combine with oxygen at the ordinary temperature of the atmosphere, but is fused at a temperature a little below red-heat, and burns very vividly. It is a compact brittle metal, and is sometimes found pure in nature, but never abundantly. It occurs mixed with lead, silver, arsenic, and other metals, but its most important ore, and that from which it is obtained for commercial and medicinal purposes, is the sulphuret. It enters into composition with other metals in several alloys used in the arts. *Type Metal* is composed of one-fourth to one-twelfth of antimony, the rest being lead, tin, bismuth, and copper. *Hard Pewter* is made of 12 parts of tin and 1 of antimony; *Britannia Metal* of antimony, tin, bismuth, and copper. The markets are supplied with the ores of antimony from Hungary, England, France, and lately from Borneo. The following are some of the forms in which antimony occurs as a mineral:—

Native Antimony, with a little silver. *Stibnite* is an antimoniate of antimony, the oxide of antimony acting as an acid. There are two oxides or acids of antimony, both of which are found native, and are called *Antimonic Acid* and *Antimonious Acid*. *White Antimony* is a sesquioxide of antimony. *Antimonophyllite* is an impure oxide of antimony. *Gray Antimony* is a compound of three of sulphur and one of antimony. It occurs in masses or veins in Metamorphic and Igneous rocks. It fuses rapidly in the flame of a candle. It is often seen in long prismatic or acicular crystals with strong vertical striæ. *Zinkenite* is a sulphuret of antimony and lead, containing 45 per cent. of antimony. *Plagionite* is the same, but contains only 38 per cent. of antimony. *Feather Ore* is the same, with 31 per cent. *Boulangerite* the same, with 25½ per cent. *Jamesonite* is a sulphuret of antimony, with iron and bismuth, containing 35 per cent. of antimony. *Red Antimony* is also called *Kermes Mineral* and *Antimony Blende*, and is a mixture of the sulphuret and oxide of antimony, containing 75 per cent. of the latter. *Antimoniate of Lead* contains 31 per cent. of antimony. *Arsenical Antimony* contains 62 per cent. of arsenic and 37 per cent. of antimony. *Berthierite* or *Hardingerite* is a sulphuret of antimony and iron. The following are sulphurets of antimony and lead:—*Steinmannite, Killbrickenite, Kobellite, White Silver, Geokronite,* and *Boulangerite.*

(Ansted, *Elementary Course of Mineralogy*, &c.)

ANTIRRHI'NUM, a genus of plants belonging to the natural order *Scrophulariaceæ*. This genus is the type of a section of the order to which also the genera *Linaria, Anarrhinum, Maurandia, Galvesia, Lophospermum*, and *Rhodochiton* belong. It is characterised by a 5-parted oblique calyx; a personate corolla, gibbous at the base, but with no distinct spur; the lobes of the upper lip erect, those of the lower spreading, 3-fid, with the middle segment smallest, and a bearded palate which closes the mouth; the capsule 2-celled, opening by two or three pores at the top; seeds oblong, minute, with black testa. The species are annual or perennial, rarely shrubby. The leaves are feather-veined, and entire, opposite below, and usually alternate above. Two of the species are indigenous to Great Britain. All of them produce showy flowers, and are much cultivated in gardens. Their medicinal properties are not very active.

A. majus, Great or Common Snapdragon, has lanceolate, opposite or alternate glabrous leaves, racemose flowers, ovate obtuse sepals, much shorter than the corolla, and the upper lip bifid. This plant attains a height of one or two feet, and has purplish-red or white flowers. It is found in Great Britain on old walls and chalk cliffs, especially in the neighbourhood of London, but it is undoubtedly a naturalised plant, being truly indigenous in the south of Europe and the north of Africa. In gardens a variety is often seen with double flowers. The leaves are bitter and slightly stimulant.

A. Orontium, Orontium Snapdragon, or Calves' Snout, has linear-lanceolate opposite or alternate leaves; the flowers loosely spiked, distant; the sepals linear and longer than the corolla. This plant appears to be truly indigenous in England and Ireland, where it occurs in dry sandy and gravelly soils. It is also a native throughout Europe, in the islands of the Mediterranean, and the north of Africa. It has been found in Virginia, but it has been probably introduced. Its leaves as well as those of other species have been used as cataplasms in indolent tumors.

Don enumerates twelve other species, many of which have been introduced into our gardens. They are pretty border-flowers, and adapted for rock-work. They are easily cultivated; the perennial species may be increased by cuttings, and the annual raised by seeds. The species from subtropical districts will however require a frame or the greenhouse in the winter.

(Babington, *Manual of British Botany*; Don, *Gardener's Dictionary*.)

ANTRIMOLITE, in Mineralogy, a hydrous silicate of alumina, with lime and potash. According to Dr. Thomson it occurs in stalactitical-looking masses about the length and thickness of a finger, adhering to the summit of cavities in an amygdaloidal rock. In the centre of each stalactite is a crystal of calcareous spar, or a fibrous-looking round mass, pretty long, and having a foliated structure and a brown colour, consisting of calcareous spar. Colour chalk-white. Texture fine silky fibrous. The fibres diverging from the central nucleus. Opaque. Dull. Hardness 3·75. Specific gravity 2·0964.

When heated it loses water and hydrochloric acid. Before the blowpipe it softens into an enamel, and with phosphate of soda gives very slowly a transparent colourless glass. It gelatinises in hydrochloric acid.

Found on the sea-shore at Bengore, about four miles from the Giants' Causeway, on the north coast of the county of Antrim.

Analysis by Dr. Thomson:—

Silica	43·470
Alumina	30·260
Lime	7·500
Potash	4·100
Protoxide of Iron	0·190
Chlorine	0·098
Water	15·320
	100·938

AO'RTA, from a Greek word, ἀορτή. The aorta is the great vessel from which all the arteries of the body which carry red blood derive their origin. It arises from the upper and back part of the left ventricle of the heart. Its origin is directly opposite the lower margin of the cartilage of the third rib on the right side of the chest. From this point it ascends behind the pulmonary artery, still inclining a little to the right side of the chest. It continues to ascend as far as the top of the second vertebra of the back. All this part of the vessel is called the *Aorta Ascendens*. When it reaches as high as the lower margin of the first rib, it bends obliquely backwards towards the body of the third vertebra of the back. This part of the vessel is called the Curvature or the Transverse Arch of the Aorta. From the third vertebra of the back, where its arch terminates, it proceeds in a straight course downwards through the chest, immediately in front of the spinal column, and towards the left side of it. Through an opening formed for it in the diaphragm it passes from the chest into the abdomen. All this part of the vessel, namely that extending between the termination of the arch and the diaphragm is denominated the Descending or the Straight Portion of the Thoracic Aorta. Having passed through the diaphragm into the abdomen, it is called the Abdominal Aorta. It continues to descend along the front of the spine a little obliquely, until it reaches the fourth vertebra of the loins: here it divides into two branches of equal size, and may be said to terminate, for it now loses the name of aorta; the two great branches into which it divides being denominated the Common Iliac Arteries. [HEART.]

A'PATITE, a mineral substance crystallised in the regular six-sided prism, usually terminated by a truncated six-sided pyramid. It occurs variously modified by the removal of its lateral sides and angles. Its specific gravity varies from 3·25 to 3·5. It is scratched by felspar, but scratches fluor-spar. In colour it passes from white through various shades of yellow to green and blue, and some specimens possess a red tint. It is usually translucent, but rarely transparent. From the analysis of G. Rose, Apatite appears to be a compound of phosphate of lime with fluoride of calcium, in which the fluorine is more or less replaced by its isomorphous element, chlorine.

This mineral principally occurs in the Primitive rocks, and is found in the tin-veins of St. Michael's Mount, Cornwall, and also in those of Bohemia and Saxony. It has also been observed in a massive mineral called phosphorite, which appears to possess a similar chemical constitution, and has been found abundantly in beds alternating with limestone and quartz, near Logrosan, in Estremadura in Spain. Since the practice of applying phosphate of lime to the soil has come into use, it was proposed to employ this mineral; but it does not appear that any of the phosphate of lime which is now used in artificial manures is obtained from this source. The phosphate of lime thus employed seems to owe its origin to an organic cause. [COPROLITES.]

APE is sometimes employed in Zoology to express a genus of Quadrumanous Mammals, which closely approaches to the human species in anatomical structure, and is justly regarded as the connecting link between man and the lower animals. The word ape seems to be of doubtful origin: in German it is *Affe*, from which the verb *äffen* appears to have come. This is perhaps more probable than to suppose that *affe* comes from *äffen*. The name exists, with very slight variation, in all the modern languages of Teutonic origin; as *Ape* in English, *Affe* in German, *Aap* in Dutch, &c. These also are the only European languages which possess original appropriate names to distinguish these animals from monkeys in general. Our own language is even more copious than others in terms for distinguishing the different characters of this class of animals; thus we say that an *Ape* is a monkey without a tail, and a *Baboon* a monkey with a short tail, reserving the term *Monkey* more particularly for those species which have very long tails; and though our early writers use these three words indiscriminately as synonymes, and apply them indifferently to the same animal, yet the significations here given have generally prevailed since the time of Ray, and are now almost exclusively adopted. It must be confessed however that these significations are extremely vague, and certainly do not express the zoological relations which subsist between the different sections of this group of animals.

According to its modern zoological definition, the genus *Ape*, or *Pithecus*, comprises those quadrumanous mammals which have the teeth of the same number and form as in man, and which possess neither tails nor cheek pouches. This definition, whilst, on the one hand, it excludes certain tailless baboons and monkeys, comprehends, on the other, the three sub-genera of Orangs, Chimpanzees, and Gibbons. Nor are these the only characters which the Apes share in common. They, of all other animals, approach most nearly to the human species in organisation, although their points of inferiority are more numerous than at first sight appear. The arms are so long as almost to touch the ground when the animals stand erect on their hind legs; but the legs themselves are scarcely one-third of the entire height. The legs moreover are not in the same line with the thighs; the knees are turned outwards, and the feet are articulated at the ankle in such a manner that their soles turn inwards so as to face or be opposed to one another. By these means the Apes are enabled to embrace or grasp the trunks and branches of trees with much greater force than if their members were constructed like our own. They thus become essentially sylvan or arboreal animals, and never voluntarily abandon the forests, where they find at once the most congenial food and the most perfect security.

The Chimpanzee.

Their whole organisation peculiarly adapts the Apes to these habits. Besides the conformation of the extremities just noticed, the fingers and toes are long, flexible, and deeply separated from one another, and the thumb, or interior finger, is completely opposeable to the other four, as well on the posterior as on the anterior extremities: thus, their feet and hands are equally formed for prehension. They are not Quadrupeds, as Buffon has justly observed, but Quadrumana; not four-footed but essentially four-handed animals. One part of their organisation renders them intermediate between the bats and ordinary mammals; another makes them the connecting link between man and the inferior animals. The great length of the fingers and anterior extremities, compared with those behind, are precisely what we observe among winged mammals, only that the fingers are not connected by a flying membrane; and their economy and habitat equally correspond with this intermediate structure. They are neither confined to the surface of the earth like the generality of mammals, nor do they possess the power of elevating themselves into the air, like the bats; but they choose a middle habitat, the forests, where they habitually reside, and where they move about with an ease and velocity which can only be compared to actual flight. On the other hand, when compelled by circumstances to traverse any part of the earth's surface, their pace, properly speaking, is neither that of a biped nor of a quadruped; they do not walk upright like a man, nor yet do they walk upon all-fours like the lower animals. The great length of their arms prevents them from adopting either of these modes of progression in its simple form, but they avail themselves of this very circumstance in another manner. Their long arms serve them instead of crutches, and their pace is precisely that of a lame man who walks with the assistance of these instruments. From the oblique articulation of the posterior extremities, they rest only on the outer edge of the foot, but the wavering equilibrium thus occasioned is secured by the long fore-arms, which can easily touch the ground in all directions; and, when an advance is to be made, it is accomplished by resting the weight of the body upon the half-closed fists, and then swinging the hinder extremities forward, precisely like a man on crutches. In their native forests the extreme length of their fore-arms is turned to the greatest advantage: here it acts upon the principle of the rope-dancer's balancing-pole, and completely secures their equilibrium even with the most precarious footing. Thus it is that travellers have seen the Apes poised at the very extremity of the slender trunks of the bamboo, waving their long arms from side to side with the most graceful and easy motions.

Orang-Outan.

Another circumstance in the structure of the Apes, in which they differ from most other Quadrumana, has considerable influence upon their habits; this is the entire want of a tail. Though the presence of this organ does not always indicate a corresponding function, and though its absence is not confined to this group of quadrumanous animals, yet a long tail would seriously embarrass the nearly erect motion of the real Apes; whilst its use is in other respects superseded by the length of the fore-arms, which supply its place in adjusting the proper balance of the body, the only function which the tail performs in the common monkeys. But another character of still greater importance distinguishes the real Apes from the rest of the Quadrumana, namely, the want of cheek-pouches. These are sacs or cavities in the cheeks, which open inside the mouth between the cheek and the lower jaw, and serve to hold any extra provision which the animal may not at the moment require. The *Semnopitheci* alone, of all the other monkeys of the old world, resemble the Apes in this respect, and hence arise some of the most striking resemblances which the characters and habits of these two genera present. In other respects they are sufficiently distinguished from one another by the long tails of the *Semnopitheci*, not to mention their extremities of nearly equal length, and the peculiar structure of their stomachs and teeth. Another character, which is common to all the other known Quadrumana of the old continents, is found in some species only of the real Apes, and is absent in others: this is the possession of Callosities, which are naked callous parts of the buttocks, upon which these animals sit when fatigued by the violent and rapid movements which they habitually execute. Illiger and some other zoologists have considered this circumstance of sufficient importance to warrant the separation of the Apes into two distinct genera, the one characterised by the absence of callosities, the other by the presence of them; but it is to be observed, that, even where these organs do exist in the Apes, it is always in a rudimentary form; they are never developed to such an extent as to influence the habits of the animals, and are consequently unfit to be considered as generic characters. In other respects, except in these diminutive callosities, the Gibbons do not differ from the Orangs and Chimpanzees; they have the same system of dentition, the same organs of sense, and the same singular modification of the locomotive organs; their manner of life also is precisely the same; both equally take up their habitation in the thickest and most solitary forests; they inhabit the same countries, and live upon the same food.

The teeth of the Apes, as indeed of all the other monkeys of the old world, are of the same number as in man; nor, as far as the incisors and molars are concerned, do they present any difference in form; but in the adult animals, and more especially in the old males, the canines are developed in the same relative proportion as in the Carnivora; the tusks of the full-grown Orang-Outan are at least as large as those of the lion, and are most formidable weapons. Unfortunately we know but little of the manners of these animals in their adult state; but this circumstance gives us strong reason to suppose that the extreme gentleness and placidity observed in the young individuals usually brought into Europe do not always continue to characterise them in their native climates, but that their disposition alters in proportion to the development of their muscular force, and that in their adult state they are as formidable and mischievous as the Baboons themselves.

The characters and habits of the Apes present differences which will be noticed in speaking of the several species. As far however as their general manners have been observed, they appear to be of a grave and gentle disposition, totally free from that petulance and mischievous curiosity which so strongly characterise the monkeys, properly so called, are very affectionate towards those who treat them kindly, solemn and deliberate in all their actions, extremely circumspect and intelligent, seldom moved to violent passion, but peevish and fretful when crossed or disappointed. They never walk on two legs except when they have occasion to use the fore hands in carrying something. Nearly or altogether deprived of callosities, they do not repose in the manner of ordinary monkeys, on their hams, but stretch themselves on their sides, like human beings, and support their heads upon their hands, or by some other means supply the use of a pillow.

For an account of the most remarkable Apes see CHIMPANZEE, ORANG-OUTAN, and GIBBON. For an arrangement of the species and their relation to other Monkeys see SIMIADÆ, and QUADRUMANA.

APEREA, a species of Wild Guinea-Pig. [HYSTRICIDÆ.]

APETALÆ, Plants without Petals, constitute one of the divisions in Jussieu's arrangement of plants according to a natural system. They comprehend all genera which are Dicotyledonous or Exogenous, and which have a calyx without corolla. By some they are called Monochlamydeous. The character by which these plants are defined is as constant as any of those which botanists employ for subordinate divisions, but it must not be considered absolute; for not only are many of the genera which, in consequence of their natural affinities, are included among Apetalous Plants provided with rudimentary petals, but it occasionally happens that in orders otherwise constantly furnished with a corolla, particular genera occur in which no petals are produced; a very remarkable instance of which is to be met with in the pretty little shore-plant found on most of the sandy beaches of this country, and called *Glaux maritima*. This species is very nearly related to the Primrose, and certainly belongs to the same natural order as that plant, but it has no corolla; in place of which the border of the calyx becomes coloured, and it therefore apparently belongs to the apetalous division, although, in reality, it forms an exception to the character of monopetalous plants.

APHANESITE, a mineral consisting of arsenic acid and oxide of copper, with water.

APHERESE, a mineral consisting of phosphoric acid and oxide of copper, and water.

APHIS, the Plant-Louse, or *Puceron*, an extensive genus of insects belonging to the order *Homoptera*. They are interesting to naturalists on account of their very peculiar economy, and no less so to gardeners and farmers, on whose crops many species commit most destructive depredations. As instances of the latter we may refer to the Hop-Fly (*A. Humuli*), and the Bean-Dolphin (*A. Fabæ*), whilst all our garden flowers, such as the Rose, the China-Aster, the Chrysanthemum, and others, suffer from their attacks. During the summer of 1833, the cabbage and turnip crops in Kent were much injured and often destroyed by countless swarms of *A. Brassicæ*.

These insects are characterised by a soft oval body, a small head, entire and semi-globular eyes, antennæ of seven joints longer than the body, often setaceous, sometimes thickened towards the top, the two joints at the base very short, the next very long and cylindrical. The beak (*haustellum*) arises from the under part of the head between the fore legs, and descends almost perpendicularly. The wings, when developed, are four in number, but some naturalists represent the upper wings rather as wing-cases (*elytra*), from their difference of texture. The legs are very long and slender, in consequence of which they walk awkwardly.

At the extremity of the abdomen most species are furnished with a pair of projecting tubes, through which they eject a sweet viscid fluid, well known under the name of honey-dew, erroneously supposed to be an exudation from the leaves on which it is found. It is also said that the Aphides feed on this, which is impossible from the structure of their mouths. Ants however and bees are very fond of it.

In sketching the history of these singular insects, it will be most convenient to begin it at the close of autumn, when many of the species, such as *A. Quercus*, *A. Rosæ*, &c., are numerous, some winged and some without wings, of both sexes, so that while the first may fly to a distance, the second are confined to their native plant or its vicinity.

After pairing, the mother Aphis deposits what have been by some naturalists termed eggs, in a place suitable for their passing the winter; but different places are chosen by different species. Some choose the oak, and place the eggs on an exposed twig high on the tree, others in the sheltered crevices of bark, or even under ground. Bonnet seems to be of opinion that the Aphides are always viviparous and never lay eggs, what are commonly called eggs produced in autumn being a sort of cocoon, consisting of the young Aphis inclosed in an envelope. From our own observations on those of the oak, we are convinced that this is the fact; but we cannot affirm, upon negative evidence, that none of the species lay real eggs.

The cocoons or eggs, whichever they may be, remain torpid during the winter (the parents having died after producing them), and are called into life with the return of genial weather in the spring. The number of insects produced must of course correspond to the number of cocoons or eggs laid the preceding autumn, but being all ushered into active life at the same time, their simultaneous appearance has led to the popular but erroneous notion, that they are generated by the air. Blighting weather, as it is termed, is also accused of spreading the destructive swarms over hop-grounds or bean-fields, but their rapid increase is wholly caused by their wonderful powers of multiplying.

All the Aphides, it has been well ascertained, which appear in spring are exclusively females, no males being found till the autumn; and these females are endowed with a fecundity almost incredible. M. Latreille says that one female during the summer months will produce about 25 a day, and M. Réaumur calculated that one Aphis may be the progenitor, during its life, of the enormous number of 5,904,900,000 descendants. It is not necessary for the young female Aphides produced during summer to pair with a male, which indeed would be impossible, as no males are then to be found; yet these females go on producing each their 25 a day of living young ones, all of which become in a short time as fertile as their parent.

The following calculation of the fecundity of a species of Aphis from Professor Owen's lectures on 'Comparative Anatomy,' will afford some explanation of the extraordinary numbers in which these creatures sometimes occur. "The *Aphis lanigera* produces each year 10 viviparous broods, and one which is oviparous, and each generation averages 100 individuals:—

1st generation		1	Aphis produces
2d	„	100	one hundred
3d	„	10,000	ten thousand
4th	„	1,000,000	one million
5th	„	100,000,000	one hundred millions
6th	„	10,000,000,000	ten billions
7th	„	1,000,000,000,000	one trillion
8th	„	100,000,000,000,000	one hundred trillions
9th	„	10,000,000,000,000,000	ten quatrillions
10th	„	1,000,000,000,000,000,000	one quintillion.

If the oviparous generation be added to this you will have a thirty times greater result."

The female Aphides thus produced must be regarded as larvæ, but they present a more developed condition than the larvæ of Coleoptera and Lepidoptera. The compound eyes are developed on the head, and the antennæ have acquired their mature form and proportions; the six thoracic legs have attained their due growth and development. The only change which these fertile larvæ afterwards undergo is increase of size, and development of the reproductive tissues. In the last generation, which, according to the species of Aphis, is the seventh, ninth, or eleventh, the power which they possess of producing individuals like themselves ceases. In the last generation wings are acquired, and male insects also with wings appear. It is these insects which produce eggs, and deposit them where, under the genial influences of the sun, they are hatched, and thus produce the multitudes which make the attacks of these creatures so remarkable.

The number of species of Aphis is very large. In the 'List of Specimens of Homopterous Insects' in the collection of the British Museum, drawn up by Mr. Francis Walker, 326 species of this genus are described. Almost every species of plant gives support to a different species of Aphis, each of which has been described with very great accuracy in the list above mentioned.

The effects of the attacks of these insects is sometimes of national importance. In the year 1802 the hop-duty fell from 100,000*l.* to 14,000*l.*, on account of the great increase of the Aphis. When the Aphis has been absent the duty has risen as high as 500,000*l.* The *Aphis Rosæ* is most destructive to the beautiful plant on which it is constantly found. Apple-trees and pear-trees are attacked with a species which injures greatly their produce. In most cases these insects are green, but a black species attacks the bean; whole acres of these plants will be suddenly covered by these insects. Their attacks on all plants seem regulated by the health of the plant. If atmospheric conditions occur which render plants unhealthy, then the Aphis makes its appearance. If these cease, the Aphis then disappears also, and one crop of plants will be attacked several times in the same year. The Aphides have their natural enemies. The larvæ of the Lady-Bird (*Coccinella*), the *Syrphus* or Bee-like Fly, the *Hemerobius perla*, and several species of *Ichneumonidæ*, devour with great avidity several species of Aphis.

The chief remedy for the destruction of the Aphis is tobacco. Where plants can be brought together under cover they may be easily exposed to tobacco fumes, but in the open air this is not so easily effected. In this case the best plan is to apply the tobacco in water. The affected branches or parts of plants may be syringed with the infusion, and afterwards washed with pure water. [*See* SUP.]

APHRITE, in Mineralogy, a crystalline variety of carbonate of lime.

APHRODITA, a genus of Dorsibranchiate Annelidea. It is easily known from the rest of the order by two longitudinal ranges of broad membranous scales covering the back, and under which the gills lie concealed in form of little fleshy crests. The body is generally flattened, and shorter and broader than in other Annelides. [ANNELIDA.]

APIOCRINI'TES (Miller), a Fossil genus of Crinoidea, found in the Oolitic formations and in the Chalk.

A'PIUM, a genus of plants belonging to the order *Umbelliferæ*. The only species of this genus of any importance is the Common Celery (*Apium graveolens*). This valuable vegetable is found naturally in the ditches of almost every part of Europe. It is even met with in the Falkland Islands, where, if it was originally carried thither, it has naturalised itself. In this country it is very common in many places, as for instance in the ditches near Sandwich.

It is a remarkable fact that this plant, which is so sweet and wholesome when cultivated, is altogether acrid and unfit for food when wild. It is by some supposed that the difference between the quality of the two states is owing to so large a part of the stem and leaves of the cultivated species being hidden from the action of light by the soil which is heaped up about it, and being in consequence unable to generate in much abundance the peculiar principle on which the acridity depends. Whatever may be the value of this explanation, it evidently does not apply to the variety called Celeriac, in which the sweetness and wholesome character of cultivated celery are maintained, although the leaves are not at all deprived of the full influence of light. [CELERY, in ARTS AND SC. DIV.]

APOCYNA'CEÆ, Dogbanes, a natural order of plants belonging to the Monopetalous subdivision of the Exogenous class. Among these they are known by their flowers being perfectly symmetrical, the segments of the corolla all twisted one way, like a Catherine-Wheel, five distinct stamens, a superior ovarium which when ripening divides into two parts that diverge from each other at right angles, and by their stems yielding, when wounded, a copious milk. The milk is generally poisonous, and that quality is general in the order, which abounds in plants the action of whose juices upon the human body is more or less violent. Among these, the Tanghin poison of Madagascar [TANGHINIA] and *Nux vomica* [STRYCHNOS] are remarkable instances. But some of the species are not unwholesome; as the Hya-Hya, or Milk-Tree of Demerara, and the Cream-Fruit of Sierra Leone. Caoutchouc is yielded in abundance by *Vahea gummifera*, *Urceola elastica*, and *Willughbeia edulis*. Several other species yield medicinal agents, but they are not much employed in the European practice of medicine. Considering, however, the great prevalence of poisonous qualities in the order, drugs obtained from any of its species should be administered with very great caution, until it has been ascertained that they may be employed without danger. The order *Apocynaceæ* is only distinguishable from *Asclepiadaceæ* by the stamens being distinct from the pistil, and by the pollen not being contained in little waxy bags.

A'PODES, in Zoology, an order of Fishes, including, according to the Linnæan system, all those which want the ventral fins, but restricted by Baron Cuvier to those which, besides possessing this character, are likewise Malacopterygious. In the latter sense, the Apodal Fishes compose a small natural family, almost restricted to the great genus *Muræna*, and of which the Common Eel offers a good and familiar example.

APOPHYLLITE, a crystallised mineral, whose fundamental form is the square prism, fig. 1. Its most general modification is obtained by supposing the angles of fig. 1 cut off, so as to give rise to a plane triangular surface, as is seen at *a* in fig. 2; these faces *a*, from the plane cutting deeper into the original crystal till they intersect each other, frequently lose their triangular form, and of course, at the same time, the face P again becomes a square, and the prism will be terminated by the form seen in fig. 3. On account of these modifications, Apophyllite sometimes assumes the form in fig. 4.

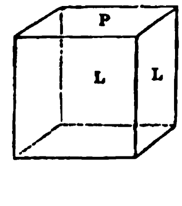
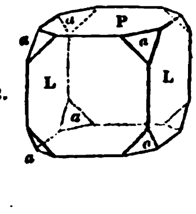


Fig. 1.

Fig. 2.


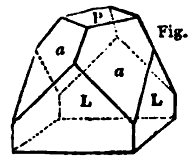
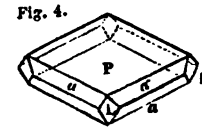


Fig. 3.

Fig. 4.


The inclination of P on *a* is 120° 5′
" L on *a* is 128° 20′
" *a* on *a* is 104° 18′

The structure of this mineral is lamellar, and admits of cleavage in directions parallel to the sides of the regular prism, but most readily in the perpendicular to its axis. Its colour is white or gray, sometimes tinged green or red. It possesses various degrees of transparency, and occurs even opaque. In hardness it approaches nearly to Apatite; and its density varies from 2·3 to 2·5. Before the blow-pipe it forms a white glass. Its chemical constitution is stated as follows:—

$$8\ (Ca + 3\ Si) + (K + 6\ Si) + 16\ Aq$$

and the mineral is therefore an hydrated silicate of potash and lime.

Apophyllite has been found in the mines of magnetic iron-ore of Sweden and Norway; in the lead-mines of the Harz Mountains; also in the cavities of several basaltic rocks, at Marienberg in Bohemia; at Fossa in the Tyrol; in the Isle of Skye, &c. In the basalts it is usually accompanied by *Analcime* and *Stilbite*.

This mineral is sometimes called *Tesselite*. *Albin* is a white variety.

APOTHE'CIA (from the Greek ἀποθήκη, a case, a repository), in Botany, a name given to some of the organs of reproduction in *Cryptogamia*. In Lichens the reproductive matter appears on the surface of its frond or thallus in two forms. First, in the form of little coloured cups or lines with a hard disk surrounded by a rim, and containing tubes filled with sporules; and secondly, in the form of little heaps of pulverulent matter, which are scattered over the surface of the thallus. These last are called *Soredia;* the first, *Apothecia*. These organs form the principal means of distinguishing the various forms of lichens, and consequently it has been found convenient to indicate minor points in their structure by other names. Thus the Apothecium, which in English is called a Shield, has various names according to its form: *Scutellum* is a shield with an elevated rim; *Pelta*, a flat shield; *Tuberculum*, a convex shield; *Trica* or *Gyroma*, a furrowed shield; *Lirella*, a linear shield; *Globulus*, a round deciduous shield; *Pilidium*, an orbicular hemispherical shield. The parts of the Apothecium or Shield have also obtained distinct names: thus *Perithecium* is the inside of the shield, in which the sporules are immersed; *Hypothecium* is the substance that surrounds or overlies the perithecium; *Nucleus* is the disk of the shield, which contains the sporules and their cases; and *Asci* are the tubes in which the sporules are contained.

Apothecia is also the name given to the cases in which the organs of reproduction of many of the *Algæ* are contained. The reproductive granules contained in the Apothecia of both Lichens and Algæ are called by some writers *Gongyli*.

APSENDE'SIA (Lam.), a genus of Fossil *Polypiaria*, from the great Oolite near Bath.

APTERYX, a genus of Struthious Birds, inhabiting Australia and the islands of New Zealand. It was first described by Dr. Shaw, who regarded it as an extinct form of bird. It evidently belongs to a group of birds that were destined to live on the earth, only as long as they were free from the attacks of carnivorous enemies endowed with greater powers of motion than themselves. Numbers of wingless birds, not belonging to the Struthious division, as the Dodo and Solitaire, seem already to have become extinct; whilst the smaller congeners of the *Dinornis* are suffering in like manner. The Apteryx is not however extinct, as many stuffed specimens exist in the museums of England; and, at the present moment (June, 1853), there is a living specimen in the gardens of the Zoological Society, Regent's Park. Of all birds at present known the Apteryx appears to have the wings the most reduced to their simplest rudiments. Its general form is that of the Penguin, and in size it is seldom quite so big as our common goose. The beak is very long and slender, marked on each side with a longitudinal groove, and covered with a membrane at its base. It differs from other birds in the completeness of its diaphragm, and in the absence of abdominal air-cells. The bones are not hollow, as is mostly the case in birds; the sternum is very small, and the ribs are extraordinarily broad; the feathers have no accessory plume, and their shafts are prolonged beyond the back; the feet have a short and elevated hind-toe, of which the claw alone is externally visible.

The native name of this bird is *Kiwi-Kiwi*, given it on account of its peculiar cry. It is a nocturnal bird, and preys on snails, insects, and worms. Whilst at rest it has the singular habit of resting on the tip of its bill, which is its most characteristic position.

Apteryx (*A. australis*).

It runs with considerable rapidity, and when hunted by dogs it makes a hole in the earth for the purpose of concealment, or it retires into the natural cavities of the rocks. When attacked it defends itself with considerable vigour. The natives hunt it for the sake of its skin, which is used by the chiefs for their dresses, and on this account it is highly valued.

A'PTYCHUS (Von Meyer), one of the generic names of a singular Fossil, supposed to be the remains of a Conchiferous Mollusk, or the opercular shell of a Cephalopod. Its other names are *Trigonellites*, *Ichthyosiagonites*, and *Lepadites*. The species belong to the Ammonitiferous strata, and specimens sometimes occur (as at Solenhofen) in the last chamber of the Ammonites. The structure is fibrous.

AQUATIC ANIMALS. The element in which animals habitually reside, or to which they occasionally resort for the purpose of procuring food or seeking shelter, is so intimately connected with, and bears so obvious a relation to, not only their manners and economy, but likewise their outward forms and internal structure, that it is not surprising that those who first turned their attention to the study of zoology, and sought to introduce the principles of classification into the animal kingdom, should have been so forcibly struck with its importance as to have made it the primary basis of their system. "Animals," says Aristotle ('Hist.' b. i. c. 1), "may be distributed into different classes according to their manner of living, their actions, their character, and their parts. . . . . Considered according to their manner of living, their actions, and their character, they are divided into terrestrial and aquatic. The aquatic are divided into two classes; the one, as is the case with many fishes, pass their whole life in the water, breathe that element, and find their food in it; nor do they ever leave it: the others obtain their food in the water, and even habitually reside in it, but they do not breathe it; they breathe air, and bring forth their young on dry land. Among these latter some are provided with feet and walk upon dry land, others have wings and fly, and others, like the water-serpent, have no feet. . . . . Aquatic animals inhabit seas, lakes, marshes, and rivers." These principles of classification, in which the habits of animals take precedence of those modifications in their organic conformation which produce these very habits, have long since ceased to be adopted by scientific naturalists; notwithstanding which there is perhaps no inquiry which can engage the attention of the zoologist more fruitful in extensive views and interesting results than the consideration of the organic structure of animals in relation to the element in which nature has ordained them to live.

Those animals which reside entirely in the water, and seek their food and nurture their young in that element, have their organisation, even to the most minute circumstance, rigidly adapted to these purposes. The extremities by which progressive motion is performed in the acts of walking and flying would be a serious impediment to the movements of animals residing in an element of the same specific gravity as their own bodies: these organs accordingly are either entirely wanting, or are reduced to mere rudiments, which serve indeed to keep the body steady and preserve its equilibrium, but are entirely useless in assisting its progression. Such are the fins of fishes, and the flippers, as they are called, of the Whale. The real organ of progression in both cases is the body itself, which is prolonged and attenuated towards the tail, compressed on the sides, and provided with extremely powerful muscles, with which, by alternately striking the water on either side, the animal propels itself forward with a force and velocity unexampled in any other class of animated beings. It is upon this principle that a boat is urged forward by means of a single oar in the stern. The great majority of these animals not only reside habitually in the water, and seek their food there, but likewise breathe that element, and are consequently furnished with an appropriate apparatus for extracting the oxygen gas from its general mass. These tribes may reside at any depth of the ocean and for any length of time; they are not under the necessity of coming frequently to the surface for the purpose of breathing, and their organisation is modified accordingly. Instead of having the tail broad horizontally, it is broad in a vertical direction, which enables them to turn with astonishing rapidity, and is no impediment, but rather an assistant to their forward movements. But the case is different in the Whales and allied animals, which, though residing entirely in the water, breathe air by means of lungs like ordinary Mammalia, and are consequently obliged to come continually to the surface. For this purpose they are provided with a powerful cartilaginous tail flattened horizontally, by moving which upwards or downwards as the occasion requires, they ascend to or descend from the greatest depths of the ocean with almost incredible speed. Fishes, though capable of proceeding straight forwards, or of turning with great rapidity, are comparatively slow in changing their depths; and if they breathed air, they would frequently be suffocated before they could arrive at the surface, from the vertical position of the tail not being adapted to propel them in a vertical direction. But by a simple change, merely by the direction of the tail being altered from the vertical to the horizontal position, the object of nature is accomplished, and the air-breathing Cetaceous Animals are adapted to all the circumstances of an aquatic life. Another beautiful adaptation is observed in the position of the mammæ, for the *Cetacea*, like warm-blooded quadrupeds, suckle their young; these are situated upon the breast, and when the young animal requires to suck, the mother stands, as it were, upright in the water, with her head and shoulders elevated above the surface, supporting herself by means of her flippers, or fore paws. In this position she is enabled to supply her cub with the food which nature has provided, and which she could not have accomplished had the mammæ been placed in any other position.

There is another extensive tribe of aquatic animals, which are provided with perfect articulated members, sometimes indeed supplied with fringes which convert them into a swimming apparatus, but always adapted to enable the animals to walk or crawl along the bottom. Such is the case with all the Crustaceous tribes—the crabs, lobsters, prawns, &c.; and these animals, as is well known, can walk on dry land with the same ease as at the bottom of the ocean. When they swim, it is by means of the tail, which is always constructed for that special purpose, and is large and powerful.

Nor is the modification of structure less striking when we examine those land-animals which breathe air, and resort only occasionally to the water. As they are intermediate in habits, so are they likewise intermediate in structure between these two extremes; and the degree in which their organisation is modified, when compared with either of the two types, is exactly proportioned to the difference of their habits and economy. All Mammals and Reptiles, for instance, which seek their food in fresh-water rivers and lakes, partake more of terrestrial than of aquatic habits. The extent of water with which they are conversant is, in this case, very small when compared to the extent of land, and their organisation differs but slightly from that of ordinary land animals; their extremities are perfectly developed, and of the ordinary form, the principal difference being that their toes are united by an expanded web or membrane, which gives the paw a broad oar-like form, and thus converts it into a convenient instrument of swimming, at the same time that it scarcely interferes with the most perfect freedom of walking and running on land. Of this nature are the extremities of all the vertebrated terrestrial animals which seek their food in fresh water, the otters, beavers, &c. among mammals; the whole order of Natatores, comprising the ducks, swans, pelicans, gulls, auks, puffins, &c. among the birds; and the crocodiles, alligators, fresh-water tortoises, and frogs, among the reptiles. All these animals are, properly speaking, web-footed, and their aquatic habits are less prominent and powerful than their terrestrial; their organs of motion in fact are but little different from those of common terrestrial animals. In those which frequent the salt-water, on the contrary, the aquatic habits greatly predominate over the terrestrial: they live less on land than in water and the structure of their extremities approximates more to that of purely aquatic than of terrestrial animals. Their legs are short, and inserted, or as it were buried, in the common integuments of the body, as far as the elbows and knees respectively, leaving apparent only a short fin-like paw, which is unadapted to terrestrial progression, exactly in proportion to its fitness as an organ of swimming. Their progress on land is consequently slow and difficult; they creep rather than walk, dragging the body along the ground, and leaving a broad mark behind them. Few species possess even this limited power of terrestrial motion; those which do however have the structure of the extremities a little less approximated to the form of fins than the purely oceanic species. The seals and walruses, for instance, have the bones of the paws and feet similar to those of ordinary land-quadrupeds, only much shorter and more flattened, and the hind legs are thrown backwards in the same direction as the tail. Still they are enabled to use the extremities in a certain degree for walking or creeping on dry land; but the numerous tribes of cetaceous animals, which can execute no kind of motion whatever out of the water, have the bones of the anterior extremities flattened and connected together like the stones of a mosaic pavement, whilst the posterior members are entirely wanting. The same is the case with the sea-tortoises, or, as they are more properly called, turtles, when compared with those which frequent fresh-water ponds and rivers; the form of their extremities approximates more nearly to that of fins than of feet, and their aquatic habits constantly predominate over their terrestrial.

Thus it is that the peculiar form of the extremities not only indicates the degree in which an animal is aquatic, but even the nature of the element which it frequents. If it inhabits fresh-water ponds and rivers, its feet are simply webbed between the toes, but in other respects perfectly developed, and its terrestrial habits predominate over its aquatic; if, on the contrary, it inhabits the salt water, its feet are flattened into the form of fins, the hind legs are thrown backwards into the plane of the body, and the aquatic habits greatly predominate over the terrestrial. The first are, properly speaking, *web-footed*, the second *fin-footed*.

AQUATIC PLANTS, or WATER PLANTS, are those plants which live entirely in water, or which require a preponderating quantity of water as the medium of their existence. The families of plants, like the families of animals that live in the water, are found to belong to all classes into which the whole have been divided, although those belonging to the lower classes are by far the most prevalent. Many of the families of plants having the highest organisation have members belonging to them which are inhabitants of the water: of this the *Ranunculus aquatilis* is an example in the natural order *Ranunculaceæ*. All the species of the orders *Nymphæaceæ*, *Callitrichaceæ*, *Ceratophyllaceæ*, and *Podostemaceæ*, belonging to the class Exogens, grow in water. Among Endogens, the orders *Butomaceæ*, *Naiadaceæ* or *Fluviales*, *Pistiaceæ*, *Alismaceæ*, &c. consist entirely of water-plants; whilst one of the largest of the few families into which Cryptogamic Plants are divided, the *Algæ*, consists almost entirely of plants which live in the water.

For the purpose of studying the distribution of the vegetable kingdom, water-plants are distributed into several groups. One of the first divisions that suggests itself in the study of their forms is derived from the composition of the waters in which they grow. Thus we have those which grow in the saline waters of the ocean, and those which grow in the fresh waters inland. Most of the plants which grow at the bottom of the ocean or float in its waters belong to the family of *Algæ*. [ALGÆ.] There are however many plants not belonging to this order which require the influence of salt-water on the soil on which they grow for their production. Thus species of the genera *Salsola*, *Anabasis*, *Salicornia*, and *Glaux* will not grow but where they can feel the influence of salt-water: hence they have been called *Plantæ Salinæ*. These plants are found not only where the sea washes, but wherever salt springs find their way to the surface of the earth. There is another group of plants which have their existence determined by saline waters, but are always found near the sea or on the banks of rivers to which the sea has access. Such are species of *Chenopodium*, *Heliotropium*, *Vitex*, *Eryngium*, *Samolus*, and the Mangrove (*Rhizophora*). These are called *Plantæ Littorales*, *seu Maritimæ*.

The largest proportion of Fresh-Water Plants belong also to the natural order *Algæ*, although by far the most conspicuous specimens belong to the tribes of Exogenous and Endogenous plants. As the sea claims nearly all the species of the genus *Fucus* and its allies, so the fresh-water claims the majority of the species of the old genus *Conferva* and its allies.

Aquatic Plants, in Horticulture, are those which naturally grow in deep water, and are carefully distinguished by the cultivator from marsh-plants. The management of them, when they are hardy, is of the simplest kind, nothing being necessary beyond planting them in boxes with holes in the sides, and sinking them 3 or 4 feet below the surface of a pond, so that the boxes lie upon or among the mud at the bottom.

But for those which demand the protection of the stove or greenhouse, some additional precautions are requisite. If left to themselves in such situations, the uniformity of temperature is such as to deprive them in some measure of the repose that they naturally receive from the alternation of seasons; kept constantly in a growing state, their excitability is gradually destroyed, and death ensues as a matter of course. The plants which demand special treatment are chiefly those which belong to the natural order *Nymphæaceæ*. [WATER-LILY.] The most beautiful of these is the *Victoria regia*. Various methods have been recommended; but they all depend for their success upon keeping in view the principle of periodical rest and rapid growth under a high temperature, with but little air during the season of vegetation.

AQUAVIVARIUM, a term proposed to be applied to arrangements which contemplate the exhibition of living aquatic specimens of animals inhabiting either fresh or salt water. Although it has been known from the earliest times that animals living in water may be kept in small glass vessels for exhibition by the daily supply of fresh-water, the discoveries of modern chemistry have pointed out how animals may be kept living in only limited quantities of water which never demand renewing. The possibility of accomplishing this depends on the absolute balance in nature which exists between the animal and vegetable kingdoms. [ANIMAL KINGDOM.] The one set of these beings are for ever engaged in giving off what the other requires, and in taking up what the other rejects. It is thus that the carbonic acid which is constantly being thrown off the tissues of animals is taken up by plants, and thus prevented from contaminating the atmosphere; whilst the plant is constantly engaged in giving off oxygen gas, and supplying the atmosphere with this element of its composition which is necessary to the life of animals. The relations which are thus found to exist on the large scale of the whole surface of the earth, are found also to occur in a jar of water. If an animal is placed in pure water it quickly exhausts the oxygen it contains, and gives out into it carbonic acid gas; the consequence is, that it is quickly poisoned unless fresh water with oxygen is supplied. But if we place with the animal some plant that lives in water, it will be found that the carbonic acid given out by the animal will be taken up by the plant, and that it will give out oxygen in its place. Thus the water becomes cleared of its injurious compound, and the needed element, oxygen, is supplied. This is really what takes place in every pond and pool where the water is fresh, and all that is required to make the inhabitants of the pond visible is to put the whole pond, plant, and animals into a glass-case. Such a plan has been tried with great success, and we propose to call the apparatus in which it is effected an Aquavivarium.

The first experiments were made with fresh-water, and we believe the public is indebted for one of the earliest accounts of such an arrangement to Mr. Warington, chemist to the Apothecaries' Company. He found out, however, that it was not sufficient to have simply any kind of plants and animals; but that, in order to maintain the balance correctly, it was necessary that certain animals which lived on decomposing vegetable matter should be present. At certain seasons of the year the tendency to decomposition in the water-plants becomes so decided that the water would be rendered impure if this decomposition was not arrested. The cure for this was found in the addition of fresh-water Mollusca to the jars containing such fish as the gold-carp and stickleback and such plants as the *Vallisneria spiralis*, *Callitriche*, &c. The best kind of snails for this purpose are the various species of *Planorbis*. Not only is it necessary that this latter precaution be taken to ensure the success of the experiment, but it is of importance to guard against the preponderance of animal life. Although in most cases it appears that there cannot be too many plants for the health of the animal as long as they grow healthily and do not decompose, yet it often happens that the excess of animals over plants in a given space will destroy the balance, and lead to the destruction of life. We are not aware that any precise experiments with regard to the quantity of water and the number of plants and animals have been yet performed. We can however state as a fact, that a gold-fish has lived for nearly twelve months in about two gallons of water with several flourishing plants of *Vallisneria spiralis*. It is probable that a smaller quantity of water would have served equally well.

Amongst the fresh-water plants adapted for growing in such jars or tanks as we have mentioned, are the *Vallisneria spiralis*, various species of *Chara*, *Anacharis Alsinastrum*, *Stratiotes Aloides*, *Callitriche autumnalis*, *C. vernalis*, *Myriophyllum spicatum*, and *Ranunculus aquatilis*. Such jars afford a good opportunity for cultivating the various species of fresh-water Confervæ, which all assist in keeping the water pure. One of the most beautiful of these is the *Hydrodictyon utriculatum*, which may be easily propagated in this manner.

Although these results have been known for many years, it is only recently that any attempts have been made to carry out the same plan with regard to marine animals and plants in sea-water. The only plan adopted of keeping the Marine Invertebrate Animals was the laborious one of supplying them every day with water from the sea. For upwards of thirty years Sir John Dalyell carried on his observations on sea-animals in the city of Edinburgh upon this system. It was however known generally amongst naturalists, that by exposing sea-water to the action of the air by pouring it from one vessel into another, it became perfectly purified. In this way many persons succeeded in maintaining alive, in the heart of London, *Actiniæ*, Star-

Fishes, and other low forms of marine animal life. It was however left for Mr. Warington to demonstrate what others had often theorised on, and that was, that marine plants purified sea-water just as fresh-water plants purified fresh-water. That the same idea had occurred to others is proved by Mr. W. Thomson's communications to the 'Annals of Natural History' (May 1853), and Mr. Gosse's account of Marine Vivaria in his 'Naturalist's Rambles on the Devonshire Coast.' The difficulties, however, are greater in maintaining the balance between the plants and animals in sea-water than in fresh. This arises from the more sluggish life, both of marine plants and animals, and the greater amount of disorganised matter which they throw from their surfaces. By care in the selection of sea-weeds, avoiding those which are large and throw off much matter from their surface, and not overcrowding the water with animal life, jars or tanks containing sea-animals and sea-plants can be easily managed. Mr. Warington recommends green sea-weeds, such as the species of *Porphyra*, &c. Mr. Gosse speaks favourably of *Chondrus crispus*, *Iridæa edulis*, and the *Delesseriæ*. In jars or tanks containing these plants various forms of sea-animals have been successfully kept for many months.

The greatest experiment of this kind which has hitherto been attempted is in a large glass-building that has been erected in the gardens of the Zoological Society, Regent's Park It was opened to the public in May, 1853. This building contains an area of 60 feet by 25 feet. The sides of this parallelogram are bounded by ponds of plate-glass, each being about 6 feet in length and 2 feet 6 inches in depth. They are placed at a height of about 3 feet from the ground, so that each division presents as it were a submarine picture 'on the line,' and may be approached so closely that the minutest animals not microscopic, may be watched with the most perfect success, under circumstances which differ as little as possible from those of nature. The whole of these tanks are supplied with gravel, sand, rocks, and sea-weeds, so as to imitate the rock-pools left on the sea-shore by a receding tide, which indeed they may be said to represent; but with this great advantage to the observer, that instead of looking vertically into a cavity in which the light becomes less and less in proportion to the depth, he has here the means of examining each animal in its turn, under an effect which is not only most delightful in itself, but which, the water being seen in section through perfectly transparent walls, afford the best possible position for investigating the structure and functions of the living beings contained in it.

At present the water in the ponds or tanks in this establishment has not been left to the purifying influence of the plants which are placed in them; a certain quantity of water being supplied to the fresh-water tanks every day, whilst the salt-water is gradually drawn off and supplied again by dropping, so as to effect aëration by means of tubes above the tanks. This however is only precautionary, at the commencement of an experiment on so large a scale.

The tanks contain fresh-water animals and marine animals. The fresh-water tanks present all the more common species of British Fishes, as the Pike, Tench, Perch, Roach, Rudd, Carp, Eel, Stickleback, Minnow, Gudgeon, &c. Some of the larger forms of fresh-water Crustacea, as the Crawfish, have also been introduced. With these are placed a large variety of the fresh-water Mollusca, belonging to the genera *Limnea*, *Planorbis*, *Anodon*, *Unio*, &c. These tanks have been occupied since Christmas, 1852, with scarcely any loss.

The marine tanks are those which will undoubtedly always form the most attractive feature in an Aquavivarium, as we are less conversant with the habits of these creatures of the mighty deep, than with those of our ponds and rivers. In the establishment in Regent's Park all the classes of the Invertebrate Animals are represented as well as the fish among the Vertebrate.

Amongst the Radiate Animals none are more remarkable for their power of resisting destruction than the *Actiniadæ*, and all experimenters agree that they are amongst the animals which may be most successfully kept in the Aquavivarium. All the more common British species are now to be seen in the Regent's Park, and some of remarkable size and beauty. The Sertularian Zoophytes and the Polyzoa are also there, but their animal inhabitants are too minute to be seen with the naked eye. Specimens of the *Echinodermata*, including several forms of Star-Fishes (*Asterias*), the Sun-Star, the common Sea-Egg, and a species of *Holothuria*, which have lived for some weeks, prove that undoubtedly these beautiful forms of animal life will live in confinement, and lead to the hope that some of the rarer sorts from tropical oceans may find their way to our collections.

As was to be expected, the *Mollusca* thrive. In the sea they play the same part as in the fresh-water: they are the scavengers of the ocean. The Pinna, the Oyster, the Pecten, the Cockle, amongst bivalves; and the Whelk, the Periwinkle, with many other univalves, have demonstrated how large a field of observation is in store for those who study the Mollusca. Several species of those gems of the ocean, the Nudibranchiate Mollusca, whose forms and colours are only known to us through the great work of Alder and Hancock, have been successfully kept alive; whilst the red leaves of the species of *Rhodymenia* have been starred with their eggs. Various forms of Ascidian Mollusca have lived, and complete the evidence that this great group of animals may be watched in their living habits as easily as their shells may be examined in a cabinet.

The *Articulata* are represented in these tanks by species of Lobster, Crab, Shrimp, and Prawn. Though many of these are inhabitants of the deep ocean, and only reward the labours of the dredger, yet they live perfectly well in the shallow lodgings provided for them by the Zoological Society. These facts demonstrate that amongst the Invertebrate tribes there are none whose habits may not be studied in the Aquavivarium.

As yet the evidence is not complete with regard to marine fish. The only species at present tried in Regent's Park have been the smaller species that frequent the rocky pools of our coasts. Amongst others, the Cork-Wing (*Crenilabrus Cornubicus*), the Fifteen-Spined Stickleback, the Long-Spined Cottus, two species of Blenny, and a Goby, testify how far this portion of the collection may be extended.

As far as experiment has gone, the success of the Aquavivarium is complete; and it is not too much to suppose that the time will speedily arrive when in every exhibition of animal life glass-tanks will be fitted up for the purpose of illustrating the habits of marine and fresh-water animals. As there are scarcely any limits to the size of which vessels made with square plates of glass can be constructed, we may hope to see sporting in our zoological collections some of the monsters of the deep of whose actions and life we know absolutely nothing, and of whose forms we only judge by the shapeless masses which their skins present when stuffed, or their carcasses when bottled in spirits of wine.

Before concluding this article, we would call attention to the fact that the principles on which the Aquavivarium is constructed are also adapted to facilitate the removal from place to place of marine and fresh-water animals. These tanks may be easily fitted up on board ships, and, with a little attention from day to day, many of those creatures which are only known to the naturalist by its skeleton or its name, might be secured, and brought into our living museums.

(*Athenæum*, May 28, 1853; *Annals of Natural History*, May, 1853; Gosse, *A Naturalist's Rambles on the Devonshire Coast;* Dalyell, *Remarkable Animals of Scotland*.)

AQUIFOLIA'CEÆ (from *aqua*, water, and *folium*, leaf), *Holly-Worts*, a natural order of plants belonging to the Polycarpous group of Polypetalous Exogens. The species consist of trees or shrubs, with alternate or opposite coriaceous leaves. The flowers are small, axillary, solitary, or fascicled. The sepals 4-6, imbricated in æstivation; the corolla 4- or 5-parted, hypogynous, imbricated in æstivation; the stamens inserted into the corolla alternate with its segments, filaments erect, anthers adnate; no disk: the ovary fleshy, superior, somewhat truncate, with from 2 to 6 cells; ovules solitary, pendulous from a cup-shaped funiculus; stigma subsessile, lobed; the fruit fleshy, indehiscent, with from 2 to 6 stones; the seed suspended, nearly sessile, with large fleshy albumen, and a small 2-lobed embryo lying next the hilum, with minute cotyledons and superior radicle. (Lindley.)

This order, which is named after the *Ilex aquifolium*, the Common Holly [ILEX], was included by Jussieu in *Rhamnaceæ*. It has however been well characterised by Brongniart, in his memoir upon Rhamneous Plants, under the name *Ilicineæ*.

This order differs from *Celastraceæ*, in which it is often included as a section, in the form of its calyx and corolla, in the insertion of the stamens, and in the structure of the ovary and fruit. It agrees closely with *Ebenaceæ*, from which, according to Brongniart, it only differs in possessing hermaphrodite flowers, and stamens equal in number to the segments of the corolla.

This order has but one representative in Europe, the Common Holly (*Ilex aquifolium*). The great bulk of the species are found in North and South America; some are found at the Cape of Good Hope.

The useful plants of this order are found in the genera *Ilex*, *Myginda*, and *Prinos*. *Ilex* is remarkable for yielding in one of its species, *I. Paraguensis*, the alkaloid *Theine*, the same principle that is found in the *Thea Chinensis*. [TEA, PARAGUAY; ILEX.]

Myginda was named after Francis von Mygind, a German botanist. *M. uragoga* is a native of South America, near Carthagena. It has small dark shining red flowers, and bears a red soft fruit about the size of a pea. It is called by the Spaniards *Yerva de Maravedi*, and a decoction of the root is used as a diuretic. *M. Gongonha*, a native of Brazil, in the provinces of St. Paul and Minas Geraes, has also the reputation of being a powerful diuretic, and its roots are used in infusion or decoction by the natives.

Prinos (from the Greek for the holly, πρῖνος), Winterberry.

P. verticillatus, Whorled Winterberry, is a native of North America, from Canada to Virginia, in sandy wet woods, and on the borders of swamps. The flowers are white, and the berries are of a crimson red. The bark is bitter, and has been substituted for Cinchona Bark in the treatment of fever. It is said to act as an antiseptic, and is used in America as an application to gangrenous sores, and also in infusion or decoction, as a lotion in cutaneous disorders.

P. glaber is a low handsome shrub, with white flowers and a black fruit; hence, in Jersey, it is called Ink-Berries. It is a native of North America, from Canada to Florida. Its leaves are said to be a good substitute for those of the Paraguay-Tea Plant, and are used for making tea.

There are several other species of *Prinos*, some of which are hardy, and well adapted for shrubberies. They will thrive in most light soils, but do best in peat. They may be propagated by laying down the shoots or by seeds. The stove species should be grown in a mixture of loam and peat, and cuttings will root freely in sand, under a hand-glass. Most of the species of Aquifoliaceous Plants may be cultivated in the same manner.

(Don, *Gardener's Dictionary;* Burnett, *Outlines of Botany;* Lindley, *Natural System.*)

AQUILA, the generic name of the Eagles. (FALCONIDÆ.)

AQUILARIA. [AQUILARIACEÆ.]

AQUILARIA'CEÆ, *Aquilariads*, a small natural order of plants belonging to the Incomplete Exogens. The species are trees with smooth branches and a tough bark. The leaves are alternate, entire, seated on short stalks without stipules, and when full-grown are smooth and shiny, with very fine veins running together into a marginal vein just within the margin. The calyx is turbinate or tubular, limb 5-cleft, segments spreading, persistent, with an imbricated æstivation, the orifice furnished with 5- or 10-bearded scales (metamorphosed stamens). The stamens are 5 or 10 in number; when 5, they are opposite the segments of the calyx; the filaments are short or absent, smooth, inserted into the orifice of the calyx a little lower down than the scales, except in cases where they are united to the tube of the calyx; the anthers are narrow, oblong, attached by their back below the middle, 2-celled, opening internally and lengthwise; the ovary is superior, sessile or stipitate, downy, compressed, 1-celled, having internally, upon each flattened side, a linear prominent placenta resembling a dissepiment, hence spuriously 2-celled, with a very narrow partition; ovules two, of which one is suspended from each placenta, tapering downwards; the style is either absent or conical and thread-shaped; the stigma is simple and large; the fruit is a capsule, pear-shaped, compressed, sessile or stipitate, 1-celled, 2-valved, the valves bearing in the middle the placentæ, which almost touch each other. One seed is mostly borne on each placenta (one is sometimes abortive); the seed rises up by aid of a funiculus, originating near the apex of the placenta, and is furnished with a tail-like aril, which descends straight from the hilum to the bottom of the capsule; the radicle is straight and superior, the albumen is absent, and the cotyledons thick, fleshy, and hemispherical.

This order, which consists at present of only three genera, was constituted by Robert Brown, who regarded it as having so close an affinity with *Chailletaceæ* as to see no objection to making it a section of that order. He also pointed out its relation to *Thymelaceæ*, in which he is followed by Lindley, who says, "*Aquilariaceæ* chiefly differ from *Thymelaceæ* in their dehiscent fruit, and probably also in the direction of their radicle. In both orders the ovary is superior and 1-celled; both have similar scale-like bodies at the orifice of the calyx, and no petals; both suspended ovules, a single style, and capitate stigma." De Candolle places the order between *Chailletaceæ* and *Terebintaceæ*.

All the species of *Aquilariaceæ* are natives of the East Indies.

The three genera of this order are *Aquilaria, Ophiospermum*, and *Gyrinops*. Of the last two little is known. One species of each has been described. There are three species of *Aquilaria*.

A. Malaccensis, the *Bois d'Aigle*, or Eagle-Wood, is a native of Malacca, and produces a whitish-yellow wood. This is the *A. ovata* of some botanists. *A. Agallochum* is a native of the East Indies, where it is called Ugoor, or Ugooroo, by the natives, and Lignum-Aloes, or Aloe-Wood, by the Europeans. The wood has a fine scent, and is supposed to be the Calambac, or Agallochum, of the ancients.

A. secundaria is another species which also yields a scented wood, and has been known in the Materia Medica, and used in perfumery, under the names of Agallochum, Lignum-Aloes, and Aloe-Wood. In a healthy state this wood is said to be white and inodorous; but it is subject to the attacks of disease, which causes the secretion of a resinous matter, and the wood then becomes coloured, and gives out a powerful scent. This secretion resembles camphor in many of its properties, and has a bitter flavour: hence the name Aloe-Wood. In medicine it is recommended in the same diseases as the fetid resins and volatile oils, and does not seem to possess peculiar properties; so that it is not used as a medicine in Europe. The Cochin-Chinese are said to make their paper from the bark of this or some kindred species of *Aquilaria*. These trees must not be confounded with the *Aloexylon Agallochum*, or Aloe-Wood, which is a tree belonging to the natural order *Leguminosæ*, and which also yields a scented wood used by the Chinese in medicine and perfumery.

(Don, *Gardener's Dictionary;* Lindley, *Natural System;* Royle, *Illustrations.*)

AQUILE'GIA, literally the Water-Gatherer, because the leaves collect water in their hollow, is a small genus of plants, commonly called Columbines, belonging to the order *Ranunculaceæ*, of which several species are cultivated in gardens. They are known from *Aconitum*, to which they are the most nearly related, by the leaves of the calyx being all of the same form and size, and by the petals having each a long curved horn or spur at the base. All the species are handsome perennials, easily propagated by dividing the crown of their roots: the commonest, hence named *A. vulgaris*, is found in woods and thickets in this and all other parts of Europe; it has produced many varieties, differing in the colour of the flowers, and in the multiplication of the petals, for the sake of which it is commonly cultivated. The other species are found either in the north of Asia, or in North America. They are all acrid plants, but much inferior to Aconite in their medicinal properties; hence little attention has been given to them.

A'RACHIS, a genus of plants belonging to the natural order *Leguminosæ*. One species, *A. hypogæa*, is called the Earth-Nut. The circumstance by which the *Arachis hypogæa* is particularly remarkable is the manner in which its fruit is produced. Instead of hanging down from among the leaves in the manner of other plants, this conceals itself in the earth, in which it is deeply buried at the period when it becomes ripe, a phenomenon which happens thus:—The young fruit, instead of being placed at the bottom of the calyx, as in other kinds of pulse, is found at the bottom and in the inside of a long slender tube, which looks like a flower-stalk. When the flower has withered, and the young fruit is fertilised, nothing but the bottom of this tube with its contents remains. At this period a small point projects from the summit of the young fruit, and gradually elongates, curving downwards towards the earth. At the same time the stalk of the fruit lengthens, until the small point strikes the earth, into which the now half-grown fruit is speedily forced, and where it finally ripens in what would seem a most unnatural position. When mature, it is a pale-yellow wrinkled oblong pod, often contracted in the middle, and containing two or three seeds the size of a hazel-nut. These are considered a valuable article of food in Africa and the tropical parts of Asia and America. In flavour the nuts are as sweet as an almond; and they yield, when pressed, an oil in no respect inferior to that of olives.

The plant will only grow in a light sandy soil, in which its pods can readily be buried, and it requires a climate as hot at least as that of the south of France. Its stems grow from one to two feet high; its leaves are composed of four broad and blunt leaflets; and its flowers are small and of a pale yellow colour.

ARA'CHNIDA, a class of animals including Spiders, Mites, and Scorpions, all ranked by Linnæus under Insects, but which are very properly separated from them, on account of external form, structure, and habits. The separation was first made, we believe, by Fabricius, who, looking chiefly to the structure of the mouth, characterised the greater number of the animals now ranked under *Arachnida*, by the jaws (*maxilla*) being horny and furnished with a claw (*unogata*). M. Lamarck afterwards made the *Arachnida* a distinct class; but we owe to M. Latreille and Dr. Leach the establishment of characters more precise, and extending to a greater number of genera. Much has been done in perfecting the knowledge of their structure, manners, and numerous species by Clerck, De Geer, Walckenaer, Treviranus, Leon Dufour, Herold, Straus-Dürckheim, Blackwall, and others. We shall condense into as short a compass as we can the most important points investigated by these naturalists.

The *Arachnida* (*Acera*, Virey) differ from Insects in having no antennæ; in the eyes being in most species 8, and, even when only two in number, never being placed laterally on the head; in the legs being usually 8, though in some species 6, and in others 10; and in their respiratory apparatus consisting of radiated tracheæ, communicating with a sort of gills inclosed in pouches in the lower part of the abdomen.

The skin or crust of the *Arachnida* is in general more leathery than horny; but whether it be soft, as in most species, or hard, as in a few, it performs a similar office to the bones of larger animals in giving support to the soft parts and attachment to muscles, the legs being joined upon and radiating from a common breast-plate (*sternum*) externally; while, according to Straus-Dürckheim, there is also an internal breast-plate of a gristly texture (*un sternum cartilagineux intérieur*) in form of a horse-shoe, the two ends of which are directed forwards.

The greater number of the *Arachnida* are carnivorous, and are furnished with appropriate organs for their predatory life. Some parasitic species, such as the minute Parasite Mites (*Lepti*, De Geer), which we have observed infesting numerous species of insects, from the largest butterflies to the smallest gnats, are furnished with a sucker, in some respects constructed like that of the Gadfly (*Tabanus*). In other species, there may be distinguished a pair of upper jaws (*mandibula*), a pair of under jaws (*maxilla*), carrying jointed feelers (*palpi*), and between them a sort of tongue formed by a projection from the breast. At the back part of the mouth is placed a piece of a horny texture, which Savigny, Latreille, and Audouin term the *pharynx*, forming the entrance into the gullet. The gullet, together with a bulging on the fore part of it, termed the stomach, as well as the intestines, run in a straight line from the pharynx to the vent. Near the upper portion of the gullet are found salivary vessels, whose exterior aperture is in the first joint of the upper jaws. The saliva secreted by these vessels appears to be poisonous. Lower down are the biliary vessels, which resemble those of insects.

In the greater number of *Arachnida* there is a complete and very distinct circulatory system. The heart, which differs materially from the dorsal vessel by some termed the heart in insects, occupies the abdomen, and its pulsations may be distinguished externally. It is a thick longitudinal vessel, giving origin to a certain number of arteries, and receiving veins by which the blood returns from the respiratory organs in other parts of the body.

The respiratory organs have two striking peculiarities, upon which M. Latreille founded his two great divisions of *Arachnida*.

The division furnished with air-pipes, similar to those of insects, comprises Harvest- or Shepherd-Spiders (*Phalangia*), Mites, and several other genera. "The presence of air-pipes (*trachées*)," says M. Latreille, "excludes all complete circulation, that is, the distribution of blood to different parts, and its return from the respiratory organs to the heart."

The other division of the class comprises the numerous species of Spiders, and the Scorpions, which M. Straus-Dürckheim and Leon Dufour place first. Their respiratory apparatus consists of small cavities formed by the union of a great number of triangular white laminæ of extreme thinness. The number of these is usually two, but in some species there are four, and in others eight. The external apertures of these, termed spiracles, and, as M. Latreille well remarks, objectionably *stigmata*, are transverse chinks, corresponding in number with the pulmonary pouches.

The nervous system of the *Arachnida* is ganglionic, consisting of nerve-knots (*ganglia*). In man and the larger animals, a ganglion is composed of two substances similar to the cortical and medullary substances of the brain, and differs from nerves in being firmer in texture, and covered with a membrane of closer tissue. In the *Arachnida* these nerve-knots are more concentrated, if the term may be used, than in Insects, and they are uniform in composition, rather than a chain of ganglions equally separated. Thus, in the Harvest-Spiders (*Phalangia*) there are a pair of nerve-knots in front of the gullet, and at the back of the gullet a medullary mass, apparently consisting of three ranges of nerve-knots united.

We know nothing of the organ of hearing in *Arachnida*, though it is certain enough that they do hear. Their eyes are all simple, not composite, like those of many insects. "The eyes of spiders and scorpions," says Swammerdam, "are externally formed exactly in the same manner, and are smooth, glittering, and without divisions; and are as much dispersed as those that are disposed at random over the body. The Wolf-Spider, which catches its prey by leaping on it, has its eyes placed in the same manner." In the greater number of Spiders they are 8 in number, but in some 6 (*Dysdera* and *Segestria*), and in others 2 (*Phalangium*). The arrangement of the eyes, when more than two, varies considerably in the different genera, and is taken advantage of in arranging them systematically, on the principle first pointed out by Dr. Lister, and improved upon by Latreille, Leach, and Walckenaer. Figures of various arrangements of the eyes in spiders may be seen in 'Insect Miscellanies,' pp. 125, 126, after Audouin. ('Lib. of Ent. Knowledge.')

With regard to the sexes, male spiders are always much smaller than the females, being often not more than one-fourth the size. The feelers (*palpi*), also, in the male are furnished with organs at the tip, which are of various forms, but usually bulging, whereas the feelers in the female gradually taper to a point.

Looking at the size of the female spider, and the eggs which she lays, it appears almost incomprehensible how they could be contained in so small a body. But, by observing them more closely, it may be discovered that they have not, like the eggs of birds, a hard shell, but, on the contrary, are soft and compressible. Accordingly, before they are laid, they lie in the egg-bag (*ovarium*) within the spider's body, squeezed together in a flat manner; and only come into a globular form after they are laid, partly in consequence of the equal pressure of the air on every side, in the same way as we see dew-drops and globules of quicksilver formed from the same cause.

The eggs of spiders, it is worthy of remark, are in most cases, though not always, placed in a roundish ball; and, as there is nothing in nature without some good reason, if we can discover it, we may infer that this form is designed to economise the materials of the silken web which the mother spins around them by way of protection. Whether we are right or not in this conjecture, there can be no question as to the manner in which the ball is shaped, as the writer has often observed the process. The mother spider, in such cases, uses her own body as a gauge to measure her work, in the same way as a bird uses its body to gauge the size and form of its nest. The spider first spreads a thin coating of silk as a foundation, taking care to have this circular by turning round its body during the process. It then, in the same manner, spins a raised border round this till it takes the form of a cup, and at this stage of the work it begins to lay its eggs in the cup, not only filling it with these up to the brim, but piling them up above it into a rounded heap as high as the cup is deep. Here, then, is a cup full of eggs, the under half covered and protected by the silken sides of the cup, but the upper still bare, and exposed to the air and the cold. It is now the spider's task to cover these, and the process is similar to the preceding, that is, she weaves a thick web of silk all round them, and, instead of a cup-shaped nest like some birds, the whole eggs are inclosed in a ball much larger than the body of the spider that constructed it.

There is a singular mechanism for the purpose of placing the eggs in the proper position. The eggs, different from what takes place in birds, are excluded from a cavity just behind the breast. Here there is an organ placed somewhat in the form of a hook or a bent spatula, which the spider can move in such a manner as to direct every individual egg which it lays to the exact spot in the nest-cup where it wishes it to be placed. The sense of touch in this organ must of course be very acute, as by touch it must be wholly guided; for its eyes, though eight in number, and very piercing, are situated on the upper part of the head, and cannot be brought within sight of the nest.

The hatching of the eggs of one species (*Epeira diadema*) has been traced with great minuteness, and the successive evolution of the embryo figured with great skill, by M. Herold of Marburg.

M. Latreille, whose method has been generally followed both in Britain and on the Continent, arranges the *Arachnida* into two orders, as follows:—

Class.		Orders.
ARACHNIDA	Pulmonary sacs for respiration; six to twelve ocelli	*Pulmonaria.*
	Tracheæ for respiration; not more than four ocelli	*Trachearia.*

The first order is divided into two families:—

		Families.
Arachnida Pulmonaria.	Palpi simple, pediform; mandibles armed with a moveable and perforated claw, emitting a poisonous liquid; abdomen inarticulate, terminated by spinnerets . . .	*Araneidæ.*
	Palpi produced, cheliform, or shaped like pincers; mandibles with a moveable digit; abdomen articulate, without spinnerets	*Pedipalpi.*

The *Araneidæ* include our common Spiders. [ARANEIDÆ.]

The *Pedipalpi* include the Scorpions and their allies. [SCORPIONIDÆ.]

The second order, *Trachearia*, includes very various forms, as the Pycnogonums and the Mites. [TRACHEARIA; ACARIDÆ.]

ARALIA'CEÆ, *Ivyworts*, are a small natural order of plants, nearly related to the *Umbelliferæ*, from which they are solely known by their young fruit consisting of more parts than two. The species of this order, which includes the Ivy [HEDERA], are frequently shrubby, and not uncommonly furnished with powerful hard prickles; but they are often also herbaceous and unarmed, like umbelliferous plants themselves. As an illustration of the order, the American Ginseng (*Panax quinquefolium*) may be taken.

Ginseng (*Panax quinquefolium*).

1. A barren flower. 2. A fertile flower. 3. Ovarium and styles. 4. Fruit cut in half, with the seeds projecting. 5. A section of a seed, showing its minute embryo.

This plant, which is nearly related to the celebrated stimulating drug called Ginseng by the Chinese [PANAX], is found occasionally on the mountains of America, from Canada to the Carolinas. It was long since introduced into our gardens, but it is now seldom seen.

This natural order seems to possess little or no sensible properties, for the singular invigorating power ascribed to Ginseng by the Chinese is considered to be apocryphal.

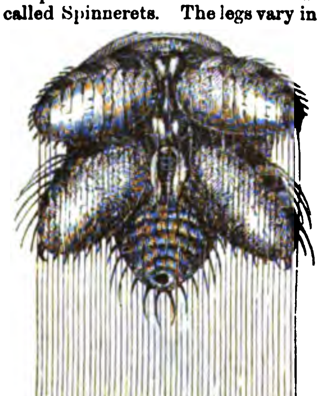
Many of the species of *Aralia*, on account of their aromatic properties, are employed in medicine. An aromatic gum-resin comes from *A. racemosa*, *A. hispida*, and *A. spinosa*. *A. medicinalis* is diaphoretic, and its shoots are employed in North America as a substitute for Sarsaparilla. *A. edulis* is employed in China as a sudorific, and its young shoots are eaten. The roots of *Gunnera scabra*, or Panke, is used by tanners on account of the tannin it contains. Mr. Darwin found it on the sandstone-cliffs of Chiloe, where it resembles rhubarb on a gigantic scale. One of the leaves measured nearly eight feet in diameter.

ARANEIDÆ, the first family of the first order of the class *Arachnida*. [ARACHNIDA.] They are also called *Spinning Arachnida*, from their peculiar habit of producing long filamentous cords with which they form their nests and webs. It is to this family that the term *Spider* is more especially applied; and scientifically it embraces all those creatures which are commonly called Spiders. All these are embraced under the old Linnæan genus *Aranea*. Externally this family is distinguished by the following characters:— The palpi resemble small feet without a claw at the tip, terminated at most in the females by a small hook, but in the males supporting various appendages, more or less complicated, connected with the function of reproduction in this family. The frontal claws are terminated by a movable hook which curves downwards, and has on its under-side a little slit for the emission of a poisonous fluid which is secreted in a gland of the preceding joint. The maxillæ are never more than two in number; the tongue is of a single piece, always external, and situated between the maxillæ, and more or less square, triangular, or semicircular. The thorax has upon it a V-like impression indicating the region of the head; it consists of a single piece, to which is attached behind a movable and soft abdomen. This part of the body is furnished with four or six nipples, fleshy at the tips, round or conical, jointed, placed close together, and pierced at the extremity with an immense number of minute orifices for the discharge of silken threads, which are produced from matter formed in internal reservoirs. These are called Spinnerets. The legs vary in length, but are composed of seven joints, of which the first two form the haunch, the next the femur, the fourth and the fifth the tibiæ, and the two others the tarsus. The last is ordinarily terminated by two claws, generally toothed beneath, and by a third smaller claw which is not toothed.

Spinnerets of a Spider, magnified.

Clawed foot of a Spider, magnified.

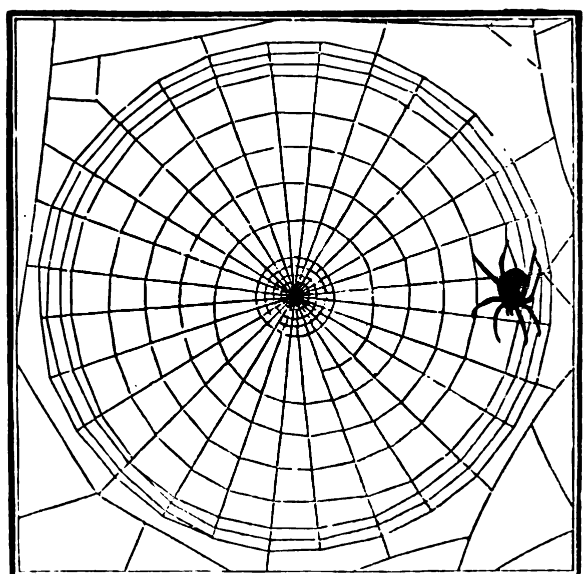
The most remarkable function performed by the *Araneidæ* is that of producing silken threads by means of the spinnerets above described and figured. From each one of the minute orifices of the spinneret there exude as many little drops of a liquid, which, becoming dry the moment it comes in contact with the air, forms so many delicate threads. Immediately after the filaments have passed out of the pores of the spinneret they unite first together and then with those of the neighbouring spinnerets to form a common thread; so that the thread of the spider, when it suspends itself from any object, is composed of an immense number of minute filaments, amounting even to many thousands, each of which is of such extreme tenuity that the naked eye cannot detect them till they are formed into a common thread. The spinnerets of the same spider differ in structure, and Lyonnet has shown that one set of spinnerets is employed in producing threads which are glutinous, whilst another set produces threads which are smooth. This may be seen by throwing a little dust on a spider's web, such as that of *Epeira diadema*, when it will be found that it adheres to the threads which are spirally disposed, but not to those that radiate from the centre to the circumference. These last are also found to be stronger than the spiral ones.



Single thread of a Spider, magnified.

Garden-Spider suspended by a thread.

The spinnerets are in connection with an internal apparatus which secretes the matter they thus elaborate. This apparatus consists of a number of intestine-like canals which are united together, and vary both in number and extent according to the species in which they occur. These canals empty themselves into tubes which open into the spinnerets from whence the thread is extruded.



Geometric Net of *Epeira Diadema*.

It is by means of these threads that spiders construct the various webs which they throw from one object to another, for the purpose of entrapping their prey. It is said that some of the larger species construct webs in which even small birds, such as the humming-bird, are caught and made subservient to the wants of the spider. No sooner is an insect or other small animal ensnared than the spider, placed in the centre of its net, or in a cell built at its side for the purpose of watching, darts forth, and uses all its efforts to inflict upon it wounds into which it pours the venom contained in its frontal claws. When the creature thus caught offers too great a resistance, so that the spider becomes endangered, he retires for a time from the contest to renew his strength, leaving his victim secure in his meshes, and gradually getting exhausted from the attempts it makes to escape. When the spider returns he frequently twists the web round and round the body of his victim, and then either at once commences to make a meal of him, or waits till his appetite suggests the proper time for feeding.

Although Spiders are not provided with wings, and are consequently incapable of flight, they have a power of ballooning with their silken threads, by means of which they can make distant journeys through the atmosphere. These aërial excursions, which appear to result from an instinctive desire to seek some more favourable spot for the gratification of their appetite or other cause, are undertaken when the weather is bright and serene, especially in the autumn, both by adult and immature individuals of many species, and are effected in the following way:—They first mount to the summit of an object, and then raise themselves still higher by straightening their limbs; the abdomen is then elevated into an almost perpendicular position, and they emit from their spinnerets a small quantity of viscid fluid, which is drawn into fine lines by the ascending current of air from the heated ground. Against these lines the current of air from below keeps impinging till the animals, finding themselves acted on with sufficient force, quit their hold of the earth and mount into the air. It has been sometimes stated that spiders can forcibly propel or dart out lines from their spinnerets; but when placed on twigs set upright in glass vessels, with perpendicular sides, all their efforts to escape are unavailing.

The webs named gossamer are composed of lines spun by spiders, which, on being brought into contact by the action of a gentle air, adhere together, till by continual additions they are accumulated into irregular white flakes and masses of considerable extent.

The poisonous effects of the wounds of spiders are produced by means of the mandibles, or frontal claws, which are each armed with a moveable and extremely sharp unguis, near to the point of which is a minute orifice, whence there is poured out a drop of poison into the wound. This orifice, which is very difficult to detect, communicates with a canal in the interior of the mandible; this canal proceeds from a gland situated in the interspace of the muscles of the thorax. The gland consists of a vesicle having internally a number of spiral filaments, which are connected together by a membrane in the form of a bag. Although dreadful stories are related of the effects of the bites of spiders on the human body, it appears from experiments made by Mr. Blackwall on British Spiders, that none of these have the power of producing any ill effects on human beings. There is still wanting good evidence on which to rest a charge of poisoning man by biting him, even against the larger forms of spiders, which inhabit tropical climates.

A curious feature in the history of spiders is the power they possess of reproducing their limbs after they have been broken off. This power, however, is not confined to spiders, as we find it in the *Crustacea* [CRUSTACEA], and even in the vertebrate animals amongst the *Amphibia*. [AMPHIBIA.] In the case of the spiders, it is never a part of a limb which is reproduced, but if a part of a leg is removed, it proceeds to throw off the remainder, and after the next moult the missing member reappears.

The species of the family *Araneidæ* are very numerous, and have been arranged by naturalists under several genera. They have been investigated with great care by M. Walckenäer, who has made them the special study of his life, and has drawn up a natural arrangement of them according to their structure and habits of life. A synopsis of this arrangement we subjoin, as by a little study it will furnish an insight into the surprisingly varied habits of this family:—

TABLE OF THE SUBDIVISION OF THE ARANEIDÆ, OR ARACHNIDA FILOSA, INTO GENERA.

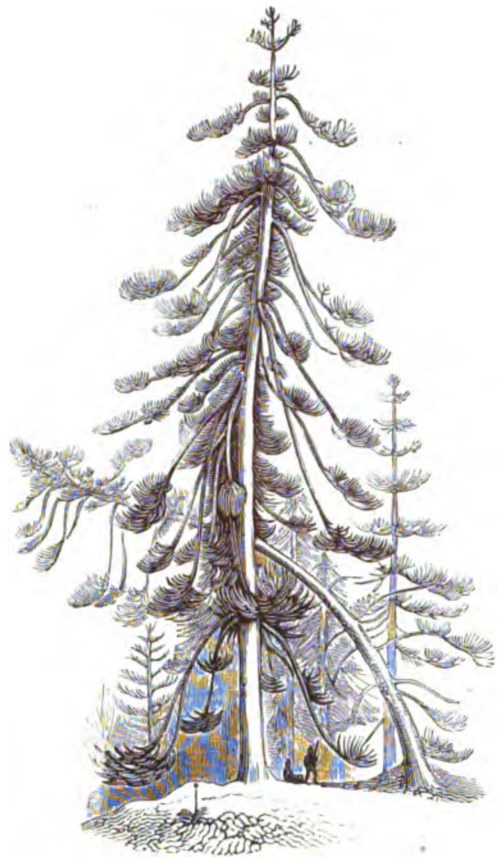
First Family.—ARANEIDÆ—SPIDERS.

			Genera.				
Mandibles articulated horizontally; moving vertically.	8 Eyes.	*Eyes* aggregated.	Mygale. Oletera. Filistata.	LATEBRICOLÆ, hiding in holes and fissures.	*Venantes*, incessantly running or leaping about the vicinity of their abode to chase and catch their prey.	*Terrestres*, living on land or in holes in the ground.	ARACHNIDA.
		Eyes segregated.	Missulena. Sphodros.				
	6 Eyes.	*Eyes* anterior.	Dysdera. Segestria.	TUBICOLÆ, inclosing themselves in silken tubes.			
		Eyes anterior and lateral.	Uptiotes. Omosites. Scytode.	CELLULICOLÆ, sheltering themselves in small cells.			
Mandibles articulated vertically or on an inclined plane; moving laterally.	8 Eyes.	*Eyes* anterior and lateral, very unequal in size.	Lycosus. Dolomedes. Storena. Ctenus. Hersilia. Sphasus. Dolophenes.	CURSORES, running swiftly to catch their prey.			
			Myrmecia. Eresus. Platiscelum. Attus.	SALTATORES, leaping and springing with agility to seize their prey.			
		Eyes anterior, almost equal in size.	Delena. Thomisus. Selenops. Eripus. Philodromus. Sparassus. Clastes.	LATERIGRADÆ, walking and running sideways or backwards; occasionally throwing out threads to entrap their prey.	*Vagantes*, wandering abroad and incessantly spying out for prey; no fixed residence except at the period of oviposition.		
			Clubiona. Drassus.	NIDITELÆ, going abroad, but making a web for their nests, whence issue threads to entrap their prey.	*Errantes*, prowling about the neighbourhood of their nests, or near the threads which they throw out, to catch their prey.		
			Clotho. Emyo. Latrodectus. Pholcus. Artema.	FILITELÆ, going abroad, but spreading long threads of silk about the places where they prowl in order to entrap their prey.			
			Tegenaria. Lachesis. Agelena. Nyssus.	TAPITELÆ, spinning great webs of a close texture like hammocks, and dwelling therein to catch their prey.	*Sedentes*, spinning large webs to entrap their prey, lying in wait in the middle or at the side.		
			Epeira. Tetragnatta. Uloborus. Zosis.	ORBITELÆ, spreading abroad webs of a regular and open texture, either orbicular or spiral, and remaining in the middle or on one side to catch their prey.			
			Lynyphia. Episina. Theridion.	RETITELÆ, spinning webs of an open meshwork and of an irregular form, and remaining in the middle or on one side to catch their prey.			
			Argyroneta.	AQUITELÆ, spreading filaments in the water to entrap their prey.	*Natantes*, swimming in water and there spreading their filaments to entrap their prey.	*Aquaticæ*, living in water.	

(*Cyclopædia of Anatomy and Physiology*, article '*Arachnida;*' Blackwall, in *Report of British Association*, 1844; Owen's *Lectures on Comparative Anatomy;* Cuvier's *Règne Animal; Insect Architecture*, in *Library of Entertaining Knowledge*.)

ARAUCA'RIA, in Botany, is the name of a singular genus of gigantic Firs, found scattered over the southern hemisphere. It is known from all the other firs by its stiff broad leaves, by a long leafy appendage with which the scales of its cones are terminated, and by its anthers having many cells. The following species are those which are best known:—

Araucaria excelsa, commonly called the Norfolk Island Pine, is found not only in the spot after which it has been named, but also in several other places in the South Seas, as in New Caledonia, Botany Island, Isle of Pines, and in some parts of the east coast of Australia. It is described as a most majestic tree, growing to the height of from 160 to 228 feet, with a circumference sometimes of more than 30 feet. Its trunk rises erect, and is sparingly covered with long drooping naked branches, towards the extremities of which the leaves are clustered; these latter, when the plant is young, are long, narrow, curved, sharp-pointed, and spreading, but when the tree is old they have a shorter and broader figure, and are pressed close to the branches; old and young trees are consequently so different that they have the appearance of distinct species. The bark abounds in turpentine; the wood, which is destitute of that substance, is white, tough, and close-grained. It was once expected that this tree would have been valuable for its timber, and that it would have afforded spars for the navy of great size; but it has been found on trial to be too heavy, and so unsound that Captain Hunter could only find 7 trees fit for use out of 34 that he caused to be felled. Its wood is, however, useful for carpenters' indoor work. Several specimens of this tree exist in the collections of this country. Unfortunately it will not live in the open air in the winter, and its growth is so rapid as to render it very soon too large for the loftiest greenhouses. A



Norfolk Island Pine (*Araucaria excelsa*).

supposed species, called the Moreton Bay Pine (*Araucaria Cunninghami*), is scarcely distinguishable from this. It is a highly interesting fact, that a plant very nearly the same as this *Araucaria excelsa* certainly once grew in Great Britain. Remains of it have been found in the Lias of Dorsetshire, and have been figured in the Fossil Flora, under the name of *Araucaria primæva.*

Araucaria Dombeyi, or, as it is more commonly called, *A. imbricata*, is a noble species, inhabiting the mountains of the Araucanian Indians in South America, whence the name of the genus derives its origin. This species has its branches closely covered with broad, lance-shaped, very rigid and pungent dark-green leaves; it produces its branches in circles around its erect stem; and when old it acquires an appearance not very unlike that of the Norfolk Island Pine, only it is much less graceful. Its wood is said to be durable, and it yields a great quantity of resin. Many specimens are now growing in England, and seem to bear our winters well.

Araucaria Brasiliensis is extremely like the last, but the leaves are longer, weaker, and less densely imbricated; and it is much more impatient of cold. It is found wild in the southern provinces of Brazil.

ARAUCARITES (Presl), a genus of Fossil Plants found in the Lias of Lyme Regis.

A'RBUTUS, a genus of evergreen shrubs, belonging to the natural order *Ericaceæ*. It is characterised by its fruit being a berry, containing many seeds. The most remarkable species is the *Arbutus* of Virgil, now called *A. Unedo*, or the Strawberry-Tree, from the resemblance borne by its berries to that well-known fruit. It is a native of the south of Europe and the Levant. In our gardens it proves a hardy evergreen-tree, sometimes as much as 18 or 20 feet high, bearing its greenish-yellow blossoms in October and November, and its bright yellow and red berries, which are studded with little projections, in November and the succeeding months. The most interesting specimens in this country are at the lake of Killarney, where they form groves of great beauty. The plant can scarcely however be considered indigenous to Ireland on this account. Its berries are hardly eatable: taken in too great quantities they are apt to produce stupefaction; nevertheless a wine, said to be pleasant enough, is prepared from them in Corsica.

A. Andrachne, the Oriental Arbutus, is superior to the last in beauty both of leaves and flowers, but it is much more tender, and does not bear fruit in Great Britain. It is readily known by its broader and less serrated leaves, and by its bark peeling off so as to leave the stem always smooth and of a clear bright cinnamon-brown. It is a native of the Levant.

A. hybrida, Mule Arbutus, is apparently a hybrid between the last two, agreeing with *A. Unedo* in the general aspect of its foliage, which is however larger and more handsome, and with *A. Andrachne* in flowers and in the deciduous bark. It is hardy, and very ornamental, but it does not bear berries in Great Britain.

A. procera, a native of California, exists in the gardens of this country. *A. mucronata*, from the Straits of Magalhaens, is a hardy evergreen bush, with small, very dark, pointed and serrated leaves, among which hang numbers of solitary white blossoms. [Arctostaphylos.]

ARCHER FISH (*Toxotes*, Cuvier), a genus of Acanthopterygious Fishes, belonging to the family *Squamipennæ*, or those which are distinguished by having not only the soft parts, but often the very spines of the dorsal and anal fins covered with scales like the rest of the body, and not always very easily distinguishable from it. Though the single species upon which this genus is founded had been long known to naturalists, and described under the various names of *Scarus Schlosseri*, *Sciæna jaculatrix*, *Labrus sagittarius*, and *Coïus chatareus*, by the different writers on Ichthyology, yet it was left for Baron Cuvier to point out its appropriate generic characters, and to distinguish it definitely from the different groups with which it had been previously confounded. These characters are found in the short and compressed form of the body; in the dorsal fin being situated very far back, provided with very strong spines, and like the anal, which is placed very nearly opposite to it, covered on its soft parts with large tough scales; in the short depressed shape of the muzzle; and in the length of the under jaw, which considerably surpasses the upper, and entails upon the animal the singular habit from which it has derived the name of the Archer. The gills have six branchiostegous rays; the teeth are small, sharp, and dispersed over the jaws, tongue, and palate; the stomach is short and broad, the air-bladder large, and the pylorus provided with twelve cœcal appendices. The only known species is—

The *Toxotes jaculator* of Cuvier, which is found in Java and Sumatra, and has been long celebrated for the singular instinct which it displays in catching flies and other insects which are its prey. Comparatively speaking, there are very few species, among the numerous class of fishes, distinguished by superiority of instinct or address; but the very rarity of their occurrence makes the partial instances which are occasionally met with still more remarkable, and among these the means which the Archer and a species of *Chætodon* (*C. rostratus*) employ for procuring food are entitled to especial notice. The tubular form of the mouth in these animals permits them to squirt or project small quantities of water to some distance, and with considerable force. When, therefore, the Archer perceives a fly or other insect resting on the leaves of the aquatic plants which overhang or swim on the surface of the stream, it projects, or as it were shoots a single drop, not directly towards the insect, but obliquely upwards, in such a manner as to strike it in falling, thus preventing it from perceiving its danger and escaping in time. With such accuracy is the aim taken, that though frequently projected to the height of four or five feet, the drop seldom fails to hit the mark and precipitate the insect into the water, where it is, of course, within reach of the Archer. The fish itself is of a yellowish colour, marked on the back with five brown spots.

ARCTIC FOX, in Zoology, a small species of Fox (*Canis lagopus*), celebrated for the beauty and fineness of its fur, which has long been considered a valuable article of commerce. The colour of the fur, as is the case with all animals which inhabit very high latitudes, varies according to the season, being slaty blue in summer, and pure white in winter. It is in the latter state that the fur is most esteemed, not only on account of its colour, but likewise because it is of a closer and finer quality than at any other time. The soles of the feet also are at all seasons covered with a thick coat of fur, like those of the common hare, which defends them from the severity of the snow, and is a character likewise common to most other northern animals. [Fox.]

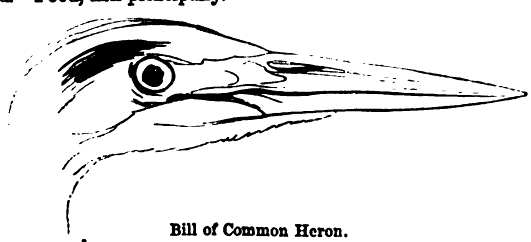
ARCTOSTA'PHYLOS, or Bear-Berry, is a genus of plants till lately considered the same as *Arbutus*, from which it is essentially distinguished by its berries containing only from one to five, instead of a great many seeds. The common Bear-Berry (*A. Uva Ursi*), is found wild in the mountainous parts of England and Scotland, and generally over the whole of the north of Europe. It is a trailing shrubby plant, with leathery dark-green entire leaves, which are broadest at their upper end. The flowers are white, tinged with pink, small, and in clusters. The berries are small and red, like those of the hawthorn. The whole plant is so astringent that it has been employed by the tanner with success, and also in dyeing a grayish black colour; it is no doubt the same property which has made it celebrated for its efficacy in gravel complaints, and in diseases of the urinary organs. When cultivated it requires to be grown in peat earth.

ARDEA (Vieillot), the Heron, a genus of birds under which Linnæus comprehended the Cranes and several other divisions now formed into distinct genera by modern naturalists. M. Vieillot followed Buffon in making four divisions of the Herons; but Temminck, who has paid peculiar attention to these birds, arranges them under one genus and two sections. The genus *Ardea*, as limited by Vieillot, is thus characterised:—

Bill strong, straight, or slightly curved, compressed, acuminated, sharp, in most species finely toothed; the upper mandible somewhat channeled, and usually notched towards the tip; nostrils on the side, almost at the base, slit lengthwise in the groove, and half shut by a membrane; eyes with a naked circle around them extending to the bill; legs long, slender, and either half-naked or feathered down to the shank (tarsus); the middle fore toe united to the outer one by a short membrane; the hind toe articulated interiorly, and upon the same level as the others; the second and third quill-feathers of the wings the longest.

HERONS.

M. Temminck thus defines the Herons properly so called:—Bill much longer than the head, as large as it is high, or larger, at the base; upper mandible nearly straight; a great portion of the tibia naked. Food, fish principally.



Bill of Common Heron.

It will only be necessary to give a sketch of the leading forms of this group. We proceed therefore to illustrate M. Temminck's first section of the true Herons by the Common Heron, which most authors consider as the type.

The Common Heron is, in the opinion of Belon and some others, the 'Ερωδιός of Aristotle, but we do not consider this as certain: the term 'Ερωδιός is doubtless applied by Aristotle to the form ('Hist. Anim.', viii., 3), but what species is meant by him is not so clear. But the bird is, without doubt, the *Ardea* of the Romans. It is the *Beccapesce*, *Airone*, *Oca-Cicogna*, and *Sgarza*, of the modern Italians; the *Garza* of the Spaniards; *Reyger* and *Rheier* of the Germans; *Héron* of the French; *Crŷr glâs* of the ancient British; and *Common Heron*, or *Heronshaw*, of the modern British.

Common Heron (*Ardea cinerea*).

Description. — Plumage bluish-ash; middle toe, the nail included, much shorter than the tarsus.

Male and Female after the Third Year.—Long loose black feathers on the back of the head; similar feathers or plumes of a lustrous white depend from the lower part of the neck; the equally elongated and subulate scapulars are of a silvery-ash. Forehead, neck, middle of the belly, border of the wings and thighs, pure white; occiput, sides of the breast, and flanks, deep black. On the front of the neck are large longitudinal black and ash spots. Back and wings very pure bluish-ash; bill deep yellow; iris yellow; naked skin of the eye bluish-purple; feet brown, but of a lively red towards the feathered part. Length 3 feet and upwards. In this state M. Temminck, whose description we have given, states the bird to be the *Ardea cinerea* (male) of Latham ('Index'); *Ardea major* of Gmelin; *Le Héron Huppé* of Buffon; *Héron commun* of Gérard; *Common Heron* (male) of Latham ('Syn.'), Pennant ('Brit. Zool.'), and Albin; *Ashgrauer Rheier* of Meyer and others; and *Sgarza cenerino* of the 'Stor. degl. Ucc.'

Young up to the Age of Three Years.—No crest, or at most the plumes composing it very short; no long loose feathers at the lower part of the neck, nor above the wings; forehead and top of the head ash-colour; throat white; neck clear ash, with numerous spots of a deeper colour than the ground; back and wings bluish-ash, mingled with brown and whitish; breast marked with longitudinal spots; upper mandible of the bill blackish-brown, with yellowish spots; lower mandible yellow; iris yellow; skin round the eyes greenish-yellow; feet blackish-ash, but yellowish towards the feathered part. In this state M. Temminck considers the bird to be the *Ardea cinerea* (female) of Latham; *Ardea Rhenana* of Sander; *Le Héron*, of Buffon; *Common Heron* (female) of Latham; *Sgarza marina*, of the 'Stor. degl. Ucc.'; and *De Blaauwe Reiger* (being the young in the first year) of Sepp.

The edge of the bill is serrated near the point, and the nail of the middle toe pectinated, as in the Herons generally.

Variety.—Nearly perfectly white. A variety of this description is figured by Frisch (t. 204); but it is very rare.

Habits, Food, Reproduction, &c.—The solitary habits of the Common Heron, excepting at the season of reproduction, are well known. At that period they congregate at their breeding stations, or heronries, for which the loftiest trees are generally chosen. Pennant says that at Cressi Hall, near Gosberton, in Lincolnshire, he counted more than eighty nests in one tree. Montagu notices a heronry on a small island in a lake in the north of Scotland, whereon there was only one scrubby oak. This being too small to contain all the nests, the herons, rather than abandon their society and a favourite station, had many of them placed their nests on the ground. In the south and west of England the heronries in Windsor Great Park in Berkshire, at Brockley in Somersetshire, and at Powderham Castle in Devonshire, are worthy of notice. The nest is built of sticks, and is large and flat. It is lined with wool or other soft materials, and on this lining are deposited four or five bluish-green lustreless eggs. The young are less prepossessing in appearance than nestlings in general, but few of which are pleasant to look upon, and they remain in the nest for five or six weeks, during which time the old birds unceasingly supply them with fish, &c. There are sometimes deadly feuds between the herons and the rooks, originating in a dispute for the possession of the nest-trees. Dr. Heysham's account of one of these battles at Dallam Tower, in Westmorland, originating in the felling of the fine old oaks occupied by the herons, and their consequent attempt upon the grove in the tenure of the rooks, is well worth perusal. The herons had the best of the fray for two successive seasons, and at length a sort of peace was patched up between the combatants; the rooks and the herons severally setting up their nests on a particular part of the now only remaining grove, and leaving the other moiety to the opposite faction.

Buffon draws largely upon his imagination for a picture of wretchedness, and then makes the heron a personification of it, with as much foundation as characterises most of his fancies of this description. When on its fishing station, the bird stands immoveable as a stump, with the neck bent and between the shoulders, watching for the passing fish, which it unerringly spears with its sharp bill. But besides fish and reptiles, such as frogs, newts, &c., mice, young water-rats, and even young water-fowl, are occasionally devoured by it. Mr. Selby, in his excellent 'Illustrations of British Ornithology,' gives, on the authority of Mr. Neill, of Canonmills, near Edinburgh, two interesting anecdotes in illustration of the habits of this bird in a state of half-domestication. "The Common Heron (a male)," says Mr. Neill, "which was winged on Coldingham Muir in autumn, 1821, when a young bird, and given to me in 1822 by Mr. John Wilson, of the College, has since resided in my garden at Canonmills, and is now so tame that he often follows me, expecting a piece of cheese, which he relishes. Four years ago Mr. Allan, of Lauriston, sent me a young female which had been taken during a severe storm. She soon associated with the older bird. In summer, 1828, she laid three or four eggs (I am not sure which) on the top of a wall next to the mill-pond. She then laid one or two on the flower-border below the wall, and close by the box-edging: here some eggs were broken by the birds suddenly starting off when alarmed by strangers walking in the garden. We supplied their place by some bantam eggs, and only one heron egg at last remained. Alas! the poor hen, having strayed to the margin of the mill-pond, was shot by some thoughtless young man with a fowling-piece. The cock continued to sit for several entire days after the death of the hen, but at last tired. He used to sit when she went off for food. During the whole time of pairing the cock was very bold, raising his feathers and snapping his bill whenever any one approached."

Mr. Neill further adds a fact, showing that the bird can swim upon occasion. "A large old willow-tree," writes Mr. Neill in continuation, "had fallen down into the pond, and at the extremity, which is partly sunk in the sludge, and continues to vegetate, water-hens breed. The old cock heron swims out to the nest, and takes the young, if he can. He has to swim 10 or 12 feet, where the water is between 2 and 3 feet deep. His motion through the water is slow, but his carriage stately. I have seen him fell a rat by one blow on the back of the head, when the rat was munching at his dish of fish."

Geographical Distribution.—Very extensive, and embracing the greater part of the Old World. (Selby.) It is permanent in England. Dr. Latham says, "In England and the milder climates this species of heron is stationary, migratory in the colder, according to the season; is rarely seen far north. Inhabits Africa and Asia in general, the Cape of Good Hope, Calcutta, and other parts of India, and is found in America from Carolina to New York." With regard to the American locality, Dr. Latham appears to have taken the Great Heron (*Ardea Herodias*, Linnæus), for the Common Heron, which last is not mentioned by any of the ornithologists who have made the birds of America their study, as an inhabitant of the New World. Dr. Von Siebold mentions this our European species among the birds which he observed in Japan.

Utility to Man.—In days of old, when the Heron was a principal feature in the noble sport of hawking, and when the destruction of its eggs was visited with a penalty of twenty shillings, it seems to have held as high a place at the tables of the great as it did in the field. Thus, at the 'intronazation' of George Nevill, archbishop of York, in the reign of Edward IV., we find in the bill of fare 400 Heronshawes and 200 Feasauntes (pheasants); and it seems, at one period, to have been valued as a dish at the same price as the latter bird, for from the prices in the household-book of the fifth earl of Northumberland, we find Hearonsewys (herons) marked at twelve pence, and pheasants at the same rate to a penny. At a marriage-feast in Henry VIII.'s time, we find Heronsews noted at the same price, and at another marriage-feast in the same year two dozen Heronsues marked at twenty-four shillings. In the first of these records no mention is made of pheasants, but in the second they appear at that earlier time to have been rather more highly valued than herons, for eighteen pheasants are priced at twenty-four shillings, the amount placed against the two dozen herons. And in the charges of Sir John Nevile of Chete (the knight in whose family the marriages above alluded to took place), at Lammas assizes, in the 20th year of the reign of king Henry VIII., the pheasants appear to have cost somewhat more than the Heronsews, thirty of which are priced at thirty shillings, while twelve pheasants cost twenty shillings. The heron-plume, made up of the fine large depending feathers, especially those above the wings, was highly valued.

In the present day the bird seems to have sunk into comparative insignificance. Mr. Selby however considers that "the low estimation in which the flesh of the Heron is now held would seem to be in a great degree the effect of prejudice, or the fashion of taste, as under proper treatment and good cookery the Heron, when fat and in fine condition, is but little inferior to some of our most approved wild-fowl."

The well-known adage expressive of ignorance, "He does not know a hawk from a hand-saw," is a corruption of "He does not know a hawk from a heronshaw."

Temminck's second section of Herons consists of the Bitterns, including the Night Herons. [BITTERN; NYCTICORAX.]

ARDWICK LIMESTONE, a Calcareous Bed, or series of beds, containing shells and fish-remains, in the upper part of the Coal Formations of Manchester and Lebetwood. There is a coal-bed above it at Manchester.

ARE'CA, a genus of Palms containing two species, both remarkable for the purposes to which they are applied. *Areça* is distinguished by a double membranous sheath in which its bunches of flowers are

Betel-Nut Palm (*Areca Catechu*).

contained, by its female corollas containing the rudiments of stamens, its calyx being divided into three parts or leaves, and its fruit being a berry or drupe, with a fibrous rind inclosing one seed only. The leaves of all the species are pinnated, with their stalks rolled up cylindrically at the base.

Areca Catechu, Betel-Nut Palm, is described by Dr. Roxburgh as being the most beautiful palm in India, with a remarkably straight trunk, often from 40 to 50 feet high, and in general about 20 inches in circumference, equally thick in every part, and smooth. The leaflets are from 3 to 3¼ feet long, and widest at the point, where they also are ragged. It is cultivated all over India for the sake of its nuts, which are about the size of a hen's egg, of a reddish-yellow when ripe, and with a firm fibrous rind about half an inch thick. It is this nut which, under the name of Pinang or Betel-Nut, is so universally chewed in the East Indies. It has an austere and astringent flavour, dependent upon the tannin it contains, and is not eatable alone; but mixed with lime, which no doubt destroys its acidity, and with the leaf of the Betel-Pepper it becomes milder and pleasant. The mixture is however still so hot and acrid as to be unfit for the use of any but persons accustomed to it. It is said to be aromatic and stomachic, and also to produce intoxication in beginners; but it is doubtful whether all these qualities are not to be ascribed rather to the Betel-Pepper leaf than to the nut of the Palm. It, or rather the mixture of the three substances, stains the saliva and teeth of a deep red colour. It is to the stems of *Areca Catechu* that the common black pepper vine is usually trained on the coast of Malabar. (Roxb.)

Areca oleracea, the Cabbage Palm, is the only other species that it is necessary for us to notice. The name of this plant is familiar to most persons from the often repeated fact that a tree of the growth of half a century is sometimes cut down for the sake of the single bud which terminates it, and which is called the cabbage.

The species is found in great abundance in the mountainous parts of Jamaica and other West India islands, growing to the height of from 100 to 200 feet, with a trunk not more than 6 or 7 inches in diameter. This gives it an extremely graceful appearance, especially as the leaves grow from the top only, in a kind of tuft or plume, to the length of 15 feet; these leaves are divided in a pinnated manner, and their divisions are deep green, and several feet long. The unexpanded leaves are arranged so closely one over the other as to obstruct all access of light, which causes them to be of a very tender and delicate nature. It is this which forms the cabbage, which is considered a great delicacy, either raw or boiled. The nuts, which are about the size of a filbert and covered with a yellowish skin, are produced in great abundance upon a very long and branched spadix; the kernel is white and sweet.

ARENG, a genus of Palms, the only species of which produces Sago and Palm-Wine. *Areng saccharifera*, is described as a plant of an ugly appearance, having a trunk 20 or 30 feet high, covered almost entirely with coarse black fibres resembling horse-hair. The leaves are from 15 to 25 feet long, and pinnated; their leaflets, which are from 3 to 5 feet long, widen gradually to the point, where they are ragged and prickly, in consequence of the projection of their hard veins beyond the margin; above they are of a deep shining green, but on their under surface they are firmly coated with ash-coloured mealy matter. The stalks of these leaves have intermixed with their coarse hair stiff bristles as thick as porcupine's quills. Each bunch of flowers is from 6 to 10 feet long, and when covered with fruit is as much as a man can carry. The berries are of a yellowish-brown colour, about the size of a medlar, and extremely acrid; each contains three seeds.

This palm is found in all the islands of the Indian Archipelago, in moist and shady ravines through which rivulets find a course; it is much used for the sake of its sap, which flows in great abundance from the wounded branches of the inflorescence about the time when the fruit is forming. A bamboo bottle is tied to the extremity of an amputated branch, and removed twice a day, morning and evening. A single tree will yield a large quantity of this fluid, which when first drawn from the tree is transparent, with the taste and colour of new wine; after a short time it becomes turbid and milky, and acquires a slight degree of acidity. When fit for drinking it is of a yellowish colour, with a powerful odour and a good deal of astringency. Strangers do not for some time become accustomed to it. It is exceedingly intoxicating; but, if drunk in moderation, is said to be stomachic and wholesome.

Besides yielding wine, the coarse fibres of the stem and leaf-stalks are manufactured into powerful cables, and the trunk contains a great quantity of nutritious meal-like sago. Dr. Roxburgh mentions that 150lbs. of that substance were obtained from one tree felled in the botanic garden at Calcutta.

(Roxburgh's *Flora Indica*, vol. iii. p. 627; Rumphius' *Herbarium Amboinense*, vol. i. The former calls this Palm *Saguerus Rumphii*.)

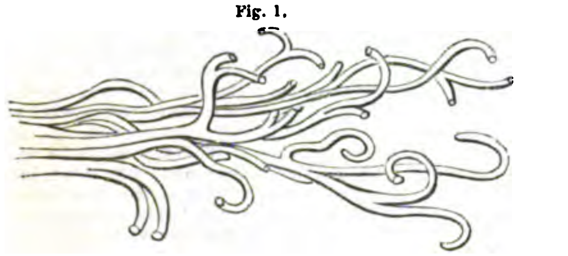
ARENICOLA, a genus of Annelidous Animals, referred by Cuvier to the Dorsibranchiate group on account of their external gills. The general structure and habits of the genus determine most naturalists in placing it with the Terricolous Annelids. [ANNELIDA.] The gills are branched, and placed upon the rings of the middle part of the body only. The mouth is fleshy, more or less dilatable, but there are no discernible teeth, tentacles, or eyes. The posterior extremity of the body has not only no gills, but is devoid of the silky bristles which are found on every other part.

A. Piscatorum, the Lob or Lug-Worm, is the most common species. It is found very abundantly in the sand of the sea-shore, where its habits afford a close resemblance to those of the earth-worm away from the shore. It is bigger than the earth-worm, sometimes being found nearly a foot in length. It is of a reddish colour, and when touched throws out a quantity of a yellow fluid which stains the hand. It is employed by fishermen as bait for various kinds of sea-fish.

AREOLAR TISSUE. The nature of this tissue will be best understood if we first describe *Fibrous Tissue*, of which it may be regarded as a modification. *Fibrous Tissue* is now usually considered under two heads, namely, as the white and the yellow tissue. *White Fibrous Tissue* occurs in ligaments, tendons, and membranes requiring great strength. On carefully dissecting away the areolar tissue with which it is associated, it seems, when examined under the microscope, to consist of extremely delicate fibrillæ running parallel to one another, and taking an undulating course. There is however reason to believe it does not in reality consist of a bundle of fibrillæ, but that it is simply a mass with longitudinal parallel streaks, and which has a tendency to split up in a longitudinal direction. (Fig. 2, *a.*)

Yellow Fibrous Tissue differs in many essential points from the preceding form. It is remarkably elastic, is of a yellow colour, and is arranged in bundles or fibres, invested by a thin sheath of areolar tissue. In man we find it extended between the laminæ of the vertebræ, in several other ligaments, and in the transversalis fascia of the abdomen. It forms the ligamentum nuchæ of animals. Examined under the microscope it is seen to consist of fibres varying in diameter from the 5000th to the 10,000th of an inch. They bifurcate, or even divide into three, and freely anastomose with each other.

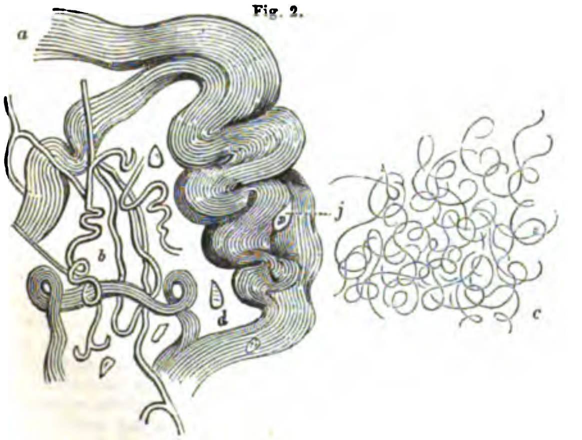
Fig. 1.



Yellow Fibrous Tissue showing the curly and branched disposition of its fibrillæ.

Areolar Tissue is dispersed over almost every portion of the body, being the substance most commonly (but incorrectly) termed *Cellular Tissue*. The following are the microscopic characters of this tissue, as described by Bowman and Todd :—" When a fragment is examined it presents an inextricable interlacement of tortuous and wavy threads, intersecting one another in every possible direction. They are of two kinds. The first are chiefly in the form of bands of very unequal thickness, and inelastic. Numerous streaks are visible in them, not usually parallel with the border, though taking a general longitudinal direction. These streaks, like the bands themselves, have a wavy appearance, but can be rendered straight by being stretched. The streaks seen have more the marks of longitudinal creasing than a true separation into threads ; for it is impossible to tear up the band into filaments of determinate size, although it manifests a decided tendency to tear lengthways. The larger of these bands are often as wide as the 500th of an inch ; the smaller can only be detected with high powers. These are the white fibrous element. The others are

Fig. 2.



The two elements of Areolar Tissue in their natural relations to one another. *a*, the white fibrous element, with cell-nuclei, *j*, sparingly visible in it ; *b*, the yellow fibrous element, showing the branching or anastomosing character of its fibrillæ ; *c*, fibrillæ of the yellow element, far finer than the rest, but having a similar curly character ; *d*, nucleated cell-nuclei, often seen apparently loose.

long, single, elastic, branched filaments, with a dark decided border, and disposed to curl when not put on the stretch. They interlace with the others, but appear to have no continuity of substance with them. They are most commonly about the 8000th of an inch in diameter. These form the yellow fibrous element.

These two tissues may be most easily discriminated by the addition of a drop of dilute acetic acid, which at once swells up the former and renders it transparent, whilst it produces no change in the latter. It thus brings into view corpuscles of an oval shape, which are probably the nuclei of the cells from which the bands have been originally produced. Oval corpuscles (*fig.* 2, *d*), either altogether isolated or having very delicate prolongations with the adjacent threads, are sometimes noticed. They seem to be either advancing or receding stages of the tissue.

Fig. 3.

In *fig.* 3, which represents the Areolar Tissue from beneath the skin of a five-months fœtus, we can perceive the cells elongating into fibres.

In a chemical point of view the leading difference between the white and yellow tissues is, that the former is acted on by acetic acid in the manner described, and yields a considerable amount of gelatine in boiling ; while the latter resists the action of acetic acid, and yields little or no gelatine.

ARFVEDSONITE, a mineral belonging to the Hornblende Series. The cleavage is parallel to the lateral planes and both the diagonals of a rhombic prism. The colour black ; fracture uneven ; hardness 6·0 ; lustre vitreous and opaque ; and has a specific gravity of 3·4 to 3·5. It is found in Norway and Greenland. According to analysis by Dr. Thomson it contains—

Silica	50·508
Peroxide of Iron	35·144
Sesqui-oxide of Manganese	8·920
Alumina	2·488
Lime	1·560
Water	0·960

ARGALI, in Zoology, the name of a species of Wild Sheep (*Ovis Ammon*) found on the mountains of Siberia and Kamtchatka. [OVEÆ.]

ARGEMO'NE, a small genus of plants belonging to the natural order *Papaveraceæ*, of which three species are cultivated in this country as ornamental plants. They are all natives of Mexico, and are characterised by having six petals and three sepals, a very unusual number of parts in the natural order to which this genus belongs. Their leaves are prickly, and generally marked with whitish or pale bluish-green veins ; the flowers are white or yellow. The commonest species is *A. Mexicana*, from the seeds of which the Mexicans obtain an oil very useful to painters ; the handsomest is *A. grandiflora*, the flowers of which are pure white, and as much as three inches in diameter. They are all hardy, and will thrive in almost any soil or situation. Their seeds should be sown in a hot-bed, and the young plants treated as half-tender annuals.

ARGENTINE, in Mineralogy, a white laminated variety of crystallised calcareous spar containing a little silica. [CALCAREOUS SPAR.]

ARGES (Goldfuss) is the *Paradoxides bimucronatus* of Murchison.

ARGULUS, a genus of Entomostracous *Crustacea*, belonging to the section *Pœcilopoda*. There is but one species of this genus, the *A. foliaceus*. This little creature is not unknown to fishermen, as it is frequently found parasitic upon various kinds of fish. It was first described by Baker in his 'Employment for the Microscope,' in 1753, under the name of 'The Louse of the Carp and Banstickle or Prickleback.' It is about the tenth of an inch in length, and is almost as broad as it is long. The head is in the form of a circular-shaped shield. The antennæ are short, thick, and two-jointed. Instead of a second pair of foot-jaws it has a pair of circular or disk-shaped suckers, by means of which it attaches itself to the animals on which it is parasitic. These suckers are admirably constructed for their use. Four muscles are attached to the base of each of these organs, and extend up by the sides. By this arrangement the creature can make use of these organs, by exhausting the air in the same way as in cupping-glasses, to fasten itself, and also by relaxing the muscles, to walk, when it wishes to change its position. These little creatures are nearly transparent, or of a slightly greenish hue, so that its internal organisation can be readily seen by means of the microscope by transmitted light. The body is marked on both sides by a series of ramifications of a dark colour. The female is larger than the male, and is distinguished, in addition to the ovary, by a black mark on each lobe of the abdomen.

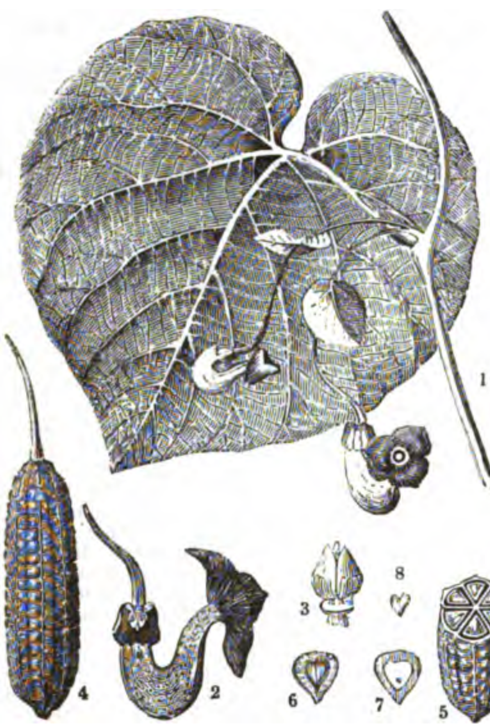
The Argulus is found upon various fresh-water fishes. It is most frequently met with near London on the Stickleback, but it has been noticed as occurring on the Carp, the Roach, the Trout, the Pike, the Rudd, and even upon the tadpole of the common Frog. It seems to abound especially when fish are in ill health.

Although mostly found upon fish it frequently leaves them, and swims freely about in the water. Fish have an instinctive knowledge of these creatures as their enemy, and it is amusing to watch in a basin of water the efforts which the stickleback will make to avoid its minute persecutor; but the efforts of the fish are in vain, for it is opposed to a creature which has the power of darting through water with such rapidity that it is almost impossible to follow it with the naked eye. The females deposit their eggs from 400 to 1500 in number on stones or other solid bodies. They are laid side by side in rows and glued together. They are hatched in about 35 days, and the young resemble their parents to a greater extent than is the case with many of the forms of *Entomostraca*. The best account, with figures and anatomy, of this parasite, is given in Dr. Baird's 'History of the British Entomostraca,' published by the Ray Society. Mr. Yarrell has given a figure of it in the second volume of his 'British Fishes.'

ARIETES. [AMMONITES.]

ARILLUS, in Botany, is a fleshy expansion either of the umbilical cord by which seeds are attached to the placenta, or of the placenta itself. It is never formed till after the fertilisation of the seed, and is only met with in a few plants; its use is entirely unknown. The most remarkable instance of the Arillus among species of common occurrence is in the Spindle-Tree (*Euonymus Europœus*), in which it is the fleshy red covering of the seed that renders that plant so ornamental in the autumn and beginning of winter. Another familiar case is the mace of the nutmeg; this substance is, when fresh, a crimson lacerated covering of the nut, which acquires its pale-brown colour in consequence of the preparation it undergoes in being dried and prepared for market. Before the term was thus accurately defined, it was applied to a variety of parts of exceedingly different natures.

ARISTOLOCHIA'CEÆ, *Birthworts*, consist of a small number of genera which principally inhabit the hotter parts of the world. They are in many cases used medicinally on account of their tonic and stimulating properties; and some of them are reputed remedies for the bite of venomous serpents. The distinguishing characters of the order reside in the flowers, which have no corolla, and are constantly divided into three segments; the number of the cells of the fruit is also three or six, and the stamens agree in the same ternary character; the fruit is always adherent to the calyx, or, as botanists say, inferior. Notwithstanding the accordance which thus exists between *Aristolochiaceœ* and Monocotyledonous Plants in the ternary number of the



Aristolochiæ.

1, A branch of *Aristolochia Sipho*; 2, one of its flowers cut lengthwise, showing the stamens lying in its bottom; 3, a cluster of stamens; 4, a seed-vessel; 5, the same cut across to show its six cells; 6, a seed; 7, a seed cut through to show the minute embryo lying in the albumen; 8, an embryo much magnified.

parts of their flowers, their structure is otherwise truly Dicotyledonous. The arrangement of the woody matter of which their stem is composed is in longitudinal plates, surrounding a central pith, and surrounded by bark; but what is very curious, these plates are not placed in concentric circles like most other exogenous plants, but continue to increase uniformly and uninterruptedly as long as the plant grows. [EXOGENS.] The leaves are veined like those of exogenous plants, and the embryo of the seed has two lobes.

The most common plants of this singular order are the different species of *Asarum*, or, as the gardeners call them, Asarabacca,—little stemless plants with dingy-brown flowers hidden among the leaves. This colour, which is far from common in plants, appears characteristic of the whole order, for even in those species which have yellow flowers, a brown stain seems to be mixed with the colour so as to change it, or brown spots are scattered over the surface. The most remarkable species of the genus *Aristolochia* are those which, in many of the tropical parts of America, excite the wonder of travellers by the gigantic size or grotesque appearance of the flowers, such as *A. cymbifera*, the border of whose calyx resembles one of the lappets of a Norman woman's cap, and measures 7 or 8 inches in length, *A. cordiflora*, and *A. gigantea*, the flowers of which are from 15 to 16 inches across, and are large enough to form bonnets for the native children.

The properties of this order are generally tonic and stimulating. Many of the species, as their common name implies, have had properties attributed to them which they are now known not to possess; at the same time some of them are emetic and others purgative, and they contain undoubtedly plants which might be used with advantage in medicine. Only one has been much used, the *Aristolochia Serpentaria*. [ARISTOLOCHIA, in ARTS AND SC. DIV.]

ARKTIZITE, one of the names for the group of minerals included under *Scapolite*. [SCAPOLITE.]

ARMADILLO (*Dasypus*, Linnæus), a genus of the class *Mammalia* belonging to the order *Edentata*, and forming, with the allied genera *Chlamyphorus* and *Orycteropus*, a small but very distinct family intermediate between the Sloths and Ant-Eaters, and characterised by the possession of molar teeth only. The Sloths [BRADYPUS] have not only the ordinary molar teeth of common quadrupeds, but are likewise provided with large and powerful canines; though, as far as we know anything of their economy, they appear to be a purely herbivorous family, and to be even incapacitated by other details of their organisation for the capture or destruction of a living prey; whilst the Ant-Eaters [ANT-EATER] are not only deprived of canine but likewise of molar teeth, consequently are without teeth of any description, and thus form the only family of the order *Edentata* that literally answers to the name and definition. Nor are these the only distinctions which subsist between the three families of edentulous mammals which we have here indicated. Others are pointed out in the articles just referred to, and it will be sufficient to mention, in addition, that the Ant-Eaters differ from the other two families by the want of clavicles (a most important and influential element in the anatomical structure of all vertebrated animals), and the Armadillos, the more immediate subject of our present consideration, by the peculiar nature of their external covering. Instead of hair, the armadillos are covered with a species of hard bony crust, forming three bucklers on the head, shoulders, and rump, respectively, the two latter being connected by a number of transverse moveable bands, very similar in form and appearance to the plate armour of the middle ages, from which indeed these animals have acquired the name of Armadillos—a name of Spanish origin, which has been adopted by English writers. These bucklers likewise hang down on each side, so as to form an effectual protection to the belly, and partially to cover the legs and feet; whilst the pliancy produced by the moveable bands interposed between the bucklers of the rump and shoulders, and which are themselves connected by the soft pliant skin of the animal, permits the most varied and rapid motions. The bucklers themselves, as well as these connecting moveable bands, are composed of numerous small polygonal plates, placed contiguous to one another like the stones of a mosaic pavement, but without any actual articulation, and they are incapable of separate motion. The whole thus forms a kind of shelly buckler not unlike that of a lobster; and though incapable of actual motion, yet the thinness of the shell, and, during life, the pliancy occasioned by the animal oil which penetrates it, allow it to yield to a certain degree, and thus to accommodate itself in some measure to the motions of the body. But the great and principal motions, as already observed, are entirely due to the moveable transverse bands, interposed between the two principal bucklers of the body, and which vary in number according to the species, and even within certain limits according to the age, sex, or individual. These are situated immediately above the loins, or in the region to which all the principal motions of the animal economy have been assigned; the bucklers of the head and shoulders are entirely disunited, and have none of these moveable bands interposed between; but that of the head projects considerably backwards, and affords complete protection to the neck, which is indeed so short as to be barely distinguishable.

The throat, breast, belly, and thighs of the armadillo are naked, or covered with a thick granulated skin, thinly furnished with warts or tubercles, which give origin to a few coarse bristly hairs. The commissures of the moveable bands on the loins are likewise provided with a number of long hairs; but with this exception the body is covered only by its peculiar shell. The tail is straight, round, thick, and pointed; it is adapted at the root to a notch or cavity in the posterior edge of the buckler of the croup, and, with the exception of one species, is universally covered with bony rings, formed, like the rings of the bucklers, of numerous small pieces connected together, but capable of a certain degree of motion, and thus admitting of considerable flexibility in the tail itself. The head of the armadillos is flat and terminated by a pointed muzzle, which assists them, like the snout of the hog and mole, to turn up the earth in search of roots and worms. Their ears are erect and pointed, and their eyes very small. They have flat corpulent bodies; and their legs are so disproportionately thick and short that they barely serve to elevate the body above the surface of the ground. Their toes, also, of which there are either four or five on the anterior and invariably five on the posterior extremities, are remarkably short; but they are furnished with extremely long powerful claws, slightly curved, and in every respect well adapted for digging or burrowing. So rapid indeed are the armadillos at this operation that they easily bury themselves to any depth beyond the reach of their pursuers. They can only be forced from their subterranean retreat by directing smoke or water into their burrows. Their strength and the tenacity of their hold are so great, that they have been known to leave their tails in the hands of the hunter rather than permit themselves to be drawn forth. Yet notwithstanding the shortness of their legs and the heavy corpulent make of their bodies, the armadillos run with a velocity which could not be anticipated from their general appearance. Most of the species will easily outstrip a man. Their ordinary burrows most commonly run for three or four feet at an angle of about 45 degrees to the plane of the horizon, then make a sudden bend, and terminate at the distance of eight or ten feet from the mouth. Here for the most part they conceal themselves during the daytime, for the greater number of the species are nocturnal, and never move abroad whilst the sun is above the horizon. This rule however admits of some exceptions—a few species being found abroad at all times indifferently; and it has been remarked that these are neither so swift nor so timid as the nocturnal species.

The teeth of the armadillos are all of a simple cylindrical form, and stand apart from one another like those of the generality of Cetacea and Reptiles. They vary in number from 7 or 8 to 17 or 18 on each side of each jaw; and are so arranged that when the mouth is closed the upper teeth fit into the interstices of the under, and these into the interstices of the upper teeth alternately. The animals never attempt to bite, nor has nature given them any other means of defence than the ease and rapidity with which they avoid danger by burrowing. Their food consists principally of fallen fruits, roots, and worms; but they do not reject carrion, and have been known to penetrate into human graves when not properly protected by stones or brick-work. Azara informs us that ants are never found in the districts inhabited by the armadillos, and that these animals break into the ant-hills and devour the insects as greedily as the true Ant-Eaters. The ordinary food of the armadillos consists chiefly of the roots of the mandioc, of potatoes, maize, and other similar substances of a vegetable nature; though, as already observed, without rejecting animal substances naturally soft or so far decomposed as to be easily torn without the help of canine teeth. They are also very destructive to the eggs and young of such birds as build their nests on the ground, and greedily devour worms, frogs, small lizards, and, Azara says, even vipers. The chief animal food of the armadillos, however, is derived from the immense herds of wild cattle which cover the plains and savannahs of every part of South America. These are rarely slaughtered but for the sake of the hide and tallow; and as the carcasses are left to rot on the pampas or plains, the smell soon attracts vast crowds of carnivorous animals of various species, and among others great numbers of armadillos, which greedily devour the half-putrid flesh, and soon become extremely fat and corpulent. In this condition, notwithstanding the filthy nature of their food, their flesh is esteemed a great delicacy both by the native Indians and by the Portuguese and Spaniards of America. The animal is roasted in its shell, and considered one of the greatest dainties which the country produces.

The armadillos see but indifferently, particularly in bright sunshiny weather; but their sense of hearing is extremely acute, and amply compensates for any imperfection of sight. When alarmed by any unusual or strange sound they prick up their ears, stop for a moment to satisfy themselves of its distance and direction, then commence a precipitate retreat to their burrow, or, if that be too remote, begin to construct a new one. Smell is, however, by far the most acute of their senses. Azara tells a singular story, which strikingly illustrates the intensity of this sense in the armadillos, as well as the unerring certainty with which, by a kind of intuitive knowledge of the principles of engineering, they are enabled to direct their subterraneous course to any particular point. "My friend Noséda," says he, "having arranged a trap for the purpose of taking Chibigouzous, and having placed in it by way of bait a cock, with a small quantity of maize to support him, it so happened that a few grains of the maize fell through between the boards which formed the bottom of the trap. An armadillo arrived during the night, and wishing to get at the maize thus accidentally spilt, opened a trench or burrow at some distance from the trap, and without deviating a hair's breadth from the straight line of his direction, pushed it on to the very spot where the grain had fallen, and possessed himself of the booty."

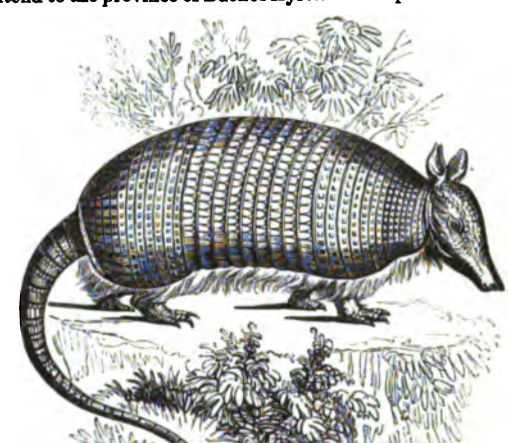
It is generally believed that the female armadillo brings forth but once during the year, but she produces at a birth frequently six, eight, or even ten young ones; yet she has never more than four teats, and, according to the report of M. Azara, the most accurate and extensive observer who has written upon the history of these animals, in some species only two—an anomaly with respect to the number of young and the number of teats which appears to contradict the general rule observable among other mammals. Azara indeed supposes that some of the young die for want of proper nourishment, and that the mother only rears those for which she has a sufficient supply of milk. This is however improbable, as we find it a general rule that only the number of young are produced at a time that can be successfully reared.

The tropical and temperate regions of South America are the original and proper habitat of all the known species of Armadillos. The armadillos are active hardy animals, and thrive and breed rapidly with a moderate portion of care in most temperate countries. Such of the species as prefer a vegetable food, and whose flesh is consequently the most palatable and wholesome, might even be domesticated with advantage, and bred in warrens, like rabbits. In their native climates, however, they still abound in such incredible numbers that the inhabitants will not be at the trouble of rearing what they can so readily procure to any required amount. When therefore the natives of Brazil or Buenos Ayres maintain the armadillo as a domestic animal, it is more for curiosity than for profit. The woods and pampas supply the wild animal in inexhaustible abundance. They are most usually taken in traps during the night; or, when found in open day at any distance from their burrows, are pursued by small dogs, which intercept their retreat till the hunter has time to secure them. One species only when thus attacked has the faculty of rolling itself up into a round ball like a hedge-hog, but they are generally timid and extremely helpless, and none ever attempt to defend themseves either by using their teeth or claws.

In arranging the Armadillos, Baron Cuvier, for the facility of definition, has divided them into five small groups.

I. The *Cachicames*, which have 4 toes on the anterior and 5 on the posterior extremities, 7 teeth only on each side both of the upper and lower jaw, a pointed muzzle, and a long tail, surrounded by a succession of osseous rings, each of which is composed of a number of polygonal plates arranged in numerous series. The two middle claws are excessively large and of equal length; the lateral, particularly the internal, which represents the thumb, are much shorter, but all are powerful, trenchant, and well fitted for burrowing. To this division belongs—

1. *Dasypus Peba* (Desmarest), the Peba, called Tatouhou, or Black Tatu, by the Guaranis, is extremely common in Paraguay, though it does not extend to the province of Buenos Ayres. This species is well figured



The Peba (*Dasypus Peba*).

in the original edition of Buffon's 'Histoire Naturelle,' and described by Daubenton under the name of *Cachicame*, which according to Gumilla is the generic name of the Armadillos among the Indians on the banks of the Orinoco. Azara calls it the Black Armadillo, from its Guarani name; and it has been admitted into the generality of zoological catalogues under the somewhat ambiguous appellations of *Dasypus novemcinctus*, *D. octocinctus*, and *D. septemcinctus*,—three different species being thus formed from the same animal, under the erroneous supposition that the number of moveable bands between the bucklers of the shoulders and croup was invariable in the same species.

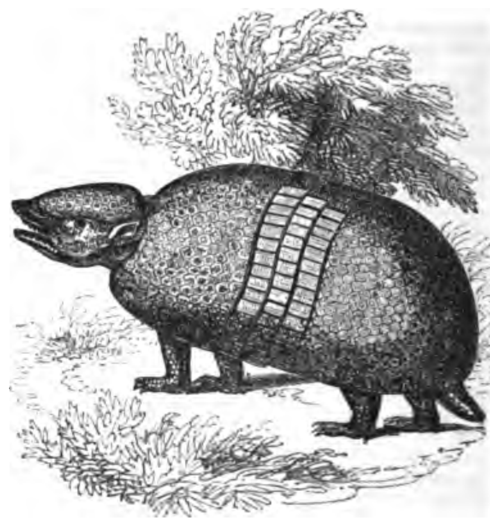
The length of the Peba, from the snout to the origin of the tail, is about 16 inches, that of the tail 14 inches, and its circumference at its base 6 inches. The head is small, long, and straight; the nose extremely elongated, taper, and terminated by a sort of small muzzle something resembling the snout of a hog; the mouth is large; the eyes small, and placed on the sides of the head; the ears long, and placed close together; the tail long and attenuated; the legs short; and the feet small. The buckler of the shoulders extends in front over the whole neck, and towards the rear as far as the back, descending on each side to the elbows. It is composed of small pieces adhering to one another, and disposed in numerous parallel concentric rings, having the concavity towards the front, the first ring embracing the neck of the animal. The buckler of the croup extends from the back to the origin of the tail, and descends on each side to the knees. It is composed, as in the former case, of small pieces arranged in a great number of parallel concentric rings, passing transversely over the hips, but having their concavity turned in the opposite direction from that of the rings on the shoulder, or in such a manner that the last embraces the root of the tail. When viewed externally, the little pieces composing these bucklers have the appearance of irregular tubercles, but when examined on the under side of the buckler they are found to be hexagons almost as regular as those of the cells of bees, and fitted as precisely to one another. Between the bucklers of the shoulders and croup are interposed a variable number of transverse moveable bands marked with zig-zag lines forming very acute angles, and in some degree gliding over one another according to the different motions of the animal. Out of 14 individuals examined by Azara, there were two with 6 of these moveable bands, one with 7, seven with 8, and four with 9; and it was observed that the full-grown ones always had the greatest number of bands, which renders it extremely probable that new bands are detached from the bucklers as they are required by the increasing growth of the animal. The buckler of the head descends from the ears to the muzzle, and covers each cheek as far down as the orbits; and there are small detached scales interspersed in various situations over the throat, the under-jaw, the legs, and feet, and even on the outer side of the ears. The tail is extremely long and taper: it is composed of a great number of osseous rings forming a long tubular case, and connected like the joints of a cane. The Peba, or, as it is commonly called in Brazil, Tatu-Peba, has 32 teeth, 8 on each side both of the upper and under jaws. It inhabits Guyana, Brazil, and Paraguay, is a timid nocturnal animal, tolerably swift-footed, and very expert in burrowing. It is never found in the woods, but delights in the open plains and cultivated fields, and is much hunted by the inhabitants on account of the delicacy of its flesh, which, when roasted in the shell, is fat and well tasted; it is said to resemble that of a sucking-pig.

2. *D. hybridus* (Desmarest), the Mule Armadillo, called M'bouriqua, or Mule Tatu, by the Guaranis, in allusion to its long upright ears, differs from the last species principally by its smaller size, and the comparative shortness and smallness of its tail. The length from the nose to the origin of the tail is stated by Azara to be only 11¼ inches; the tail itself is 6½ inches long, and 3 inches in circumference at the root; whence it appears that the tail of the present species is only half the length of the body, whilst in the Tatu-Peba its dimensions are very nearly equal. The legs of the present species are also rather shorter than those of the Peba, the body is broader and less covered with hair on the under surface, and the moveable bands generally fewer in number, and capable of being separated to a greater distance from one another. Their number generally varies from 5 to 7, without distinction of sex, but it is to be observed that the former number is only found in very young animals; and altogether the small size and general external resemblance of the two species make it sometimes difficult to distinguish between the adult M'bouriqua and the young Peba, especially if great attention be not paid to the comparative length of the body and tail, which forms the only certain criterion. This species inhabits the open uncovered country, like the former, but extends much farther south, and is common on the pampas of Buenos Ayres.

3. *D. Verdadeiro*, the Tatu Verdadeiro, is a species very similar in size and proportions to the Mule Armadillo; but the point of its tail is terminated by a horny case of a single piece; the moveable bands are broader, and the plates of the croup-buckler are of considerably larger size. We know very little more about this species than the few characters here reported. It inhabits the woods of Brazil, resides in burrows, and is found abroad at all hours during the day-time. Koster is the only traveller who mentions this animal, but Baron Cuvier had an opportunity of establishing its specific distinctions by the examination of some specimens brought to France by M. Auguste de St. Hilaire.

II. The second subdivision which Baron Cuvier establishes among the Armadillos, and which he calls *Aparas*, is characterised by having the claws and teeth in all respects similar to those of the preceding, save that the number of the latter amounts to nine or ten on each side both of the upper and lower jaws; but the animals of the present group are immediately distinguishable from all others of the genus by the faculty which they possess of completely rolling themselves up like a hedgehog into a round ball, in which situation they may be tumbled about, or even, it is said, thrown over precipices, without receiving any material injury. There is but a single known species.

4. *D. Apar* (Desmarest), and *D. tricinctus* (Linnæus), the Mataco, called also Bolita, or the little ball, from its faculty of assuming a spherical form, is nearly 15 inches long from the nose to the origin of the tail; the head is 3 inches long, and the tail not quite 2½ inches. The head is oblong and of a pyramidal form; the muzzle pointed;

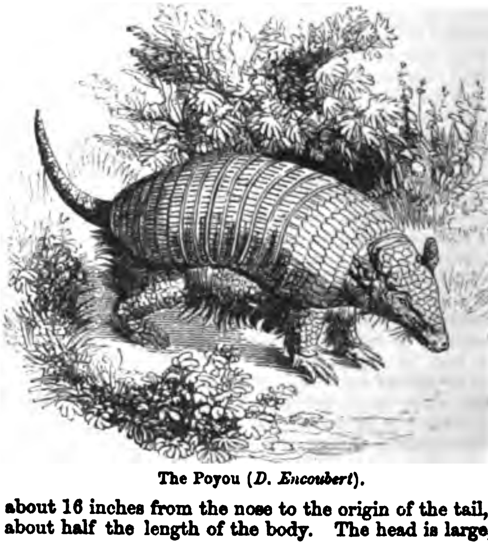


The Mataco (*D. Apar*).

the ears short and nearly round; and the legs and claws comparatively smaller and weaker than in the other species; the tail also is much shorter, and does not taper so much; it is flattened at the root, and covered above with a rough granular crust. The small pieces which compose the bucklers and moveable bands are themselves of very irregular figures, and disposed in a more confused manner than in other species, bearing no distant resemblance to a number of small rough fragments of stones thrown at random over the surface. The buckler of the shoulders forms a prominent angle on each side which advances forwards over the cheek; it is composed of 9 or 10 parallel bands of small plates, of a polygonal figure, except those of the last row, which, like the plates of the moveable bands, form irregular parallelograms. The buckler of the croup is composed of 13 transverse rows of small plates, similar to those of the shoulders, and between the two bucklers are interposed three moveable bands only; a number by which the Mataco is readily distinguishable from all other armadillos, though it is probable that it may vary in a small degree, as it is found to do in other cases. Its usual resource, and only defence when frightened or surprised, is to roll itself up; for it does not construct burrows like the Tatu-Peba, nor does it possess sufficient speed to escape by flight. It is found in Brazil, Paraguay, and Buenos Ayres, but is nowhere very common.

III. The *Encouberts*, or third division of Baron Cuvier, have 5 toes on the fore feet, and 9 or 10 teeth throughout, but they are principally distinguished by having 2 teeth in the intermaxillary bones of the upper jaw, representing, as it were, the incisor teeth of ordinary mammals, and thus forming an exception, not only to the other Armadillos, but even to the order of *Edentata*, which are principally characterised by their want of teeth of this description.

5. *D. Encoubert* (Desmarest), *D. sexcinctus* (Linnæus), the Poyou, or Yellow-Footed Armadillo (for thus Azara interprets the name), measures about 16 inches from the nose to the origin of the tail, which is itself about half the length of the body. The head is large, flat, and



The Poyou (*D. Encoubert*).

nearly triangular, the face short, the muzzle obtuse, the ears erect and of moderate size, and the eye small. The number of moveable bands varies from 7 to 8, according to the individual; the tail is surrounded at the base with three or four bony rings, but throughout the rest of its length it is merely covered with regular tuberculous scales; the interstices of the moveable bands give origin to a great number of long bristly gray hairs, and the female is provided with only two pectoral mammæ. But independently of all other considerations, the Tatu-Poyou is easily distinguished from all the other armadillos by the unusual flatness and broadness of its body, and the consequent comparative shortness of its legs. It is very common in Paraguay, and burrows in the ground with an almost incredible agility. Its strength and activity are very remarkable; and notwithstanding the shortness of its legs, it runs so swift that few men can outstrip it. It is of a restless unquiet character, bold, curious, and intrepid. When any noise is made at the entrance of its burrow, or when otherwise tormented, it grunts like a young pig, and comes forth without fear to investigate the cause; yet when actually attacked it is incapable of making any sort of defence, and can only save itself by retreating to the bottom of its hole, or burrowing to a still greater depth. The Poyou feeds much upon carrion, and for this reason its flesh, though fat, is never eaten by the inhabitants of European origin, though the Indians make no distinction in this respect between it and the other armadillos. When it stops or rests, it has a custom of squatting close to the ground like a hare in her form, and in this situation the great breadth of the body is remarkably apparent, being nearly three times its height.

6. *D. villosus* (Desmarest), the Hairy Armadillo, measures 14 inches in length from the nose to the origin of the tail; the head is nearly 4 inches in length, the ear two-thirds of an inch, and the tail 5 inches. In form and appearance this species bears a very strong resemblance to that last described, but it is of smaller size, and is comparatively better covered with hair, a circumstance from which it derives the name by which it is most usually distinguished. The head is triangular, the muzzle pointed, the ears large, elliptical, and inclined outwards, and the number of moveable bands varies from 6 to 7 according to the individual. The border of the bucklers, as well as the lower side of the moveable bands, is indented in a remarkable manner, and forms sharp angular points, which serve to approximate the present species to the following, not less than to distinguish it from all the other known armadillos. There are eight teeth on each side, both above and below. Numerous long flexible brown hairs spring from every part of the body, but more especially from the sides and belly, and even cover the first half of the tail. The female, as in the Poyou, has only two pectoral mammæ.

This species does not inhabit Paraguay, nor, as far as we are at present aware, any other part north of the Rio Plata, but it is found at every step on the pampas or plains of Buenos Ayres, south of that river. "In an expedition," says Azara, "which I made into the interior, between the parallels of 35° and 36° south latitude, I met with vast multitudes of this species of armadillo, so that there was scarcely an individual of the party who did not each day capture one or two at least; for, unlike the Poyou, which moves abroad only during the night, this animal is to be found at all times, and upon being alarmed promptly conceals itself, if not intercepted. In March and April, when I saw them, they were so extremely fat that their flesh surfeited and palled the appetite; notwithstanding which the pioneers and soldiers ate them roasted, and preferred them to beef and veal." "The hairy armadillo," continues M. Azara, "like others of the genus, has undoubtedly a very acute sense of smell, since it scents the carcasses of dead horses from a great distance, and runs to devour them; but as it is unable to penetrate the hide, it burrows under the body till it finds a place which the moisture of the soil has already begun to render putrid. Here it makes an entrance with its claws, and eats its way into the interior, where it continues feasting on the putrid flesh, till nothing remains but the hide and bones, and so perfectly do these preserve their position, that it is impossible, from a mere external view to anticipate the operations which the armadillos have been carrying on within." The same author observes further, that this species never constructs burrows to reside in, that it avoids low damp situations, and is only found on the dry upland plains.

7. *D. minutus* (Desmarest), the Pichiy, measures only 10 inches in length from the snout to the origin of the tail, which is itself 4½ inches long; the head is 2 inches and 8 lines long, 2 inches broad across the orbits, and the ears are a quarter of an inch in length, and very sharp-pointed. The frontal buckler is composed of irregular plates, the eyes being small and nearly concealed under its margin; there are no plates on the temples, but their place seems to be supplied by a pencil of stiff brown hairs; the neck is extremely short, and furnished above with a row of minute scales; the shoulder-buckler presents nothing remarkable, but that of the croup is deeply indented along the edges, and the moveable bands, to the number of six or seven, according to the age of the individual, are composed of rectangular plates, bordered on each side by compressed scales, lunated and pointing backwards. Each scale is more or less distinctly marked with two longitudinal linear depressions, which divide it into three parts, of which the middle is plain and of an oblong figure, but the lateral are, as it were, divided into six or eight tubercles. The claws are but moderately developed, the tail is covered with strong scales disposed in rings, and the interstices of the scales and bands are furnished with a considerable quantity of hair, though less abundantly and not so long as in the last species.

The Pichiy inhabits the pampas to the south of Buenos Ayres, and extends from 36° of latitude southward to the confines of Patagonia. It inhabits burrows, to which however it does not confine itself during the day, like some other species. Its flesh is said to be remarkably tender and well tasted. Two individuals of this species which had been brought from Port Desire, on the east coast of Patagonia, lived for some time in the Jardin des Plantes at Paris, and would doubtless bear even the rigour of our more northern climate without injury or inconvenience.

IV. The *Kabassous* have likewise five toes, both on the anterior and posterior extremities, but those of the fore feet are disposed obliquely, in such a manner that the thumb and index are small, the middle and fourth toes armed with tremendously large trenchant claws, and the fifth very small. This construction gives them the means of burrowing with extraordinary facility, and of clinging to the ground with such determination and obstinacy that it is with the utmost difficulty they can be taken from it. They have nine or ten teeth throughout.

8. *D. Tatouay* (Desmarest), the Tatouay, or Wounded Armadillo, is so called by the Indians in allusion to its tail, which is naked, or as it were rudely deprived of the crust or bony tube which covers this organ in all the other species. The whole length of the Tatouay, as given by Azara, is 26½ inches, from which if we subtract 7½ inches for the length of the tail, it leaves 1 foot 7 inches for that of the body.

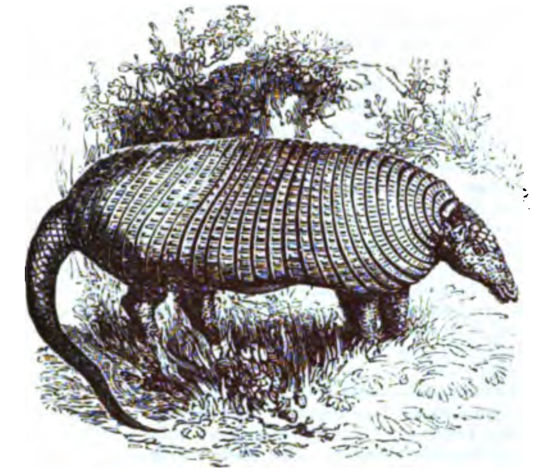
The Tatouay (*D. Tatouay*).

The tail is round, pointed and naked, with the exception of a few small round scales or crusts on the under surface of the third ring nearest to the extremity, which frequently trails along the ground when the animal walks; the rest is covered with soft brown fur, interspersed with a few stiff short hairs on the superior surface. The head is longer, narrower, and more attenuated than that of the Poyou, though considerably less so than in the Peba and Mule Armadillo; there are 8 molars on each side of the upper jaw, and 7 on each side of the lower jaw; the ears are unusually large, being nearly 2 inches long, and in figure forming a segment of a circle; the body is round; the claws of the fore feet, particularly that of the middle toe, are excessively large; and the female is provided with only two pectoral mammæ. The bucklers of the croup and shoulders are composed of 10 and 7 rows of scales respectively, each scale forming an oblong rectangle, those of the coccia being the largest of all; the moveable bands are 13 in number, composed of scales much smaller than those of the bucklers, and of a nearly square figure. The habits of this species are altogether unknown. It inhabits Guyana and Brazil, and is rarely found south as far as Paraguay.

V. The *Priodontes*, or last subdivision of the Armadillos, in addition to the unequal toes and enormous claws of the Kabassous, have from 22 to 24 small teeth throughout, on each side of the jaws, making in all from 88 to 96 teeth—a greater number than is found in any other mammal. This group contains but a single species at present known, namely—

9. *D. gigas* (Cuvier), the Great Armadillo, which is nearly 3 feet 3 inches in length, from the nose to the origin of the tail; the head is 7½ inches long, the ears 1¾ inch, and the tail 1 foot 5 inches. Its superior size is alone sufficient to distinguish this species from all the other known armadillos, but it possesses numerous other characters not less remarkable. Its head is proportionably smaller than in the other species, the forehead is more protuberant, and the face from the eyes downwards assumes a tubular cylindrical form, like that of the Peba;

the ears are of a moderate size, pointed, and habitually crouched backwards; the bucklers of the shoulders and croup are composed of 9 and 18 rows of plates respectively, and separated by moveable bands



Great Armadillo (*D. gigas*).

to the number of 12 or 13, formed of rectangular scales, about half an inch square. The tail is remarkably thick at the root, being upwards of 10 inches in circumference: it is gradually attenuated towards the tip, covered with plates disposed in rings at the base, and forming spiral or crescent-shaped lines throughout the rest of its length. The claws are remarkably large and powerful, but in their relative form and dimensions differ little from those of the Tatouay already described.

This species inhabits Brazil and the northern parts of Paraguay. It is never found in the open country, but keeps close to the great forests, and burrows with surprising facility. Those who are employed in collecting the Jesuit's Bark frequently meet with it in the woods, and report that when any of their companions happen to die at a distance from the settlements, they are obliged to surround the body with a double row of stout planks, to prevent it from being scratched up and devoured by the Great Armadillo.

The remains of Armadillos have been found in the Tertiary Strata, the most remarkable of which is the *Glyptodon* of Owen. [GLYPTODON.]

ARMATI. [AMMONITES.]

ARNI, the native Indian name of the Wild Buffalo. [BOVIDÆ.]

ARNI'CA, a genus of plants belonging to the natural order *Compositæ*, the tribe *Vernoniaceæ*, the sub-tribe *Senecioneæ*, and the division *Eusenecioneæ*. It has a cylindrical involucre, with equal 2-rowed scales; the flowers of the disk hermaphrodite, tubular; the limb 5-toothed; the stigmas thickened above, and terminated with a conical pubescent apex; the flowers of the ray female, bearing degenerated stamens, or with only the rudiments of an anther; the achenium winged and striated; the receptacle naked; the pappus hairy. One species of this genus grows in Europe, the *A. montana*, and is known by the common name of Leopard's-Bane. It has oblong-obovate nearly entire 5-nerved radical leaves, a few-flowered stem, with villose or glandulose pubescent peduncles and involucres. This plant is not found in the British Isles, but is abundant in the meadows and forests of mountainous districts in the middle and north of Europe, and also on the Alps. It blossoms in June and July.

This plant was at one time admitted into all the British Pharmacopœias, but at the present time is only retained in the Dublin. It does not appear ever to have been much used in this country, and perhaps never sufficiently to refute or confirm the strong recommendations of it by German writers. In Germany all parts of the plant are used, the flowers, leaves, and root. The whole plant, but especially the root, possesses a peculiar aromatic but not pleasant odour, and a nauseous taste. The plant has been examined by various chemists, and in every part there has been found an acrid resin and a volatile oil. In combination with these Chevallier and Lassaigne found in the flowers an acrid bitter principle, which they have called Arnicine, and the root contains a considerable quantity of tannin. In large doses it produces inflammation of the alimentary canal, and coma. In small doses it acts as a general stimulant, increasing the pulsations of the heart, and acting as a diaphoretic and diuretic. It is used in Germany in cases of low fever, also in nervous diseases, in amenorrhœa and adynamic diseases generally. The root by means of its tannin acts as a tonic on the system. The root is given in powder in the dose of about 10 grains, three times a day, or in infusion. The flowers are used in infusion, in the proportion of 1 drachm of the flowers to 80 of boiling water, of which 2 ounces may be given at a dose. In making this infusion care should be taken that the pappus be prevented from getting into it, by means of straining through a linen bag. The German Pharmacopœias contain several preparations of Arnica, amongst others a tincture, an extract, an essence of the flowers, and a vinegar (*Acetum Arnicæ*). Amongst homœopathic practitioners the tincture is applied to wounds and bruises, and other external uses, and infinitesimal doses of this substance are recommended, according to their practice, in many severe diseases.

(Bischoff, *Medicinisch-Pharmaceutische Botanik*, 1844; Christison's *Dispensatory*.)

AROI'DEÆ, or ARACEÆ, *Arads*, an order of Monocotyledonous Plants, which approach Dicotyledons in the form and veining of their leaves, but agree with the former in everything else of importance. They are readily known by their flowers being placed very closely upon a cylindrical or lengthened axis, called technically a spadix (*fig.* 2), which is itself inclosed in a leaf of a peculiar figure, the edges of which are curved inwards till they meet, forming a sort of hollow sheath, which botanists name spathe (*fig.* 1).

The fruit is generally a cluster of little berries, each of which contains a small number of seeds. The flowers themselves are extremely variable in structure; sometimes having neither calyx nor corolla, and sometimes possessing both those parts; sometimes furnished with anthers opening in a singular manner by little lobes, or having anthers of the commonest construction. Many of the species grow upon the trunks of trees, clinging to them in tropical countries like ivy; a very few are found in Europe, and those are always little stemless herbs; a small number are small erect shrubs. They are all acrid in a high degree, some of them so much so as to be dangerous poisons, as for example the Dumb-Cane of the West Indies, which paralyses the mouth if only chewed. Nevertheless this acrid principle is so far removed by roasting or boiling, that the underground stems may in some cases be used as food. The Colocasia of the tropics, and some other species, are common articles of food among the negroes; but they are said not to agree very well with Europeans. In this country only one kind of Aroideous plant, the *Arum maculatum*, is found wild.

Arum maculatum.

1, A spathe with the point of the spadix seen within it; 2, the spadix separated; 3, the ripe fruit; 4, an ovarium; 5, the same cut perpendicularly; 6, one of the little fruit cut perpendicularly; 7, a seed.

The root of that species which is vulgarly named the Cuckoo Pint, and its spadixes Lords and Ladies, is eatable when properly prepared, just as those which have already been mentioned. What is called Portland Sago is prepared from it. The spadixes of some species give out a fetid smell. The emanations of *Arum Dracunculus* when in flower produce dizziness, headache, and vomiting.

ARO'MA is the supposed principle of odour in plants, formerly called by Boerhaave *Spiritus Rector*. This quality generally resides in the essential oil; but there are some vegetables that have a strong odour which yield but little or no essential oil, as the jasmine and the violet; or when an oil in small quantity is procured from them it has not the powerful smell which, considering the smallness of its proportion compared with the fragrance of the plants, it might be expected to possess. As plants exhale their odour when exposed to the air, and communicate it to water at a lower temperature than that at which it could be distilled, it has been imagined that some principle of a more subtile nature exists in which the odour resides, and that it is this which imparts smell to the oil. In fact, however, the property of odour belongs to proximate vegetable principles of different kinds, in which there is no reason to suppose the existence of any common principle; essential oil is unquestionably the most usual cause of its production, and it is capable of being volatilised in small quantity at a low temperature, and thus diffused through the atmosphere or communicated to water.

ARONIA, the Linnæan name for a species of plants of the genus *Mespilus*, the *Mespilus Amelanchier*, or *Mespilus vulgaris*. [AMELANCHIER; MESPILUS.]

ARQUERITO, a native amalgam, consisting of six parts of silver and one of quicksilver. It has been regarded as native silver. It is malleable, and is worked with great success in the mines of Arqueros in Chile.

ARRACA'CHA, a genus of plants belonging to the natural order *Umbelliferæ*, which comprehends a species of as much importance in the tropical parts of America as the parsnip and carrot are in Europe. This plant, the *Arracacha esculenta* of botanists, is cultivated in great quantities in the neighbourhood of Santa Fé de Bogota, in the cooler districts among the mountains, and in other parts of the state of Colombia, where it is called Arracacha. It resembles the common hemlock in appearance, but the leaves are much broader, the stems are not spotted, and the flowers are of a dingy purple colour; it is also of smaller stature.

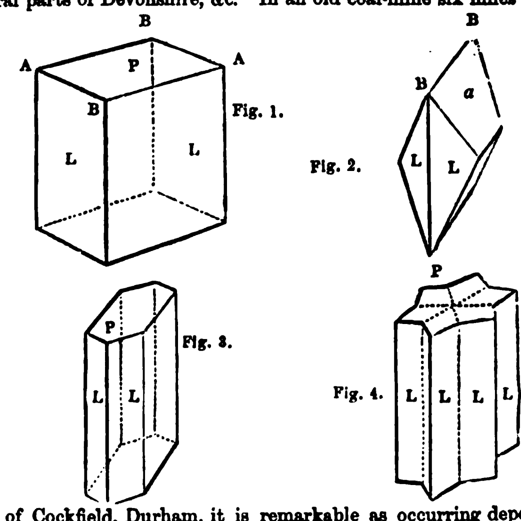
The root is of the same nature as the tuber of a potato, only it is forked, or divided into several lobes, each of which is about the size of a large carrot. These when fit for eating are boiled like the potato, and become of a firm but tender consistence, not at all mealy, and have a flavour intermediate between a chestnut and a parsnip. It appears that an immense produce of Arracacha is obtained in the South American provinces, where it has long been as much the staple nutriment of the population as the potato or the yam in other places;

The Arracacha (*Arracacha esculenta*).
1, A barren flower; 2, a fertile flower; 3, a stamen; 4, a petal; 5, a ripe fruit; 6, the same cut across.

and as it will only thrive in the colder districts, it was once expected to form an important agricultural plant in Europe. It has however been found upon trial unable to accommodate itself to our uncertain climate, and to perish as soon as the cold nights and damp weather of autumn approach, without having been able during the summer to perfect its tubers. It is therefore only cultivated now in botanical collections. (Hooker, *Botanical Magazine*, tab. 3092.)

ARRAGONITE, *Prismatic Carbonate of Lime*, called by Mohs the Prismatic Lime-Haloide. It is a mineral substance consisting of carbonic acid and lime, admitting of cleavage in planes parallel to the faces of a right rhombic prism of 116° 5′ and 63° 55′, which may therefore be considered as its fundamental form (*fig.* 1). The most general modifications which occur consist either in the removal of the four acute angles at A by planes *a* intersecting each other in the short diagonal B B, and inclined to each other at an angle of 108° 18′, by which the face P being entirely removed, the form of *fig.* 2 is produced; or the change may be effected by the truncation of the acute lateral edges of the prism by planes parallel to the axis of the crystal, and therefore inclined to the faces L, at 121° 57′, giving rise to the form seen in *fig.* 3. These modified forms usually present themselves in twin crystals, in which the short diagonals of the prism B B are placed at right angles to one another, when only two crystals are present, thus producing a very simple cross. It is usual however that three of the crystals of *fig.* 3 cross each other, producing a crystal of the appearance of *fig.* 4, which at first sight may be mistaken for an hexagonal prism, but on a closer inspection it will be found that what appeared to be a single face is really composed of two planes, making a re-entrant angle.

The intersections of the individual crystals with each other are visible both in the lateral and terminal faces, and are indicated in *fig.* 4 by the dotted lines. These crystals have been found abundantly in a ferruginous clay in Aragon in Spain, where they occur accompanied by a sulphate of lime. From this circumstance the mineral has derived its name. It has also been found very beautifully crystallised in a vein of a massive variety of the same mineral traversing basalt at Bilin in Bohemia. (Mohs.) Fine specimens have been found at the following places in England:—in the Dufton lead-mines; in a cavern of Grauwacke, near Merridge, Somersetshire; and also in several parts of Devonshire, &c. In an old coal-mine six miles south-



west of Cockfield, Durham, it is remarkable as occurring depending from a roof of clay-slate, and accompanied by tubular calcareous stalactites. (Phillips.) Varieties of this mineral are also common in beds of iron-ore in the mines of Eisenerz in Styria, and in several other iron-mines of Hungary, of Transylvania, &c., consisting of numerous fibrous crystals, of a satin-like lustre, radiating from a centre, and to these the name of *Flos Ferri* has been applied.

In a chemical and crystallographical point of view *Arragonite* is peculiarly interesting, as presenting to us carbonate of lime differing in its system of crystallisation from that of the common Calc-Spar, and thus affording us an instance of the influence of any difference in the aggregation of matter in changing its physical properties, as will be seen by comparing this substance with the rhombohedral Calc-Spar, with which it agrees in chemical constitution. In the scale of Mohs its hardness varies from 3·5 to 4, while that of Calc-Spar is 3. The specific gravity of

Arragonite is	2·931
Calc-Spar	2·721

They act also differently on light, the index of ordinary refraction of

Arragonite being	1·693
Calc-Spar	1·519

Attempts have been made to account for these differences by considering them the effects of small quantities of carbonate of strontia, which Professor Stromeyer first discovered to be contained in many specimens of *Arragonite*; but the conclusion is unfounded, as will be seen by the results of two analyses given by Stromeyer:—

	First.	Second.
Carbonate of Lime	95·2965 . .	99·2922
Carbonate of Strontia . . .	0·5090 . .	4·1048
Water	0·1544 . .	0·5992

where the carbonate of strontia is in small and varying proportion, and must therefore be considered as an accidental impurity.

ARSENIC and ARSENICAL MINERALS. Arsenic is found pure and combined with other substances, both as an acid and a base. Those minerals in which arsenic acts the part of the electro-negative element or as an acid may be considered as forming a mineralogical family or class, according to the chemical arrangement of Berzelius. This family comprehends four genera, a tabular view of the principal species of each of which is here given:—

First genus.

Species. Metallic or native arsenic.

Second genus (metallic arseniurets).

First species. Octahedral cobalt pyrites: speiskobalt of the Germans.
Second species. Hexahedral cobalt pyrites: kobaltglanz.
Third species. Copper nickel: arsenuret of nickel: prismatic nickel pyrites.
Fourth species. Arsenical silver: octahedral antimony of Jameson: silberspeisglanz of Hausmann: antimonial silver of Phillips.
Fifth species. Arsenuret of bismuth.
Sixth species. Axotomous arsenical pyrites (Mohs).
Seventh species. Prismatic arsenical pyrites (Mohs); *Mispickel* (Phillips): arsenikkies.

Third genus.

Species. White arsenic, or arsenious acid.

Fourth genus (compounds of arsenic acid).

First species. *Pharmacolite:* arseniate of lime.
Second species. Cobalt bloom.
Third species. Nickel ochre.
Fourth species. *Scorodite:* martial arseniate of copper from Cornwall.
Fifth species. *Olivenite:* of this there are two species, the one crystallised in the right, the other in the oblique, prismatic system.
Sixth species. *Euchlore Mica* (Mohs): rhombohedral arseniate of copper (Phillips): kupferglimmer.
Seventh species. Cube ore: hexahedral *Liriconite:* arseniate of iron.
Eighth species. Rhombohedral lead spar.

In addition to the minerals classed in the above genera, several other substances contain arsenic, acting, however, as the electro-positive element or base: of these there are but two particularly worthy of attention, namely, *Orpiment* and *Realgar*, both of which are sulphurets of arsenic in definite but different proportions. *Orpiment* (A 2, S 3) is the yellow sulphuret of arsenic. It is rarely crystalline, and contains 61 per cent. of arsenic. It is obtained from Hungary, Turkey, China, and South and North America. It is made use of as the basis of the pigment called King's Yellow. *Realgar* (As S) is the red sulphuret of arsenic. It is found in oblique prisms or massive. It comes chiefly from Transylvania and Hungary, with tellurium and gold; it is also found in China. It contains 70 per cent. of arsenic, and is used in making fireworks.

The geological position of Arsenical Minerals is confined to primitive districts, where they occur in metalliferous veins, usually associated with metallic sulphurets, to which the arseniurets have considerable analogy. The only genus which has been found in any quantity is the second, the most abundant species of which are the arseniurets of cobalt, nickel, and iron, which are found both in veins and beds. The fourth genus appears to owe its origin to the action of the atmosphere on the arseniurets; they occur frequently in union with the phosphates, with which they are isomorphous; consequently the phosphoric acid is frequently more or less replaced by the arsenic, or the reverse.

The Arsenic contained in any mineral may in general be readily detected by the blow-pipe, owing to the characteristic odour of the vapour of metallic arsenic. In performing this operation it is necessary to be careful to submit the mineral to the interior or de-oxidising flame, or in order to insure the reduction of the metal more completely it is advisable to add a small quantity of the powder of charcoal. This reduction to the metallic state is essential, for it is the vapour, not of the white arsenic, but only of the metallic arsenic, which possesses the peculiar smell of garlic. If the mineral be, from its colour, suspected to be orpiment or realgar, it must be mixed with a small quantity of black flux in a glass matrass, and heated in the flame of a spirit-lamp, by which the arsenic will be liberated, and a sulphuret of potassium formed.

Native Arsenic is usually found in veins, accompanied by sulphur and sulphurets; it occurs massive, also in reticulated and stalactitic shapes, and of a curved lamellar composition, exceedingly like the layers of an onion. When fractured the new surface presents a metallic lustre and a tin white colour, which however soon tarnishes, becoming a very dark gray. It is brittle, has the specific gravity 5·766, and its hardness is 3·5.

According to Mohs it is frequently met with in the mines of Annaberg, Schneeberg, Marienberg, and Freiberg in Saxony; at Joachimsthal in Bohemia, at Andreasberg in the Harz, in the Black Forest, in Alsace, at Allemont in Dauphiny, at Kongsberg in Norway, at Kapnik in Transylvania, and in beds at Orawitza in the Bannat of Temeswar.

The second genus presents us with a very valuable series of minerals, owing to properties of the metals with which the arsenic is combined. [Cobalt Ores; Copper Ores.] The arsenical silver, which constitutes the fourth species, has not been sufficiently investigated. Professor Hausmann considers it as a more or less intimate mixture of prismatic arsenical pyrites with antimonial silver, a compound according to Klaproth of 16 to 24 parts of antimony and 84 to 76 of silver. The same chemist states 96 parts of arsenical silver to contain of

Arsenic	35·00
Antimony	4·00
Silver	12·75
Iron	45·25

Many mineralogists, on the other hand, consider the antimonial and the arsenical silver varieties of the same species. The first of these occurs in crystals and in granular masses; the latter possesses a curved lamellar composition of thin crystalline plates. They both readily tarnish, and assume a dark gray colour. The specific gravity has been stated by Haüy at 9·446, by Klaproth at 9·82. The antimonial siver is found in veins at Altwolfach in Fürstenberg, and at Andreasberg in the Harz; the arsenical in various mines in the Harz, at Guadalcanal in Spain, and also in Herland mine, Cornwall, &c. It is scarcely necessary to mention that this mineral, when found in sufficient quantity, is highly valuable for metallurgic purposes.

Axotomous Arsenical Pyrites is a compound of arsenic and iron, occurring in beds of prismatic iron, and also in primitive mountains, accompanied by cobalt and nickel, at Schladning in Styria. Its specific gravity is 7·228.

Prismatic Arsenical Pyrites, described by some mineralogists under the name of *Mispickel*, is composed, according to the analysis of Stromeyer, of

Iron	36·04
Arsenic	42·88
Sulphur	21·08

This mineral possesses a tin-white colour and a metallic lustre. The specific gravity is 6·127, and its hardness 6. It occurs massive, and also crystallised in the system of the right rhombic prism; crystals are seen in many modifications of this system; they admit of cleavage in planes parallel to the faces of a prism whose angles are 111° 12′ and 68° 48′, which may therefore be considered as the fundamental form.

This mineral is found commonly in most of the localities of arsenical minerals, associated with ores of silver, lead, and tin, both in veins and beds. It is a product of almost every mine in Cornwall, as well as those of Saxony, &c. Some specimens contain silver, of which the principal are found at Braunsdorf near Freiberg, in veins of quartz, traversing mica-slate.

White Arsenic, which constitutes the third genus, is found crystallised in octahedrons, and also in botryoidal and stalactitic forms, frequently pulverulent. It occurs in metallic veins, and probably is the product of the decomposition of other minerals. The lustre is vitreous, and colour white, with a slight degree of transparency. Its specific gravity is 3·698. It is readily recognised by its behaviour before the blow-pipe: if alone, being volatilised; if on charcoal, being volatilised with the production of the garlic odour.

ARTEMI′SIA, an extensive genus of plants belonging to the natural order *Compositæ*, and remarkable for the intense bitterness of many of its species. It is easily recognised by the multitude of fine divisions into which its leaves are usually separated, and the numerous clusters of small, round, drooping, greenish-yellow, or brownish flower-heads, with which its branches are loaded. The flowerets are all tubular, but those in the circumference of each head are very imperfect.

A. Absinthium, Wormwood, is met with frequently in waste places all over Europe and the northern parts of Asia. Its leaves have a silky or hoary aspect, in consequence of a thick covering of exceedingly delicate hairs, and they are deeply lobed. The flower-heads are very numerous, and of a light-buff colour. Wormwood is celebrated for its intensely bitter, tonic, and stimulating qualities, which have caused it to be an ingredient in various medicinal preparations, and even in the preparation of liqueurs. It derives its name from its use in destroying worms in children. *A. pontica* has also the same properties.

A. Dracunculus, Tarragon, is a Siberian species, the stems of which grow 2 or 3 feet high, are perfectly smooth, and of a bright green. Its leaves are undivided, very narrow, smooth, and rather succulent; when bruised they emit a stimulating odour, and if chewed produce a peculiarly pungent moisture in the mouth, which is so generally considered agreeable that the leaves are employed as a pickle, and as an ingredient in some kinds of vinegar. The flower-heads are small, round, and smooth, and contain seven or eight flowerets.

A. Mutellina has properties intermediate between Wormwood and Tarragon: from it and *A. spicata* the bitter aromatic liqueur called Crême d'Absinthe is prepared.

A. Abrotonum, Southernwood, an odoriferous herb found all over the south of Europe from Portugal to the Dardanelles, and thence through Palestine, Persia, and the middle of Asia into China, is frequently seen in old-fashioned gardens where it was cultivated for its peculiar aromatic scent. It is a hoary plant, becoming in warm countries a shrub, and even with us acquiring a woody stem after a few years; its branches bear loose panicles of nodding yellow flower-heads, which are externally gray with down; the leaves belonging to the panicles are much longer and narrower than those of the stem.

A. acetica, a Persian species, is said to have a strong odour of vinegar.

A. Chinensis yields the material from which moxas are made that are burned upon the human body as a cautery in cases of gout and rheumatism.

A. maderaspatana and *A. Indica* are used by the Indian doctors. The flower-heads of *A. Sieberi*, *Lercheana*, *Contra*, and *pauciflora* constitute the drugs called *Semen contra*, or *Semen Cinæ*, which are used as vermifuges. The same part of *A. Vahliana* yields the Persian Wormseed, or *Semen Cinæ Levanticum;* and that of *A. cærulescens*, the *Semen Seriphii*, or Barbotine. *A. camphorata* and *A. Gallica* are used in France also as anthelmintics under the name of Sanguerié or Sanguerite.

ARTERY, from the Greek ἀρτηρία, signifying an air-vessel, because the ancients, ignorant of the circulation, and finding the arteries always empty after death, supposed they were tubes containing air. Why after death the arteries are empty and the blood accumulated in the veins will be explained hereafter. By the term Artery is meant a vessel which conveys blood from the heart to the different parts of the body: a Vein, on the contrary, is a vessel which conveys blood from the different parts of the body to the heart. [CIRCULATION OF THE BLOOD.] All the arteries of the system proceed from two great trunks immediately connected with the cavities of the heart, namely, the Pulmonary Artery, which arises from the right ventricle, and the Aorta, which springs from the left ventricle. [AORTA; HEART.]

The arterial system is arborescent, that is, the branches which spring from the aorta successively increase in number and diminish in size as they proceed from the heart towards their ultimate terminations in the system. Each trunk commonly ends by dividing into two or more branches, the combined area of which is always greater than that of the trunk from which they spring. The capacity of the branches is estimated to exceed that of the trunks in the proportion of one and a half to one. The arterial trunk always dividing into branches, and the larger branches into branches more and more minute, it is obvious that the blood in the arterial system is always flowing from larger into smaller tubes.

The arteries are of a yellowish-white colour, loose and flocculent on their external surface, but their internal surface is smooth and polished. They are composed of three distinct membranes, which are superimposed one upon the other, and which are ultimately united by delicate cellular tissue. Each of these membranes is called a tunic, or coat, and each possesses a peculiar structure, and performs a separate function in the circulation of the blood.

1. The internal tunic consists of a membrane, colourless, transparent, and thin, yet so firm and strong that it is supposed to resist more than any of the others the bursting of the artery by the current of the blood; for if, in a living animal, the other coats be entirely removed, this alone is found capable of sustaining the impetus of the circulation, and of preventing rupture from the dilatation of the artery.

2. The middle tunic, called also the fibrous and the muscular, is composed of yellowish fibres [AREOLAR TISSUE], which pass in an oblique direction around the calibre of the vessel, forming segments of circles which are so joined as to produce complete rings. In the larger trunks, several layers of these fibres can be raised in succession by the forceps, so that this coat is of considerable thickness, and it is proportionally thicker in the small branches than in the large trunks. This coat is firm, solid, and highly elastic. It is the main tunic by which the artery resists dilatation in the transverse direction, which it does so effectually that when the left ventricle of the heart propels a fresh current of blood into the aorta little or no dilatation of the vessel is perceptible. The characteristic property of the fibrous coat is contractility. If it be mechanically irritated, or if a chemical stimulant, such as ardent spirit or ammonia, be applied to it, the vessel contracts forcibly upon its contents. This contractile power, which properly belongs to the muscular fibre, induced anatomists to believe that the fibrous tunic consists of muscular fibres; but careful examination has shown that its organisation possesses nothing in common with that of the muscular tissue, while chemical analysis has demonstrated that it contains no fibrin, which is the basis of muscle.

3. The external tunic, called also the cellular, consists of small whitish fibres, very dense and tough, interlaced together in every direction. It is much thicker in the large trunks than in the small branches, the reverse of the fibrous coat. Its outer surface is covered by a loose and flocculent cellular substance, which connects the artery with the surrounding parts, and particularly with the sheath of the vessel. Its firmness and resistance are so great that it is not divided however firmly a ligature may be placed around the artery; and its elasticity, especially in the longitudinal direction, is so remarkable that it has been called, by way of eminence, the elastic coat.

Arteries are themselves abundantly supplied with arteries, constituting their nutrient vessels, and called *Vasa Vasorum;* but these nutrient vessels of the artery form but few anastomoses, that is, but few communications with any other arteries.

The principal nerves of arteries are derived from the ganglionic or the organic system, but with these are mingled branches derived from the sentient or the animal system. [NERVE.] Accordingly, under ordinary circumstances, arteries carry on their functions independently of any influence derived from the brain and spinal cord, but they are capable of being affected by agents applied to those organs.

Among the physical properties of arteries, the most important are their extensibility and their elasticity. Their extensibility is chiefly in the direction of their length.

After an artery has been extended, either lengthwise or transversely, it suddenly retracts on itself when the extending force is removed. If the finger be forcibly introduced into the section of a large artery, the sides of the vessel re-act on the finger, and proportionally compress it. If an artery be divided in the dead body, though emptied of its contents, it maintains its cylindrical form, and preserves its capacity unimpaired. The elastic property on which these phenomena depend is common to all the coats, but it is greatest in the external tunic, and least in the internal tunic, and it is also much greater in the large trunks than in the small branches.

The most important vital property of the artery is its contractility, that is, its power of diminishing its capacity, or approximating its parietes, and thus proportionally acting upon its contents. Even the large trunks possess this property in some degree; but it resides chiefly in the ultimate divisions of the arterial branches, that is, the capillary vessels. [CAPILLARY VESSELS.]

ARTHRO'PTERUS, a Fossil Fish from the Lias near Bristol. (Agassiz.)

ARTICULA'TA, or *Articulated Animals*, form the third great section of the animal kingdom, according to the arrangement of Cuvier. They are so called because the different portions of their body are composed of moveable pieces articulated (jointed) to each other. They differ from the Mollusca in generally possessing a flexible skeleton, and from Vertebrated Animals by the skeleton being external, while that of the vertebrated is internal. Though presenting considerable diversity of character among themselves, they are generally provided with a skin, which is either soft (as in the leech), or horny and crustaceous (as in the crab and craw-fish). Certain families are destitute of feet, but the greater number are provided with these members, which, when present, are never fewer than six. The connection of the joints of the members is so close as to permit only a very limited range of motion to each; which is, however, compensated by the greater number of pieces which constitute each member or limb.

The animals of this division have the trunk of the body for the most part long and cylindrical, and divided transversely into segments. In the lowest forms of these animals the segments are perfectly simple, but as we ascend we observe that gradually the segments develop lateral organs which are of very various kinds, according to the character of the animal. In many of the *Annelida* and *Myriapoda* legs are produced on a large number of the segments, whilst in the *Crustacea* and *Arachnida* we find these reduced in number to 8 or 10, and in the Insects to 6. Where the object is lightening the body there the segments are reduced in number and size, as in the insects and the crabs, in the Annelides as the earth-worm and lug-worm, we have instances of a great extension of the number of these segments. In fact, in the same manner as we can reduce the varied bones of the vertebrate endoskeleton to the type of the vertebra, so may we reduce the varied forms of the invertebrate articulate exoskeleton to the typical form of the segment. It results from this that the parts of their skeleton or external organs are symmetrical. The animals of this class are active; hence their skeletons are light and thin. The muscles or organs of motion are attached to the interior of the skeleton; but as this is hard and unyielding, it is necessary for it to undergo a process of exuviation, which occurs in all the articulate classes. This process of exuviation goes on through all stages of life in these animals. The material out of which the skeleton is formed in the majority of cases is the phosphate of lime, the same material as enters into the bones of the vertebrate classes. In the *Mollusca*, in which the skeleton is hard, solid, and unchangeable, the carbonate of lime is the material employed.

The muscular system is more fully developed amongst the *Articulata* than in either the Radiate or Molluscous tribes of the Invertebrate classes. This corresponds to their greater activity. Perhaps in proportion to their size there are no animals that exhibit so great an amount of muscular power as the *Articulata*. Throughout the animal kingdom we find that the muscular force corresponds with the amount of respiratory action and the development of animal heat, and in various forms of articulate animals this is remarkably exemplified.

The point in which there exists the greatest degree of accordance or resemblance among Articulated Animals is the nervous system. Their brain is extremely small, and two nervous cords, surrounding the œsophagus or gullet, and continued along the abdomen, unite here and there into knots, or ganglia: in some *Crustacea* it is still more simple, consisting merely of two knots, one placed at the head, the other in the thorax, united by slender threads. The organs of sense are very imperfectly developed, and in some cases are altogether wanting, except the organ of sight. No organ of smell has yet been discovered, unless the antennæ of insects be considered such. The eye presents considerable diversity of structure, being sometimes one and single, or three united in a triangle; but in the majority of cases it is composed of a considerable number of little plates, or facettes (as in the fly), each of which receives a branch from the optic nerve. Such eyes are called Compound Eyes, whilst the Single Eyes, which exist sometimes in conjunction with the compound eyes in the same individual, are called *Ocelli*. The eye as an organ of sense is first distinctly developed in the Articulate Animals, as many of the organs which have been indicated as eyes in the Radiate Animals have probably no relation to the function of vision. Some anatomists have described organs of hearing in the insects, whilst others regard the antennæ as destined for the performance of this function.

The digestive apparatus of the *Articulata* is for the most part in accordance with their carnivorous habits. Where animal flesh is eaten there digestion is a less complicated process than where vegetable food is principally partaken of. The mouth is generally provided with masticatory organs, which move laterally and are provided with palpi. Hard parts subservient also to the function of preparing the food for digestion, are also found in the intestinal cavity. The mucous membrane which covers the alimentary passages is of the simplest kind, whilst those glands which contribute to the digestive functions in the higher animals, as the salivary and pancreatic glands and the liver, are either not present or exist only in the most elementary form.

The elongated form of the *Articulata* impresses this character on their circulating as well as digestive apparatus. In most of the articulate tribes the blood moves forwards in one or more large, dorsal, pulsating, arterial vessels. Side branches from these arteries are given off, and terminate in various trunks which convey the blood backwards to the dorsal vessel. The blood is more highly organised, has a deeper colour, containing a larger quantity of corpuscles and fibrin than in either the Radiate or Molluscous classes.

The respiration is effected either by branchiæ, as in those which habitually live in water, such as the *Crustacea*, or by tracheæ, or air-tubes formed of three parts, one membrane internal and one membrane external, both of which are cellular; and a sort of cartilaginous elastic tube, rolled spirally, and placed between the two membranes. These tracheæ receive air by certain lateral openings termed *Stigmata*. More rarely there exist cellular cavities analogous to lungs. In all instances the respiratory organs are perfectly symmetrical.

The following are the families of animals which are referred to the Articulate Type :—

1. *Entozoa*, including various forms of animals that inhabit the organs of higher animals. [ENTOZOA.]

2. *Rotifera*, or Wheel Animalcules, minute creatures scarcely visible to the naked eye, very abundant in all waters, and formerly classed with the Infusoria. [ROTIFERA.]

3. *Annelida*, or Annulose Animals, including the Leeches, Worms, and Sea-Mice, mostly inhabiting water. [ANNELIDA.]

4. *Myriapoda*, of which the Galley-Worm (*Iulus*) and the Centipede may be taken as types, and which occupy an intermediate position between the highest and lowest forms of the class. [MYRIAPODA.]

5. *Insecta*, in which the locomotive power of the class is most fully developed, nearly all possessing wings for flight. [INSECTA.]

6. *Crustacea*, the insects of the ocean, which breathe by gills instead of tracheæ, and include the well-known forms of Lobsters, Crabs, and Shrimps. [CRUSTACEA.]

7. *Cirrhipedia*, the Barnacles and Sea-Acorns. They were formerly referred to the Mollusca, but their structure, habits, and economy place them amongst the Articulata. [CIRRHIPEDIA.]

8. *Arachnida*, including Spiders, Scorpions, and Mites. They are distinguished from insects by possessing eight legs. Their instincts and intelligence place them at the head of this class as well as their structure. [ARACHNIDA.]

(Grant, *Outlines of Comparative Anatomy;* Owen, *Lectures on Comparative Anatomy;* Jones, *Animal Kingdom; Cyclopædia of Anatomy and Physiology;* Carpenter, *Principles of Physiology*.)

ARTICULATION, the term by which anatomists express the union of the different bones of the skeleton. The junction of any two bones, however firmly or loosely connected, or in whatever mode the union may be effected, is designated by the name of Articulation. Commonly two substances are employed as the media by which the connection is established, namely, a firm and strong membranous tissue termed ligament [LIGAMENT], which may be considered as the band by which the bones are tied together, and a peculiar substance termed cartilage or gristle [CARTILAGE], which is often interposed between the surfaces of the bones to be united, and which besides serving as the bond of union, accomplishes other purposes.

Of all the parts of the animal fabric, there is none in which mechanism is more clearly or beautifully shown than in the connections of the bones with each other, and more especially in the structure of joints.

The objects to be obtained in the economy by the union of the several bones of the body are various and even opposite, requiring almost every conceivable variety in the mode of their connection. And such variety actually exists; but still these varieties admit of classification, and they may all be arranged under three heads, namely, those which form Immoveable, Moveable, and Mixed Articulations.

1. One object to be accomplished by the union of bones is, to form a secure situation for tender and delicate structures. Accordingly the bones are often so disposed as to inclose cavities in which the organs that need protection are placed; such, for example, is the cavity of the head which incloses the delicate substance of the brain; the cavity of the spinal column, which incloses the no less delicate substance called the spinal marrow; and the cavities of the chest and abdomen, which inclose soft and tender organs, on the security of which life depends. Bones forming cavities of this class are generally so firmly united that they admit either of no motion whatever, or only of a very slight degree of it, the union being effected sometimes by the apposition of the surfaces of strong and flat bones; at other times by the formation of numerous prominences and depressions which mutually receive each other: examples of both these modes of union are found in the articulation of the bones of the head and face. The firmness of the union is sometimes increased by alternate indentations and projections, like the teeth of a saw, formed on the surfaces of bones, the surface of the one bone being precisely adapted to that of the other; by this mechanism the bones become firmly impacted, and deficiency in extent of contact is compensated by what may be truly called (and it is an admirable example) dove-tailing. *Suture* is the term given to this mode of union, and the bones of the cranium are nicely adjusted and firmly united to each other in this manner. At other times a ridge is formed in one bone which is received into a groove fissured in another. The bony part of the septum which divides the nostrils affords a specimen of this mode of union, while the teeth are secured in their sockets (that is, a conical surface is firmly impacted in a cavity) very much as a nail is fixed in a board.

2. The Moveable Articulations are those in which the bones are in contact, but not continuous with each other; such, for example, is the union of the arm with the shoulder, the fore arm with the arm, the wrist with the hand, the lower jaw with the head, the head with the trunk, and so on. In these cases the articulating surfaces are mutually adapted to each other, in general one being convex and the other concave, and the bones are maintained in their situation by the firm and strong membranes termed ligaments. Sometimes the union is assisted by the muscles which surround the joint, as is strikingly exemplified in the shoulder-joint, in which the head of the humerus is kept in contact with the cavity which receives it, partly without doubt by ligamentous substance, but partly also by the surrounding muscles. This is proved by the effect of disease; for if by paralysis, or any other cause, the neighbouring muscles become very much weakened, dislocation of the joint readily takes place. Both the strength of the joint and the range of its motion depend mainly on the extent of its articulating surface, and on the arrangement of the ligamentous substance by which the bones are held in their situations. The extent of contact, and the strength and adjustment of the uniting band, are different in every different joint, the diversity being regulated in every case by the kind and degree of motion which it is intended that the joint should exercise.

3. The Mixed form of Articulation resembles the Immoveable, in having the bones connected by an intermediate substance (cartilage), and the Moveable in admitting some degree of motion between the surfaces. The articulations between the several bones that form the spinal column afford examples of this mode of union. There are numerous modifications of these several kinds of articulation, which are described with great minuteness in anatomical books, and most of which are distinguished by specific names.

ARTI'SIA (Presl), a Fossil Plant from the Coal Formation. At present the opinion prevails that this is an internal portion of another plant, and not a palm-stem as once conjectured.

ARTOCARPA'CEÆ, *Artocarpads*, the Bread-Fruit Tribe, a natural order of plants nearly related to *Urticaceæ* (the Nettle Tribe), from which it is so difficult to separate them by any precise character that there are many who consider them nothing more than a section of *Urticaceæ*.

Whether a distinct order or a section only of *Urticaceæ*, the *Artocarpaceæ* are known by having flowers with a very imperfectly formed calyx, no corolla, leaves with conspicuous stipules, a rough foliage, and an acrid milky juice, which often contains Caoutchouc, or India Rubber, in abundance; the flowers are collected into round heads, and the ovules are suspended singly from the upper part of the solitary cavity of the ovarium. They are distinguished from the *Urticaceæ* by the position of their ovules, the manner in which their flowers are arranged, and by their yielding a milky juice; the juice of *Urticaceæ* being watery.

The species are all found in the warmer parts of the world, and many of them are natives of the tropics only. Their milk, which is always acrid, renders some of them intensely poisonous, as the Upas Tree of Java [ANTIARIS], and certain Indian species of Fig [FICUS]; nevertheless, if the milk is naturally absent from any particular part of an Artocarpad that part becomes eatable and even wholesome. Thus the fruit of the cultivated fig, up to a short period before its maturity, remains milky, and at that time it would prove exceedingly unwholesome; but when ripe the milk disappears, is replaced by sugar, and the fruit becomes, as we all know, extremely wholesome. The same explanation is probably applicable to the case of the Bread-

Fruit, which forms an article of food with the South Sea Islanders. [ARTOCARPUS.]

A species of *Antiaris* produces sacks, hence it is called Sack-Tree. The following is the process by which these sacks are obtained. "A branch is cut corresponding to the length and diameter of the sack wanted. It is soaked a little, and then beaten with clubs till the fibre separates from the wood. This done, the sack formed of the bark is turned inside out, and pulled down till the wood is sawed, with the exception of a small piece left to form the bottom of the sack." These sacks are in general use in the West Indies, and specimens may be seen in the Museum of the Gardens at Kew. The Water-Vine (*Phytocrene*) belongs to this order, the sap and porous wood of which when cut discharges a quantity of pure water, which is drunk by the natives of the province of Martaban, where it grows. The seeds of many of the species are eaten in the countries where they grow.

To those unacquainted with botany it may appear strange that the Nettle and the Fig are both arranged in the same order. If, however, we investigate the matter carefully, we shall find that in the structure of the stem, leaves, stipules, calyx, stamens, and fruit, these two plants are so like each other that it is impossible to discover more than one solitary essential character, namely that of the position of the young seeds, by which they can be distinguished; and that the differences which meet the unpractised eye are entirely connected with the size and manner in which the flowers are arranged.

ARTOCARPUS, the Bread-Fruit, is the genus which has given its name to the natural order *Artocarpaceæ*. It consists of trees having stems of very considerable size; large leaves, which are exceedingly rough with little points; stipules like those of the fig; and monœcious flowers, of which the stamen-bearing ones are disposed in long club-shaped spikes (*fig.* A 3), and the pistil-bearing ones in round heads (*fig.* A 2), which become the fruit, and often arrive at a very considerable size (*fig.* A 4).

A Bread-Fruit is a fig (FICUS) turned inside out, and much larger in all its parts; that is to say, the flowers which form the Bread-Fruit and Fig grow in both cases upon a fleshy receptacle; but in the former the receptacle is solid, and bears its flowers externally, while in the latter it is hollow, and bears its flowers internally.

The stamen-bearing flowers of *Artocarpus* (*figs.* B, C) consist of a tubular calyx containing a single stamen; the pistil-bearing flowers

Bread-Fruit (*Artocarpus incisa*).

A, a shoot very much less than the natural size with stamen-bearing flowers 3; pistil-bearing flowers 2; fruit 4; and its stipules 1: B, a stamen-bearing flower; C, the same opened; D, three pistil-bearing flowers, sliced open at the bottom to show the ovaries; E, a portion of the fruit showing the nuts in the inside.

(*fig.* D) consist of two or three fleshy sepals grown closely together and meeting at the points, between which passes a long slender style with two stigmas, which are hairy and curved downwards. The ovary is simple, and contains but one ovule. At a very early period the flowers grow firmly together into a solid fleshy mass, which finally becomes the fruit. The seeds are large nut-like bodies, which lie beneath the rind of the fruit.

Many species are known, some of which, as *Artocarpus Chaplasha* and *hirsuta*, are large trees, and yield valuable timber in the forests of Bengal and Malabar. The species, however, best known are those which yield the Bread-Fruit and the Jack.

A. incisa (the Bread-Fruit) is a native of the South Sea Islands and of many parts of the Indian Archipelago; it inhabits only such places as are both hot and damp. Dr. Roxburgh complains that the winters of Bengal are much too cold for it. In the South Sea Islands it forms a moderate-sized tree, rarely exceeding 40 feet in height, with leaves deeply divided into sharp lobes, and sometimes as much as 3 feet long. The fruit is green and of considerable size, equalling a melon of the larger kind in dimensions, and is of many different forms: one variety produces it free from all spines on the surface or from seeds internally; this is the best sort: others are split into deep lobes, or covered all over with the sharp-pointed fleshy tops of the calyxes. The nuts, when roasted, are said to be as excellent as the best chestnuts; but it is principally for the fleshy receptacle that it is valued. When roasted it becomes soft, tender, and white, resembling the crumb of a loaf; but it must be eaten new, or it becomes hard and choky. Others compare the flavour to that of a roasted potato. What we have tasted has been in thin slices which had been thoroughly dried, and it was very like a piece of dried biscuit. In 'Anson's Voyages' it is said to be delicious when ripe, and when mixed with lime-juice or orange-juice to have a grateful tart flavour, not unlike apple-sauce.

It forms so important a part of the support of the South-Sea Islanders that it was introduced by the British Government into the West Indies, where it is still cultivated, and whence it has been carried to the continent of America. It was to obtain this plant that the unfortunate expedition of Captain Bligh was fitted out. It does not appear, however, equal to the plantain as an article of human food.

A. integrifolia, the Jack, is also a native of the islands of the Indian Archipelago, and is in its general appearance like the Bread-Fruit, but its leaves are totally destitute of all laceration, and its fruit, which is very prickly, weighs 60 or 70 lbs. This latter is yellow, and constitutes the principal part of the diet of the natives in some parts of India; but it is said to have an offensive odour, and to be little esteemed by Europeans: all, however, concur in attesting the excellence of the nuts when roasted.

Like all other Artocarpads this tree exudes a great quantity of a viscid milky juice, from which the best bird-lime of India is prepared. (*Botanical Magazine*, vol. ii.)

ARUM. [AROIDEÆ.]

ARUNDO, a genus of Grasses, possessing the following characters:— Spikelets, each containing from two to five flowerets, which are distant from each other, arranged in two ranks, hermaphrodite, the uppermost being withered; glumes two, sharp-pointed, channeled, and keeled, nearly equal, membranous, as long as the flowerets, and at some distance from each other; paleæ two, membranous; the lowermost slit at the end, with a very short beard between the sides of the slit, covered externally, especially at the lower end and rachis, with very long silky hairs. The species attain a considerable size, sometimes acquiring a woody stem, and are found in many climates.

Arundo Donax, a native of the south of Europe, the Caucasus, Egypt, and Siberia, is one of the largest grasses that we have in cultivation; it is not unusual to see it in rich soil 9 or 10 feet high, with leaves as broad and as long as the blade of a small sword. A beautifully variegated variety is usually seen in gardens.

Arundo arenaria, the Sea-Reed, or Marrum-Grass, a dwarf plant which pierces the sand-banks on the shores of the north of Europe with its tough subterranean stems, and which thus converts them into living barriers against the inroads of the ocean, differs a little from the exact character of Arundo, and is called by modern botanists *Ammophila arundinacea*. It is a very rigid plant, with bluish rolled-up leaves, and a stem 2 or 3 feet high, terminated by a dense tuft of flowers.

The Common Reed was formerly referred to the genus *Arundo*: it is now placed under *Phragmites*. [PHRAGMITES.]

A'SAPHUS (Brongniart), a very extensive genus of Fossil *Crustacea* (*Trilobites*), most abundant in the lower Palæozoic Strata. *Asaphus Buchii* marks the Cambrian or Lower Silurian, as *A. caudatus* is frequent in the Upper Silurian Beds.

ASA'RUM, a genus of plants belonging to the natural order *Aristolochiaceæ*, distinguished by having the calyx bell-shaped and 3-lobed; the stamens placed upon the ovarium, the anthers adnate to the middle of the filaments, the style short, stigma stellate, and 6-lobed; the fruit capsular and 6-celled. The *A. Europæum* is known by having two obtuse kidney-shaped leaves on each stem. It is a perennial plant, found in woods in different parts of Britain. The root, which is employed under the name of Asarabacca, contains a camphor-like principle, and a bitter principle called Asarin, which is combined with gallic acid. To these it is indebted for its action on the human system. Taken into the stomach in a state of very fine powder, it causes vomiting; in coarser powder, it generally purges. It was formerly employed as an emetic instead of ipecacuanha; but, from the violence of its effects, it is now properly laid aside in medical practice: it is still however used in veterinary medicine, to vomit and purge. The fine powder applied to the nostrils causes sneezing, and a flow of mucus from the membrane which lines those parts. It is therefore extensively employed as an errhine, and is the basis or chief ingredient of many cephalic snuffs. It is used in chronic inflammations and some other diseases of the eye, and in headaches. Where these last arise from disorders of the digestive function, such means can be of no avail: where they are connected with congestion or fullness of the vessels of the head, the increased discharge from the Schneiderian membrane may give temporary relief in the same way as a few drops of blood flowing spontaneously from the nose, or obtained by puncturing the membrane. When taken into the stomach in considerable quantity, it acts as a poison.

ASBESTUS must be considered, in Mineralogy, rather as a term implying a peculiar form sometimes assumed by several minerals, than as a name denoting a particular species; it is in fact applied to varieties of the Amphibolic Minerals, such as *Actinolite*, *Tremolite*, &c., which occur in long capillary crystals, placed side by side in parallel position, and thus giving rise to a fibrous mass. As might be expected, the above conditions are fulfilled in various degrees, and there are accordingly various kinds of Asbestus. Those varieties, the fibres of which are very delicate and regularly arranged, are called *Amianthus*, a Greek term signifying unpolluted, unstained. The individual crystals are here readily separated from each other, are very flexible and elastic, and have a white or greenish colour with a fine silky lustre. Though a single fibre is readily fused into a white enamel, in mass it is capable of resisting the ordinary flame, so that when woven it produces a fire-proof cloth, and hence the name from the Greek *ἄσβεστος*, in the sense of indestructible. The most beautiful specimens have been found in the Tarentaise in Savoy; but Corsica must be considered as its principal locality, from its great abundance. It is also found in Cornwall, at St. Keverne; likewise in several parts of Scotland. It occurs also in the United States of America, where it is sometimes used as a wick for an oil-lamp.

Those varieties in which the crystals are coarser, with scarcely any flexibility, are called Common Asbestus. It is generally of a dull green, and sometimes a pearly lustre, and readily fuses before the blow-pipe flame. It occurs more frequently than amianthus, and is usually found in veins traversing serpentine.

There are three other varieties, known by the names of Mountain Leather, Mountain Wood, and Mountain Cork, which differ from the Common Asbestus by the fibres interlacing each other. The two first have received their names from their appearance; the third from its extreme lightness, and from its swimming in water. They have been found in Scotland.

ASCARIDES. [ENTOZOA.]

ASCI'DIA, a genus of Molluscous Animals belonging to Cuvier's order of *Acephalæ* without Shells. Savigny has considered these animals sufficiently important to constitute a class under the name of *Ascedies* (*Ascidia*); while Lamarck has also formed them with others into a class under the name of *Tuniciers* (*Tunicata*). [TUNICATA.]

ASCLEPIADA'CEÆ, *Asclepiads*, a natural order of Exogenous Plants, known from all others by the single character of its grains of pollen adhering together within a sort of bag which occupies the whole of the inside of each cell of the anther; and when it falls out sticks to glands of a peculiar character occupying the angles of the stigma. Independently of this circumstance the anther and stigma adhere firmly together, and the fruit is a very curious body, consisting of two carpels, which, when young, are parallel to each other, and united at the point; but when ripe are both on the same plane, pointing in different directions, and shedding a large quantity of seed, the ends of which terminate in long down.

The most important and typical genus of this order is *Asclepias*. It consists of shrubs or herbaceous plants, abounding in an acrid and usually milky juice, and found in their greatest abundance in tropical countries, but rarely in cold latitudes. At the Cape of Good Hope they form a singular stunted deformed vegetation, in the form of the leafless succulent stapelias, the flowers of which are among the most fetid productions of the vegetable kingdom. A great many species of *Asclepias* inhabit North America, and for their beauty are frequently cultivated in Europe, especially the orange-coloured *Asclepias tuberosa*. Their roots are acrid and stimulating, and usually emetic. Their flowers have curious horned processes added to the corolla. [ASCLEPIAS.]

The roots of the whole order appear to be acrid and stimulating, and some of them, as *Tylophora asthmatica* and *Secamone emetica* are employed as emetics. The Cow-Plant of Ceylon, or Kiriaghuna Plant (*Gymnema lactiferum*), yields a milk which the Cingalese make use of as food. Species of *Cynanchum* act as purgatives. The leaves of *Solenostemma Argel* are used in Egypt for adulterating senna. Several species yield caoutchouc, whilst others afford indigo. (Lindley, *Vegetable Kingdom*.)

ASCLE'PIAS, a genus of plants, the type of the natural order *Asclepiadaceæ*. Many of the species possess powerful medicinal qualities, and hence the name of the genus from Æsculapius (Asclepias), the god of medicine. The genus is characterised by possessing a reflexed 5-parted corolla; a 5-leaved corona seated on the

Asclepias Syriaca.

1, A flowering shoot; 2, a single flower magnified; 3, the same seen from above; the centre is occupied by a broad cushion-like stigma; 4, the anthers much magnified, *a*, one of the horned processes of the corolla; 5, the same cut vertically, and less magnified, *a*, one of the horned processes; 6, pollen masses, *a*, the gland; 7, one half of a ripe fruit; 8, a transverse view of its inside near the point, showing how the seeds are arranged; 9, seed; 10, the same cut across; 11, the same cut vertically, showing the embryo; 12, the embryo separate.

upper part of the tube of the filaments; the leaflets cucullate, having a horn-formed process protruding from the bottom; the anthers terminated by a membrane; pollen masses compressed, fixed by the tapering tops, pendulous; the stigma depressed; the follicles smooth; the seeds coarse. Most of the species are North American herbs, with opposite, alternate, or verticillate leaves.

A. Syriaca, Syrian Swallow-Wort, has simple stems with lanceolate oblong or oval leaves, gradually acute, and tomentose beneath; drooping umbels. Lamarck states that the native country of this plant is Syria and Egypt. The nectaries or leaflets of the corona, like some other species of *Asclepias*, act as fly-traps. The sap of this plant is white, and contains a considerable quantity of caoutchouc. It has been recommended as an expectorant. The seeds are covered with down, which it was at one time proposed to spin into textures for wearing apparel; it is, however, more adapted for stuffing mattresses and pillows.

A. Curassavica, Bastard Ipecacuanha, has a simple stem, with oblong-lanceolate glabrous leaves tapering at both ends; umbels erect, solitary, lateral. It is a native of Curaçoa, Essequibo, Cumana, and Trinidad. Its roots are frequently sent to England as ipecacuanha. The juice in the West Indies is reputed to be anthelmintic and styptic. The root dried and powdered acts as an emetic, but not so efficaciously as the root of the true Ipecacuanha (*Chepaelis Ipecacuanha*). The roots of *A. prolifera* are also emetic.

A. tuberosa, Tuberous Swallow-Wort, has suberect stems, very hairy, and branched at top; scattered oblong-lanceolate hairy leaves; umbels disposed in a terminal sub-corymb. It is a native of North America, in stony places and sandy fields. The roots are famed for diaphoretic properties, and in Virginia it is used for this purpose in inflammatory diseases, more particularly in pleuritis and dysentery. The *A. decumbens* of some authors is probably only a variety of this species, and has the same properties.

Many other species of this genus are used as medicines in the countries where they grow. The buds of *A. stipitacea* are eaten by the shepherds of Arabia after the manner of asparagus in this country. The whole plant of *A. aphylla* may be eaten. *A. gigantea*, an East Indian species, is very poisonous. It kills cattle which eat it, but it is used in Hindoo medicine in typhus fever. The milky sap of *A. lactifera* is quite innocuous, and is drunk in India as a wholesome food; whilst, on the other hand, the milk of *A. laniflora* and *A. procera* is acrid and irritating. The juice of *A. laniflora* is used with butter and lard as an ointment for itch, and that of *A. procera* is applied to hides for removing the hair before tanning. The *A. asthmatica* and *A. vincetoxicum* have both active properties, and are now included under the genus *Cynanchum*. [CYNANCHUM.]

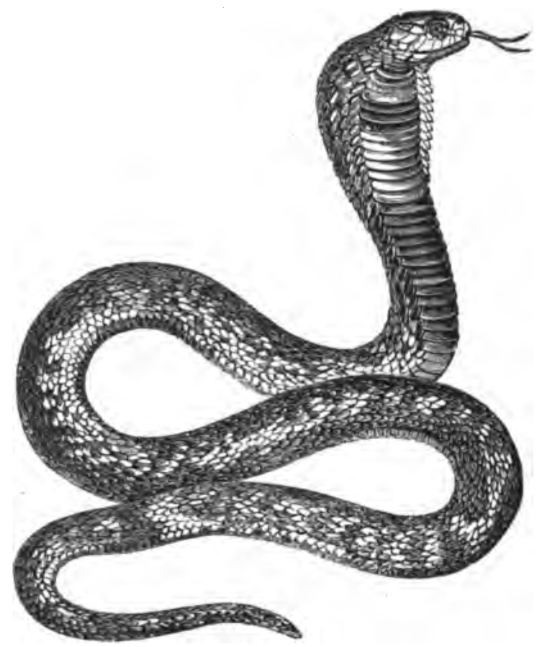
Many of the species of *Asclepias* are handsome border-flowers, and worthy of cultivation. They thrive well in peat-earth, or a light rich soil of any kind. They may be propagated by dividing the root in the spring, or by sowing the seed. Many of the species will require protection at the roots during severe winters. The tropical and subtropical species require the ordinary treatment of other stove and greenhouse plants.

ASE'LLUS, a genus of Malacopterygious Fishes, to which Willughby referred the Whiting-Pout, and Ling. They are now referred respectively to the genera *Morrhua* and *Lota*.

ASH. [FRAXINUS.]

ASP, a name commonly given to several species of venomous serpents. By naturalists the term is confined to the *Vipera aspis*, which is an inhabitant of the European Alps. The asp which is historically interesting from having been employed by Cleopatra as the instrument of her own destruction, is supposed to be the *Cerastes Hasselquistii*. The Asp (ἀσπίς) is often mentioned both by Greek and Roman writers. From various circumstances, however, and particularly from the description of Pliny ('Nat. Hist.' viii. 35.), it is evident that the most common and celebrated is the species to which the modern Arabs give the name of El Haje, or Haje Nascher. This animal measures from 3 to 5 feet in length: it is of a dark green colour, marked obliquely with bands of brown; the scales of the neck, back, and upper surface of the tail are slightly carinated, and the tail is about one-fourth part the length of the whole body. The Haje is closely allied to the Cobra Capello, or Spectacled Snake of India, the chief apparent difference being its want of the singular yellow mark on the back of the neck, from which the latter species derives its name. In other respects these two serpents are nearly of the same size; they are equally venomous, and both have the power of swelling out the neck when irritated, and raising themselves upright upon their tails to dart by a single bound upon their enemies.

The poison of the Asp is of the most deadly nature. Pliny, in the passage above referred to, gives the following account of this celebrated serpent:—"The neck of the asp is capable of distension, and the only remedy against its bite is the immediate amputation of the wounded part. This animal, otherwise so much to be dreaded, has a sentiment, or rather a kind of affection, truly wonderful. It never lives alone, the male and female being constantly found together, and if one happens to be killed, the other seeks with the utmost fury to avenge its death. It knows and selects the destroyer from among crowds; it follows him to great distances, surmounts every obstacle, and can only be deprived of its revenge by the most speedy flight, or the intervention of some rapid river. It is difficult to say whether nature has been more prodigal of evils or remedies. For instance, she has bestowed upon this reptile, so terrible from the deadly effects of its poison, so indifferent



a vision, its eyes being placed on the sides of the head so as to prevent it from seeing straight before it, that it is frequently trodden under foot before it is aware of its danger." Forskal, a Swedish naturalist, who has written on the animals of Egypt, informs us that the jugglers of Grand Cairo have the art of taming the Haje, as those of India do the cobra capello, and teaching it to dance for the amusement of the populace; taking care, however, to deprive it of its poison fangs, though even then they avoid its bite when irritated. The habit which this serpent has of erecting itself when approached, made the ancient Egyptians imagine that it guarded the places which it inhabited. They made it the emblem of the divinity whom they supposed to protect the world; and accordingly they have represented it on their temples sculptured on each side of a globe.

ASPA'RAGUS, a genus of plants belonging to the natural order *Liliaceæ*. It is comprised by some botanists under the order *Asphodeleæ*. The species eaten under the name of Asparagus is the *A. officinalis*. [ASPARAGUS, in ARTS AND SC. DIV.) There are a great number of species, natives of Asia and Africa, which are cultivated in our gardens rather as matter of botanical interest than on account of their beauty or utility. The roots of *A. racemosa* and *A. adscendens* are employed medicinally in the North of India.

ASPEN. [POPULUS.]

ASPERGI'LLUM, a genus of *Tubicolous Mollusca*, furnished with a bivalve shell incrusted as it were in a tubular testaceous sheath. This tubular sheath gradually lessens in diameter to the aperture which is farthest from the incorporated bivalve. The end nearest to the bivalve is dilated into a concave disk, with a central fissure, and perforated with minute but raised holes. The disk is bordered by a tubular frill. There are but few species, and of these *Aspergillum Javanum*, known to collectors as the Watering-Pot, is the most common.

ASPE'RULA, a genus of plants belonging to the natural order *Rubiaceæ* or *Galiaceæ*. The genus is known by its funnel-shaped corolla, and by the fruit being dry and not crowned with the limb of the calyx.

A. odorata, the Woodruff, has its leaves six or eight in a whorl, with perfectly white flowers. It occurs in woods, and is found throughout Europe. It is abundant in some parts of England. The whole plant is remarkable for its fragrance when dried.

A. Cynanchica has its leaves four in a whorl, and flowers of a lilac colour. It is found on dry banks and hills in limestone districts. It is common in Great Britain, where it is called Quinsy-Wort on account of its supposed value as a remedy in sore throat. It is slightly astringent. Two other species, *A. arvensis* and *A. taurina*, are doubtful natives, but found wild now in England.

(Babington's *Manual of British Botany*.)

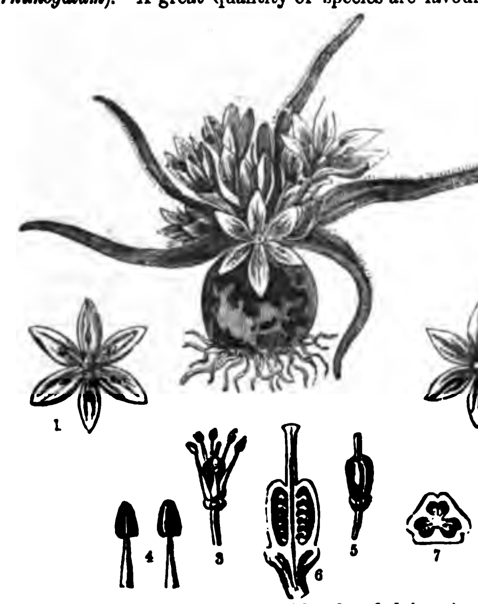
ASPHA'LTUM (a Greek word, ἄσφαλτος, of unknown etymology), frequently known by the name of Slaggy or Compact Mineral Pitch, is one of the varieties of Bitumen arising from the decomposition of vegetable matter. It occurs massive, of a dark brown or black colour, with a conchoidal fracture and a resinous lustre. It is opaque, and exceedingly brittle at a low temperature, but softens and fuses by the application of heat; in density it varies from that of water to 1·6. It may be recognised by the following characters:—It is insoluble in alcohol, but soluble in about five times its weight of naphtha, with which it forms a good and useful varnish; its combustion is rapid and brilliant, with the production of the bituminous odour.

It is found in most countries, but most abundantly on the shores or floating on the surface of the Dead Sea; at Hit, above Babylon, on the Euphrates; near the Tigris: in Trinidad in the West Indies it fills a basin of three miles in circumference, and of unknown depth. There is a pitch-spring in Zante which is known to have been at work for above 2000 years. (Herod. iv. 195). It is also found in limestone at Bleiberg in Carinthia; in beds of sandstone in Albania, and in veins in the Harz in Germany; in Derbyshire, Shropshire, and several other places. It is the principal colouring matter of the dark indurated marl, or shale, which is found in coal districts.

ASPHODE'LEÆ, or the Asphodel Tribe, are Monocotyledonous Plants, which, although they form a very natural assemblage alone, are now placed by Lindley as a subdivision of the order *Liliaceæ*. They are for the most part easily recognised, although in certain species and genera they approach other orders so closely as to be distinguished only with great difficulty. They all have regular flowers with 3 sepals, and 3 petals of nearly equal size and colour, 6 (very seldom 3) stamens, and a superior 3-celled ovary, with only 1 style. Their fruit is either dry or succulent, and their seeds have a brittle coat.

Asphodeleæ are known from *Junceæ*, or the Rush Tribe, by their larger and more coloured flowers, and by the hardness of the coat of their seeds; from *Liliaceæ*, or the Lily Tribe, by the smallness of their flowers, and the hard coat of the seeds; and from *Melanthaceæ*, or the Colchicum Tribe, by their single style, and by their anthers being turned towards the ovary. They may be formed into two subdivisions.

The first, or the *Alliaceous* subdivision, in which there is no true stem, and which consists entirely of bulbous species, the roots being emitted and perishing annually. To this belong the Onion, Garlic, and their allies, together with the Hyacinth, Squill, and Star of Bethlehem (*Ornithogalum*). A great quantity of species are favourites with the



Star of Bethlehem (*Ornithogalum fimbriatum*).

1, A flower seen from within; 2, the same viewed from without; 3, the stamens and ovary; 4, two stamens apart; 5, an ovary; 6, the same cut perpendicularly; 7, the same cut horizontally.

horticulturists on account of their early appearance in the spring and their easy cultivation.

The second subdivision, consisting of the true Asphodels [ASPHODELUS] and those which resemble them, have no bulbs, but in their stead clusters of fleshy roots such as we find in the Asparagus, which belongs to this subdivision; the stems of these are frequently woody, but in that case they are branched: *Dracæna*, or the Gum-Dragon Tree, is a most remarkable instance of this, it having almost the appearance of a Dicotyledon when deprived of foliage. This subdivision also contains Aloes, with their thick fleshy leaves and forked stems. [ALOE.]

ASPHO'DELUS, a genus of plants the type of the natural order *Asphodeleæ*. It comprehends some handsome hardy perennial plants, with fleshy finger-like roots, and upright undivided annual stems covered with long leaves; they are among the most highly developed of the Monocotyledonous plants of northern countries. The most remarkable species are the following:—

A. luteus, the common Yellow Asphodel, is a beautiful perennial, very often seen in cottage-gardens or on the outskirts of shrubberies. It grows wild in Barbary, Sicily, Dalmatia, the Peloponnesus, and even spreads into the Crimea. Its stems are from 2 to 3 feet high, never branched, and covered all over with long narrow bluish-green leaves, which have very broad sheathing bases. The flowers are handsome, deep yellow, with a green streak on the outside of each petal. The fruit consists of red pulpy berries.

Very nearly related to this are *A. capillaris*, which differs chiefly in its very narrow leaves, shorter bracts, and extremely narrow divisions of the flower; and *A. Sibiricus*, figured in the 'Botanical Register,' plate 1507, which is principally known by its dwarfer stature, earlier and paler flowers, more glaucous leaves, and shorter bracts.

A. albus, or the White Asphodel, found all over the southern provinces of Europe and the basin of the Mediterranean Sea, is as frequently seen as the first, and in similar situations. Its flowers are white with a reddish streak on the outside of each petal, and are disposed in branched clusters. *A. ramosus* of many gardens seems merely a branched state of this species, and several other reputed species with white flowers are also in all probability not distinct.

ASPIDIA'RIA (Presl). Several species of the *Lepidodendra* of Sternberg are thus named. They are from the Coal Formation.

ASPI'DIUM, a genus of Ferns, and one under which many species were arranged by older botanists, which are now placed under new genera. [POLYPODIACEÆ.] One of the most remarkable species of this genus is the *Aspidium Baromez*, or Tartarian Lamb, which has been referred by Mr. Smith to the genus *Cibotium*. This plant, from its peculiar colour and form, was at one time really supposed to be a kind of vegetable animal, as the following account from Struys, an old traveller, proves:—"On the western side of the Volga," he says, "there is an elevated salt plain of vast extent, but wholly uncultivated and uninhabited. On this plain, which furnishes all the neighbouring countries with salt, grows the Boranez or Bornitsch. This wonderful plant has the shape and appearance of a lamb, with feet, head, and tail distinctly formed. Boranez, in the language of Muscovy, signifies a little lamb, and a similar name is given to this plant. Its skin is covered with very white down as soft as silk. The Tartars and Muscovites esteem it highly, and preserve it with great care in their houses, where I have seen many such lambs. The sailor who gave me one of these precious plants found it in a wood, and I had its skin made into an under-waistcoat. I learned at Astracan, from those who were best acquainted with the subject, that the lamb grows upon a stalk about three feet high; that the part by which it is sustained is a kind of navel, and that it turns itself round, and bends down to the herbage which serves for its food. They also said it dries up and pines away when the grass fails." Struys adds many other wonderful things about this plant. His statement is however substantially correct. The rhizoma of the *A. Baromez* presents a rude resemblance to an animal. It is covered with a silky down, and when cut into has a soft inside with a reddish flesh-coloured appearance, sufficient to account for the origin of the fables with regard to its animal nature. Is is not improbable that this fern dries up when the grass does, but of course the one has no dependence on the other. The Baromez possesses the astringent property which is common to all ferns; hence it has been used as a styptic.

Aspidium Filix-Mas (now *Lastræa Filix-Mas*), the Male Fern, is a native of Great Britain, and is admitted into the British Pharmacopœias on account of its anthelmintic properties. It has bipinnate fronds, obtuse and serrated pinnules, the sori near the central nerve, the lateral nerves forked. It is abundant throughout Europe, and grows in stony places on the skirts of woods, in open plantations and roadsides. The part used in medicine is the root, or rather the root-stock. This part of the plant is collected for medicinal purposes between the end of May and the middle of September. It will not keep well, and should be renewed at least every two years. It has often been chemically analysed, and is found to contain—

Lignin	45
Starch	10
Uncrystallisable Sugar	10
Gum	10
Fixed Oil	7
Resin	4
Salts, Volatile Oil	14
	100

The ancients used this plant as a vermifuge, but it was nearly given up by modern practitioners of medicine when Peschier pointed out the conditions in which he had found it efficacious in expelling tapeworm. The best mode of administering it is as an etherial tincture; the ether seems to dissolve the resinous oil on which the active properties of the plant depend. The dose of the root according to Peschier is about one drachm.

A. dilatatum (*Lastræa dilatata*), a British fern, is often confounded with the last for medicinal purposes. It has sub-tripinnate fronds; oblong, blunt, inciso-pinnatifid lobes; spinose, mucronate segments; a deciduous unfringed indusium. This is a common fern, but less generally diffused than the last.

A. Filix-Fœmina (*Athyrium Filix-Fœmina*), Lady-Fern, has a lanceolate pinnate frond; pinnæ linear, acute, regularly pinnate; pinnules linear-oblong, quite distinct, deeply serrate or pinnatifid; segments with 2 or 3 teeth. This is one of the most beautiful of the British ferns. The root is sometimes gathered for that of the Male Fern. It has "a short perpendicular root-stock, black externally, with black root-fibres; and the tufts or bases of the leaf-stalks, which compose the greater part of it, form a very acute angle with its axis, while those of the Male Shield-Fern extend outwards at a more open angle." (Christison.)

(Burnett, *Outlines of Botany;* Babington, *Manual of British Botany;* Christison, *Dispensatory*.)

ASPIDOPHO'RUS, a genus of Acanthopterygious Fishes. One species, the *A. Europæus* is found on the coasts of England and Scotland. It is known by the names of the Armed Bullhead, the Pogge, the Lyrie, Sea-Poacher, Pluck, and Noble. It is a small fish seldom exceeding 6 inches in length. (Yarrell, *British Fishes*.)

ASPIDORHY'NCHUS, a genus of Fossil Ganoid Fishes, from the Lias and Oolite of England. (Agassiz.)

ASPIDU'RA. A fossil species of Ophiuroid Echinoderms is thus named by Agassiz. From the Lias of Yorkshire.

ASPLE'NIUM, a genus of plants belonging to the natural order of Ferns. [POLYPODIACEÆ.] It has elongated straight sori, with an indusium opening towards the central nerve or midrib. The species of this genus are known by the name of Spleenworts. Several of them are common in Great Britain.

A. lanceolatum, of Hudson, has lanceolate doubly pinnate fronds; the pinnules ovate and deeply and sharply toothed, or lobed; the sori short, nearly marginal. It is a native of England and Wales, on rocks and walls, but its distribution is very local. It is also a native of France, but its European habitats are few.

A. Adiantum-nigrum, Black Spleenwort, has triangular attenuated fronds, twice or thrice pinnate, the pinnæ and pinnules triangular, sharply toothed; sori elongated, central. This plant is a native of Europe, and is abundantly distributed throughout the United Kingdom, where it occurs on rocks, walls, ruins, and hedge-rows. This is one of the ferns formerly much used in medicine, and is stated by Ray to be efficacious in cough, asthma, pleuritis, jaundice, stone, gravel, and other diseases. It has not however any reputation amongst modern practitioners of medicine.

A. Ruta-muraria, Wall-Rue, has bipinnate fronds, the pinnules rhomboid wedge-shaped, notched or toothed at the end; the indusium jagged. This fern is very common on rocks and old walls in Great Britain and throughout Europe, and is also a native of North America. It was at one time used as a remedy in coughs and asthmas, obstructions of the liver, and in cutaneous diseases; but has now fallen into disuse.

A. Trichomanes, Common Spleenwort, has pinnate linear fronds; roundish ovate, crenate, stalked pinnæ; the nerves forked below the sori. It is very common throughout Great Britain on rocks, walls, churches, ruins, bridges, and hedgerows. It is a native also of Europe, Africa, and the United States. This fern has been also used in medicine, and for the same diseases as the previous species, but it has fallen now entirely into disuse.

The other British species of *Asplenium* are *A. alternifolium*, *A. septentrionale*, *A. marinum*, *A. viride*.

These and other ferns may be easily cultivated by placing them in situations resembling their natural habitats. They require a pure atmosphere, plenty of space, and natural shade, with a due supply of water. They may be planted on decayed wood, in holes of rocks and brick, with almost any soil. One of the most elegant modes of cultivating them is by means of inverted jars, under which they will thrive in any sandy or light soil.

(Babington, *Manual;* Newman, *History of British Ferns;* Ward, *Growth of Plants in Glazed Cases*.)

ASPRE'DO, a genus of Abdominal Malacopterygious Fishes, characterised by the horizontal flatness of the head, and the enlargement of the anterior part of the trunk, arising from an unusual development of the bones of the shoulder. They are further distinguished from the *Silures* of Linnæus (from which extensive genus, indeed, they were originally separated by that great naturalist himself) by the proportional length of the tail; by having the eyes placed in the upper surface of the head, and the intermaxillary bones concealed beneath the ethmoid, directed backwards, and furnished with teeth only along their posterior margin; and finally, they are remarkable as being the only known fish, not being cartilaginous, which have not moveable opercula, the bones of which these organs are composed being soldered on either side to the tympanum and pre-operculum. The opening of the gills is consequently formed by a single slit in the skin immediately behind the posterior side of the head; and their membrane is composed of six branchiostegous rays. The lower jaw is transverse, and the upper projects considerably beyond it, and forms a small attenuated muzzle. There is but a single dorsal fin, which is of small extent, and situated on the fore-part of the body: the anal fin on the contrary is very large, and occupies the entire length of the tail. This genus contains but very few species, the principal of which, the *Silurus Aspredo* of Linnæus, inhabits the rivers and lakes of North America.

ASS, a well-known and useful domestic animal, whose good qualities are too frequently undervalued, from being contrasted with those of the horse, without considering the different nature of the treatment which these two quadrupeds receive—the care and attention bestowed upon developing the form and cultivating the spirit of the one, and the neglect and ill usage to which the other is so generally subjected. Buffon has well observed that the ass is despised and neglected only because we possess a more noble and powerful animal in the horse; and that if the horse were unknown, the care and attention which is lavished upon him, being transferred to his now neglected and despised rival, would have increased the size and developed the mental qualities of the ass to an extent which it would be difficult to anticipate, but which eastern travellers who have observed both animals in their native climates, and among nations by whom they are equally valued and the good qualities of each justly appreciated, assure us to be the fact. Indeed, the character and habits of these two quadrupeds are directly opposed in almost every respect. The horse is proud, fiery, and impetuous, nice in his tastes, and delicate in constitution; like a pampered menial he is subject to many diseases, and acquires artificial wants and habits which are unknown in a state of nature. The ass on the contrary is humble, patient, and contented with scanty and coarse fare which other cattle reject; he bears with patience and fortitude the most cruel and oppressive treatment; yet he is more susceptible of strong attachment than the horse, has apparently more prudence and reflection, and is capable of a degree of education which would not be anticipated from the forlorn and dejected appearance which coarse food and harsh treatment have rendered habitual to him. In Persia, Arabia, and other eastern countries however the ass is a very different animal from what he is in Western Europe. There, instead of being neglected and despised, half-starved, and treated with cruelty, care is taken to cultivate the breed by crossing the finest specimens; even the Wild Ass is procured for this purpose, the pedigrees of the different races are carefully recorded, and the size, strength, and symmetry of the ass so much improved that he is rendered equal to the horse for most purposes, and in some cases even his superior. "The asses of Arabia," says Chardin, "are perhaps the handsomest animals in the world; their coat is smooth and clean; they carry the head elevated, and have fine and well-formed legs, which they throw out gracefully in walking or galloping. They are used only for the saddle, and are imported in vast numbers into Persia, where they are frequently sold for 400 livres; and being taught a kind of easy ambling pace, are richly caparisoned, and used only by the rich and luxurious nobles."

The ass is properly speaking a mountain animal; his hoofs are long, and furnished with extremely sharp rims, leaving a hollow in

Wild Ass.

the centre, by which means he is enabled to tread with more security on the slippery and precipitous sides of hills and craggy places. The hoof of the horse on the contrary is round and nearly flat underneath, and we accordingly find that he is most serviceable in level countries; and indeed experience has long since taught us that he is altogether unfitted for crossing rocky and steep mountains. As however the more diminutive size of the ass rendered him comparatively less important as a beast of burden, the ingenuity of mankind early devised a means of remedying this defect, by crossing the horse and ass, and thus procuring an intermediate animal, uniting the size and strength of the one with the patience, intelligence, and surefootedness of the other.

The Wild Ass, called Koulan by the Persians, is still common in many parts of Central Asia. It stands much higher on its limbs than the common ass, its legs are longer and more slender, and it is altogether a more graceful and symmetrical animal. The mane is composed of short erect hair of a dusky colour and rather a woolly texture; the colour of the body is a uniform silvery gray, with a broad coffee-coloured stripe extending down the back from the mane to the tail, and crossed on the shoulder by a transverse band, as in the domestic variety. The Koulan inhabits the parts of Central Asia from 48° N. lat. to the northern confines of India. They migrate from north to south according to the season. In summer they are commonly found about Lake Aral, but in autumn they collect in vast troops under the conduct of a regular leader, and proceed towards the south, arriving at Cutch and Guzerat in October or November, and returning northward again in the middle of spring. The Persians and Tartars hold the flesh of the Koulan in high esteem, and hunt it in preference to all other descriptions of game. Olearius assures us that he saw no fewer than thirty-two wild asses slain in one day by the Shah of Persia and his court, the bodies of which were sent to the royal kitchens at Ispahan; and we know from Martial that the epicures of Rome held the flesh of the Onager, or Wild Ass, in the same estimation as we do venison ('Epig.' xiii. 97).

From a passage in Pliny (lib. viii. c. 44) it would appear that the Onager inhabited Africa, and that the most delicate and best flavoured lalisiones, or fat foals, were brought from that continent to the Roman markets. Leo Africanus repeats the same story of wild asses being found in Africa, but no traveller has since met with them, and, so far as we at present know, the species is confined to Asia. It has even retired from Syria and Asia Minor, where it was formerly found. [EQUIDÆ.]

ASSAPANS, the name of a species of Flying Squirrels.

ASTACOLITES, in Zoology, one of the names given by ancient geologists to the fossil remains of the Long-Tailed or Lobster-like Crustaceans.

A'STACUS (Leach, Desmarest), a genus of Long-Tailed Crustaceous Animals, including the common Lobster. It was formed by Gronovius from the genus *Cancer* of Linnæus and of ancient authors, which also comprised the Short-Tailed Crustaceous Decapods, with the exception of *Hippa*. Fabricius broke it down into the genera *Pagurus*, *Galathea*, and *Scyllarus*; leaving *Astacus* to represent a certain number of Crustaceans, from which he afterwards, having the advantage of Daldorff's labours, separated the genera *Palinurus*, *Palæmon*, *Alpheus*, *Peneus*, and *Crangon*. Our countryman Leach, in adopting the genus as left in its last shape by Fabricius, separates from it the genus *Nephrops*, of which there is only one species recorded, the Norway Lobster (*Nephrops Norvegicus*). Desmarest adopts the views of Leach, and the genus *Astacus* is now reduced to very few species.

Of these species the most interesting, from their commercial value as food, are the common Lobster (*Astacus marinus*) and the Craw-Fish (*Astacus fluviatilis*.)

The Lobster is found in the greatest abundance on the rocky coasts of this kingdom, in clear water of no very great depth, at the time of depositing its eggs, about the middle of summer. Pennant mentions the great quantities supplied to the London markets, in his time, from the Orkneys and the eastern coasts of Scotland; and states the number annually brought in well-boats from the neighbourhood of Montrose alone at 60,000 or 70,000. But almost incredible as the consumption of this species is, nature has provided for its security by the most profuse fecundity. Doctor Baster says that he counted 12,444 eggs under the tail of one female lobster, besides those that remained in the body unprotruded.

Lobsters are very voracious, and the fishery for them is carried on sometimes by means of traps, or 'pots' (as they are called in some places), made of twigs, baited with garbage, lowered into the sea and marked by a buoy; sometimes by nets baited with the same materials; and in some countries, by torch-light, with the aid of a wooden instrument, which acts like a forceps or a pair of tongs.

One of the best narratives of the habits of the lobster extant, is to be found in the following letter from Mr. Travis, of Scarborough, to Mr. Pennant, dated on the 25th October, 1768:—

"We have vast numbers of fine lobsters on the rocks near our coast. The large ones are in general in their best season from the middle of October till the beginning of May. Many of the small ones, and some few of the larger sort, are good all the summer. If they be 4½ inches long, or upwards, from the tip of the head to the end of the back shell, they are called sizeable lobsters. If only 4 inches, they are esteemed half size; and when sold, two of them are reckoned for one of size. If they be under 4 inches, they are called Pawks, and are not saleable to the carriers, though in reality they are in the summer months superior to the large ones in goodness. The pincers of one of the lobster's large claws are furnished with knobs, and those of the other claw are always serrated. With the former it keeps firm hold of the stalks of submarine plants, and with the latter it cuts and minces its food very dexterously. The knobbed, or numb claw, as the fishermen call it, is sometimes on the right side, and sometimes on the left, indifferently. It is more dangerous to be seized by them with the cutting claw than the other; but, in either case, the quickest way to get disengaged from the creature is to pluck off its claw. It seems peculiar to the lobster and crab when their claws are pulled off that they will grow again, but never so large as at first.

"The female or hen lobster does not cast her shell the same year that she deposits her ova, or in the common phrase, is 'in berry.' When the ova first appear under her tail, they are very small and extremely black; but they become, in succession, almost as large as ripe elderberries before they are deposited, and turn of a dark-brown colour, especially towards the end of the time of her depositing them. They continue full and depositing the ova in constant succession, as long as any of that black substance can be found in their body, which when boiled turns of a beautiful red colour, and is called their Coral. Hen-lobsters are found in berry at all times of the year, but chiefly in winter. It is a common mistake, that a berried hen is always in perfection for the table. When her berries appear large and brownish, she will always be found exhausted, watery, and poor. Though the ova be cast at all times of the year, they seem only to come to life during the warm summer months of July and August. Great numbers of them may then be found, under the appearance of tadpoles, swimming about the little pools left by the tides among the rocks, and many also under their proper form, from half an inch to four inches in length.

"In casting their shells, it is hard to conceive how the lobster is able to draw the fish of their large claws out, leaving the shells entire and attached to the shell of their body; in which state they are constantly found. The fishermen say the lobster pines before casting, till the fish in its large claw is no thicker than the quill of a goose, which enables it to draw its parts through the joints and narrow passage near the trunk. The new shell is quite membranous at first, but hardens by degrees. Lobsters only grow in size while their shells are in their soft state. They are chosen for the table by their being heavy in proportion to their size, and by the hardness of their shells on their sides, which when in perfection will not yield to moderate pressure. Barnacles and other small shell-fish adhering to them are esteemed certain marks of superior goodness. Cock-lobsters are in general better than the hens in winter; they are distinguished by the narrowness of their tails, and by their having a strong spine upon the centre of each of the transverse processes beneath the tail which support the four middle plates of their tails. The fish of a lobster's claw is more tender, delicate, and easy of digestion, than that of the tail. Lobsters are not taken here in pots, as is usual where the water is deeper and more still than it is upon our coast. Our fishermen use a bag-net fixed to an iron hoop, about 2 feet in diameter, and suspended by three lines like a scale. The bait is commonly fish-guts tied to the bottom and middle of the net. They can take none in the daytime, except when the water is thick and opaque: they are commonly caught in the night; but even then it is not possible to take any when the sea has that luminous appearance which is supposed to proceed from the *Nereis noctiluca*. In summer, the lobsters are found near the shore, and thence to about 6 fathoms depth of water; in winter, they are seldom taken in less than 12 or 15 fathoms. Like other insects [crustaceans] they are much more active and alert in warm weather than in cold. In the water they can run nimbly upon their legs or small claws, and if alarmed can spring tail foremost to a surprising distance, as swift as a bird can fly. The fishermen can see them pass about 30 feet, and by the swiftness of their motion, suppose they may go much farther. Athenæus remarks this circumstance, and says that the incurvated lobsters will spring with the activity of dolphins. Their eyes are raised upon moveable bases, which enables them to see readily every way. When frightened they will spring from a considerable distance to their hold in the rock; and, what is not less surprising than true, will throw themselves into their hold in that manner through an entrance barely sufficient for their bodies to pass, as is frequently seen by the people who endeavour to take them at Filey Bridge. In frosty weather, if any happen to be found near the shore, they are quite torpid and benumbed. A sizeable lobster is commonly from one pound to two in weight. There was one taken here this summer which weighed above four pounds, and the fishermen say they have seen some which were of six pounds, but these are very rare."

There is no doubt that the lobster changes its shell annually; but the mode in which this operation is performed is not satisfactorily known. Some suppose that the old shell is thrown off, and that the animal retires to some lurking place to avoid the voracity of his crust-clad fellows, till his new covering acquires sufficient hardness; others contend that the process is one of absorption, and these ask, in proof of their views of the case, what becomes of the old shells if there is a true ecdysis or moult, for that the sea-coast at the moulting period would be strewed with them? The most probable conjecture is, that the shell sloughs off piecemeal as it does in the crawfish. Lobsters, in common with most of the Crustaceans, have the power of reproduction to a great extent. If a claw be torn off, it is renewed; and if it be injured, the animal will sometimes throw it off by an effort. It seems that any violent shock to the nervous system will cause this act. If a lobster be thrown into boiling water, it will generally throw off its large claws on the instant; and the same effect has been produced by plunging the animal, when in full life, into spirit. Pennant goes so far as to make them out to be very nervous subjects indeed. "Lobsters," says he, "fear thunder, and are apt to cast their claws on a loud clap. I am told they will do the same on firing a great gun; and that when men-of-war meet a lobster-boat, a jocular threat is used, that if the master does not sell them good lobsters they will salute him."

That the lobster was well known to the ancients appears from the reference in Mr. Travis's letter, and from many other evidences. It will be sufficient to add that, under the name of ἀστακὸς, Aristotle, in the second chapter of the fourth book of his 'History of Animals,' gives a most faithful and elaborate account of the species which is still an inhabitant of the Mediterranean.

Astacus fluviatilis, the Crawfish, is to be found in the fresh waters of Europe and the north of Asia. It thrives best in rivers, where in holes in the banks and under stones it lies in wait for the small molluscous animals, little fishes, the larvæ of insects, and decomposing animal substances, which form its prey. Desmarest says that it will live for upwards of 20 years, and that it becomes large in proportion to its age; that towards the end of spring it casts off the pieces which form its shell, and some days after becomes covered with a crust as solid as the former one, but larger, sometimes by as much as one-fifth. The eggs, which are excluded about two months after impregnation, are collected under the lower part of the body or tail, as it is popularly called, after the manner of the hen-lobster. From these proceed the young crawfishes, which are very small and soft, but which bear an exact resemblance to the parent, under whose tail they are nursed for several days.

The crawfish is taken either by nets or by bundles of thorns in which flesh in a state of decomposition is placed. It is also taken by inserting the hand into the hole which it inhabits; and at night it is caught by means of lighted torches. [CRUSTACEA.]

ASTA'RTE, a genus of *Conchiferous Mollusca*, with two muscular impressions and a simple mantle-line. The hinge has two divaricated teeth in the right-hand valve; in the other, one distinct and one obsolete tooth, and the rudiment of a lateral tooth. The ligament is external.

The species consist of some of the *Veneres* of Montagu, one of which is a *Crassina*. (Lam.) Some of them are English shells, and they are generally found on the sandy mud of coasts at a depth which ranges from near the surface to ten fathoms.

The Crag, the Green-Sand, and some of the old fossiliferous beds afford many species.

A'STER, a genus of plants belonging to the natural order *Compositæ*, and comprehending a great multitude of species scattered over all parts of the world, especially North America and Australia. Many of them are handsome herbaceous plants, others are small-leaved shrubs, and the remainder are mere weeds. (Nees von Esenbeck, 'Genera et Species Asterearum.')

Although the number of species of this genus is very great, none of them are of any use to man. A large number are cultivated, and we are indebted to their very handsome flowers for some of the greatest ornaments of our gardens at the latter end of summer. One of the species, *Aster Tripolium*, is a British plant. It is very common in muddy salt marshes. It has a stem from 1 to 2 feet high, which is erect, hollow, leafy, and many-flowered. The flowers are yellow in the disk and lilac in the circumference. Sometimes the latter are wanting.

ASTERACA'NTHUS, a genus of Fossil Placoid Fishes, including five British species, from the Oolitic and Lias Formations. (Agassiz.)

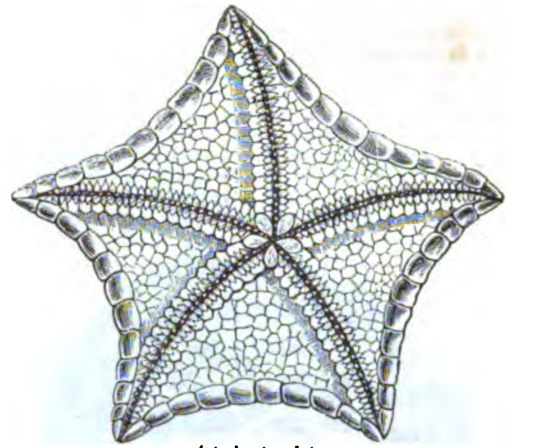
ASTERI'ADÆ, a family of the order *Echinodermata* including the true Star-Fishes. This family is distinguished from the rest of the order by the body being more or less lobed, and the lobes channeled beneath for cirrhi, which act as suckers and are the organs of motion. Professor E. Forbes in his 'History of British Star-Fishes' has arranged the British species of this family under four heads :—

1. The *Urasteriæ*, Stellate Star-Fishes with rounded arms and four ranges of suckers in each avenue. Of this family there is only one genus *Uraster*, inhabiting the British coasts. Of this there are four species—*U. glacialis*, *U. rubens*, *U. violacea* and *U. hispida*.

2. The *Solasteriæ*, also stellate (sometimes multi-radiate), with rounded arms, but only two ranges of suckers in each avenue. To this tribe belong the genera *Cribella* and *Solaster* of which *C. oculata*, *C. rosea*, *S. endeca*, and *S. papposa* inhabit the British coasts.

3. *Goniasteriæ*, which are pentagonal and have two ranges of suckers. The British genera of this tribe are *Asterina*, *Palmipes*, and *Goniaster*. The species are *A. gibbosa*, *P. membranaceus*, *G. Templetoni*, and *G. equestris*.

4. *Asteriæ*, Stellate Star-Fishes with the upper surface of the body flat. It includes the British genera *Asterias* and *Luidia*. Each of these have one species, *A. aurantiaca* and *L. fragilissima*. [ECHINODERMATA.]



Asterias tesselata.

ASTE'RIAS (Lam.), a genus of Radiated Animals widely diffused over the seas. The Linnæan genus comprises every form of radiation which appears in the tribe, but the genus *Asterias* of Lamarck includes only the Star-Fishes properly so called. These are divided into two sections, 'the Scutellated Star-Fishes,' and 'the Radiated Star-Fishes.' The former have an angular body, the lobes or rays of which are short, their length not exceeding the diameter of the disk: the latter have a body furnished with elongated rays, whose length far exceeds the diameter of the disk. The following is a general description of the animals to which the name *Asterias* has been applied :—

Each ray is furnished with a longitudinal furrow on its lower side, and this furrow is pierced laterally with small holes, through which pass the feet or tentacula, which are membranous, cylindrical, and each of them terminated with a little disk, which performs the office of a cupping-glass, somewhat in the same manner as the acetabula or suckers of the cuttle-fishes. By elongating or shortening these numerous little organs, and by fixing them by means of their terminal disks, the progressive motions of the Star-Fish are regulated. The rest of the lower surface is furnished with small moveable spines, which also assist progression. The whole surface is also pierced by pores, through which pass tubes much smaller than the feet, serving probably to absorb the water, and to introduce it into the general cavity, for the purposes of a kind of respiration. A large stomach lies close to the mouth; and two ramified cæca, each suspended to a kind of mesentery, are given off to each ray, which is also furnished with two ovaries, by means of which the animals are supposed to reproduce their species without the aid of a second individual. A fine cord, which surrounds the mouth and sends a branch to each arm, is considered as the development of their nervous system. [ASTERIADÆ; ECHINODERMATA.]

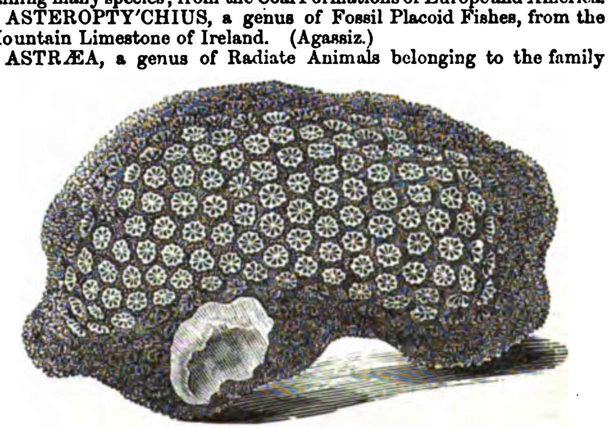
ASTERI'NA, a genus of Star-Fishes, including the smallest of the British species, *A. gibbosa* of Pennant. The Gibbous Starlet has a 5-sided body, which is thick and covered above and below with short spines; the avenues are bordered by a single row of spines, and the suckers are in two rows. De Blainville makes out of this species two, which he calls *Asterias minuta* and *A. pulchella*. *A. gibbosa* is found very generally around the British Islands, and also in the Mediterranean, and on all the shores of Europe.

ASTEROIDA, a group of Zoophytes, belonging to the *Anthozoa* or *Polypifera*. [POLYPIFERA.]

ASTEROPHYLLI'TES (Brongniart), a genus of Fossil Plants containing many species; from the Coal Formations of Europe and America.

ASTEROPTY'CHIUS, a genus of Fossil Placoid Fishes, from the Mountain Limestone of Ireland. (Agassiz.)

ASTRÆA, a genus of Radiate Animals belonging to the family



Astræa rotulosa.

Polypifera. The species are found sometimes incrusting marine bodies, sometimes collected in a hemispherical or globular mass, which is occasionally lobated. The upper surface is covered with orbicular or subangular starry disks, which are lamellar and sessile. Each disk is the seat of a polype, with a single row of numerous arms, in the centre of which is the mouth. Lamarck divides these corals into two sections: the first, consisting of species whose starry disks are separated from each other, leaving interstices between them; and the second, of species whose starry disks are contiguous. Of the first section, *A. rotulosa*, an inhabitant of the West Indian seas, is an example; of the second, *A. favosa*, common in the seas of the East Indies affords a good illustration. The species are numerous.

Astræa favosa.

ASTRA'GALUS, a genus of plants belonging to the natural order *Leguminosæ*. It has the calyx 5-toothed; the keel of the flower obtuse; the stamens diadelphous; the legume bilocular or half-bilocular, from the upper suture being bent in so much. The species are shrubs or under-shrubs.

A. hypoglottis, the Purple Milk-Vetch, is a native of Europe in gravelly and chalky places.

A. glycyphyllos, Liquorice-Vetch, is another British species. It has a sweetish taste in its leaves, but they are not pleasant, and cattle do not eat it.

A. verus, Goat's-Thorn, is the plant which is said to yield Gum Tragacanth. It is a small bush with pinnated gray leaves, terminated by a spiny midrib and half-covering clusters of axillary pale yellow flowers. It grows in the Levant. The gum is a natural exudation from the plant. Many other species of *Astragalus*, as *A. Creticus*, *A. gummifer*, *A. aristatus*, and *A. strobilifera*, are now known to yield this substance. The species of *Astragalus* are very numerous, and above 250 have been described by botanists. Many of them are cultivated, most of them being hardy plants, but they are not remarkable for their beauty.

ASTRAKANI'TE, a variety of native sulphate of magnesia (Epsom Salts), which is called *Epsomite*.

ASTROCA'RYUM, a genus of Palms found in small groups, or in single specimens, in the tropical parts of America, of middling stature, and of a very singular appearance on account of the spines with which they are armed. Their stems are covered all over, except at the places where the leaves are set on, with stiff and very numerous prickles. The leaves are pinnated. The fruit resembles cocoa-nuts.

These plants are found exclusively in South America, where several species were collected by Dr. Von Martius, the great illustrator of the Palm Tribe. Among the more remarkable are *Astrocaryum murimuri*, a common inhabitant of swampy places in the neighbourhood of Para, where it is called Murumurú. The flesh of the fruit resembles the melon in flavour and the musk in odour, and is considered a great delicacy by the Americans. We give a figure of it in the next column, but so much reduced that the armature of the stem cannot be shown. The leaves are found to form an excellent thatch.

Another species, *A. airi*, has very hard wood, which is much used for bows and similar purposes, where hardness and toughness are required.

The fibres of the leaves of *A. Tucuma* are greatly valued for fishing-nets. (Martius, *Palms*, p. 69, &c.)

ASTROCRINI'TES (Austin), a genus of Fossil *Crinoidea*, from the Mountain Limestone of Yorkshire.

ASTROLO'MA, a genus of plants belonging to the natural order *Epacridaceæ*. One species, the *A. humifusa*, yields the Tasmanian Cranberry. The fruit is of a green or whitish colour, sometimes slightly red, of the size of a black currant, and consisting of a viscid apple-flavoured pulp, inclosing a large seed. It grows singly on the trailing stems of the plant. The flowers are of a beautiful scarlet. (Lindley, *Vegetable Kingdom*.)

ASTROPECTEN, a genus of Star-Fishes, including the *Asteria aurantiaca* of Müller and others, which is called *Astropecten irregularis* [ECHINODERMATA.]

Astrocaryum murimuri.

ASTROPHY'TON, a genus of Star-Fishes, remarkable for the branched character of its rays. One species, the *A. scutatum*, is British. It is however a rare animal; and although occasionally found in other places, is most commonly caught off the Shetlands: hence it is called the Shetland Argus. (Forbes, *British Star-Fishes*.)

ASTUR, a genus of Hawks formed by Bechstein, and characterised by a short beak bent downwards from the base and convex above, with somewhat oval nostrils. The feet are rather short, and the toes (of which the exterior are united at the base by a membrane) are long.

Numerous species of this genus are diffused over all parts of the world; but Europe only contains one, *Astur palumbarius*, the Goshawk, so highly prized by the falconers of old, and famous for its flights at cranes, geese, pheasants, and partridges. [FALCONIDÆ.]

ATACAMI'TE (*Chloride of Copper, Muriate of Copper*). It occurs massive, pulverulent, and crystallised. Its primary form is a right rhombic prism. The colour is green, of various shades, but chiefly emerald green. The streak is lighter. The fracture uneven. Hardness 3·0 to 3·5. Lustre vitreous. Transparent to opaque. Specific gravity 4·4. It is found at Remolenos in Chili; the pulverulent variety at Atacama in Peru. The massive variety is reniform, with a fibrous structure. The analysis by Proust is as follows:—

Muriatic Acid	10·6
Oxide of Copper	76·6
Water	12·8
	100·0

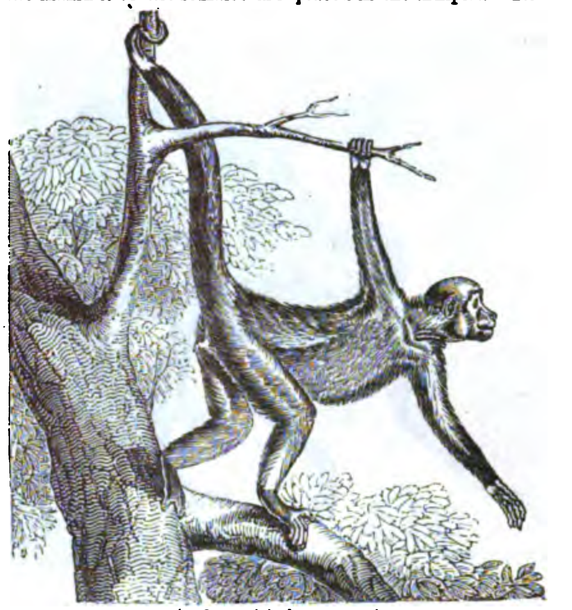
A'TELES, a genus of *Sapajous*, or American Monkeys, called also Spider Monkeys, formed by M. Geoffroy St. Hilaire, and presenting numerous and remarkable modifications of organic structure, which readily distinguish them from all other groups of *Quadrumana*. The most prominent characters of the genus consist in their long, attenuated, and powerfully prehensile tails; fore hands either entirely deprived of thumbs, or having only a very small rudiment of that organ; and their dental system, which, like that of all the American Quadrumanes, consists of two molar teeth in each jaw (one on each side) more than are found either in man or in the kindred genera of the Old World. The first and last of these modifications are common to the *Ateles* and other American genera; the second is shared with them only by the *Colobi*, a small African genus, consisting only of two species, neither of which has been observed by any zoologist since the days of Pennant, and with whose other characters we are very imperfectly acquainted. The *Ateles* are further distinguished by their small round heads, corpulent bodies, and remarkably long slender limbs, which characteristics giving these animals much of the general appearance of a spider, have procured for them the appellation of Spider-Monkeys, by which they are commonly known. Like the other *Quadrumana* of the New World, they are destitute of cheek-pouches and callosities—characters which approximate them in some measure to the real Apes. The skull of the *Ateles* is rounder and the brain larger than in the common monkeys; the forehead also is more elevated, and the muzzle less prominent. The eyes are widely separated from one another by the base of the nose; the nostrils open laterally, and are separated by a thick cartilaginous partition; the ear only differs from that of man in having no inferior lobe; the mouth is small, the lips thin and extensible, and the hair generally long, coarse, and of a glossy appearance.

But they are chiefly distinguished by the organs of locomotion. The anterior extremities, in particular, are by their length and the slenderness of their form out of all proportion with the other parts; they are in general, as above observed, destitute of thumbs; or if some species are provided with this organ, it is only in a rudimentary form, and consists merely of a flat nail, or at most of a single joint. On the posterior extremities, on the contrary, the thumb is largely developed, placed far back towards the heel, and is completely opposeable to the fingers. But these animals possess, in their long and muscular tail, an organ of prehension much more powerful than the other extremities; it executes in fact all the functions of a fifth limb, though probably, on account of its distance from the seat of sensation, it is not endowed with a very delicate sense of touch. For six or seven inches from the point it is naked and callous on the under surface; and it is by this portion that the animal hangs suspended from the branches, or swings itself from tree to tree with an ease and velocity almost incredible.

Their entire organisation is adapted exclusively to an arboreal life; on the earth nothing can be more awkward and embarrassed than their motions. They trail themselves along with a slow and vacillating gait, sometimes using their long fore-arms as crutches, and resting upon their half-closed fists whilst they project the body and hind legs forward; at other times walking in a crouching position on the hind legs only, balanced by the long arms and tail, which are elevated in front and rear respectively, and always ready to take advantage of any object by which to avail themselves of their natural powers of progression. But in proportion to their embarrassment on a plain surface is their dexterity and agility among the trees of their native forests. Here they live in numerous troops, mutually support one another in danger, beat and expel the less favourably organised Sakis from the vicinity of their cantonments, and exercise a perfect tyranny over all the other arboreal mammals of their neighbourhood. Though leaves and wild fruits compose the principal part of their food, yet they do not reject flesh, but hunt after insects and the eggs and young of birds, and are even said to adopt the stratagem of fishing for crabs with their long tails. They are exceedingly intelligent, easily domesticated, and soon become strongly attached to those who treat them kindly: they exhibit none of the petulance and insatiable curiosity of the common monkeys; their character, on the contrary, is grave, and approaches even to melancholy: but if their passions are less violent, and more difficult to excite, their affections are infinitely stronger; and if they are without the amusing tricks of the monkeys, so likewise are they without their fickleness and mischief.

Dampier relates, that when a troop of *Ateles* have occasion to pass any of the larger rivers of South America, they select a situation in which the trees are highest and project farthest over the stream; then mounting to the topmost branches, they form a long chain by grasping one another's tails successively. This chain being allowed to hang freely at the lower end, whilst it is suspended from the top, is put in motion, and successively swung backwards and forwards till it acquires an impetus sufficient to carry it over to the opposite bank. When this is accomplished, the animal at the lower end catches the first branch which comes within his reach, and mounts to the highest, where as soon as he is firmly attached, the other end of the chain is permitted to swing, and thus the whole troop are passed over. The *Ateles*, as well indeed as all the other American Quadrumanes, are esteemed as an article of food by the native Indians; and even Europeans, whom curiosity or necessity has induced to taste it, report their flesh to be white, juicy, and agreeable. The only thing disgusting about it is a strong resemblance which the whole body, and particularly the head and hands, bear to those of a young infant. Nor is it without being strongly disposed to question the nature of the act, that European sportsmen, unaccustomed to shooting monkeys, witness for the first time the dying struggles of these animals. Without uttering a complaint, they silently watch the blood as it flows from the wound, from time to time turning their eyes upon the sportsman with an expression of reproach which cannot be misinterpreted: some travellers even go so far as to assert that the companions of the wounded individual will not only assist him to climb beyond the reach of further danger, but will even chew leaves and apply them to the wound for the purpose of stopping the hemorrhage. The following species of *Ateles* have been distinguished and characterised by naturalists and travellers:—

1. *A. paniscus* (Geoff.), the Quata, or as the French write it Coaita, is a large species, covered with long coarse hair of a glossy black colour; the belly is protuberant, the head small and round, the limbs long and slender, the fore hands entirely deprived of thumbs, the tail robust and powerful, the eyes and cheeks deeply sunk, and the face copper-colour. On the back and outsides of the limbs the hair is very long and thick, but the belly and groins are nearly naked, and the mammæ of the females are placed in the armpits. The hair



The Quata (*Ateles paniscus*).

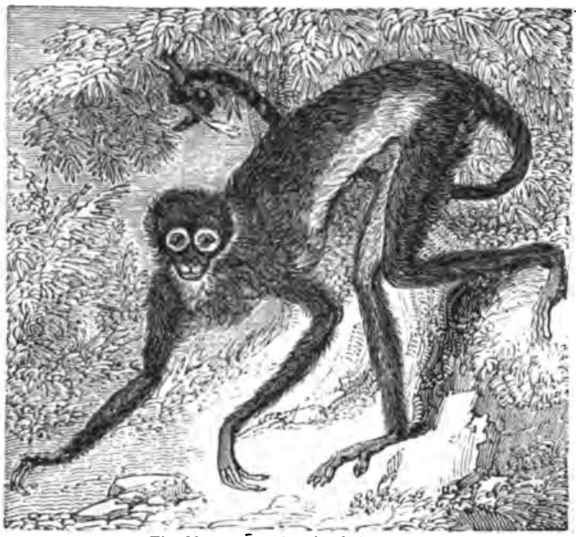
of the head is directed forwards, and the ears, concealed beneath it, differ from those of the human species only in having no inferior lobe. This species is very common in the woods of Surinam and Brazil. It is active and intelligent, and unites considerable prudence and penetration to great gentleness of disposition. They go in large companies, and when they meet with a man or any animal which is strange to them, come down to the lower branches of the trees to examine them, and having satisfied their curiosity, begin to pelt them with sticks, and endeavour to frighten them away. They cannot leap, but exhibit the most surprising agility in swinging from tree to tree. Acosta, in his 'History of the West Indies,' relates the following anecdote of a Quata which belonged to the Governor of Carthagena:—"They sent him," says he, "to the tavern for wine, putting the pot in one hand and the money in the other; they could not possibly get the money out of his hand before his pot was full of wine. If any children met him in the street and threw stones at him, he would set his pot down and cast stones against the children, till he had assured his way, then would he return to carry home his pot. And what is more, although he was a good bibber of wine, yet he would never touch it till leave was given him."

2. *A. marginatus* (Geoff.), the Chuva, closely resembles the Quata in physiognomy, size, and proportions. The quality and colour of the hair are also the same in both, except that the face of the Chuva is surrounded with a rim of white, which on the forehead particularly is broad, and directed upwards, so as to encounter the hair of the occiput and form a low crest on the top of the head. The hair of the fore-arm is directed partially towards the elbow; like that of the body it is long and coarse, and though perfectly black, has not the glossy appearance of the Quata's covering. The face is nearly naked, and tan-coloured; the palms of the hands, soles of the feet, and callous part of the tail are violet-black, and the whole skin beneath the hair appears to be of the same hue. The disposition and manners differ in no respect from those of the Quata.

3. *A. ater* (F. Cuvier), the Cayou, is considered by Messrs. Geoffroy and Desmarest as a variety of the Quata; but F. Cuvier, from observations which he made upon the living animal, has recognised and described it as a distinct species. It must however be confessed that it approaches so nearly to the Quata as to render further observations necessary to determine the question of their specific difference. The size, form, and colour are the same in both, and the only marked distinction reported by M. Cuvier consists in the colour of the face, which is black in the Cayou and copper-coloured in the Quata. "The hair," says M. Cuvier, "is long, and of a harsh silky quality. It is rather shorter on the head and tail than on the rest of the body, where it falls backwards in the ordinary way, but on the head it is directed forwards, and falls over the face."

4. *A. Belzebub* (Geoff.), the Marimonda, has the top of the head, the back, sides, and external surface of the extremities black, and all the under parts, the cheeks, throat, breast, belly, inside of the limbs, and under surface of the tail for its first half, white, with a slight shade of yellow. The naked parts are violet-black, except immediately about the eyes, which are surrounded by a flesh-coloured circle. This species, according to Humboldt, replaces the common Quata in Spanish Guyana, where it is extremely common, and is eaten by the

Indians. "It is," says this celebrated traveller, "an animal very slow in its movements, and of a gentle, melancholy, and timid character; if it occasionally bites, it does so only in its fits of terror. The Marimondas unite in great companies and form the most grotesque groups



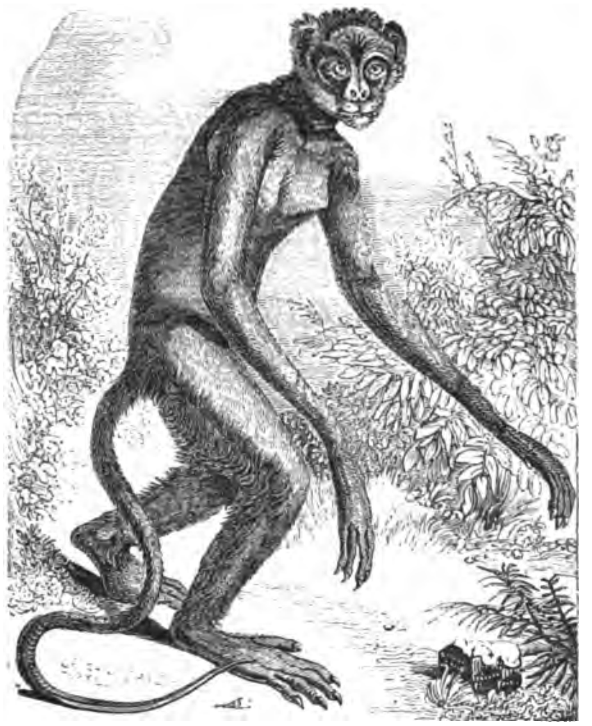
The Marimonda (*Ateles Belzebub*).

All their attitudes announce the extremity of sloth. I have frequently seen them, when exposed to the heat of a tropical sun, throw their heads backwards, turn their eyes upwards, bend their arms over their backs, and remain motionless in this extraordinary position for many hours together." The young of this species appear to have the upper parts of the body mixed slightly with gray, but this mixture gradually disappears as it grows towards maturity, till the adult animal presents the uniform black above and white below, as already described.

5. *A. melanocheir*, Geoff., with the native Indian name of which we are unacquainted, is also a distinct species. The head, members, and tail are black or dark brown on the superior surface; the internal face of the arms and fore-arms as far as the wrists, and of the thighs and legs, the under surface of the tail, the throat, breast, belly, and sides of the hips, are white or silvery gray; the shoulders are yellowish gray, and the remainder of the upper parts of the body, as well as the whiskers, are pure gray; the four hands and the naked part of the tail are black, as are also the face, the cheeks, and the under half of the nose; but round the mouth and eyes the fur is flesh-coloured. The hair is uniformly of a silky quality: that on the black and white parts is of the same colour throughout, but on the gray parts it is annulated with alternate rings of black and white. This species, as well as all those hitherto described, is entirely deprived of the fore thumb, and does not even exhibit a rudiment of that organ. Only a single individual has been observed alive; its manners are the same as those of the *Ateles* in general, but its habitat has not been definitely determined.

6. *A. Arachnoïdes*, or the Brown Quata, as it is called by Baron Cuvier, partakes in fact very much of the characters and appearance of the common Quata, from which it is principally distinguished by its uniform reddish-brown colour. This species when full grown measures rather more than 2 feet in length; the tail is about 2 inches longer than the body; the fore legs are 1 foot 9 inches long, the hind legs 1 foot 8 inches, and the hands 6 inches. The hair is short, fine, and soft, and that of the forehead is directed backwards, contrary to what is usually observed in the other Ateles; the back and upper parts of the body are, generally speaking, well covered with hair, but the breast, belly, and groins are nearly naked, or at least sparingly covered with scattered hairs, of a longer and coarser quality than those on other parts; the root of the tail is rather thick and bushy, but it is gradually attenuated towards the point, and for the last ten inches naked underneath. The general colour is uniform chestnut-brown, the first of these colours becoming clearer and more intense upon the head, and more especially round the eyes; the forehead is bordered by a circle of stiff coarse black hairs, beneath which a semicircle of light silvery gray passes over the eyes in the form of brows, and becomes gradually more and more obscure, till it is finally lost in the uniform reddish-brown of the temples. The face is naked and flesh-coloured, the under parts of the body of a silvery gray slightly tinged with yellow, with the exception of the abdomen, which, as well as the inner surface of the thighs, and the naked stripe underneath the tail, are of a bright red colour. The manners and habits of this species are unknown in its native forests. Those which have been observed in a state of confinement exhibited all the gentleness and listless apathy of character which distinguish the *Ateles* from the common monkeys of South America, as eminently as they do the Gibbons of the Indian isles from the other Quadrumanes of the Old World. Except in the total want of the thumb on the anterior extremities, the *A. Arachnoïdes* approaches very nearly to the following species, and appears indeed to be intermediate between it and the common Quata.

7. *A. hypoxanthus* (Kuhl), the Mono, or Miriki, inhabits the forests in the interior of Brazil, and, as has just been observed, approaches



The Mono (*Ateles hypoxanthus*).

very nearly to the *A. Arachnoïdes*, as well in the colour of its fur as in the general form and proportions of its body and members; but it is readily distinguished from that species as well as from all the other *Ateles* hitherto described, by the presence of a small rudimentary thumb on the fore hands. The face also is more uniformly covered with hair than in the generality of the other species, being naked only about the region of the eyes; the hairs which compose the eyebrows are long, black, and directed upwards: the cheeks, lips, nose, and a narrow line descending from the forehead, are covered with short hairs of a pale yellowish-white colour; the chin also is furnished with short hair of the same colour and quality, but intermixed with thinly scattered long black hairs, forming a species of beard, and extending over the upper lip in the form of thin moustaches. The ears are small and nearly concealed by the hair of the head, which though not very long is thickly furnished, and of a pale gray colour slightly tinged with yellow. The whole body and members are of a uniform grayish-fawn colour, only differing in the greater degree of intensity which distinguishes the back and upper parts from those beneath, and in the lighter gray tinge which predominates on the extremities. The backs of the fingers are hairy down to the very nails, and there is a rudiment of a thumb on the fore hands, covered with a short compressed nail.

The Mono was discovered by Prince Maximilian of Neuwied, during his travels in Brazil. It is the largest species of the Quadrumanes which inhabit the part of the country through which that scientific traveller passed, and though sufficiently common in particular districts, appears to have upon the whole but a very limited geographical range. Its hide is said to be more impervious to moisture than any other description of fur known in that part of the world, and for this reason the Brazilian sportsmen have cases of the skin of the Mono made to protect the locks of their guns from the rain.

8. *A. subpentadactylus* (Geoffroy), the Chameck, the last species of the genus distinctly known at present, resembles the Mono in having a small rudimentary thumb on the anterior extremities, but it is without a nail, and in other respects the two animals are sufficiently distinguished by their difference of colour and habitat. The Chameck indeed approaches more nearly in external form and appearance to the Quata than to any other of its congeners, being furnished with a similar coat of long dense hair, of an intense and uniform black colour; but it may be readily distinguished from that species by the presence of the rudimentary thumb on the anterior members, as well as by its size, which considerably exceeds that of the Quata. It has a protuberant muzzle, and its lips, like those of the Quata, are capable of prolongation; the forehead is high; the face, cheeks, ears, and chin,

are naked and of a brown colour, with a few long black hairs thinly scattered over them; the hair of the head is long, matted, and directed forwards over the forehead, that of the body and members very long and thick; the fingers, both upon the anterior and posterior extremities, are long, slender, and nearly naked; the tail is considerably longer than the body, very thick and covered at the base with close shaggy hair, but attenuated towards the point, where it is more sparingly furnished with shorter hair, and entirely naked underneath.

This species inhabits Guyana and some of the neighbouring provinces of Brazil. Von Sack, in his 'Voyage to Surinam,' gives the following account of its manners under the name of Quata, with which species its general appearance probably causes it to be frequently confounded. "The Quata," says this author, "is of a very docile disposition, and capable of being quite domesticated. I have seen a pair of them at a gentleman's house at Paramaribo which were left quite at liberty. When the female negroes were employed at their needlework, they used to come and sit amongst them, and play with a piece of paper, and afterwards go out to gambol upon the trees, but never went over to the neighbouring gardens; and they knew well the usual hour of dinner at their master's, when they would come to the gallery, look in at the windows, though without attempting to enter into the room, being aware that this was a liberty not allowed them; they therefore patiently waited for their dinner on the outside."

ATHANAS (Leach), a genus of the *Long-Tailed Crustacea*, bearing much resemblance to *Lysmata* (Risso), from which it differs in having the first pair of feet of larger size than the rest, while the second pair of *Lysmata* are the largest. It is small in size, and has been taken on the south coast of England and on the shores of France.

ATLANTA, a genus of the *Heteropodous Mollusca* of Lamarck, which Cuvier places next to *Carinaria*. The animal is very small, and the shell very delicate. Lamanon thought that he had discovered in one of these shells the original of the fossil Ammonites, or *Cornua Ammonis*, which however must have belonged to the class of Cephalopodous Mollusks, or cuttle-like animals. *Atlanta* inhabits the Indian seas. [GASTEROPODA.]

Atlanta Peronii. *a*, natural size.

Lesueur describes another marine genus, *Atlas*, which must not be confounded with the above. *Atlas* has no shell; and Cuvier confesses his inability to class it, "so confused," says he, "is the description." De Blainville thinks that it belongs to the same family as *Gasteroptera*, and places it accordingly under *Akera*, though he confesses that it is not entirely known.

ATLAS, the first vertebra of the neck, so named because it sustains the globe of the head. It differs in several important circumstances from all the other vertebræ that enter into the composition of the spinal column, because it has distinct and peculiar offices to perform. It has to support the head, and to allow it the power of exercising two different kinds of motion, namely, a motion forwards and backwards, or that of flexion and extension; and a rotatory motion, or the power of describing a certain portion of a circle, as it does when it turns from side to side. These motions are accomplished by the peculiar mode in which the head is connected to the atlas, and the atlas to the second vertebra of the neck, the *Vertebra dentata*, or Axis. The head is so united with the atlas as to form a perfect hinge-joint, that is, a joint which admits of flexion and extension, or a motion forwards and backwards. The second vertebra, the dentata, forming a pivot on which the atlas turns, and therefore called axis, is united with the atlas in such a manner as to constitute a perfect rotation-joint, or a joint which admits of a rotatory motion. The head being firmly connected with the atlas and carried round with it whenever the latter turns upon its axis, it is plain that by the combination of the two joints, namely, the hinge-joint and the rotation-joint, the head can be moved in every direction—forwards, backwards, and from side to side. In the construction of these joints such is the perfection of the mechanism that these combined motions are attained to the utmost extent, and are performed with the greatest ease. The connection of the different parts with each other forms a union of amazing strength and security, and at the same time certain organs of extreme delicacy and of vital importance are effectually guarded from injury. [*Spinal Column*, under SKELETON.]

A'TRIPLEX, a genus of plants belonging to the natural order *Chenopodiaceæ* and the tribe *Atripliceæ*. It has monœcious rarely perfect flowers, the perigone of two more or less connected parts, two stigmas, a free membranous pericarp, a crustaceous testa; the seed is vertical, attached by a lateral hilum, either near the base or by means of an elongated funiculus in the middle of the side; the radicle basal; the stamens five, continuous. Most of the species of this genus are insignificant weeds, and are sometimes troublesome pests in corn-fields. Babington, in his 'Manual of British Botany,' enumerates ten species

as inhabitants of Great Britain. The most common forms of the genus on cultivated lands are *A. angustifolia*, *A. erecta*, and *A. patula*. Mr. Babington has described a new species, which is also found not uncommonly in the United Kingdom. This is *A. deltoidea* (Babington): it has an erect stem with ascending branches; opposite leaves, all hastate-triangular, with two descending lobes unequally dentate or sinuate-dentate; the perigone of the fruit ovate-triangular, dentate, tunicated on the back, rather longer than the fruit, collected into a many-flowered, branched, dense panicle; seeds smooth, shining. *A. rosea*, *A. laciniata*, *A. littoralis*, are frequent plants on the sea-shore. *A. prostrata* is a coast plant, but is rare in Great Britain, and Babington suspects that it may be a maritime form of *A. patula*.

A'TROPA, a genus of Dicotyledonous Plants belonging to the natural order *Solanaceæ*, and consisting for the most part of poisonous species. It is distinguished from other genera of the same natural order by its regular bell-shaped corolla, its 5-parted permanent calyx, which never acquires a bladdery appearance, and by its succulent fruit.

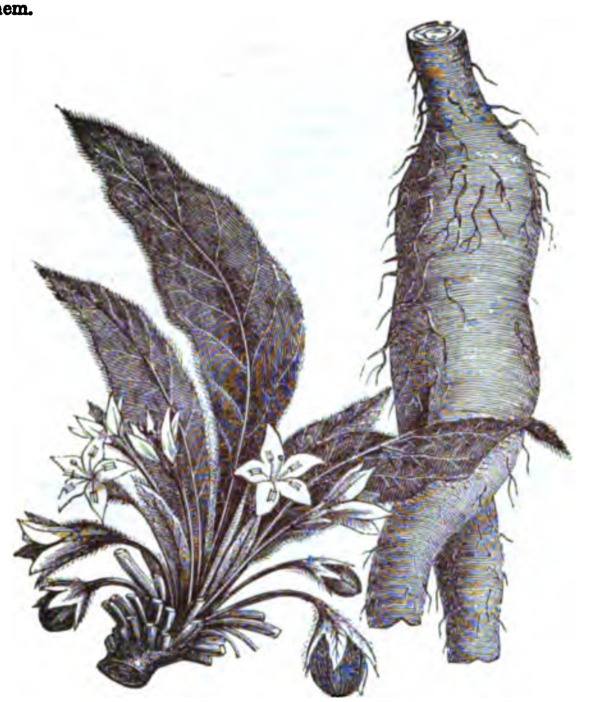
Atropa Belladonna, Deadly Nightshade, or Dwale, is found not unfrequently in thickets and hedges in this country. The whole

Deadly Nightshade (*Atropa Belladonna*).

1, A corolla cut open, showing the position of the stamens; 2, the calyx, with the pistil; 3, a berry cut in half to show its two cells, in each of which are several seeds.

plant is of a lightish green colour, except the flowers, which are large and of a dingy brownish purple, and the berries, which are of the rich deep black of black cherries. The root is perennial, the stem grows about 2 feet high, and the leaves are acute, with an oblong figure, tapering to each end. The flowers are bell-shaped, larger than those of the harebell, and placed singly in the bosom of the leaves. The border of the corolla is cut into 5 equal lobes: there are 5 stamens, a tapering pistil with 2 cells, and many seeds in the ovary, a long slender style, and a flattened stigma slightly divided into two lobes. The odour of the whole plant is nauseous and oppressive, as if to warn us of its venomous nature. It is in the leaves, root, and berries that the poison resides, and particularly in the berries, which from their resemblance to cherries have often been eaten by children with fatal consequences. The active property of Belladonna, though most commonly remarked in the fruit, exists also in the leaves, and especially in the roots, both of which have the same acrid narcotic property. They have nevertheless been frequently employed medicinally, and extract of Belladonna is one of the most energetic preparations in the modern Materia Medica.

Atropa Mandragora, or Mandrake, is another species still more venomous and dangerous than the last. It is found in many parts of the south of Europe, particularly in the Grecian islands, where it is common. Its root is a large dark-coloured fleshy mass, often divided into two or three forks, which have been fancied to resemble a human body; this circumstance, and its well-known poisonous qualities, gave it in the days of popular ignorance and credulity the reputation of being endowed with animal feelings; the roots were said to shriek when torn from the earth, and it was accounted dangerous to disturb them.



Mandrake (*Atropa Mandragora*).

This remarkable plant has no apparent stem, but its long hairy sharp-pointed leaves rise from the surface of the ground, and form a deep green tuft, from the midst of which the flowers rise on slender stalks about two inches long. Their corolla is of a whitish colour, stained with veins of dingy purple; the fruit is pale orange-coloured, and about as large as a sparrow's egg. The smell of the whole plant is very fetid.

Atropa physaloides, a plant called Alkekengi in gardens, where it is often cultivated as a hardy annual, belongs now to the genus *Nicandra*.

A'TRYPA (Dalman), a subdivision of the great genus *Terebratula*, chiefly (if not entirely) confined to a fossil state, and to the Palæozoic Strata. Many of the *Spiriferæ* of Sowerby (as *S. glabra*, *S. fimbriata*) and some of the *Terebratulæ* of the same author (as *T. pugnus*), have been referred to this genus. *T. psittacea* is the recent analogue.

ATTALE'A, a genus of Palms, found chiefly in the tropical parts of America, where it occupies the richest soil and the hottest forests, rarely ascending the sides of mountains, or spreading from the woods into the open country. It extends, according to Von Martius, as far south as the tropic of Capricorn. It belongs to the same division of the natural order *Palmaceæ* as the cocoa-nut, from which as well as from all its immediate allies, except Areng [ARENG], it is distinguished by its nut containing three cells and three seeds. It is described by Von Martius as consisting of lofty or middle-sized or even occasionally stemless species, with a thickish trunk, the wood of which is soft and of a reddish-brown colour; it is irregularly marked externally with scars, and is terminated by large pinnated leaves, the stalks of which are broad, and the segments smoothish, rather thick, plaited, and neat-looking. The bunches of fruit are simply branched, but are often of a vast size, and hang down from the bosoms of the leaves, covered with brownish nuts, the seeds of which are eatable. Several species are known, of which the most remarkable are the two following:—

Attalea funifera, called by the natives Piaçaba, is found in the native forests of the maritime provinces of Brazil, where it is one of the most valuable gifts which the bountiful hand of nature has conferred on man. The best cordage in South America for naval purposes is manufactured from the fibres of the leaf-stalks and other parts; such ropes are of great strength, and are extremely durable in salt water: no other cables are employed in a great part of the Brazilian navy. This species does not grow more than from 20 to 30 feet high; its nuts, which are about as large as an ostrich's egg, have a hard shell like that of the cocoa-nut.

Attalea compta, another species, is equally useful, but for different purposes. This plant, the Pindova of the old writers on Brazil, and the Indajà of the modern Portuguese, forms delightful groves in the interior of the country, growing from 20 to 50 feet clear of its branch-like leaves; the latter are from 15 to 20 feet long, and about 3 feet wide. The fruit is the size of a goose's egg, and contains an eatable kernel, of which the negroes are fond. Its leaves form an excellent thatch, and are woven into hats mats, and baskets.

Attalea compta.

Attalea speciosa is the plant which, in the provinces of Maranhaõ and Para, furnishes the nuts which the Brazilians burn for the purpose of smoking the juice of *Siphonia elastica*, or Indian Rubber, until it becomes black.

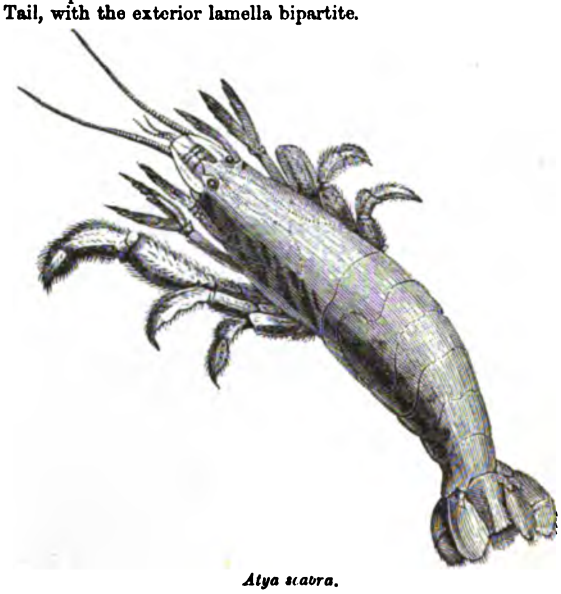
A'TYA, a genus of Crustaceous Animals, thus characterised by Leach:—

Antennæ, interior, furnished with two bristles, inserted in the same horizontal line; exterior, inserted below the interior, about the length of the body, furnished at the base with a great scale which is unidentate, or one-toothed, externally.

Pedipalpi external, the last joint shortest; flagrum elongated.

Feet: the two anterior pairs equal, penultimate joint shortest; last joint divided; laciniæ equal, furnished at the apex with long cilia; third pair large, unequal, furnished with a very short nail; two posterior pairs furnished with a moderate-sized nail.

Tail, with the exterior lamella bipartite.



Atya scabra.

"It forms," says Leach, "a peculiar subdivision of the Shrimp Family, and one species only is known."

A'TYLUS, a genus of Crustaceous Animals, thus characterised by Leach:—

Antennæ composed of four joints, the last of which is formed of several minute articulations: upper ones rather shortest, with the second joint longer than the third; under ones with the second joint rather shorter than the third.

Atylus carinatus.

Eyes slightly prominent, inserted on a process between the upper and lower antennæ.

Legs fourteen; first and second pair furnished with a small compressed hand, which has a moveable thumb; the other pairs having only a simple claw.

Tail, on each side, with a triple series of double styles; upper part on each side armed with a small spine or style.

Body (including the head) composed of twelve joints. Example—*Atylus carinatus* (*Gammarus carinatus*, Fabr.).

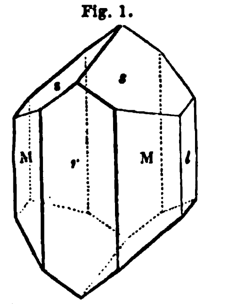
AUCHE'NIA, a genus of *Ruminating Mammalia*. [LLAMA.]

AU'CUBA, a genus of plants belonging to the natural order *Cornaceæ*. Only one species is known. It is a Japanese plant, commonly cultivated in the gardens of this country as a hardy evergreen shrub, remarkable for its shining pale-green leaves mottled with yellow, hence sometimes called Variegated Laurel. It is described by Thunberg as growing to the height of a man or higher, and as common in various places in Japan, both wild and cultivated. Its fruit, which it bears in March, is a red berry, about the size of that of a laurel, and containing a single stone, with a bitter nauseous kernel. This plant is diœcious, and in this country we have only the pistilliferous flowers. The plant, however, which is cultivated in this country is only a variety: in its natural state it is said to have brownish-green leaves without any blotches.

AUGITE. The minerals to which this name has been applied present us with some of the most interesting and at the same time most difficult investigations that can fall under the notice of the mineralogist and chemist, and have frequently occupied the attention of the most eminent men in both sciences. Nor are these bodies unworthy of such attention; for not only would a thorough knowledge of their constitution, and the relation which they bear to other minerals, particularly to the genus *Hornblende*, tend much to the perfection of the mineralogical system; but, owing to their frequent occurrence in nature, and from their forming one of the principal ingredients in many porphyritic and trap rocks, such as the Syenite, Diallage, and Schorl-Rocks, Greenstone, &c., they form a class of bodies of the highest importance to the geologist. A due regard to the circumstances which are favourable to the formation of one or other of the species, to the exclusion of the rest, would be likely to afford a safe guide in many geological inquiries into the character and formation of rocks of igneous origin. Werner was the first to divide a large class of minerals occurring commonly in basalt, lavas, and other volcanic rocks, into two species, to which he applied the names of *Augite* and *Hornblende*. This division was founded on the difference existing between the crystallised forms and structure, which, according to the experience up to that time, were never associated with each

Augite, or *Pyroxene*.

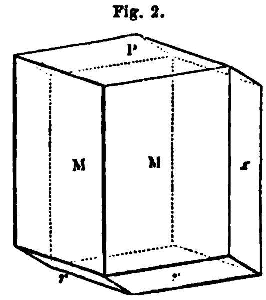
Fig. 1.



Inclination of M on M is 87° 6′
M on r 133° 33′
M on l 136° 27′
s on s 120° 57′
$\frac{s}{s}$ on r 106° 6′

Hornblende, or *Amphibole*.

Fig. 2.



Inclination of M on M is 124° 31′
M on x 117° 44′
P on M 103° 13′
P on $\frac{M}{M}$ 104° 57′
r on r 148° 25′
$\frac{r}{r}$ on $\frac{M}{M}$ 104° 57′

By $\frac{s}{s}$, $\frac{M}{M}$, is meant the edge formed by the intersection of the faces s and s, M and M, &c.

other. The same division was shortly after adopted by Haüy, who applied to them the names of *Pyroxene* and *Amphibole*, and gave the measurements, determining the oblique rhombic prisms, with their most general modifications characteristic of either species, which however we have modified by the later measurements of Rose, Mitscherlich, and Kupffer.

Professor Mohs, however, together with Professor Jameson of Edinburgh, has used the term *Augite* to denote the eighth genus of their respective systems, which consists of the four species designated as follows:—

First species. The *Oblique-Edged Augite*, corresponding with the *Augite* of Werner, and *Pyroxene* of Haüy.

Second species. The *Straight-Edged Augite*, corresponding to *Hornblende* and *Amphibole*.

Third species. *Prismatoidal Augite*, containing as sub-species the minerals *Epidote* or *Zoisite*.

Fourth species. *Prismatic Augite*; Tabular Spar or *Wollastonite*.

Berzelius, on the contrary, viewing the subject in a chemical point of view, has been induced to use the term Augite or Pyroxene, Hornblende or Amphibole, in the same signification as employed by Werner and Haüy. According to him, the Augites are composed of one equivalent of the bisilicate of lime united with one equivalent of the bisilicate of magnesia.

There are several varieties of this genus formed by the removal of the magnesia or lime, which are replaced either by one or both of the isomorphous substances—the protoxide of iron, and protoxide of manganese. Of these the following are the principal:—

1. *Diopside*, which may be considered as the type of the Augite Genus, is readily recognised by the form of its crystal given in *fig.* 1, and by the direction of its four cleavage planes, the most perfect corresponding with the faces M, those in the direction of r and l being less easily obtained; and by its pale-green or grayish-white colour, and vitreous lustre. Its hardness is 5·5, and its specific gravity is 3·299. Alone before the blowpipe it melts into a colourless semi-transparent glass; with borax, very readily into a transparent glass. It consists chiefly of silica, lime, and magnesia, as will be seen by the following analysis of a variety from Tammare by Bonsdorff:—

Silica	54·83	Protoxide of Iron	0·99
Lime	24·76	Alumina	0·28
Magnesia	18·55	Loss by heating	0·32
			99·73

Several varieties, little differing from the above, are called *Backalite* and *Fassaite*, names indicative of their locality.

2. *Hedenbergite* consists chiefly of silica, lime, and protoxide of iron, as may be seen by the following analysis by G. Rose of a variety from Lunaberg:—

Silica	49·01
Lime	20·87
Protoxide of Iron	26·08
Protoxide of Manganese with Magnesia	2·98
	98·94

It is of a dark-green colour, sometimes nearly black.

3. *Sahlite*, those varieties in which the magnesia is only in part replaced by protoxide of iron, and which may be regarded as consisting of one equivalent of *Hedenbergite* united with two of *Diopside*. A variety is called *Malakolith*. ('Anwendung der Löthrohrs,' by Berzelius.)

4. *Diallage*. The difference in the analysis by Köhler of two specimens, the first from Tuscany, the second from Ulthenthal in the Tyrol, were as follows:—

Silica	53·20	56·81
Lime	19·08	2·19
Magnesia	14·91	29·67
Protoxide of Iron	8·67	8·46
Protoxide of Manganese	0.38	0·61
Alumina	2·47	2·07
Water	1·77	0·21
	100·48	100·02

This variety is characterised by its mother-of-pearl lustre, and by its possessing the most perfect cleavage in the direction of the diagonal of the prism. It is seldom found in perfect crystals. Its most general colour is a bronze yellow.

5. *Hypersthene*, which is very similar in its general appearances and characters to *Diallage*, is a bisilicate of iron and magnesia. Both of the last-mentioned varieties may be distinguished from the former, as well as from each other, by means of the blowpipe, and by attending to the following characters as stated by Berzelius:—

Diallage alone in a matrass decrepitates, becomes of a lighter colour, and gives off a little water.

On charcoal it is with difficulty melted on the edges into a gray scoria.

With borax it is with difficulty fused into a clear glass, somewhat coloured by the protoxide of iron.

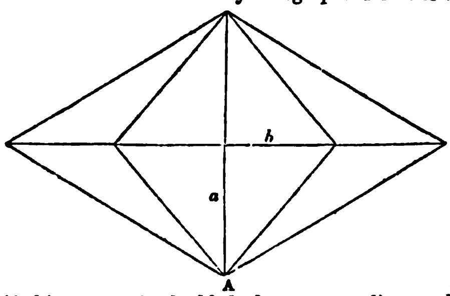
It is decomposed by the phosphate of soda and ammonia, with the development of the silica.

Hypersthene, on the contrary, when heated alone in the matrass, decrepitates slightly, gives out a little water, but does not change its appearance; while on charcoal it readily forms a green opaque glass, as is also the case when heated with borax.

The salt of phosphorus does not apparently decompose it, but the mineral at first becomes rounded on the edges, and may at length be entirely fused.

The structure also deserves particular attention, the cleavage-planes in *Hypersthene* being perfect, both in the direction of the faces *r* and M, the latter of which are obtained in *Diallage* with very great difficulty.

We have now described the various species generally considered as comprehended within the genus *Augite* or *Pyroxene;* but Professor Gustave Rose has endeavoured to prove the necessity of uniting *Augite* and *Hornblende* (*Pyroxene* and *Amphibole*) into one genus. His arguments for this union are the following:—He first shows that the two prisms of *Augite* and *Hornblende*, however different in appearance, admit of being derived the one from the other, according to the laws observed to connect the crystallographic forms of varieties of the same genus in other minerals. To show this, let the accompanying parallelogram, whose semi-diagonals are *a* and *b*, represent the horizontal section of the prism of *Augite;* since the whole angle of this prism at A is 87° 6′, *b* is the tangent of an angle of 43° 33′; if this tangent be doubled, the corresponding angle will be found to be 62° 15′ 25″, the double giving 124° 30′ 50″, an angle agreeing most closely with 124° 31′, the angle obtained by Mitscherlich in a species of *Hornblende* when measured by Wollaston's reflecting goniometer. The larger parallelogram, therefore, formed by doubling the diagonal *b*, is the horizontal section of the prism of *Hornblende.*



A similar relation is also approximately true for the inclination of the faces *s* in *Augite* and *r* in *Hornblende;* for if the angle 120° 57′ of *Augite* be halved, and its tangent doubled, the corresponding angle is 74° 11′ 21″, and by doubling this we obtain 148° 22′ 42″, not much differing from 148° 25′, as found between *r* in *Hornblende* of Vesuvius by Rose.

His argument drawn from the chemical constitution of these minerals is by no means so satisfactory; for though in *Hornblende* we find a series of bisilicates of the same bases, and as it were running parallel with those already described as *Augites*, the circumstance observed by Bonsdorff, that all the varieties of *Hornblende* contain fluorine, while Gustave Rose has been unable to detect that element in *Augite*, weakens the connection between these minerals, and renders the determination of what part the fluorine acts in their constitution a most desirable object. Our ignorance on this point, however, and the difficulty of determining what is the action of the alumina, which occurs in considerable quantity in some *Hornblendes*, prevent us from forming any opinion from the results of chemical analysis.

The observations of Rose, however, on the Greenstone of the Uralian Mountains, tend to prove the existence of that connection between the forms of *Augite* and *Hornblende* which is essential to their constituting one genus, in a more satisfactory manner than any remark hitherto made. He discovered in a soft grayish Greenstone, near the village of Mostowaja, which is situated north of Katharinenburg, and on the road to Newiansk, and also at the gold-washings of Cavellinski, near Miask, in a Greenstone somewhat harder and darker than the former, imbedded crystals, having the form of *Augite*, but not its cleavage planes, these last being found to coincide with those of *Hornblende.* This mineral was therefore either *Hornblende* in the form of *Augite*, or *Augite* with the cleavage planes of *Hornblende.*

At the village of Muldakajewak, near Miask, he discovered still more interesting crystals embedded in a Greenstone similar to that last described. They were abundant, and possessed the form of *Augite:* the smaller crystals had cleavage-planes parallel to the sides of the prism of *Hornblende*, and were similar in their appearance and colour to those obtained from Cavellinski. The larger crystals, however, possessed a kernel of a grass-green colour, and of a lighter tint and greater lustre than the exterior. This kernel differed from the darker exterior portion of the crystal, the latter giving the cleavage of *Hornblende*, while the former presented those of *Augite*, with faces sufficiently bright and perfect to admit of measurement by the reflecting goniometer.

The observations of Mitscherlich and Berthier on the formation of *Augite* as an artificial product, are so interesting in themselves and throw so much light on the nature of *Augite* in general, and on those crystals we have just described, for which Rose proposes the name of *Uralite*, that we cannot omit to notice them in this place. Mitscherlich has observed that at many foundries in Sweden and Germany the scoriæ possessed the form, structure, and chemical composition of certain minerals found in nature. From this source he has obtained upwards of forty varieties; and among these specimens possessing the form and structure of *Augite* are frequently found, whereas *Hornblende* has never been discovered. Guided by these observations, a mixture of silica, lime, and magnesia, in the proportion indicated by the formula of *Diopside*, given below, was submitted to fusion in the porcelain-ovens of Sèvres, near Paris. On examination, the mass was found to have been completely fused: it possessed cleavage-planes corresponding with those of *Augite*, and a hollow formed in the centre from the contraction in cooling contained crystals of the form of *fig.* 1. By these processes they failed in obtaining crystals either of the form or structure of *Hornblende.*

Professor G. Rose, in accounting for this production of *Augite* to the exclusion of *Hornblende*, was led to consider that it was not the absence of the fluorine, or any error in the proportion of the elements, which prevented the production of *Hornblende*, but that it was the effect of the rapid cooling. This he fully confirmed by the following experiments:—A light-green variety of *Hornblende*, the *Strahlstein* of the Germans, from Zillerthal in the Tyrol, was submitted in a platinum crucible to the heat of a porcelain oven. It was completely fused, and in cooling had formed fibrous tufts of dark crystals, which however admitted of measurement by Wollaston's goniometer, when the angles were found to correspond with those of *Augite.* A specimen of *Diopside*, of the same locality, was also fused; it cooled into a dark mass, but regained its former structure.

We may therefore consider it to be demonstrated that *Augite* is formed whenever the process of cooling, and consequently of crystallisation, is rapid; and *Hornblende*, when it is conducted more slowly. Many circumstances confirm this view: the *Uralites* of Rose appear to be its natural consequence; for as by the laws of caloric we know that the quantity of heat lost during equal portions of time varies with the temperature, the exterior portions of the crystal from this cause alone must have crystallised under a more gradual loss of heat than the interior, while at the same time the temperature would be maintained by the specific heat given out by the parts first consolidated. The general localities of *Augite* and *Hornblende*, and the minerals with which they are found associated, afford another argument in favour of this supposition; for *Hornblende* is usually met with in Syenite, Trachyte, and Lava, accompanied by Quartz, Felspar, Albite, &c.,—minerals which decidedly require a slow process of cooling for their formation; on the contrary, *Augite* occurs in Basalt and Lava with *Olivine*, which Mitscherlich has recognised in the scoriæ of various foundries, and which is therefore formed by a process of rapid cooling. We are thus able to account for H. von Buch's remark in his observations on volcanoes, that those Lavas which contain Felspar have *Hornblende*, but no *Augite.*

Induced by these circumstances Rose, in a tabular view of the minerals which he has added to his 'Elements of Crystallography,' published at Berlin in 1833, has united into one genus the following species.

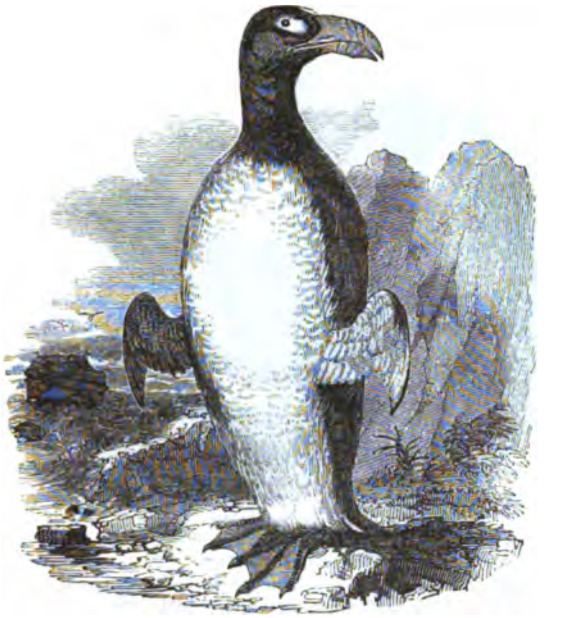
1. *Diopside* . . . . $\dot{Ca}\,\dot{Si}^2 + \dot{Mg}\,\dot{Si}^2$.
2. *Sahlite* . . . . . $\dot{Ca}\,\dot{Si}^2 + \left.\begin{matrix}\dot{Mg}\\ \dot{Fe}\end{matrix}\right\}\dot{Si}^2$.
3. *Hedenbergite* . . . $\dot{Ca}\,\dot{Si}^3 + \dot{Fe}\,\dot{Si}^2$.
4. *Basaltic Augite* . . $\dot{Ca}, \dot{Mg}, \dot{Fe}, \dddot{Al}, \dot{Si}$.
5. *Rothbraunstemerz* . $\dot{Mn}\,\dot{Si}^2$.
6. *Acmite* . . . . . $3\,\dot{Na}\,\dot{Si}^3 + 2\,\ddddot{Fe}\,\dot{Si}^6$.
7. *Diallage* . . . . $\dot{Mg}\,\dot{Si}^2 + \left.\begin{matrix}\dot{Ca}\\ \dot{Fe}\end{matrix}\right\}\dot{Si}^2$.
8. *Bronzite* . . . . . $\dot{Mg}\,\dot{Si}^2$.
9. *Hypersthene* . . . $\dot{Mg}\,\dot{Si}^2 + \dot{Fe}\,\dot{Si}^2$.
10. *Uralite* . . . . . .
11. *Tremolite* . . . . $\dot{Ca}\,\dot{Si}^3 + 3\,\dot{Mg}\,\dot{Si}^2$.
12. *Antophyllite* . . . . $\dot{Fe}\,\dot{Si}^3 + 9\,\dot{Mg}\,\dot{Si}^2$.
13. *Strahlstein* . . . . $\dot{Ca}, \dot{Mg}, \dot{Fe}, \dddot{Al}, \dot{Si}$.
14. *Basaltic Hornblende* $\dot{Ca}, \dot{Mg}, \dot{Fe}, \dddot{Al}, \dot{Si}$.

AUK, the common name for certain sea-birds of the family *Alcadæ*, including species of the sub-genera *Alca, Fratercula, Mergulus,* and *Phaleris.*

Alca. [ALCA.]

The true Auks, though they are strictly oceanic birds, scarcely ever leaving the water except for the purposes of reproduction, will sometimes proceed swiftly though awkwardly on foot when pursued on land. They breed in large companies, in caverns and rocky cliffs, laying only one disproportionately large egg. Their food, which they obtain by diving (an operation in which they are materially assisted by their wings as well as by their feet), consists of small fishes, crustaceans, and other marine animals. The young are said to be fed from the crops of their parents, not only before they are able to leave the place of their birth, but also for some time afterwards.

The genus *Alca*, as it is reduced by modern ornithologists, includes but two species. The first of these, the Great Auk (*Alca impennis*, Linnæus), is remarkable for the imperfect development of its wings. It seldom leaves the Arctic Circle and the regions bordering on it, and is a rare visitant to the British Isles. Dr. Fleming however gives an account of one taken alive at St. Kilda, where they are sometimes known to breed, which, even with a long and heavy cord tied to its



Great Auk (*Alca impennis*).

leg, swam under water with extraordinary speed. The power of the apparently useless wings as organs of progression was still more strongly shown in the Great Auk chased ineffectually by Mr. Bullock during his tour to the Northern Isles; for the four oars of the bird are said to have left the six-oared boat of his pursuers far behind. According to the same authority, only a single pair had been known to breed in Papa Westra for several years. Newfoundland is recorded as one of their breeding places, and Pennant relates that the Esquimaux who frequented the island made clothing of their skins. In the ocean that washes the Faroe Isles, Iceland, and Greenland, where they dwell in great numbers, they may be frequently seen on the floating ice; but Pennant says that they are observed never to wander beyond soundings, and that seamen direct their measures according to their appearance.

The food of the Great Auk consists principally of fish; and the Lump-Fish (*Cyclopterus lumpus*) is said to be its favourite morsel.

The length of the bird is somewhat under three feet. The winter plumage, which begins to appear in autumn, leaves the cheeks, throat, fore part and sides of the neck white. In spring the summer-change begins to take place, and confines the white on the head to a large patch, which extends in front and around the eyes; the rest of the head, the neck, and upper plumage is of a deep black. There is a specimen of the bird in its summer dress in the British Museum. The Great Auk breeds in June and July, laying one egg, about the size of a swan's, of a whitish-yellow, marked with numerous lines and spots of black, which have been supposed to bear some resemblance to Chinese characters.

In the Black-Billed Auk, Razor-Bill, or Murre (*Alca torda*, Linnæus), the development of the wings is carried to the usual extent necessary for the purposes of flight, though the bird uses them with great effect as oars when swimming under water.

The northern hemisphere, where they are widely diffused, is the region allotted to these birds; but it is in the higher latitudes that they swarm. In England, the Needles and other adjacent precipitous cliffs have a fair share of them; and here, as in other places, the 'dreadful trade' of taking their eggs, which are esteemed a delicacy for salads especially, is carried on. In Ray's ed. of Willughby the habits of the Razor-Bill are thus described:—"It lays, sits, and breeds up its young on the ledges of the craggy cliffs and steep rocks by the sea-shores that are broken and divided into many as it were stairs or shelves, together with the Coulter-Nebs and Guillemots. The Manksmen are wont to compare these rocks, with the birds sitting upon them in breeding-time, to an apothecary's shop—the ledges of the rocks resembling the shelves, and the birds the pots. About the Isle of Man are very high cliffs broken in this manner into many ledges one above another from top to bottom. They are wont to let down men by ropes from the tops of the cliffs, to take away the eggs and young ones. They take also the birds themselves when they are sitting upon their eggs, with snares fastened to the ends of long poles, and put about the necks of the birds. They build no nests, but lay their eggs upon the bare rocks."

On the coast of Labrador they abound, and the thousands of birds there killed for the sake of the breast-feathers which are very warm and elastic, and the quantities of eggs there collected, amount to almost incredible numbers.

The summer and winter dress of the Razor-Bill, though different,

Razor-Bill (*Alca torda*).

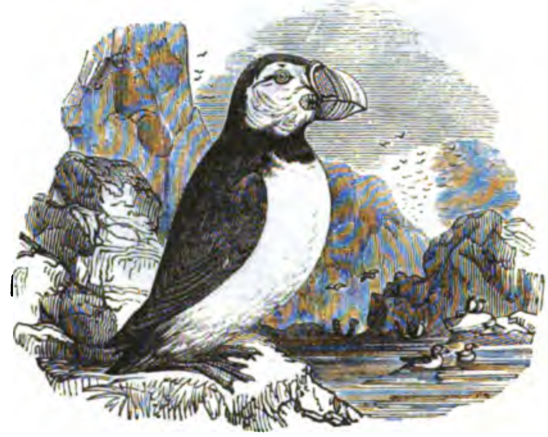
do not vary so remarkably as the plumage of many other birds. In the summer dress, the white streak which goes to the bill from the eyes becomes very pure; and the cheeks, throat, and upper part of the front of the neck are of a deep black, shaded with reddish. In winter the throat and fore part of the neck are white.

The young of the year is by the best authorities supposed to be the *Alca Pica* of Gmelin.

The Razor-Bill is little more than 15 inches long. The egg (for they lay but one) is very large in proportion to the bird, being about the size of that of a turkey, but of a longer shape, pointed towards the smaller end, white or sometimes yellowish, blotched, and streaked with dark brown, chiefly towards the larger end.

Fratercula.

Leaving the true Auks we come to the genus *Fratercula*, Briss. (*Mormon*, Illiger), of which the Labrador Auk, Common Puffin, or



Common Puffin (*Fratercula Arctica*).

Coulter-Neb (*Fratercula Arctica*, *Mormon fratercula*, Temm., *Alca Arctica*, Linn.), may be taken as an example.

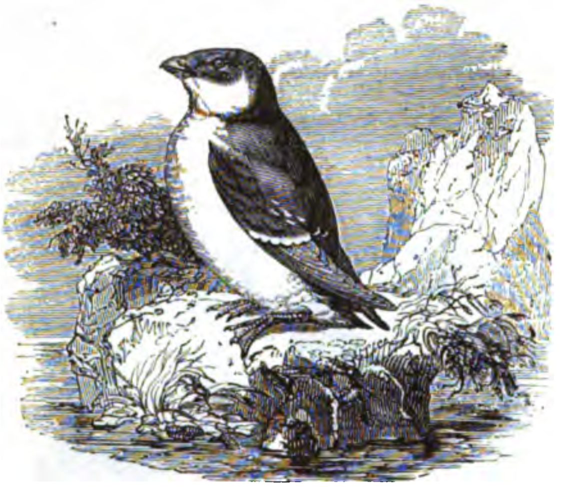
Selby gives the following account of the habits of this bird, and is corroborated by others who have written on the subject:—"Although the Puffin is found in very high latitudes, and its distribution through the Arctic Circle is extensive, it is only known to us as a summer visitant, and that from the south, making its first appearance in the vicinity of its breeding stations about the middle of April, and regularly departing between the 10th and 20th of August for the southern coasts of France, Spain, and other parts of Europe, where it passes the remainder of the year. It breeds in great numbers upon Priestholm Island, off the coast of Anglesey, on the Isle of Man, and most of the islands indeed of the English and Scottish coasts. Many resort to the Faroe Islands, selecting such as are covered with a stratum of vegetable mould; and here they dig their own burrows, from there not being any rabbits to dispossess upon the particular islets they frequent. They commence this operation about the first week in May, and the hole is generally excavated to the depth of three feet, often in a curving direction, and occasionally with two entrances. When engaged in digging, which is principally performed by the males, they are sometimes so intent upon their work as to admit of being taken by hand, and the same may also be done during incubation. At this period I have frequently obtained specimens by thrusting my arm into the burrow, though at the risk of receiving a severe bite from the powerful and sharp-edged bill of the old bird. At the farther end of this hole the single egg is deposited, which in size nearly equals that of a pullet, and, as Pennant observes, varies in form; in some instances one end being acute, and in others both equally obtuse. Its colour when first laid is white, but it soon becomes soiled and dirty from its immediate contact with the earth, no materials being collected for a nest at the end of the burrow. The young are hatched after a month's incubation, and are then covered with a long blackish down above, which gradually gives place to the feathered plumage; so that at the end of a month or five weeks they are able to quit the burrow, and follow their parents to the open sea. Soon after this time, or about the second week in August, the whole leave our coasts, commencing their equatorial migration. At an early age the bill of this bird is small and narrow, scarcely exceeding that of the young Razor-Bill at the same period of life; and not till after the second year does this member acquire its full development, both as to depth, colour, and its transverse furrows."

In rocky places (Dover cliffs for instance) they deposit their single egg, as Montagu observes, in the holes and crevices. The length of the bird is about 12 inches. The half of the bill nearest the head is bluish; the rest red. The corners of the mouth are puckered into a kind of star. The legs and feet are orange. The plumage is black and white, with the exception of the cheeks and chin, which are sometimes gray. The young pickled with spices are by some considered dainties; they are also occasionally potted in the north.

Sprats are supposed to be the principal food of the Puffin, but there is little doubt that other fishes and crustaceans are acceptable to the bird.

Mergulus.

The Little Auk, Common Rotche, or Sea-Dove (*Mergulus melanoleucos* of Ray, *Uria Alle* of Temminck, and *Alca Alle*, Linnæus), is an example of the genus *Mergulus* of our countryman Ray.



Little Auk (*Mergulus melanoleucos*).

The Little Auk braves the inclemency of very high latitudes, and congregates in great flocks far within the Arctic Circle. The inhospitable coasts of Greenland and Spitzbergen are the dwelling-places of these birds, and thousands have been seen at Melville Island. In those dreary regions they are said to watch the motion of the ice, and when it is broken up by storms down they come in legions, crowding into every fissure to banquet on the crustaceans and other marine animals which there lie at their mercy. It can hardly be called an occasional visitant to this country, for those which have appeared here have been evidently exhausted birds, buffeted by storms and driven by contrary winds far from the spot congenial to their habits. The Little Auk is between 9 and 10 inches in length; the bill is black, and the legs inclining to brown; the plumage is black and white, and in winter the front of the neck, which is black in summer, becomes whitish: the change takes place in the autumn.

The bird lays only one egg of a pale bluish-green, on the most inaccessible ledges of the precipices which overhang the ocean.

Phaleris.

The Perroquet Auk (*Phaleris psittacula*, Temminck, *Alca psittacula*, Pallas), may be taken as an illustration.

Kamtchatka and other northern regions shelter these birds in abundance. They swim and dive admirably. Stories are told to prove their unsuspicious character; and it is said that the natives place a dress with large sleeves near their holes and burrows, into which the artless birds, mistaking the sleeves aforesaid for their own retreats, creep and are taken.

About midsummer they lay one large egg nearly of the size of a hen's, with brown or dusky spots on a whitish or yellowish ground.

The Perroquet Auk is about 11 inches in length. From behind the

Perroquet Auk (*Phaleris psittacula*).

eye a tuft of white feathers, which hang on either side of the neck, shoots forth. The head, neck, and upper parts are black, blending into ash-colour on the fore part of the neck; the under parts from the breast are white; the legs are yellowish. In the old bird the bill is red, while the young one has it of a yellowish or dusky colour.

(Yarrell, *British Birds*.) [See SUPPLEMENT.]

AU'LOLEPIS, a genus of Fossil Cycloïd Fishes, from the Chalk of Sussex and Kent. (Agassiz.)

AULO'PORA (Goldfuss), a genus of Fossil *Polypiaria*, from the Silurian Strata.

AURANTIA'CEÆ, *Citron Worts*, or the Orange Tribe, are Dicotyledonous Polypetalous Plants, with dark-green jointed leaves, filled

Common Orange (*Citrus Aurantium*).

1, A flower with its calyx, corolla, stamens, and style; 2, a portion of the stamens; 3, an ovary cut through transversely; 4, a fruit cut through in the same direction.

with fragrant essential oil collected in little transparent dots, and a superior ovary changing to a succulent berry, the rind of which is also filled with fragrant essential oil. No natural order can well be more strictly defined than the Orange Tribe, and none have properties more uniform and definite. It consists of trees or shrubs found exclusively in the temperate or tropical parts of the Old World, and unknown in a wild state in America. Their flowers are usually odoriferous, and their fruits subacid; the rind has some shade of yellow. They principally differ from each other in the number and proportion or arrangement of their stamens, in the number of cells or seeds in the fruit, and in the texture of the rind of the fruit, which does not always pull off as in the orange, the lemon, the citron, and their congeners, but is frequently a mere skin inclosing the pulp. [CITRUS.] The natural order which is most nearly allied to the Orange Tribe is that called *Xanthoxylaceæ*, into which the oranges pass by their climbing genus, *Lavanga*, and which differ principally in having a hard dry fruit which splits into several carpels.

The Orange, Lemon, Lime, Shaddock, Pompelmoose, Forbidden Fruit, and Citron, are the produce of this order. The Wampa, a fruit highly esteemed in China and the Indian Archipelago, is produced by *Cookia punctata*. The fruit of *Glycosmis citrifolia* is delicious; that of *Triphasia* is very agreeable. The *Ægle Marmelos* is used in medicine: a perfume is prepared from the rind of the fruit, which itself is delicious to the taste, and acts as a laxative medicine. The leaves of *Feronia elephantum* have a very agreeable smell. Orange flowers yield a delicious odour, and the oils of Bergamot and Lemon are obtained from the rind of the fruit of species of Citrus.

(Lindley, *Vegetable Kingdom.*)

AURE'LIA, in Entomology, a name given to that state of an insect which is between the caterpillar and its final transformation, and is commonly called a Chrysalis or Pupa. The term Aurelia was first applied by the Romans, and that of Chrysalis by the Greeks, to certain butterfly pupæ which have a golden colour. In England, those of the Peacock-Butterfly (*Vanessa Iö*) and the small Tortoise-Shell Butterfly (*Vanessa Urticæ*) are beautiful examples, and may be seen in abundance hanging to the common stinging nettles about the latter end of the month of June. [PUPA.]

AURICHA'LCITE, a carbonate of Copper and Zinc. It occurs amorphous, sometimes granular, or in radiating masses. The colour is green. It is slightly transparent. Hardness but slight. It is found at Loktewsk in the Altai. The analysis by Böttger gives—

Oxide of Copper	28·19
Oxide of Zinc	45·84
Carbonic Acid	16·06
Water	9·91
	100

AURI'CULA, the name given to a commonly-cultivated species of the genus *Primula*. [PRIMULA.]

AURI'CULA, a genus of Phytophagous or Plant-Eating *Trachelipodous Mollusca*, whose organs of respiration are formed for breathing air. Cuvier observes, that the species of this genus differ from all the Pulmoniferous Aquatic Mollusks which precede them in his system, in having the columella or pillar of the shell marked by large plaits. The species of *Auricula* appear to live in the neighbourhood of rivers, lakes, or morasses, and their respiratory system, though formed for breathing air, is so framed as to enable them to sustain any vicissitudes to which such a locality might render them liable. *Auricula Midæ* (Lam.), *Voluta Auris Midæ* (Linn.), the Midas's Ear of collectors, is a good example of the genus.

Midas's Ear (*Auricula Midæ*).

It is said to be an inhabitant of the East Indies. Lamarck also names the Moluccas as its locality.

The following is the generic character:—Shell somewhat oval, or ovate-oblong; aperture longitudinal, narrowed above, and with the base entire; pillar with one or more plaits; outer lip either reflected or simple and acute.

The true *Auriculæ* are the inhabitants of warm climates. There is one in the south of France, near the shores of the Mediterranean (*Auricula myosotis* of Draparnaud), but it is a small species.

AUROTELLINITE, a mineral containing Gold combined with Tellurium.

AUST CLIFF. In the Bone-Bed of this famous locality, usually classed with the Lias Formation, occur a few organic remains which appear to belong also to the Keuper deposits. This has been thought a sufficient reason for removing these beds out of the Lias. But if we regard their mineralogical and geological relations, this displacement will hardly be allowed.

AUTOMALITE. [GAHNITE.]

AUTOMOLITE, a variety of *Spinel* [SPINEL] containing 34 per cent. of oxide of zinc. It is infusible alone, and nearly so with borax. It occurs in granite at Haddam, in Connecticut, together with Beryl, Chrysoberyl, Garnet, &c.; also near Falun in Sweden, in Talcose Slate.

AUTONO'MEA (Risso), a genus of Long-Tailed Decapodous *Crustacea*, founded on *Autonomea Olivii*, which is a little more than an inch in length, and bears great resemblance in form to *Nika* and *Alpheus*. *Autonomea* lives solitarily in sea-weed, &c., and the female produces red eggs, which she carries with her about the middle of summer. It is found in the Adriatic Sea.

AVANTURI'NE, a variety of Quartz, remarkable for the brilliancy with which it reflects light, the effect being in general produced by fine points of Mica imbedded within the crystalline mass. From this circumstance it is sometimes used in jewellery, but is of little value.

AVE'NA, the botanical name of the genus to which the cultivated Oat belongs. As understood by Linnæus and the writers of his school, it comprehended many very distinct forms of Grasses, as well as the common cultivated kinds; but by other botanists it is more correctly limited to the species that yield corn, and to such as are closely allied to them. They are known by their lax panicles, their two loose membranous glumes, and by the small number of their florets, each of which has one of its husks or paleæ armed with a strong twisted beard or awn. The grain is generally, but not uniformly, closely invested with the hardened husk.

The Common Oat (*Avena sativa*), is that which is most generally cultivated for the use of man. Like most other corn-plants its native country is unknown; it cannot however be supposed to be the offspring of cultivation or of chance, but is more likely to be an inhabitant of some of the northern provinces of Asia to which Europeans have little access. [OAT, in ARTS AND SC. DIV.]

The Tartarian Oat is considered a distinct species, on account of its more compact and one-sided panicle, and of both its florets having a beard; it is however doubtful whether it can be regarded as anything more than a variety of *A. sativa*. Botanists call it *A. orientalis*, but its native country seems as uncertain as that of the last.

The Naked Oat (*A. nuda*), so called because its grain is loose in the husk, is found wild in many parts of Europe, and by some is thought to be a mere degeneration of the Common Oat. It is common in Austria, where it is cultivated for its grain, which is however small, and not much esteemed.

The Chinese Oat (*A. Chinensis*), is another species, the grain of which is loose in the husk. It is said to have been procured by the Russians from the north of China along with their tea. This species is the most productive of all the known kinds, every flower producing from three to five grains, which are large and of excellent quality. It is however said to be difficult to harvest on account of the grains not adhering to the husks, but being very easily shaken out.

Besides the species cultivated for the corn which they yield, there is another that deserves to be noticed on account of its remarkable hygrometrical action. This plant, the Animal Oat of gardeners, the *A. sterilis* of systematic writers, is something like the Common Oat when young; but when ripe its grains are inclosed in hard hairy brown husks, from the back of which rises a stout bent and twisted awn. Usually two such husks grow together, and separate from the stalk by a deep oblique scar. Taking the scar for the head of an insect, the husks with their long stiff brown hairs resemble its body, and the two bent awns represent its legs. In this state fishermen use a smaller but nearly allied species, called Havers (*A. fatua*) instead of artificial flies for catching trout. When the Animal Oat is ripe it falls out of its glumes, and in warm dry weather may be seen rolling and turning about on its long ungainly legs, as they twist up in consequence of their hygrometrical quality. It necessarily advances as it turns over, because the long stiff hairs upon its body catch against every little projecting point on the surface of the soil and prevent its retreat. Nothing can be more curious than to see the path of a garden-walk covered with these things tumbling and sprawling about in different directions, until their awns are so twisted that they can twist no further. They then remain quiet till the dews fall, or they are moistened by a shower, when they rapidly untwist and run about with renewed activity, as if anxious to get out of the wet.

AVENS. [GEUM.]

AVE'RRHOA, a genus of plants belonging to the natural order *Oxalidaceæ*. It consists of two species, both of which form small trees in the East Indies. They are remarkable for their leaves, which are pinnated, possessing in a slight degree the kind of irritability found in the sensitive plant, and for their fleshy oval fruits with five thick longitudinal wings. From the other genus of *Oxalidaceæ* they are known by this character, independently of all others.

In the Carambola (*A. carambola*) the leaves are smooth, the flowers of a violet-purple, and the fruit about the size of a goose's egg; it is of a pale yellow colour, and is said to be agreeably acid in the East Indies. It was expected that it would prove worth cultivating in the hothouse for the dessert, but it proves upon trial to be insipid, and much inferior to the common fruit of the European markets.

The other species, called the Beimbing (*A. bilimbi*), has downy leaves, and fruit resembling a small cucumber. The fruit is intensely acid, and cannot be eaten raw. It is pickled or candied, or a syrup is obtained from it by boiling with sugar, and its juice is found an excellent agent for removing iron-moulds or other spots from linen. To the Malays it answers the same purposes as the citron, the gooseberry, the caper, and the cucumber of Europe.

AVES. [BIRDS.]

AVES (Fossil). Fossil Birds have been recognised by bones and foot-prints in the Red-Sandstone of Connecticut (Hitchcock), in the Wealden of Sussex (Mantell), in the Chalk of Maidstone (Owen), in the Tertiary Beds of England and France (Cuvier), in the bone-caves of Kirkdale (Buckland), and in many late deposits. From New Zealand comes the *Dinornis* of Owen. [DINORNIS.]

AVICE'NNIA, a genus of plants belonging to the natural order *Myoporaceæ*. The calyx is 5-parted, persistent, the segments erect, subovate, obtuse, concave; the corolla monopetalous, 2-lipped, upper lip square, emarginate, flat, lower bifid, with ovate, equal, flat divisions, tube bell-shaped, short; the stamens 4, didynamous; ovary 2-celled; style, subulate, erect, length of stamens; the stigma bifid, acute, the lower division bent down; the seed single, large, albuminous. The species are natives of Australia and America.

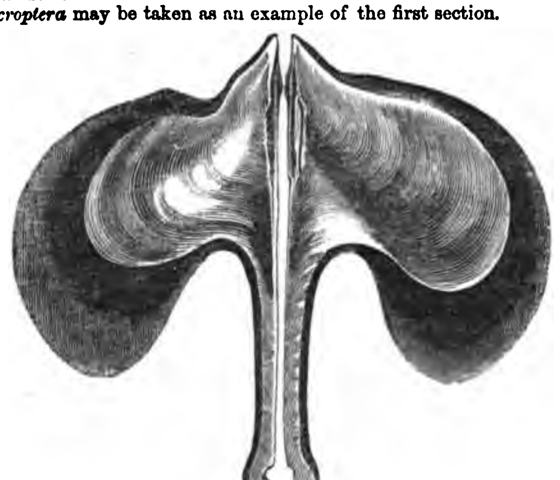
A. tomentosa, White Mangrove, has cordate ovate leaves, tomentose beneath. It puts forth twigs from the stem, resembling those of the common mangrove. The bark is found to contain tannin, and is used in Rio Janeiro for tanning.

A. resinifera is a native of New Zealand, and is said by Forster to yield a green resinous substance that is eaten by the New Zealanders as food. It is remarkable also for its clusters of large flowers. *A. nitida* is a native of Martinique.

(Burnett, *Outlines*; Lindley, *Natural System*.)

AVI'CULA, a genus of *Marine Conchifera*, or Bivalves with unequal valves, in which Sowerby, with much show of reason, includes the genus *Meleagrina*, also formed by Lamarck. The shell in both is foliaceous externally; and internally, of a brilliant pearly lustre. The left-hand valve is contracted and notched posteriorly; and so is the right, but very slightly. Through this sinus passes the byssus, by which they are moored to rocks and other marine bodies. The ligamental area is marginal, and broadest in the centre; and there is generally a small tooth in each valve near the umbones. This is most conspicuous, generally speaking, in *Avicula* (Lam.), but is not always found, while it is often present in Lamarck's *Meleagrinæ*, though it is sometimes absent. The muscular impression is nearly central, somewhat orbicular, and large.

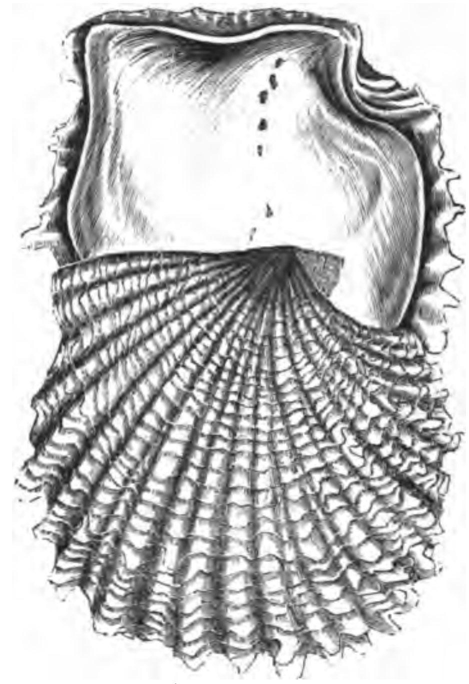
Avicula, then, as characterised by Sowerby, will comprise two sections; the first including those species which have their base, or hinge-line, considerably prolonged; the second embracing those which are without that prolongation—in other words, the *Meleagrinæ*. Both sections are the inhabitants of warm climates. *Avicula macroptera* may be taken as an example of the first section.



Avicula macroptera.

Avicula margaritifera (*Meleagrina margaritifera*, Lam., *Mytilus margaritiferus*, Linn.), commonly known as the Pearl-Oyster, the source whence the most precious pearls are derived, will afford an illustration of the second section.

The shell itself is imported in great quantities, for the manufacture of the nacre, or mother-of-pearl, into buttons, knife-handles, paper-knives, &c.; but its great commercial value rests on the pearls which it contains. For these beautiful productions, which may be considered as extravasated nacre, there are fisheries in both hemispheres. The pearl of great price, however, is found in the East, where the principal fisheries, at Ceylon, Cape Comorin, and in the Persian Gulf, are carried on by means of divers. Captain Percival, in his 'Account of Ceylon,' has given the best description of the pearl-fishery there. [SHELL.]



Pearl-Oyster (*Avicula margaritifera*).
The figure represents a young individual. The shell grows to a large size, and then the delicate foliations disappear.

A'VOCET, the common name of the *Recurvirostra Avocetta*. It belongs to the order of *Grallatores*, or Waders, and the family *Scolopacidæ*.

The Avocet (*Recurvirostra Avocetta*).

The genus *Recurvirostra* includes other species besides the Avocet. The muddy shores of the ocean and the banks of æstuaries are their favourite haunts, where they feed on aquatic animals, such as the smaller conchifers and mollusks, and the spawn of fishes. They are deep waders, but do not seem to be adepts at swimming. The Avocet is the only European species, and has been long remarked for the singularity of the shape of the bill. "There needs no great pains be taken, or time spent in exactly describing this bird," says Ray in his edition of Willughby, "for the singular bill reflected upwards is sufficient alone to characterise and distinguish it from all other birds we have hitherto seen or heard of." It is widely diffused through the temperate climates of Europe. Siberia, the shores of the Caspian, and the salt-lakes of Tartary, are also stated to be plentifully supplied with these birds, and it is said to be met with in Egypt and other parts of Africa. In England they were formerly found on the eastern coast below the Humber, and in Romney Marsh, but recently they have become much more scarce. Mr. Yarrell says that some years ago "more than twenty specimens were received at Leadenhall Market for sale within one month; but now scarcely an example appears once in a year."

Pennant well describes the Avocet's bill as "very thin, flexible, and of a substance like whalebone." Buffon makes it the subject of one of his lamentations upon the errors of nature and her niggard disposition in providing for some of the less favoured of the animal creation. But in truth no organ could have been devised more admirably adapted for the function which it has to perform than the bill of the Avocet, as he who has seen the bird scooping, probing, or apparently patting and beating the water and soft mud with it, while the mandibles act as a strainer and retain the prey, will readily acknowledge. The Avocet frequently wades up to the breast, and its long legs are well formed for this purpose; for they are compressed laterally, and present but a thin edge, so as to offer hardly any resistance to the medium through which they have to make their progress. Though the feet are palmated, they appear to be adapted not for swimming, but for supporting the bird upon the ooze, after the manner of the mud-boards used by fowlers, and figured by Colonel Hawker; this office the feet of the Avocet execute in perfection. Montagu says, "We remember one of this species being wounded in the wing, and floating with the tide for near a mile, when it was taken up alive without ever attempting to swim; so that the palmated feet seem only intended to support it on the mud."

The nests of the Avocet, which are very inartificial, are generally formed in the spring, in marine marshes, where the driest point is selected. They breed in the fens of Lincolnshire and Norfolk. The eggs are greenish, spotted with brown or black. When disturbed soon after the young are hatched, they fly round and round, repeating their peculiar cry 'twit-twit' incessantly, and are said to feign

... y the intruder away.

... the beard of grasses, is a rigid
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... lso called *Jade*, *Nephrite*, and

... rmed by the separation of a leaf
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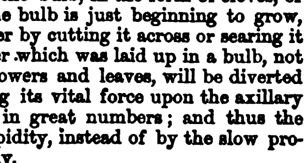
stances, of bringing it to ... opment. Gardeners sometimes profit by a knowledge of this law, to propagate plants in which, from the close manner in which the leaves are arranged upon the stem, it would be impossible to increase them by the ordinary modes. Thus a hyacinth bulb is a short branch with rudimentary leaves, called scales, growing closely over all its surface; and consequently at the axilla of each rudimentary leaf there exists a bud either latent or manifest. Under ordinary circumstances, two or three only of those buds develop near the outside of the bulb, in the form of cloves, or young bulbs; but if at the time the bulb is just beginning to grow, the central shoot is destroyed, either by cutting it across or searing it with a hot iron, the nutritive matter which was laid up in a bulb, not being expended upon producing flowers and leaves, will be diverted into other channels, and exercising its vital force upon the axillary buds, will cause them to develop in great numbers; and thus the hyacinth will be increased with rapidity, instead of by the slow production of two or three cloves yearly.

Although buds, or bulbs, which is the same thing, are universally axillary to leaves, and indeed to every part which is theoretically a modification of a leaf, yet one leaf cannot be axillary to another leaf, although it may seem so in consequence of the incipient development of an axillary branch to whose system it belongs. Thus in pine-trees, the clustered needle-shaped leaves seem to be axillary to the withering rudimentary leaf that grows round their base; but in reality each cluster of leaves is a small branch without perceptible axis, as is proved by the Cedar of Lebanon, where the axis sometimes lengthens and sometimes does not.

AXINI'TE. This mineral usually occurs crystallised in flat prismatic crystals, with very sharp edges, from which it has received its name. The fundamental form is a double oblique prism, from which Neumann has obtained the following angles:—



M on T = 135° 24′ and 44° 36′
P on M = 134° 48′ and 45° 12′
P on T = 115° 39′ and 60° 21′

It is imperfectly cleavable in the direction of the faces P and M. Its colour is clove-brown, sometimes inclining to plum-blue; sometimes transparent, at other times only translucent on the edges; its lustre is vitreous. The specific gravity of a crystallised variety from Cornwall is stated by Mohs to be 3·271, and its hardness 6·5 to 7.

Before the blowpipe it readily fuses with intumescence into a dark-green glass, which in the oxidising flame becomes black on account of the presence of super-oxide of manganese. With borax the glass is either green from iron, or of an amethyst tint from manganese, according as it has been exposed to the interior or exterior flame of the blowpipe. By fusing it with sulphate of ammonia and fluor-spar, the presence of boracic acid may be detected. The following is an analysis by Wiegmann of a variety from Treseburg, Harz:—

Silica	45·00
Alumina	19·00
Lime	12·50
Peroxide of Iron	12·25
Peroxide of Manganese	9·00
Magnesia	0·25
Boracic Acid	2·00
	100·00

Berzelius, however, has marked the iron and manganese as protoxides.

This mineral is not very abundant; it is found at Thum in Saxony, whence it is sometimes called Thumerstone. It occurs at Botallack, near the Land's End, Cornwall, both crystallised and forming a rock with Tourmaline and Garnet.

AXI'NUS (Sowerby), a genus of Fossil *Conchifera*, of which some species occur in the Magnesian Limestone, and one in the London Clay. To those which are found in the Magnesian and other Palæozoic Limestones Mr. King applies the title of *Schizodus*.

AXIO'TIMA. [ACALEPHÆ.]

AXIS, in Anatomy, the second vertebra of the neck, on which the Atlas, the first vertebra, moves. [ATLAS.]

AXIS, in Botany, a term that is applied to the root and stem of the whole plant. The result of placing the seed of a plant in a place fitted for its growth is the development of the embryo. The plumule ascends into the air, whilst the radicle descends towards the earth. The former is said to be the ascending axis of the plant, the latter the descending axis. It is around these axes of growth that all other parts of the plant are arranged. Those which are found upon the ascending axis, or stem, are collectively termed the appendages of the axis, and individually constitute the scales, leaves, bracts, flowers, sexes, fruit, and modifications of those parts of the plant; all these parts are in connection with the vascular system of the axis, and must not be confounded with mere expansions of the epidermis and the like, such as ramenta, thorns, &c., which have no real connection with the axis.

The cause of the direction taken by the ascending and descending axes of plants has been variously explained. This is evidently a complicated question, and one which involves the great mass of facts in the organisation of plants, and probably animals, which determine their peculiar forms, habits, and movements. Dutrochet says—"The downward direction of the roots may appear easy of explanation: it may be said that, like all other bodies, they have a tendency towards the centre of the earth, in consequence of the known laws of gravity (as is the opinion of Knight in 'Phil. Trans.' for 1806); but on what principle then is to be explained the upward tendency of the stem, which is in direct opposition to those laws? And here lies the difficulty. Dodart is the first who appears to have paid attention to this circumstance; he pretends to explain the turning backward of seeds sown in an inverted position by the following hypothesis:—He assumed that the root is composed of parts that contract by humidity; and that the stem, on the contrary, contracts by dryness. For this reason, according to him, it ought to happen that when a seed is sown in an inverted position, the radicle will turn back towards the earth, which is the seat of humidity; and that the plumule, on the contrary, turns to the sky, or rather atmosphere, a drier medium than the earth. The experiments of Du Hamel are well known, in which he attempted to force a radicle upwards and a plumule downwards by inclosing them in tubes which prevented the turning back of these parts. It was found that as the radicle and plumule could not take their natural direction, they became twisted spirally. These experiments, while they prove that the opposite tendencies of the radicle and the plumule cannot be altered, still leave us in ignorance of the cause of such tendencies." The well-known fact of the stems of plants seeking the light when confined in dark places, has led De Candolle and other observers to attribute the tendency of the stem to an upward growth to the influence of light. Another well-known fact, that of the tendency of the roots of plants to grow towards water or moisture, might have suggested water as a cause of the tendency of the root to grow downwards. Observing that the ascending axis of plants is always coloured, and that the descending axis is white, Dutrochet suspected that the action of light on the coloured parts of the plant was the cause of its growing upwards. He found by experiments on the *Mirabilis Jalapa* and other plants, that although roots have in general no tendency towards the light, yet such a disposition does become manifest provided the terminal shoot of a root becomes slightly green, as occasionally happens. He found that the ends of the roots of *Mirabilis Jalapa* became occasionally coloured, and on placing the plants in damp moss, he found these roots had a tendency to come to the surface towards the light. Not only is this the case, but the colourless stems of such plants as *Sagittaria sagittifolia* are known to assume the directions of roots. In this plant "shoots are produced from the axillæ of all the radical leaves which grow at the bottom of the water. These shoots have their points directed towards the sky, like those of all vegetables. The young stems which are produced by these shoots are entirely colourless, like roots; and instead of taking a direction towards the sky, as coloured stems would do, they lead downwards, pointing towards the centre of the earth. This subterranean stem next takes a horizontal course, and does not assume any tendency towards the sky until the points become green."

(Meyen, *Pflanzen-Physiologie*; Lindley, *Introduction to Botany;* Dutrochet, *Ann. des Sciences Naturelles*, xxix., 1833.)

AXIS, a species of Indian Deer. The word is also used generically to denote a small group or sub-genus of solid-horned ruminants, presenting the same characters and inhabiting the same climate as the Common Axis. [CERVIDÆ.]

A'XIUS, a genus of Long-Tailed Decapodous *Crustacea*, founded by Leach on *Axius stirhynchus*, which is about 3 inches or 3½ inches in length, and rarely found on our coasts. It has been taken near Sidmouth and Plymouth. Desmarest, with much reason, considers this genus entirely artificial; and thinks that it ought not to be separated from *Callianassa*. [CALLIANASSA.]

AXOLO'TL (*Gyrinus*, Hernandez and Shaw), a genus of *Amphibia* belonging to a group called Perennibranchiate, as they retain their gills throughout life. They are distinguished from other genera of the same family by having four feet furnished with four toes before and five behind. This group contains the genera—*Axolotes, Menobranchus, Proteus*, and *Sirenus;* and comprises animals which possess at the same time both lungs and gills, and which are consequently organised to live either on land or in water. [AMPHIBIA.]

The Axolotl was the earliest observed of these remarkable animals. At the period of the Mexican conquest the Spaniards found this animal in great abundance in the lake which surrounded the city of Mexico, to the inhabitants of which capital it then furnished, as it still continues to furnish to their successors, an agreeable and much-esteemed article of food. Hernandez, who seems to be the first writer who actually described the Axolotl, expressly mentions it having been thus used by the ancient Mexicans; and adds that the flesh was considered as an aphrodisiac, that it was wholesome and agreeable, and tasted not unlike eel. Succeeding authors, without taking the trouble of observing for themselves, were content to copy what Hernandez had said before; but distorting his short description by absurd comments of their own, and adding the figures of far different species, the whole subject became at length involved in such inextricable confusion that finally all memory of the Axolotl was lost, or the animal itself considered as a fictitious being. The late Dr. Shaw however, who received a specimen of the animal direct from Mexico, recognised in it the Axolotl of Hernandez, as is proved by his having used the generic term *Gyrinus* in his account of it published in the 'Naturalist's Miscellany,' which had been originally applied to it by its first describer, though Baron Cuvier seems disposed to deprive the British naturalist of this credit, and to ascribe the sole honour of re-discovering the Axolotl to Baron Humboldt. It is indeed true that Dr. Shaw subsequently described the same animal in the third volume of his 'General Zoology' under the very different name of *Siren pisciformis;* but this only proves that he considered it, as Baron Cuvier was himself afterwards inclined to do, not as a perfect animal, nor in fact as the type of a new genus, but rather as the immature state of some species belonging to a genus already known. To Baron Cuvier himself however we are indebted for the complete description and elucidation of the form and organic structure of this curious reptile. Two specimens brought by M. Humboldt from Mexico were submitted to the examination of the French naturalist, whose researches on the subject of their anatomy, compared with that of the kindred genera, are recorded in his 'Recherches sur les Reptiles Douteux,' inserted in the zoological part of Messrs. Humboldt and Bonpland's Travels. A detailed examination of all the Batrachian Reptiles, and more particularly a careful investigation into their anatomical structure during the tadpole state, and the gradual change which they undergo in passing from this state to their mature and perfect form, led Baron Cuvier to establish as an unquestionable fact that certain of these animals retain both lungs and gills throughout the entire period of their existence; but whilst he unhesitatingly announced this fact with regard to the Siren and Proteus, he was disposed to consider the Axolotl as the tadpole of some of the larger species of American salamanders—an error induced as well by the general similarity which these animals bear to one another as by the immature age of the specimens of the Axolotl which were submitted to his observation. Succeeding naturalists adopted M. Cuvier's views upon this subject; but that great zoologist himself subsequently altered his original opinion, and candidly confesses in the second edition of the 'Règne Animal' that the concurrent testimony of all original observers overbalances the mere deductions of the physiologist, however plausible or apparently well founded.

The generic characters of the genus *Axolotl*, Cuvier (*Axolotes*, Owen, *Gyrinus*, Hernandez), in addition to those above mentioned, consist in having the gills formed of three long ramified or branch-like processes on each side of the neck, four toes on the anterior extremities and five on the posterior, and teeth in the vomer as well as in both jaws. The tail is compressed on the sides like that of the common Water-Newt (*Salamandra palmata*), and surrounded both on the upper and under surfaces by a thin erect membranous fin, which is prolonged upon the back, but becomes gradually narrower as it approaches the shoulders, between which it finally ceases. The head is broad and flat; the nose blunt; the eyes situated near the muzzle; the tail nearly as long as the body; and the toes unconnected by intermediate membranes. The singular form of the gills will be best understood from the accompanying figure, which represents the under jaw and throat of the animal as seen from beneath.

Axolotl (*Gyrinus edulis*, Hernandez).

The *Axolotl* of the Mexicans (*Gyrinus edulis*, Hernandez), when full grown, measures about 8 or 9 inches in length; its ground colour is a uniform deep brown, thickly mottled both on the upper and under surfaces of the head and body as well as on the limbs, tail, and dorsal and caudal fins, with numerous small round black spots. The head and body are larger and broader than in the generality of reptiles, and but for the long tail which terminates the latter the whole animal might be not inaptly compared in form to a large frog; the gills are prolonged into three principal processes, with numerous smaller ramifications from the sides of each, the whole being as long as the fore legs, and resembling three small branches; the legs are short, though fully developed; and the toes are long, slender, separate, and without claws. The communications which open from the gills into the mouth are four in number, and of a size considerably larger than those of the kindred genera; they are covered externally by a species of operculum formed by a fold in the skin of the head.

The Axolotl is very common in the lake of Mexico, and, according to Baron Humboldt, likewise inhabits the cold waters of mountain-lakes at much greater elevation above the level of the sea than the plains surrounding that city. It is commonly sold in the markets of Mexico, and esteemed a luxury by the inhabitants. It is dressed after the manner of stewed eels, and served up with a rich and stimulating sauce.

Professor Owen has described a second species under the name of *Axolotes maculata*, which also is an inhabitant of Mexico.

AYE-AYE. [CHEIROMYS.]

AYMESTRY LIMESTONE, one of the calcareous bands in the Upper Silurian series which has been produced by coral and shell accumulations amidst the masses of argillaceous sediments. It is not traceable beyond the districts of Ludlow, Abberley, Malvern, Woolhope, May Hill, and Usk. It is partially characterised by *Pentamerus Knightii*.

AZA'LEA, in Botany, is the name of a genus belonging to the natural order *Ericaceæ*, and consisting of shrubs remarkable for the beauty and fragrance of their flowers; on which account they are very generally cultivated in Europe. By some botanists the genus is esteemed the same as *Rhododendron*, in which it is accordingly sunk; and it must be confessed that it is difficult to point out any positive character except the thin and generally deciduous leaves by which *Azalea* can be distinguished from *Rhododendron*.

The forms of *Azalea* may be reduced to four principal heads, to one or other of which all the species are referrible—namely, 1, those with glutinous flowers and short stamens; 2, those with glutinous flowers and stamens much longer than the corolla; 3, those with flowers that are scarcely at all glutinous, and stamens much longer than the corolla; and 4, those with flowers that are scarcely at all glutinous, and short stamens.

Section I.—*Flowers covered with numerous glutinous hairs. Stamens little or not at all longer than the tube of the corolla.*

1. *Azalea viscosa*, Linn. (*A. odorata, vittata, fissa, lucida* of various authors). Leaves shining, green on both sides, fringed at the edge. A native of swamps, copses, and wet and shady woods, throughout the United States of North America, from Canada to Georgia. It is a shrub from 3 to 8 feet high, with the young branches covered with numerous stiffish brown hairs. The leaves are bright green, shining, and smooth on the upper side; paler but not at all glaucous on the under side. The flowers are deliciously fragrant, usually white or nearly so, with a long narrow tube, and a contracted limb with narrow sharp-pointed divisions; they are covered all over externally with glutinous brownish-purple glands. The stamens are not so long as the segments of the corolla, but longer than its tube. It is one of the most common species and the most fragrant.

2. *Azalea glauca*, Lamarck. Leaves dull green, somewhat wrinkled and wavy at the edge, glaucous on the under side, fringed at the edge. Found in clayey swamps in the middle states of North America, where it flowers rather earlier than the last. In a wild state it is a much rarer plant, and does not grow so tall; its white flowers appear in the utmost profusion, and are very like those of *A. viscosa*, but the stamens are a little longer. In the nurseries it is called *A. viscosa floribunda.*

Section II.—*Flowers covered with numerous glutinous hairs. Stamens much longer than the corolla.*

3. *Azalea nitida*, Pursh. Branches with very few hairs. Leaves small, rather leathery, shining, and smooth on both sides. Found in deep mossy swamps on the mountains of North America, from the state of New York to Virginia, flowering in June and July. The leaves of this plant, which appear a little earlier than the flowers, are dark-green, shining, and smaller than in any other species: the only parts which are hairy are the midrib and the margin. The flowers are white, with a red tinge, and glutinous; their tube is a little longer than the segments; the calyx is very short; the stamens are longer than the corolla. It is doubtful whether this is to be met with in cultivation.

4. *Azalea hispida*, Pursh. Branches clothed with numerous stiffish hairs. Leaves long-lanceolate, covered with bloom on both sides, hairy on the upper surface, and smooth on the lower. A native of the borders of lakes; and on the highest part of the Blue Ridge in the state of Pennsylvania, flowering in July and August. An upright shrub, growing 10 or 15 feet high, with a bluish aspect, by which it may be recognised at a distance.

5. *Azalea pontica*, Linn. Leaves large, not shining, puckered, reflexed and wavy at the edge, green and slightly hairy on both surfaces. Flowers yellow, long-stalked, covered with long hairs and glutinous glands. Common in the Crimea, the Caucasus, and the eastern parts of Poland, rendering the whole country a brilliant garden with its golden fragrant flowers during the month of May. Although found on the mountains, it is by no means an alpine plant, but disappears in the higher regions of the air, where the Pontic Rhododendron takes its place. Its flowers abound in a fluid nectar, which is said to render poisonous the honey collected by the bees at the time of its blooming. It is readily known by its large yellow corolla from all the American species: in the gardens it deviates to a pale straw colour, which is called white by collectors.

Section III.—*Flowers with scarcely any glutinous hairs. Stamens much longer than the corolla.*

6. *Azalea periclymena*, Persoon (*A. nudiflora*, Willd.; *periclymenoides*, Michaux; *coccinea, speciosa, rubra, rutilans, carnea, alba, papilionacea, partita, polyandra*, of the Gardens). Leaves flat, nearly hairless, except the midrib, which is bristly. Tube of the corolla much longer than the limb, which is white. Found wild on the sides of hills, in woods all over North America, where it is called Upright Honeysuckle—a name which it well merits for its fragrance and beauty. It is a smaller plant than *A. viscosa*, rarely exceeding the height of a man, and being generally much shorter, and exceedingly branched. By botanists it was formerly distinguished by its flowers appearing before its leaves, whence it was called *A. nudiflora*; but as this is an uncertain circumstance, the name we have adopted from Persoon deserves the preference. Its leaves are bright green, and nearly smooth on the upper side, flat, and by no means puckered or wavy; their under side and the branches are slightly downy, and their margin covered with stiff hairs.

7. *Azalea canescens*, Michaux (*A. bicolor*, Pursh). Leaves hoary, especially beneath, where they are also downy; their midrib without any stiff hairs. Tube of the corolla of about the length of the limb, which is white. On barren sandy hills, in the southern parts of the United States, on the banks of rivers in South Carolina, and on the mountains of Virginia, this species grows wild; it resembles *A. periclymena* very much, but is a tenderer plant, and has the same gray appearance which renders *A. glauca* so conspicuous an object. Its flowers are small and white, with a deep rosy-red tube; they appear the earliest of the American species.

8. *Azalea calendulacea*, Michaux. Leaves convex, shining, bright green, slightly hairy on both sides, reflexed and wavy at the edge; their midrib without stiff hairs. Tube of the corolla not longer than the broad orange-coloured or scarlet limb. A native of moist places in the southern states of North America; sometimes inhabiting the banks of rivers, but more frequently adorning the mountains with a garment of living scarlet.

9. *Azalea arborescens*, Pursh. Leaves covered on the under side by a glaucous bloom, and smooth on both sides. Tube of corolla longer than the segments. Calyx with leafy divisions. The only botanist who has described this remarkable plant is Pursh, who says it grows on rivulets near the Blue Ridge in Pennsylvania, flowering from May to July. He speaks of it thus:—"This beautiful species has, to my knowledge, not yet been introduced into the gardens. I have only seen it in its native place, and in the garden of Mr. John Bartram, near Philadelphia. It rises from 10 to 20 feet high, and forms, with its elegant foliage and large abundant rose-coloured flowers, the finest ornamental shrub I know. The flowers are not so much pubescent as the rest of the species; the scales of the flower-buds are large, yellowish-brown, surrounded with a fringed white border."

Section IV.—*Flowers entirely destitute of glutinous hairs. Stamens short. Corolla bell-shaped.*

10. *Azalea Sinensis* (*A. pontica; A. Sinensis*, 'Botanical Register,' plate 1253). Leaves downy on both sides, sharp-pointed, glaucous beneath, reflexed and wavy at the edges. Flowers covered externally only with a fine silkiness; their tube much shorter than the bell-shaped limb, the divisions of which are acute. Introduced from China by the late Mr. W. Wells, of Redleaf, about the year 1826, and supposed to be a native of that country. Its leaves are very like those of *Azalea pontica*, except that they are glaucous underneath, and its flowers are of a bright clear ochry yellow; it is even supposed to be a mere variety of that species. Its bell-shaped corolla, however, without any glandular or other conspicuous hairs on the outside, and with scarcely any tube, distinguishes it sufficiently. The segments of the corolla are broadly ovate, slightly wavy, and the upper one is distinctly dotted in the manner of a rhododendron.

11. *Azalea Indica*, Linnæus. Leaves obovate, flat, green on both sides, and very abundantly clothed with stiffish brown hairs. Flowers quite smooth externally; their tube much shorter than the bell-shaped limb, the divisions of which are rounded. Calyx small and very hispid; stamens five. This and the following are the most beautiful plants which exist in the rich flora of China, where they far exceed in splendour of appearance the camellias, moutans, chrysanthemums, and roses of that favoured climate. This forms a bush varying in height from two to six feet, with the branches usually drooping, and covered when young with rigid brown hairs. The leaves are deep green, flat, and half evergreen, usually tinged with brown, in consequence of the many brown hairs with which they are clothed. The flowers are large and showy, and gaily marked with brilliant colours. The calyx is very small, and closely covered with stiff hairs. There are many varieties, of which the Brick Red, the Double Purple, and the Variegated are the principal.

12. *Azalea ledifolia*, Hooker. Leaves obovate, flat, evergreen, green on both sides, and clothed with brown hairs. Flowers quite smooth externally; their tube much shorter than the bell-shaped limb, the divisions of which are dilated and wavy. Calyx with leafy acute sepals; stamens ten. A native of China, and less impatient of cold than the last, from which it chiefly differs in its leafy calyx, evergreen less rusty shining leaves, larger flowers, and more numerous stamens. There are two varieties in the gardens, the White and the Royal Purple, or Phœnicea.

A'ZURITE, a term used by Phillips to denote *Lazulite*, under which name this mineral is most generally described by mineralogists [LAZULITE.] It is different from Azure-Stone, by which name Lapis Lazuli, the Ultramarine of painters, is sometimes known.

B

BABIA'NA, a genus of plants belonging to the natural order *Iridaceæ*. It derives its singular name from Babianer, which the Dutch colonists call these plants, because their round subterranean stems are greedily eaten by baboons. It differs from *Gladiolus* in its round leather-coated seeds, and in the flowers having the tube of *Ixia*, and from *Ixia* in their having the irregular limb of *Gladiolus*. Fourteen or fifteen species are known, among which are some of the handsomest of the Cape Bulbous Plants, as they are commonly though incorrectly called. Of these all have narrow, plaited, sword-shaped leaves, rising from a cormus which is covered with rigid, netted, brown scales; this part, which is sometimes called the bulb, sometimes the root, but which is in reality a short underground stem, is propagated by one or more young buds near its point, which shoot up at the season of growth, feed upon the old cormus till they have sucked it quite dry, and by that time become new cormi themselves elevated upon the point of the original one. In this way the underground cormi gradually rise towards the surface of the earth, and afford an instance of vegetable progression which by some has been adduced as extremely remarkable, but which is in fact, if the phenomenon be rightly considered, precisely analogous to the progression of the stem of a tree into the air by the formation of fresh branches year after year.

The flowers of *Babiana* are yellow, purple, and even scarlet, of considerable size, and extremely handsome. They are produced in perfection, provided the plants are so cultivated as to be exposed abundantly to air, light, warmth, and moisture, when in a state of growth, and preserved cool and dry while in a state of repose. It is in the plains of the Cape of Good Hope that these plants are found, where they are exposed for two or three months, at the most, to rain; and where, during the remainder of the year, they are buried beneath a soil so dry that even succulent plants themselves can scarcely contrive to exist upon it.

Babiana sulphurea, one of the commonest species, grows about a foot high, with oblong, plaited, hairy leaves, and a one-sided spike of

Babiana sulphurea.

A, a diminished figure of the flowering spike; B, one of the cormi, showing how they gradually ascend by rising annually upon the remains of cormi of former years.

four or five flowers. The latter are about two inches long, of a pale sulphur-yellow, with a short sky-blue tube and eye; the segments are oblong, slightly wavy, nearly equal in size, and spreading nearly equally round three short erect stamens. The style and stigma are sky-blue; the latter very narrow and channeled.

BABINGTONI'TE, a mineral which occurs crystallised. Its primary form is a doubly oblique prism; the colour is black or greenish-black; the fracture uneven; hardness, 5·5 to 6·0; lustre, vitreous; it is faintly translucent; the specific gravity is 3·5. It has been found at Arendal in Norway, the Shetland Isles, and in the United States at Charles-town, Massachusetts. The following is the analysis by Arppe of a specimen from Arendal:—

Silica	54·4
Protoxide of Iron	21·3
Lime	19·6
Magnesia	2·2
Protoxide of Manganese	1·8
Alumina	0·3
Volatile matter	0·9

BABIROU'SSA is sometimes called the Horned Hog by travellers, from the great length and curved form of its upper tusks, which pierce through the upper lip and grow upwards and backwards like the horns of the *Ruminantia*. It is a species of wild hog which inhabits the woods of Java, Celebes, and others of the larger Sunda Isles. From its more slender proportions and longer limbs, compared with other species of the same genus, this animal has been likewise called the Stag-Boar, and was not altogether unknown to the ancients; at least it seems probable that it is the *Sus tetraceros* of Ælian (lib. xviii., cap. 10), and is plainly referred to by Pliny (lib. viii., cap. 52). [SUIDÆ.]

BABOON (*Cynocephalus*, Cuvier), a genus of *Quadrumana*, or Four-Handed Mammals, which forms the last link in the chain that unites the *Simiadæ*, properly so called, with the lower animals. The zoological or technical name of this genus, *Cynocephalus*, is from a Greek word used by Aristotle and other ancient writers to designate the common species of Egypt and Arabia, the *C. Hamadryas* of modern writers, and is plainly derived from the marked resemblance which the head and face of these animals bear to those of a dog, and which, in truth, constitutes the most distinctive character of the genus. The origin of the common name Baboon is a subject of greater doubt. Skinner and other British etymologists are content with deriving it from our vernacular word Babe, without considering that the German Pavian, the Dutch Baviaan, the French Babouin, and the Italian Babbuino, are manifestly but so many different modes of writing the same term. A more probable origin of all these terms appears to be the Italian Babbuino, from which is likewise derived, according to the opinion of Aldrovandus, the vulgar Latin word Papio, applied by the writers of the 15th and 16th centuries to these animals, and which is itself a diminutive of the common Italian word Babbo, which answers to our Papa.

Though the Baboons differ widely from the other groups of quadrumanous animals, and may be readily distinguished at sight even by those who are not much in the habit of observing them, yet it has been found not a little difficult to form such a simple definition of the genus as will comprehend all the species properly belonging to it, and also distinguish them from those which appertain to the proximate genera, *Macacus* and *Cercopithecus*. The most marked and prominent of the characters which more immediately distinguish the Baboons from the other *Simiadæ* consists in the great prolongation of the face and jaws, and in the truncated form of the muzzle, which gives the whole head a close resemblance to that of a large dog, and from which, as already observed, the Greeks and Romans very appropriately denominated them *Cynocephali*, or Dog-Headed Monkeys. In the ordinary *Quadrumana*, which have the head and face round, as in the human species, the nose is flat, and the nostrils situated about half-way between the mouth and the eyes, the whole bearing no unapt resemblance to that of a man who has lost the greater part of his nose: but in the Baboons this organ is prolonged uniformly with the jaws; it even surpasses the lips a little in length, and the nostrils open at the end of it exactly as in the dog. Here there is a marked difference in form and development from what we observe in the Apes and other higher groups of *Quadrumana*. The great length of the face detracts from the size of the skull; the organs of mastication are strongly developed to the prejudice of the brain and intellectual functions; the facial angle, which has been generally regarded as a pretty accurate measure of the mental capacity, is reduced to 30°, whilst it is never less than 45° in the Monkeys, and among the Apes amounts even to 60° or 65°; and the character of the Baboons, as might be readily suspected from these indications, is less docile and intelligent than that of the kindred genera. To the same prolongation of the face, and preponderance of the anterior part of the head, is to be attributed, at least in a great measure, the fact that the Baboons less frequently assume an erect posture than any of the other *Quadrumana*, and are less capable of maintaining it for any length of time. The weight of the long nose, to which the small size of the skull forms but a very inefficient counterbalance, fatigues the muscles of the neck, and constantly tends to make the animal seek for support upon all fours, as may be observed in a dog or a bear; and in fact the Baboons are but very little superior to these animals in the facility with which they maintain themselves in an upright posture.

In their native mountains the ordinary food of the Baboons is berries and bulbous roots, but in the vicinity of human habitations they make incursions into the cultivated fields and gardens, and destroy a still greater quantity of grain and fruits than they carry away with them. In well-inhabited countries where they are likely to meet with resistance, their predatory incursions are usually made during the night, and travellers assure us that, taught by experience of the risks to which they expose themselves during such expeditions, they place sentinels upon the surrounding trees and heights to give them timely warning of the approach of danger; but in wilder and more solitary districts, where the thinness of the population and the want of fire-arms place them on some degree of equality with the inhabitants, they make their forays in the open day, and dispute with the husbandman the fruits of his labour. "I have myself," says Pearce, in his 'Life and Adventures in Abyssinia,' "seen an assembly of large monkeys [baboons] drive the keepers from the fields of grain, in spite of their slings and stones, till several people went from the village to their assistance, and even then they only retired slowly, seeing that the men had no guns." Some travellers even assert that if the troop happens to be surprised in the act of pillaging, the sentinels pay with their lives for their neglect of the general safety; but however this may be, it is certain that individuals are frequently met with which exhibit marks of ill-usage from their companions, and which even sometimes appear to have been expelled from their society. Others assure us that the troop sometimes forms a long chain extending from the vicinity of their ordinary habitation to the garden or field which they happen to be engaged in plundering, and that the produce of their theft is pitched from hand to hand till it reaches its destination in the mountains. By this means they are enabled to carry off a much larger booty than if every individual laboured for his own peculiar benefit; but notwithstanding this attention to the general interest, each takes care before retiring to fill his cheek-pouches with the most choice fruits or grains which he can procure, and also, if not likely to be pursued, to carry off quantities in his hands. After these expeditions the whole troop retire to the mountains to enjoy their booty. They likewise search with avidity for the nests of birds, and suck the eggs; but if there be young, they kill them and destroy the nest; as, notwithstanding the evident approximation of their organisation and appetites to carnivorous animals, they are never known to touch a living prey in a state of nature, and even in captivity will eat no flesh but what has been thoroughly boiled or roasted. In this state we have seen various baboons enjoy their mutton-bone and pick it with apparent satisfaction; but it was evidently an acquired habit, like that of drinking porter and smoking tobacco, which they had been taught by the example of their keepers.

Of all the *Quadrumana* the Baboons are the most frightfully ugly. Their small eyes deeply sunk beneath huge projecting eyebrows, their low contracted forehead, and the very diminutive size of their cranium compared with the enormous development of the face and jaws, give them a fierce and malicious look, which is still further heightened by their robust and powerful make, and by the appearance of the enormous teeth which they do not fail to display upon the slightest provocation. The fierceness and brutality of their character and manners correspond with the expression of their physiognomy. These characters are most strongly displayed by the males; but it is more especially when, in addition to their ordinary disposition, they are agitated by the passion of love or jealousy that their natural habitudes carry them to the most furious and brutal excess. In captivity they are thrown into the greatest agitation at the appearance of young females. It is a common practice among itinerant showmen to excite the natural jealousy of their baboons by caressing or offering to kiss the young females who resort to their exhibitions, and the sight never fails to excite in these animals a degree of rage bordering upon frenzy. On one occasion a large baboon of the species which inhabits the Cape of Good Hope (*Cynocephalus porcarius*) escaped from his place of confinement in the 'Jardin des Plantes' at Paris, and far from showing any disposition to return to his cage, severely wounded two or three of the keepers who attempted to recapture him. After many ineffectual attempts to induce him to return quietly, they at length hit upon a plan which was successful. There was a small grated window at the back part of his den, at which one of the keepers appeared in company with the daughter of the superintendent, whom he appeared to kiss and caress within view of the animal. No sooner did the baboon witness this familiarity than he flew into the cage with the greatest fury, and endeavoured to unfasten the grating of the window which separated him from the object of his jealousy. Whilst employed in this vain attempt the keepers took the opportunity of fastening the door and securing him once more in his place of confinement. Nor is this a solitary instance of the influence which women can exert over the passions of these savage animals: generally untractable and incorrigible whilst under the management of men, it usually happens that baboons are most effectually tamed and led to even more than ordinary obedience in the hands of women, whose attentions they even appear to repay with gratitude and affection. Travellers sometimes speak of the danger which women run who reside in the vicinity of the situations which these animals inhabit, and affirm that the negresses on the coast of Guinea are occasionally kidnapped by the baboons, and carried off to their fastnesses: we are even assured that certain of these women have lived among the baboons for many years, and that they were prevented from escaping by being shut up in caves in the mountains, where however they were plentifully fed, and in other respects treated with great kindness. It is to be observed however that these accounts rest upon authority which is by no means unexceptionable. Credible and well-informed modern travellers do not relate them, and even their older and more credulous predecessors give them only from hearsay.

In addition to the mental and physical characters already mentioned, the Baboons, besides the great development of their canine teeth, are distinguished by having a fifth tubercule upon the posterior molar of the under jaw, in which respect they differ from the Apes and *Cercopitheci*, and resemble the *Macaci* and *Semnopitheci*. They are furnished with large callosities and capacious cheek pouches, and their tails, always shorter than those of the Macacks and Monkeys, are carried erect at the root, and then hang pendant perpendicularly, like that of a horse which has not been truncated. Those species which have very short tails carry them upright and erect. The bones of their cheeks also are protuberant and form large swellings on each side of the nose; and though this character is more strongly marked in the Mandrill and Drill than in the other species, yet all exhibit it in a greater or less degree. It is only since the labours of Messrs. Geoffroy and F. Cuvier have developed the true generic characters of the different groups which compose the family of *Quadrumana*, that we have become acquainted with the geographical distribution of these animals, and the habitats of the different genera. We have thus learned that the *Quadrumana* of the African continent are as distinct from those of Asia in their zoological characters as they are in the localities which they inhabit; in fact, among upwards of fifty species of *Simiadæ* belonging to the Old World there are only two known instances of an Asiatic genus occurring in Africa, or of an African genus occurring in Asia. One of these instances is even doubtful, since the animal to which it refers, the Common Magot or Barbary Ape, though generally considered as a Macack, is in reality an intermediate species between that genus and the Baboons, which it resembles equally in its habitat as it does in its powerful and muscular frame, and in its general habits and character, and from which it only differs in the comparative shortness of its face and the less truncated form of its nose. These, to be sure, are very essential characters in the true Baboons; but in all departments of zoology we find intermediate species, which partake as it were equally of the characteristic forms and organisation of two or even three conterminous genera, and which it is often impossible to include in either without a considerable relaxation in the strict import of their respective definitions. The other instance to which we have alluded regards a real species of Baboon, the *Cynocephalus Hamadryas* of authors, which is found in Asia and Africa, and which forms the only indisputable instance of any quadrumanous animal being common to both these continents. In other respects the Baboons are a strictly African genus. They inhabit all the great mountain ranges of that continent, from the shores of the Mediterranean to the Cape of Good Hope, and are capable of supporting a much lower degree of temperature than any of the other *Quadrumana*. The lofty mountains of Samen in Abyssinia, and the bleak and desolate range of the Sneeuwbergen in South Africa, are both tenanted by numerous troops of these animals, which appear to prefer the more rigorous climate of these elevated regions to the hot and sultry forests of the lower plains. Fischer enumerates eleven different species of baboons, but it is evident that some of those which he describes are the females or young of other species; and in fact the most judicious naturalists, those who describe from their own original observations, do not reckon more than five or six. The following are very distinctly marked, and have been universally admitted:—

1. *C. porcarius* (Desmarest), the Chacma. The colour of this species is a uniform dark brown, almost black, mixed throughout with a dark green shade, deepest on the head and along the ridge of the back, and paler on the anterior part of the shoulders and on the flanks. The hair over the whole body is long and shaggy, more particularly on the neck and shoulders of the males, where it forms a distinct mane; each hair is of a light gray colour for some distance from the root, and afterwards annulated throughout its entire length, with distinct rings alternately black and dark green, sometimes though but rarely intermixed with a few of a lighter and yellowish shade. The green predominates on the head more than on other parts; the face and ears are naked, as are likewise the palms of the hands and soles of the feet; the interior surfaces of the arms and thighs are but thinly covered with hair, which is long and of a uniform dark-brown colour; the hair on the toes is short, bristly, and uniformly black; the neck and shoulders of the male are furnished with a mane of long shaggy hair, which is wanting in the females and young; and the cheeks of both sexes have small whiskers directed backwards, and of a grayish colour. The tail is rather more than half the length of the body, and is terminated by a tuft of long black hair; the skin of the hands, face, and ears, is of a very dark violet-blue colour, with a paler ring surrounding each eye; the whole of the upper eyelids are white, as in the Mangabey (*Cercopithecus fuliginosus*); the nose projects a little beyond the upper lip, the nostrils are separated by a small depression or rut, as

in the dog and other carnivorous animals, and the callosities are less strongly marked than in most other species of this genus. In the adult animal the muzzle is extremely prolonged in comparison with the skull, which is proportionately contracted and flattened: the young on the contrary have the region of the brain much larger in

The Chacma (*C. porcarius*).

proportion to the length of the face, the head considerably rounder, and in form resembling that of the adult Monkeys (*Cercopitheci*).

The Chacma, so called from the Hottentot word T'Chackamma, the aboriginal name of this baboon in South Africa, is one of the largest species of the present genus, and when full grown is equal in size, and much superior in strength, to a common English mastiff. This animal inhabits the mountains throughout the colony of the Cape of Good Hope, and associates in families more or less numerous. They are still found on the Table Mountain above Cape Town, though they do not exist in such numbers as they appear to have done formerly. Still however they pay occasional visits to the gardens at the base of the mountains, and with such skill and caution, that even the most watchful dogs, as we are assured by Professor Lichtenstein, cannot always prevent them. "Although," he remarks, "Kolbe somewhat exaggerates the regular and concerted manner in which their robberies are carried on, yet it is very true that they go in large companies upon their marauding parties, to support each other reciprocally, and carry off their plunder in greater security." Their common food consists of the bulbous roots of different plants, particularly of the *Babiana* [BABIANA]; these they dig up with their fingers, and peel them with their teeth, and heaps of the parings are frequently seen near the large stones upon which the baboons delight to sit and look round them. In ascending the kloofs or passes in the mountains of South Africa, which are frequently steep, narrow, and dangerous, travellers often disturb troops of these animals which have been sunning themselves on the rocks: if not attacked they scamper up the sides of the mountains yelling and screaming; but if fired at and wounded, they no sooner get beyond the range of the gun than they commence rolling and throwing down stones, and otherwise resenting the injury. A full-grown Chacma is more than a match for two good dogs, and though there is no animal which hounds pursue with so much fury, yet the boers of the interior would rather set their dogs upon a lion or panther than upon one of these baboons.

2. *C. Hamadryas* (Linnæus), the Derrias, the most celebrated of all the Baboons, and probably the only species of this genus known to the ancients, inhabits the mountains of Arabia and Abyssinia, and grows to the size of a large pointer, measuring upwards of 4 feet when standing erect, and 2½ feet in a sitting posture. The face of this species is extremely elongated, naked, and of a dirty flesh-colour, with a lighter ring surrounding the eyes; the nostrils, as in the dog, are separated by a slight furrow; the head, neck, shoulders, and all the fore part of the body as far as the loins, are covered with long shaggy hair; that on the hips, thighs, and legs, is short, and contrasted with the former has the appearance of having been clipped, so that the whole animal bears no unapt resemblance to a French poodle. The hair of the occiput and neck is upwards of a foot in length, and forms a long mane which falls back over the shoulders, and at a distance looks something like a full short cloak. The whiskers are broad and directed backwards so as to conceal the ears; their colour, as well as that of the head, mane, and fore part of the body, is a mixture of light gray and cinereous, each hair being marked with numerous alternate rings of these two colours; the short hair of the hips, thighs, and extremities is of a uniform cinereous brown colour, rather lighter on the posterior surface of the thighs than on the other parts; a dark-brown line passes down the middle of the back, the hands are almost jet black, and the feet are rusty brown. The tail is about half the length of the body, and is carried drooping as in other baboons; it is terminated by a brown tuft of long hair; the callosities are large and of a dark flesh-colour; the palms of the hands and soles of the feet dark-brown. The female when full grown is equal to the male in point of size, but differs considerably in the length and colour of the hair. This sex wants the mane which ornaments the neck of the male, and is covered over the whole body with short hair of equal length, and of a uniform deep olive-brown colour, slightly mixed with green. The throat and breast are but sparingly covered with hair, and the skin on these parts, as well as on the face, hands, and callosities, is of a deep tan-colour. Hemprich and Ehrenberg in their 'Symbolæ Physicæ' compare the female Derrias to a bear, whilst the copious mane which adorns the fore quarters of the male gives to that sex much of the external form and appearance of a small lion. The young of both sexes resemble the female, and the large whiskers and manes of the males only begin to make their appearance when the animals arrive at their full growth and mature age, that is, when they have completed their second dentition. At this period they undergo as great a change in their mental propensities as in their physical appearance. While young they are gentle, docile, and playful, but as soon as they have acquired their full development, they become sulky, malicious, and morose.

This species inhabits Arabia and Abyssinia, but is not found either in Egypt or Nubia, though its figure is often sculptured on the ancient monuments of both these countries. Hemprich and Ehrenberg found large troops of them in Wadi Kanun and in the mountains near the city of Gumfud in the country of the Wahabees, as well as in the mountains above Arkeeko on the Red Sea; and we learn from Salt and Pearce that they are extremely common upon all the high lands in Tigré. The travellers above-mentioned found troops of 100 and upwards in the neighbourhood of Eilet, in the chain of the Taranta. These were usually composed of ten or twelve adult males, and about twenty adult females; the remainder of the troop was made up of the young of the four or five preceding years. When seen at a distance approaching a small stream for the purpose of quenching their thirst, they bore a close resemblance to a flock of wild hogs; and it was observed that the young ones always led the van, and that the old males brought up the rear, probably for the purpose of having the whole family continually under their immediate observation. The Arabic name of this animal is Robah or Robba; the Abyssinians call it Derrias, according to Pearce's orthography, or Karrai, according to the spelling of Hemprich.

The name of this species in the ancient Ethiopic or Geez, the learned language of the Abyssinians, is Tot or Tota. The figure of this animal in a sitting posture is common upon the ancient monuments of Egypt and Nubia; small metal images of it have been dug up among the ruins of Memphis and Hermopolis, and mummies containing the embalmed body of the animal are still found among the catacombs. Strabo indeed (p. 812), in mentioning Hermopolis as the centre of the adoration paid to the *Cynocephalus*, says that the Babylonians in the vicinity of Memphis paid divine honours to the *Cebus*: yet though the geographer makes use of very different names, and though these in reality apply to very different animals, there is good reason to believe that they both refer in the present instance to the same species; no quadrumanous animal is ever found represented upon the sacred monuments of ancient Egypt except the Baboon nor have the images of any other species ever been dug up in searching for antiquities. One or two instances, indeed, occur in the representations of profane subjects, such as the procession of a returning conqueror, in which Monkeys (*Cercopitheci*) are introduced, as for instance the painting discovered at Thebes by the late Mr. Salt and represented by Minutola (tab. xii., fig. 9), in which a monkey is represented riding on the neck of a cameleopard; but this was manifestly intended merely to fix the locality of the country or people whose subjection the triumph was meant to commemorate, and by no means indicates a participation in the divine honours which were paid to the baboon. Neither does the female ever appear to be represented as an object of worship; all the figures and images seem to be those of males, as is proved by the mane which covers the neck and shoulders, and which gives a fullness to the fore part of the body in this sex which is wanting in the other.

3. *C. papio* (Desmarest), the Common Baboon, is of a uniform yellowish-brown colour, slightly shaded with sandy or light red upon the head, shoulders, body, and extremities; the whiskers alone are of a light fawn-colour; the face, ears, and hands are naked and entirely black, the upper eyelids white and also naked, and the tail about half the length of the body, but not terminated by the tuft which distinguishes it in the last two species. The hair of the occiput and neck is rather longer than that on the neck and shoulders, but is neither so long nor so thick as to give it any resemblance to the mane of the Chacma or Derrias; neither is the face of the present species so much prolonged as in these two animals; the nose however is advanced rather beyond the extremity of the lips, and has the nostrils opening as in the other baboons; the cheeks are considerably swollen immediately below the eyes, after which the breadth of the face contracts suddenly, giving the muzzle or nose the appearance of

having been broken in that situation by a heavy blow. The whiskers are not so thickly furnished as in the species already described; they are however equally directed backwards, but do not conceal the ears, which are black, naked, and less regularly oval than in man and the generality of the *Simiæ*. The under parts of the body, the breast, belly, abdomen, and inner face of the arms and thighs, are very sparingly furnished with long hairs of a uniform brown colour. The females and young differ in no other respect from the adult males, except in being of a lighter and more active make.

This species inhabits the coast of Guinea, and is that most commmonly seen about the streets, and in menageries and museums. In youth it is gentle, curious, gluttonous, and incessantly in motion, smacking its lips quickly, and chattering when it wishes to beg contributions from its visitors, and screaming loudly when refused or tantalised. As it grows older however it ceases to be familiar, and assumes all the morose look and repulsive manners which characterise the baboons in general. The specimen observed by Buffon was full grown, and exhibited all the ferocity of disposition and intractability of nature common to the rest of its kind. "It was not," says he, "altogether hideous, and yet it excited horror. It appeared to be continually in a state of savage ferocity, grinding its teeth, perpetually restless, and agitated by unprovoked fury. It was obliged to be kept shut up in an iron cage, of which it shook the bars so powerfully with its hands as to inspire the spectators with apprehension. It was a stout-built animal, whose nervous limbs and compressed form indicated great force and agility; and though the length and thickness of its shaggy coat made it appear to be much larger than it was in reality, it was nevertheless so strong and active that it might have readily worsted the attacks of several unarmed men."

4. *C. Mormon* and *C. Maimon* (Linnæus), the Mandrill, is the largest of the whole genus, and may be readily distinguished from all the other baboons by the enormous protuberance of its cheeks, and the bright and variegated colours which mark them, as well as by its short upright tail. The full-grown Mandrill measures above 5 feet when

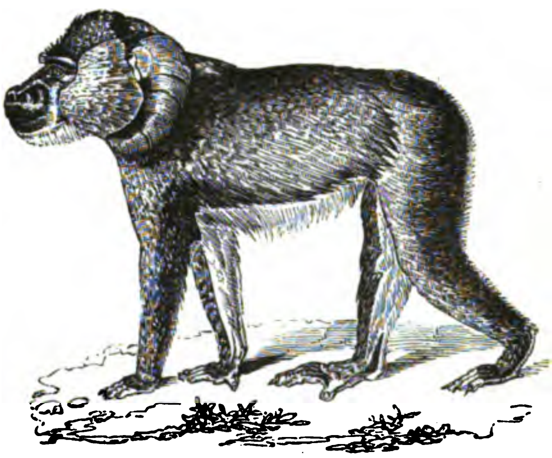
The Mandrill (*C. Mormon* and *C. Maimon*).

standing upright; the limbs are short and powerful, the body thick and extremely robust, the head large and almost destitute of forehead, the eye-brows remarkably prominent, the eyes small and deeply sunk in the head, the cheek-bones swollen to an enormous size, and forming projections on each side of the nose as large as a man's fist, marked transversely with numerous alternate ribs of light blue, scarlet, and deep purple; the tail not more than a couple of inches in length, and generally carried erect; the callosities large, naked, and of a blood-red colour. The general colour of the hair is a light olive brown above, and silvery gray beneath, and the chin is furnished underneath with a small pointed yellow beard. The hair of the forehead and temples is directed upwards so as to meet in a point on the crown, which gives the head a triangular appearance; the ears are naked, angular at their superior and posterior borders, and of a bluish black colour; and the muzzle and lips are large, swollen, and protuberant. The former is surrounded above with an elevated rim or border, and truncated like the snout of a hog—a character which we have observed in no other baboon, and which leads us to suspect that the Mandrill is the species that Aristotle incidentally mentions by the name *Chœropithecus* (χοιροπίθηκος), ('Hist. Anim.,' lib. ii. cap. 2), and which may have been brought into Egypt or Greece by the merchants who kept up a regular intercourse between Egypt and the countries of the interior. There are other considerations which give a strong degree of probability to this conjecture. The short, indeed almost tuberculous, tail of the Mandrill, for instance, would have led Aristotle to compare it with the ape or *Pithecus* (πίθηκος), rather than with the other *Simiadæ*, all of which have tails of considerable length; and the truncated form of the snout would readily suggest its similarity to the hog (χοίρος). We are aware that the *Chœropithecus* of the Greek philosopher has been generally identified with the Common Baboon or the Derrias; but neither of these species possesses any character which justifies that supposition; and besides, the Derrias is indisputably allowed to be the species designated by the much more appropriate name of *Cynocephalus* (κυνοκέφαλος). Nor does the Mandrill differ much in its general form and appearance from the *Pithecus* of Aristotle, which was the common Magot or Barbary Ape (*Macacus inuus*): there is no very great difference in the size of these animals, their colour is very nearly the same, both are equally remarkable for the powerful make of their bodies, and the sinewy character of their short stout limbs; and in fact the only striking difference which exists between them is the prolonged, truncated, swinish snout of the one, and the round head and short face of the other. Thus we can very satisfactorily account for both members of the compound name employed by Aristotle; nor can an objection be fairly taken to the approximation which we have here made of his *Chœropithecus* to the Mandrill of Guinea, on account of the extremely limited knowledge which the ancient Greeks possessed of the western coasts of Africa; since we know that they were well acquainted with other animals from the same or even a more remote locality; such, for instance, as the Gnu (*Antilope Gnu*), which is clearly the *Catoblepas* of ancient writers, and the Pecasse or buffalo of the Gold Coast.

The females and young Mandrills differ from the adult males in the shorter and less protuberant form of the muzzle, which is moreover of a uniform blue colour; the cheek-bones have little or no elevation above the general plane of the face, nor are they marked with the longitudinal furrows which give the other sex so singular an appearance; at least they are far from being so prominently developed. It is only indeed when they have completed their second dentition that these characters are fully displayed in the males, and that the extremity of the muzzle assumes that bright red hue by which it is so remarkably distinguished.

The Mandrill is often mentioned by travellers, and bears the different names of Smitten, Choras, Boggo, Barris, &c., according to the language or dialect of the tribes in whose territories it has been observed. Those which have been observed in a domestic state are generally remarked to have had a strong taste for spirituous and fermented liquors. A remarkably fine individual, which was long kept at Exeter Change, and afterwards at the Surrey Zoological Gardens, drank his pot of porter daily, and evidently enjoyed it. In a state of nature his great strength and malicious character render the Mandrill a truly formidable animal. As they generally march in large bands, they prove more than a match for any other inhabitants of the forests, and are even said to attack and drive the elephants away from the districts in which they have fixed their residence. The inhabitants of those countries themselves are afraid to pass through the woods unless in large companies and well armed; and it is said that the Mandrills will even watch their opportunity when the men are in the fields, to plunder the negro villages of everything eatable, and sometimes attempt to carry off the women into the woods.

5. *C. leucophæus* (F. Cuvier), the Drill, is a species only recently admitted by the most judicious modern naturalists, though long since



The Drill (*C. leucophæus*).

described by Pennant, and after him by various other writers. It is likewise a native of the coast of Guinea, and like the Mandrill is distinguished by a short erect stumpy tail, scarcely two inches in length, and covered with short bristly hair. The cheeks are not so protuberant as in that species, neither are they marked with the same variety of colours; and the size and power of the animal are much inferior. The colours of the body bear some resemblance to those of the Mandrill, but they are more mixed with green on the upper parts, and are of a lighter or more silvery hue beneath. The head, back, sides, outer surface of the limbs, a band at the base of the neck, and the backs of the fore hands, are furnished with very long fine hair, of a light-brown colour at the root, and from thence to the point marked with alternate rings of black and yellow, the two last colours alone appearing externally, and by their mixture giving rise to the greenish shade that predominates over all the upper parts of the head and body. The under parts of the body are equally covered with long fine hair, but of a uniform light-brown or silvery-gray colour, and more sparingly furnished than on the back and sides; the whiskers are thin and directed backwards; there is a small orange-coloured beard on the chin; the hair on the temples is directed upwards, and meeting from both sides forms a pointed ridge or crest on the crown of the head; and the tail, short as it is, is terminated by a small brush. The face and ears are naked, and of a glossy black colour like polished ebony; the cheek-bones form prominent elevations on each side of the nose, as in the Mandrill, only not nearly so large; neither are they marked with the same series of alternate ridges and furrows, nor with the brilliant and varied colours which render that species so remarkable; the palms of the hands and soles of the feet are also naked in the Drill, and of a deep copper-colour; the colour of the skin, when seen beneath the hair, is uniform dark-blue, and that of the naked callosities bright-red. The female differs from the male by her smaller size, shorter head, and much paler colour; and the young males exhibit the same characters up to the time of their second dentition.

The Wood-Baboon, the Cinereous Baboon, and the Yellow Baboon of Pennant, are all manifestly referrible to this species, and differ only from the difference of the age and sex of the specimens from which he took his description. The habits and manners of the Drill have not been observed in a state of nature, nor do we find the animal itself indicated in the works of any of the travellers which we have consulted. In its native country it is probably confounded with the Mandrill, at least by casual and passing observers, but it is frequently brought into this country, and is well known as a menagerie-animal. Its habits in confinement do not appear to differ in any material respect from those of its congeners.

BA'CCA, the technical name by which botanists distinguish the fruit commonly called a Berry. While however the English word is familiarly applied to all soft fruits, of whatever construction internally, it is strictly speaking made use of to designate those fruits only which have a thin skin, are pulpy internally, and have several seeds finally lying loose in the pulpy mass; such are the gooseberry, currant, grape, fruit of the potato, &c. When a fruit has only a fleshy rind, without any internal pulpiness, as is the case with the capsicum, it is not called a Berry, but a Berried Capsule. It will be seen that this definition excludes the berries of the hawthorn, the raspberry, the orange, the rose, &c. [POME; ETÆRIO; HESPERIDIUM; CYNARRHODON.]

BA'CCHA, a genus of Insects belonging to the natural order *Diptera* and family *Syrphidæ*. The species of this genus of two-winged flies are peculiar in having the two basal joints of the abdomen remarkably long and slender, with the remaining joints depressed, and suddenly increased in breadth. They are generally of a black or bronze colour, with yellow spots or markings. They are met with near London, and frequent flowers.

BACILLA'RIA, a large family of Infusorial Animalcules, constituted by Ehrenberg, who includes in it upwards of 30 genera. The silicious shields of these animalcules are amongst the most numerous of the forms of *Microzoaria* in the Cretaceous, Tertiary, and Superficial Deposits. *Xanthidia* occur in the Chalk and its included nodules of flint: *Gaillonellæ, Naviculæ, Actinocycli, Coscinodisci, Gomphonemæ,* and other genera, abound in the white Tertiary Marls of Greece, Italy, Bohemia, England, and North America. The Silicious Beds of Bohemia (Polierschiefer), which are 14 feet in thickness, contain innumerable shields of *Naviculæ*, and probably few of the superficial lacustrine deposits of Europe are wholly devoid of these exuviæ. [DIATOMACEÆ.]

BA'CTRIS, a genus of Palms, consisting of a considerable number of species, found about rivers and in marshy places in America within the tropics, especially near the Line. Their trunk is usually of moderate height, or even dwarfish, never exceeding 20 feet; sometimes having the stout tree-like aspect of palms in general, but often more resembling reeds. They often grow in dense patches, forming impassable thickets, on account of the numerous, long, hard, black spines with which the stem is protected. The wood is generally hard and black towards the outside, but pale yellow internally, with black fibres. The leaves usually grow all over the surface of the stem, instead of being confined to the summit only. They have extremely spiny stalks, and are either pinnated after the manner of the date-palm, or merely consist of two broad, sharp, diverging, plaited lobes. The fruit is small, soft, with a subacid rather fibrous pulp inclosed in a bluish-black rind, and affords a grateful fruit to small birds.

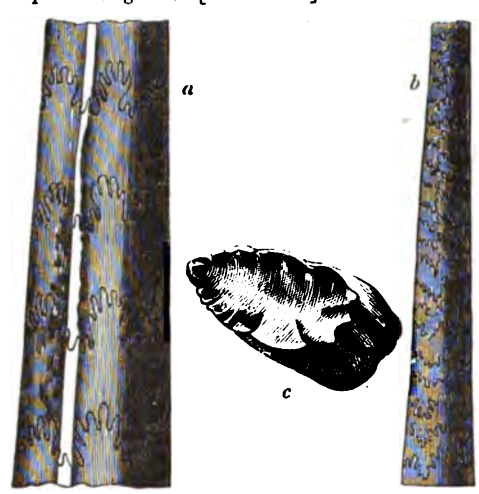
Bactris acanthocarpa, a species which grows 12 or 15 feet high in the primæval woods about Bahia, forming patches 30 feet in circumference, and having elegant pinnated leaves 6 or 8 feet long, with stout spines on their stalks, yields an extremely tough thread, from which the natives, who call it Tucum, manufacture strong nets. Its drupes are of a kind of vermilion-red, bristling with short black prickles.

Martius mentions 17 other species.

BACULI'TES, a genus of Lamarck's Polythalamous or Many-Chambered Cephalopods, belonging to the family of *Ammonitea*. *Baculites*, which was first discovered by Faujas de St. Fond in the limestone of Maestricht, is only known in a fossil state, and is comparatively abundant in the limestone of Valognes, in Normandy. The shell is straight, more or less compressed, conical, or rather tapering to a point, and very much elongated. The chambers are

Bactris acanthocarpa.

sinuous, and pierced by a marginal siphon, and the last chamber is several inches in length. *Baculites vertebralis*, Montfort, affords a good example of the genus. [AMMONITES.]



Baculites vertebralis.

a, b, Portions of *Baculites vertebralis*; *c*, a detached piece of the same.

BADGER (*Meles*, Cuvier), a genus of Plantigrade Carnivorous Mammals included by Linnæus among the Bears, but, as well as the Gluttons, Racoons, Coatis, &c., very properly separated from that group by succeeding naturalists.

This genus, as definitely characterised by modern zoologists, is distinguished by a system of dentition which is in many respects analogous to that of the Moufettes (*Mephitis*), a genus of *Carnivora*, which indeed is scarcely to be recognised as differing from the badgers except in the plantigrade or rather semi-plantigrade formation of their extremities. There is nothing remarkable either in the size or number of the incisor or canine teeth; the grinders however are in some respects peculiar, and it is this part of the dentition which principally distinguishes the Badgers. There are 4 false molars in the upper and 8 in the under jaw, 2 and 4 on each side respectively, followed by a carnassier and a single tuberculous tooth of large dimensions. The whole system is better adapted for masticating and bruising vegetable substances than for cutting and tearing raw flesh;

and in fact the Badgers are much less carnivorous than any other animal of the order to which they belong, except perhaps the bears. The quality of the food is in all cases necessarily dependent upon the nature of the dentition. The principal character of the feet in the badgers consists in their having five toes both before and behind, short, strong, deeply buried in the flesh, and furnished with powerful compressed claws, admirably calculated for burrowing or turning up the earth in search of roots. The legs are short and muscular; the body broad, flat, and compact; the head more or less prolonged; the snout pointed; the ears small, and the tail short. Beneath the anus there is an aperture of considerable size which opens transversely, and exudes from its inner surface a greasy or oleaginous matter of very offensive odour. The same formation is observed in many other genera of carnivorous mammals, though the qualities of the substance secreted differ according to the species. In the Civets and Genets, for instance, its smell is so pleasing as to entitle it to the rank of a perfume; whilst in the Moufettes, on the contrary, its odour is so extremely fetid as to have acquired for them above all other animals the generic name of *Mephites*, or Stinkards.

The Badgers sleep all day at the bottom of their burrows, and move about during the night in search of food. They are frequently accused of destroying rabbits, game, and even young lambs; but roots and fallen fruits appear to constitute the chief part of their food, and they certainly exhibit a more marked taste for vegetable than for animal food, at least when kept in confinement. With the powerful claws of their fore feet they construct a deep and commodious burrow, generally in a sandy or light gravelly soil; this has but a single entrance from without, but it afterwards divides into different chambers, and terminates in a round apartment at the bottom, which is well lined with dry grass and hay. The habits of the badgers are extremely solitary; they are never found in company even with the females of their own species, and as they sleep all day rolled up in their bed of warm hay at the bottom of their holes, they are always fat and in good condition: their flesh is relished in many places as an article of food. They carefully remove everything of an offensive nature from their earths, never deposit their excrements in the vicinity of their habitations, and are even said to abandon them if accidentally or intentionally polluted by any other creature. In its geographical distribution the genus extends throughout the whole of Europe, Northern and Central Asia, and North America: we have no accounts of its extending into Africa or South America, in the former of which continents it appears to be represented by the Rattel (*Gulo mellivora*, Desmarest), and in the latter by various species of Moufettes (*Mephitis*). Australia possesses no species of mammal belonging to the Plantigrade Family, at least none has been hitherto discovered in that country; and in the Eastern Peninsula and Isles of India the place of the Badger is supplied by the Telagon (*Mydaus meliceps*, F. Cuvier).

The number of species which zoologists admit into the genus *Meles* is very limited indeed. All writers, without exception, have followed F. Cuvier's example in excluding the Indian Badger, for the purpose of making it the type of a new genus, though for what reason it would be difficult to say, since the dental system of this animal has never been properly described, and in all its other characters it differs in no respect from the Common Badger. Many again are disposed to consider the American Badger as only a simple variety of the European: so that according to these authors the genus includes only a single species. The observations of Sir John Richardson however have placed the distinctness of the American animal beyond a doubt; and so long as we have no definite observations to contradict the approximation, we shall continue to associate the Indian species with the genus to which its known characters so nearly assimilate it.

1. *M. vulgaris* (Desmarest), the Common Badger, is about the size of a middling dog, but stands much lower on the legs, and has a broader and flatter body. The head is long and pointed, the ears almost concealed in the hair of the head, and the tail so short that it scarcely reaches to the middle of the hind legs; the hide is amazingly thick and tough; the hair uniformly long and coarse over the whole body, and trailing along the ground on each side as the animal walks. The Badger and its congeners offer a strange intermixture of colours, which is seen in no other mammal, except those of the genera *Gulo* and *Mephitis*, which, as already remarked, approximate so nearly to it in many other respects: in general the darker shades are found to predominate upon the back and upper parts of the body, and the lighter below; but in the animals above-mentioned this general rule is reversed, and it is the light shades which occupy the back and shoulders, whilst the dark ones are spread over the breast and abdomen. The head of the Badger for instance is white, except the region beneath the chin, which is black, and two bands of the same colour, which rise on each side a little behind the corners of the mouth, and after passing backwards and enveloping the eye and ear terminate at the junction of the head and neck. The hairs of the upper part of the body, considered separately, are of three different colours, yellowish-white at the bottom, black in the middle, and ashy-gray at the point; the last colour alone however appears externally, and gives the uniform sandy-gray shade which covers all the upper parts of the body: the tail is furnished with long coarse hair of the same colour and quality, and the throat, breast, belly, and limbs are covered with shorter hair of a uniform deep black.

Though the Badger is found throughout all the northern parts of Europe and Asia, it is rather a scarce animal everywhere. Its food is chiefly roots, fruits, insects, and frogs, but it likewise destroys the eggs and young of partridges and other birds which build on the ground, and attacks the nests of the wild bees, which it robs with impunity, as the length of its hair and the thickness of its hide render it insensible to the sting of the bee. It chooses the most solitary woods for its residence, is quiet and inoffensive in its manners, but when attacked defends itself with a courage and resolution which few dogs of double its own size and weight can overcome. It bites angrily, and holds on with great tenacity, which it is enabled to do the more easily from the peculiar construction of the articulation or hinge that connects its under jaw with the skull, and which consists of a transverse condyle completely locked into a bony cavity of the cranium. The Badger is not mentioned by Aristotle, and possibly may not be found in Greece, as the ancient language of that country has not even a name for it, and as it is less common in the southern than in the northern parts of Europe. Pliny however notices it under the name of *Melis* (viii. 38), and various other Roman authors have spoken of it. More recent writers also use *Taxus*, perhaps derived, like other Roman names of northern animals, from the German language, in which the Badger is called *Zachs* or *Dachs*; in Dutch *Das*. The female brings forth her young in the early part of spring, to the number of three, four, or five; she continues to suckle them carefully for the first five or six weeks, and afterwards accustoms them gradually to shift for themselves. When taken young they are easily tamed, and become as familiar and playful as puppies; they soon learn to distinguish their master, and show their attachment by following or fawning upon those who feed them; the old however are always indocile, and continue solitary and distrustful under the most gentle treatment.

The Badger is hunted in some parts of the country during the bright moonlight nights, when he goes abroad in search of food. The hide, when properly dressed, makes the best pistol furniture; the hair is valuable for making brushes to soften the shades in painting; and the hind-quarters, when salted and smoked, make excellent hams. This kind of food indeed is not so universally esteemed in our own country as in China, where Bell informs us that he saw dozens of Badgers at a time hanging in the meat-markets of Pekin; but there is no reason why it should be inferior to the flesh of the bear, which is universally esteemed by all who have tasted it.

2. *M. Labradorica* (Sabine), the American Badger, measures, when full grown, about two feet and a half from the muzzle to the root of the tail, which is six inches more. Its snout is less attenuated than that of the European species, though its head is equally long; its ears are short and round, the claws of its fore feet much longer in proportion than those of the common species, its tail comparatively shorter, its fur of a quality altogether different, its colours also very different, and its appetites more decidedly carnivorous; the head and extremities alone are covered with short coarse hair; all the other parts of the body are furnished with remarkably soft, fine, silky fur, upwards of four inches in length, and differing only in being rather more sparingly supplied on the under than on the upper parts.

The American Badger is called Brairo and Siffleur by the Canadians, Mistonusk and Awawteekæoo, or the Digging Animal, by the Crees, and Chocartoosh by the Pawnee Indians. Its form and habits have been well described by Sir John Richardson in his admirable 'Fauna Boreali-Americana.'

"The *Meles Labradorica*," says Sir John, "frequents the sandy plains or prairies which skirt the Rocky Mountains as far north as the banks of the Peace River, and sources of the River of the Mountains, in lat. 58°. It abounds on the plains watered by the Missouri, but its exact southern range has not, as far as I know, been defined by any traveller. The sandy prairies in the neighbourhood of Carlton House, on the banks of the Saskatchewan, and also on the Red River that flows into Lake Winipeg, are perforated by innumerable badger-holes, which are a great annoyance to horsemen, particularly when the ground is covered with snow. These holes are partly dug by the badgers for habitations, but the greater number of them are merely enlargements of the burrows of the *Arctomys Hoodii* and *Richardsonii*, which the badgers dig up and prey upon. Whilst the ground is covered with snow, the badger rarely or never comes from its hole; and I suppose that in that climate it passes the winter, from the beginning of November till April, in a torpid state. Indeed, as it obtains the small animals upon which it feeds by surprising them in their burrows, it has little chance of digging them out at a time when the ground is frozen into a solid rock. Like the bears, the badgers do not lose much flesh during their long hybernation, for on coming abroad in the spring they are observed to be very fat. As they pair however at that season they soon become lean. The badger is a slow and timid animal, taking to the first earth it meets with when pursued; and as it makes its way through the sandy soil with the rapidity of a mole, it soon places itself out of the reach of danger. The strength of its fore feet and claws is so great, that one which had insinuated only its head and shoulders into a hole resisted the utmost efforts of two stout young men, who endeavoured to drag it out by the hind legs and tail, until one of them fired the contents of his fowling-piece into its body. Early in the spring however, when they first begin to stir abroad, they may be easily caught by pouring water into their holes; for the ground being frozen at that period, the water does not escape through the sand, but soon fills the hole, and its tenant is obliged to come out. The American Badger appears to be a more carnivorous animal than the European one. A female which I killed had a small marmot, nearly entire, together with some field mice, in its stomach. It had also been eating some vegetable matters." As to the southern limit of the geographical range of the species, at least in one direction, it is known to inhabit Mexico, as appears from the detailed and correct description of Fernandez, who calls it by the native name of Ilacoyotl or Coyotlhumuli; and a very fine skin was some time ago sent from California to the Zoological Society.

3. *M. collaris*, the Indian Badger, called Bhalloo-Soor, or Bear-Pig, by the Hindoos, is about the size of the Common Badger, but stands

Indian Badger (*Meles collaris*).

higher upon its legs, and is at once distinguished by its attenuated muzzle ending in a truncated snout, like that of the common hog, and by its small and nearly naked tail. The whole height of this animal is about 20 inches, and the length of its tail 9 inches. It has the body and limbs of a bear, with the snout, eyes, and tail of a hog. Its ears are short, completely covered with hair, and surrounded by a slight border of white.

The individuals, a male and female, observed in the menagerie of the Governor-general at Barrackpoor by the French naturalist Duvaucel, who furnished Mons. F. Cuvier with the materials for his description, were remarkably shy and wild. The female however was less savage than the male, and showed a certain degree of intelligence, which gave reason to believe that, if taken young, this animal might be easily domesticated. They passed the greater part of the day buried beneath the straw of their den in deep sleep. All their movements were remarkably slow. Though they did not altogether refuse animal food, yet they exhibited a marked predilection for bread, fruits, and other substances of a vegetable nature. When irritated they uttered a peculiar kind of grunting noise, and bristled up the hair of their back; if still further tormented, they would raise themselves upon their hind legs like a bear, and appeared, like that animal, to possess a power in their arms and claws not less formidable than their teeth. This is confirmed by Mr. Johnson in his 'Sketches of Indian Field Sports.' "Badgers in India," says he, "are marked exactly like those in England, but they are larger and taller, are exceedingly fierce, and will attack a number of dogs. I have seen dogs that would attack a hyæna or wolf afraid to encounter them. They are scarce, but occasionally to be met with among the hills. In their nature they resemble the bear."

BADI'STER, a genus of Insects belonging to the order *Coleoptera*, and family *Harpalidæ*. This genus, together with the genera *Trimorphus*, *Licinus*, *Rembus*, and *Dicælus*, form a conspicuous group among the *Carnivora* of the Beetle Tribe. [LICINUS.]

BAËTIS, a genus of Insects of the order *Neuroptera*, and family *Ephemeridæ*. This is one of the four genera of the British family of May-Flies. The generic characters are taken from the number of wings, and the setæ, or hair-like appendages to the abdomen. The genus *Ephemera* has four wings and three setæ; *Baëtis* has four wings and two setæ; *Brachycercus* has two wings and three setæ; and *Cloëon* has two wings and two setæ. These setæ are of great use to the little animal in steering its way through the air whilst performing that beautifully undulating flight which all must have observed. It is to the first of these genera (*Ephemera*) that the common May-Fly belongs.

BAGO'US, a genus of Insects belonging to the order *Coleoptera*, and family *Curculionidæ*. The little Beetles composing this genus are all of a mud-colour, and feed upon aquatic plants, probably both in the larva and imago states. There are six or eight species found in England.

BAGSHOT SAND. One of the lower members of the Tertiary Group of England is thus designated.

BAIKALITE, a light-green variety of Augite, deriving its name from its locality, the mouth of the river Sljumanka, which falls into Lake Baikal. [AUGITE.]

BALA LIMESTONE, one of the most interesting of the Calcareous Deposits which have been examined by Professor Sedgwick in the midst of the Schistose Rocks of North Wales. There are two bands of this rock, exhibited on the west of the Berwyn Mountains and on the east of Bala Lake. Two miles north-east of Bala the limestone and the schistose rocks in which it lies may be well seen, and numerous fossils may be gathered at this and at many other points in the vicinity of Bala, on both sides of the lake. Professor Sedgwick has satisfied geologists of the true position of these rocks with reference to the slates of the Berwyn range, and the flags and slates of Llangollen. The series is in two parts, thus:—

Upper Part. Flags and schistose beds of Llangollen, with upper Silurian fossils.

Lower Part. Schistose beds with limestone bands, the lowest of which occur at Bala, and yield lower Silurian fossils.

This is the view of Professor Sedgwick, and the Bala and Llandeilo limestones are thus nearly coeval.

BALÆ'NA (from the Greek Φάλαινα), the Latin name of the Common or Greenland Whale, and adopted by naturalists as a generic term, to comprehend all the other species which agree with it in their zoological characters. [CETACEA.]

BALÆNO'PTERA. This term was invented by Lacépède, to denote those whales which are distinguished by having an adipose fin on the back, whence they are called Finners by sailors, and which he proposed to separate from the other *Balænæ* for the purpose of forming them into a distinct genus. The character however upon which he proposed to make this separation is utterly void of importance, and exercises no assignable influence upon the habits and economy of animal life. His division is consequently vicious, and cannot be admitted into a natural or philosophical system of mammalogy, at least for any other purpose than as a matter of simple convenience. The word itself is compounded of the terms *balæna*, a whale, and πτέρον, a wing or fin.

BALANI'NUS, a genus of Insects belonging to the order *Coleoptera*, and family *Curculionidæ*. The species of this genus are all remarkable for possessing a long slender rostrum or snout, which is furnished at the tip with a minute pair of sharp horizontal jaws: this instrument is used by the animal in depositing its eggs, which are generally placed in the kernel of some fruit.

Balaninus Nucum, the Nut-Weevil, deposits its eggs in both the common nut and the filbert, having bored a hole for that purpose

Nut-Weevil (*Balaninus Nucum*).

1, The tip of the rostrum magnified, showing the jaws, *a a*; 2, side view of the same; 3, the larva; 4, the pupa. The larva, pupa, and perfect insect, are each represented rather larger than the natural size.

while the nut is young and tender. When about to perform this operation, the little animal may be seen travelling over the nut, and feeling with its antennæ to discover a convenient situation, in selecting which it shows great care. The spot being determined on, it cuts a hole with the jaws at the top of the snout until it reaches the kernel; in this hole the egg is deposited, which in a short time is hatched and becomes a maggot or larva. The nut being but slightly injured continues to grow and ripen, while the larva feeds upon its kernel. In course of time this larva gnaws a hole in the shell, through which it makes its escape, and immediately burrows into the ground, where it assumes the pupa state, from which, in the following summer, the perfect insect proceeds. The preceding figure represents a nut which has been pierced by the larva.

Balaninus Glandium, another species of the same genus, attacks the acorn in the same manner as the one above mentioned does the nut.

BALANOPHORA'CEÆ, *Cynomoriums*, a natural order of Parasitical Plants belonging to the sub-class *Rhizantheæ*. They grow upon the roots of woody plants, in tropical countries, rooting into their wood, from which they draw their nutriment, as the mistletoe from the branches of the thorn. None of the species have fully-formed leaves; but, in lieu of them, closely-packed fleshy scales clothe their stems and guard their flowers in their infancy. Succulent in texture, dingy in colour, and often springing from a brown and shapeless root-stock, *Balanophoraceæ* remind the observer of *Fungi* more than of flowering plants: and in fact they appear intermediate in nature between the two. If they have flowers and sexes, both are of the simplest kind; and their ovules, instead of changing to seeds, like those of other flowering plants, become, according to Endlicher, bags of spores, like those of true flowerless plants. Even their woody system is of the most imperfect kind, for it is either entirely, or almost entirely, destitute of spiral vessels. It is probable that numerous genera and species of this singular order still remain undiscovered in the depths of tropical forests, where they lurk among the herbage, and are not likely to attract the attention of the mere flower-gathering traveller. All the species, with the exception of one found in Malta, are natives of the tropics. The species have had a reputation as styptics. The *Cynomorium coccineum*, or *Fungus Melitensis*, has been employed for this purpose. Various species of *Helosis* have had a similar reputation. Pöppig says the *Ombrophyton* is eaten in Peru. The species of *Sarcophyte* have an atrocious odour.

Balanophoraceæ.

a, A head of flowers cut through vertically; *b*, a highly-magnified view of a portion of the receptacle with two fertile flowers; *c*, a male flower in the midst of some fertile ones; *d*, an ovary; *e*, a ripe fruit; *f*, a transverse section of the same; *g*, a vertical section of the same; *h*, a jointed hair of the receptacle.

BALA'NTIA, from βαλάντιον, a bag or pouch, the generic name which the German naturalist Illiger gave to the animals commonly called *Phalangers* (*Phalangista*): the latter name he reserves for the *Petaurists* (*Petaurus*) of other zoologists. [MARSUPIATA.]

BA'LANUS, a genus of Sessile Cirrhipeds or Barnacles, formed by Bruguières from some species of the genus *Lepas*, Linn. *Balanus* offers a great variety of form; but the shell will be found to consist of six valves, four of which are comparatively large, coalescing at the sides, and forming altogether a rude hollow cone, whose aperture is closed by an operculum of four valves (between the two foremost of which issue the jointed feather-like tentacula), and its base by a testaceous plate.

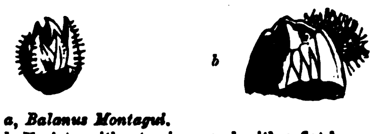
The genus is most widely diffused, and abounds upon almost all bodies, whether fixed or moveable, that offer an opportunity for it to attach itself to them, and are immersed in the sea. On rocks left dry at low water, on ships, on timber, whether floating or at rest, on lobsters and other crustaceans, on the shells of conchifers and mollusks, colonies of *Balani* are to be found.

Balanus Psittacus (*Lepas Psittacus*, Molina) is described by Captain P. P. King, R.N., in his 'Description of the Cirrhipeda, Conchifera, and Mollusca, in a Collection formed by the Officers of H.M.S. Adventure and Beagle, employed between the years 1826 and 1830 in surveying the Southern Coasts of South America, including the Straits of Magalhaens and the Coast of Tierra del Fuego.'

a, *Balanus Psittacus*, about one-fourth of the natural size.
b, The opercular valves, natural size.

"This cirrhiped," writes Captain King, "which at Concepcion de Chile is frequently of a larger size than 5¼ inches long and 3¼ inches in diameter, forms a very common and highly-esteemed food of the natives, by whom it is called Pico, from the acuminated processes of the two posterior opercular valves. The anterior and posterior opercular valves, when in contact, present some resemblance to a parrot's beak, whence Molina's name. It is also found very abundantly at Valdivia and at Calbuco, near the north of the island of Chiloe. It occurs in large bunches, and presents somewhat of a cactus-like appearance. The parent is covered by its progeny, so that large branches are found composed of from 50 to 100 distinct individuals, each of which becomes in its turn the foundation of another colony. One specimen, in the possession of my friend W. J. Broderip, Esq., consists of a numerous group based on two large individuals. They are collected by being chopped off with a hatchet. At Concepcion, where they are found of larger size than to the southward, they are principally procured at the island of Quiriquina, which lies across the entrance of the bay; whence they are exported in large quantities to Valparaiso and Santiago de Chile, where they are considered as a great delicacy; and indeed with some justice, for the flesh equals in richness and delicacy that of the crab, which, when boiled and eaten cold, it very much resembles."

The spined and smooth varieties of *Balanus Montagui*, Sowerby (*Acasta Montagui*, Leach), afford examples of those species which live in sponges.



a, *Balanus Montagui*.
b, Variety without spines, and with a flat base.

Fossil *Balani* have been found in the later deposits, and species are recorded from the beds at Piacenza, Bordeaux, Paris, Essex, &c. [CIRRHIPEDA.]

BALAS RUBY, a term used by lapidaries to designate the rose-red varieties of *Spinel*. [SPINEL.] It should be carefully distinguished from *Oriental Ruby* (the *Sapphire*), a gem of much greater rarity and value. [ADAMANTINE SPAR.]

BALBUSARDUS HALIÆTUS, a name for the Bald Buzzard or Osprey. [FALCONIDÆ; OSPREY.]

BALD BUZZARD, one of the English names for the Osprey or Fishing Eagle, the *Falco Haliætus* of Linnæus, *Pandion Haliætus* of Savigny. [FALCONIDÆ; OSPREY.]

BALIO'STICHUS. A fossil plant in the Laminated Lithographic Limestone of Pappenheim, is named *Baliostichus ornatus* by Sternberg.

BALISTES, a genus of Fishes belonging to the order *Plectognathes*, and family *Sclerodermes* of Cuvier. These groups are intermediate in point of structure between the common or osseous tribes and the cartilaginous tribes; for though the skeleton is in reality of a fibrous or bony texture, it ossifies very slowly, and is never entirely complete; the ribs in particular usually remain imperfect throughout the whole period of the animal's life. The maxillary and intermaxillary bones, again, form but a simple piece, distinguished only by a slight suture or furrow at the point of junction, and the palatal arch is soldered firmly to the skull, and consequently devoid of individual motion. The opercula and gill-rays are concealed beneath the skin, which gave origin to an opinion, at one time common even among professed naturalists, that these fishes wanted the branchial apparatus altogether.

The *Balistes* are particularly distinguished by the vertical compression of the body, by having eight teeth arranged in a single row in each jaw, and a scaly or granulated skin. They have two dorsals; the first composed of numerous powerful spines, articulated to a peculiar bone, itself articulated to the skull, and furnished with a longitudinal furrow for the reception of the spines, which can be erected or depressed at the will of the animal; the second large, soft, or without spines, and placed opposite to an anal fin of similar structure. Like other genera of the same order, the *Balistes* have no ventral fins; notwithstanding which, however, their skeleton is furnished with a complete pelvis, suspended from the bones of the shoulder. The intestinal canal is large, but without cæca, and the air-bladder of considerable size. These fish abound in all the seas of the torrid zone, where they swim on the surface of the water, particularly in the neighbourhood of rocky coasts and coral reefs, feeding with avidity upon the polypi of the reefs, and shining with the most brilliant and varied colours. Their flesh is at all times very indifferent food, and is said to be actually poisonous during the period that the coral-worms are in season. The species are very numerous. They are easily distinguished by the rhomboidal form of their large and hard scales, which are disposed in regular rows, not overlapping one another as in the generality of fishes, but merely touching at their edges, and thus giving the whole body the appearance of being divided into so many regular compartments. Though, as already observed, they have no real abdominal fins, yet a few isolated spines are often found in the vicinity of the pelvis, which have been generally considered as representing these organs; and the greater number have the sides of the tail armed with one or more rows of strong spines curved forwards.

BA'LLOTA, a genus of plants belonging to the natural order *Labiatæ*, and the tribe *Stachydeæ*. It has the anthers approximating in pairs, the cells diverging, bursting longitudinally. The upper lip of the corolla is erect, concave, the lower three-lobed, the middle lobe cordate. The calyx is funnel-shaped, with five equal teeth. There are two British species of this genus, *B. fœtida* and *B. ruderalis*. *B. fœtida* is the most common plant, and goes by the name of Horehound. The White Horehound is the *Marrubium vulgare*. [MARRUBIUM.]

BALM. [MELISSA.]

BALSAM. [IMPATIENS.]

BALSAMI'FLUÆ, *Liquidambars*, a natural order of plants consisting of only one genus, *Liquidambar*, first indicated by Theodore Nees von Esenbeck, defined by Dr. Blume in his 'Flora Javæ,' and adopted by Lindley in his 'Vegetable Kingdom' under the name of *Altingiaceæ*. It is intermediate between the Willow and Plane Tribes, from the former of which it differs in having a 2-celled fruit and downless seed, and from the latter in having numerous seeds. It consists of lofty trees, flowing with balsamic juice, bearing the flowers in small scaly heads, without either calyx or corolla, and having the stamens in one kind of head and the pistils in another. The different species yield the resinous fragrant substance called Liquid Storax, which is so much prized by the inhabitants of the East. [LIQUIDAMBAR; STORAX, in ARTS AND SC. DIV.]

BALSA'MINA, one of the two genera of which the natural order *Balsaminaceæ* consists. It differs from *Impatiens* in having all its anthers 2-celled, its stigmas distinct, and the valves of its fruits curling inwards when bursting. There are numerous species, several of which have very handsome flowers. They are chiefly found in the damper parts of the East Indies; but the only one that is much known in Europe is the common Garden Balsam (*Balsamina hortensis*), which in its double state has been an object of cultivation since the earliest records of modern horticulture. This plant, which is supposed to be found wild in the mountainous parts of Silhet, in the form of what botanists call *Balsamina tripetala*, is one of those species which not only has a tendency to vary with double flowers, but has also the power of continuing to produce them when renewed from seeds. On this account it particularly deserves the attention of the cultivator, especially as it may be brought by art to a state of beauty equalled by few plants. All that is necessary in order to secure fine Balsams, is, first to save the seed with great care from the finest and most double flowers only, throwing away all whole-coloured and single blossoms: and secondly, to cultivate the plants with a due regard to the natural habits of the species. A native of the hot damp shady woods of Silhet, it is incapable of bearing much drought or bright sunshine. It should therefore be raised in a hot-bed, treated with great care as a tender annual, grown in rich soil, sheltered from excessive sunlight, and kept constantly in a damp atmosphere, but freely and fully ventilated. It should not however be stimulated into extremely rapid growth until the plants have become stout bushes and the flowers have grown to the size of small peas. At that time the plants should have all the heat and moisture they can bear, and the most brilliant flowers the plant is capable of producing will be the result. In the latter stage of growth great care is still to be taken to expose the plants fully to air.

BALSAMINA'CEÆ, a small natural order of plants belonging to the Gynobasic group of Dicotyledons, and principally distinguished from *Geraniaceæ* by their many-seeded fruit and unsymmetrical flowers. They are succulent herbs, most abundant in hot countries, with simple opposite or alternate leaves, and showy flowers, with a spur to their calyx. They have no sensible properties of importance, but are the ornament of the damp or swampy places in which they grow wild. The order is remarkable for the elastic force with which the valves of its fruit contract and reject the seeds.

Impatiens Noli-tangere.

a, a calyx magnified, with one of the petals; *b*, the front of an anther; *c*, the back of the same; *d*, an ovary cut across; *e*, the ripe fruit; *f*, the same in the act of bursting and scattering its seeds; *g*, a seed; *h*, the same cut transversely.

BALSAMODE'NDRON, a genus of oriental trees belonging to the natural order *Amyridaceæ*, and remarkable for their powerful balsamic juice. They have small green axillary diœcious flowers, a minute 4-toothed persistent calyx, four narrow inflected petals, eight stamens inserted below an annular disk, from which eight little excrescences arise alternating with the stamens, and a small oval drupe with four sutures, and either one or two cells, in each of which is lodged a single seed. The leaves are pinnated, with one or two pairs of leaflets, and an odd one.

B. Opobalsamum, the Balessan of Bruce, has a trunk from six to eight feet high, furnished with a number of slender branches ending in a sharp spine. The leaves consist of from five to seven sessile, obovate, entire, and shining leaflets, within which are placed the small flowers, which grow in pairs on short slender stalks, and are succeeded by small oval plums. From this is distinguished the

B. Gileadense, supposed to be the βαλσάμου δένδρον of Theophrastus, which is described as a middle-sized tree, with the leaflets growing in threes, and the flowers singly. But it is probable that, as these balsam-trees are found in the same places, and produce the same substance, they are in fact nothing but varieties of the same species. They both produce three different substances: 1, Balm of Mecca, or Balm of

Gilead, or Opobalsamum; 2, Xylobalsamum; and 3, Carpobalsamum; the first obtained from the trunk of the balsam-trees by simple incision; the second by boiling the branches and skimming off the resin as it rises to the surface of the water; and the third by simple pressure of the fruit. They are no longer met with, even in gardens, about Gilead in Palestine.

B. Myrrha is a small scrubby tree found in Arabia Felix, near Gison, scattered among species of *Acacia*, *Euphorbia*, and *Moringa*. Both its wood and bark have a strong and remarkable odour. The branches are stiff, short, and spiny; the leaves composed of three obovate unequal leaflets, with distinct crenatures, and the fruit a narrow, oval, furrowed plum, surrounded at the base by the persistent calyx.

Balsamodendron Myrrha.

B. Katof has fewer spines, and downy and more distinctly serrated leaves. Its wood, which is red and resinous, is a common article of sale in Egypt.

Whatever may be the product of the last species, which Forskäl states to produce the myrrh of commerce, it is now certain that this substance is yielded by *Balsamodendron Myrrha*, which Ehrenberg found on the frontiers of Nubia and Arabia, bearing a substance identical with the myrrh of the shops. It is therefore no longer to be doubted that the suggestion of Bruce, that it is the produce of a kind of Mimosa—a most improbable circumstance, by the way—originated in some incorrect observation.

B. Zeylanicum is mentioned as a fifth species, producing oriental Elemi, which is very different from the American kind; but of this too little is known to enable us to do more than advert to its existence.

Myrrh, a natural gum-resin, the source of which was long doubtful, was observed by Ehrenberg to exude from the bark of the above-mentioned species of balm, much in the same way as gum tragacanth exudes from the *Astragalus verus*. It is at first soft, oily, and of a yellowish-white colour, then acquires the consistence of butter, and by exposure to the air becomes harder, and changes to a reddish hue. As met with in commerce it is of two kinds, that which is called Myrrh in Tears, and that called Myrrh in Sorts.

Dr. Von Martius mentions a White Myrrh, which has a very bitter taste like colocynth, and an external appearance like ammoniacum; it is probably ammoniacum treated with tincture of colocynth. Another false myrrh may be distinguished by its transparency and less bitter taste. [BALSAMS; MYRRH, in ARTS AND SC. DIV.]

BALTIMORITE, a mineral which is a variety of Serpentine, and is composed of longitudinal fibres adhering to each other. It has a silky lustre, is opaque, but in thin pieces translucent on the edges. Its hardness is less than that of calcareous spar. It is found at Baltimore, United States. The following is the analysis by Dr. Thompson:—

Silica	40·95
Magnesia	34·70
Protoxide of Iron	10·05
Alumina	1·50
Water	12·60

BAMBU'SA, the *Bamboo*, a genus of Grasses, well known for its great economical importance, but consisting of species which are very imperfectly understood by botanists. It is remarkable in structure, among other things, for having only one style, which is more or less deeply two- or three-parted, three minute scales at the base of its ovary, and six stamens.

It is doubtful whether nature has conferred upon the inhabitants of hot countries any boon more valuable than the Bamboo, unless it be the Cocoa-Nut; to such a multitude of useful purposes are its light, strong, and graceful stems applicable. These are universally pushed forth by a strong, jointed, subterranean, creeping rootstock, which is the true trunk of the Bamboo, the shoots being the branches. The latter are hard externally and coated with flint; in the inside they are hollow, except at the nodes, where strong partitions stretch across the inside, and cut off the interior into a number of closed-up cylinders. In the cavity of these cylinders water is sometimes secreted, or, less commonly, an opaque white substance, becoming opaline when wetted, consisting of a flinty secretion, of which the plant divests itself, called Tabasheer, concerning the optical properties of which Sir David Brewster has made some curious discoveries.

In their manner of growth they exhibit a beautiful example of a contrivance by which they are enabled to grow into the dense tufts which they usually form. When full-grown a bamboo is a straight rod, bearing a number of stiff branches, which shoot at nearly right angles from the main stem; and it is difficult to conceive by what arrangement such a stem elevates itself through the dense mass of rigid branches which cross each other in every direction. This is however contrived by nature in a very simple manner. The young shoot of a bamboo, whatever its length may be, when it is first produced, is a perfectly simple sucker, like a shoot of asparagus, but having a sharp point, and in this state it pierces readily the dense overhanging branches; it is only when it has arrived at its full length and has penetrated through all obstacles, that it begins to form its lateral shoots; and these, which are emitted horizontally, readily interpose themselves between the horizontal laterals of the bamboo stems among which they grow. In the words of Dr. Roxburgh, the shoots, on their first appearance, resemble a large straight elephant's tusk invested in stout leathery sheaths.

The purposes to which different species of Bamboo are applied are so numerous that it would be difficult to point out an object in which strength and elasticity are requisite, and for which lightness is no objection, to which the stems are not adapted in the countries where they grow. The young shoots of some species are cut when tender, and eaten like asparagus. The full-grown stems, while green, form elegant cases, exhaling a perpetual moisture, and capable of transporting fresh flowers for hundreds of miles: when ripe and hard they are converted into bows, arrows, and quivers, lance-shafts, the masts of vessels, bed-posts, walking-sticks, the poles of palanquins, the floors and supporters of rustic bridges, and a variety of similar purposes. In a growing state the spiny kinds are formed into stockades, which are impenetrable to any but regular infantry, aided by artillery. By notching their sides the Malays make wonderfully light scaling-ladders, which can be conveyed with facility where heavier machines could not be transported. Bruised and crushed in water, the leaves and stems form Chinese paper, the finer qualities of which are only improved by a mixture of raw cotton and by more careful pounding. The leaves of a small species are the material used by the Chinese for the lining of their tea-chests. Cut into lengths and the partitions knocked out, they form durable water-pipes, or by a little contrivance are made into excellent cases for holding rolls of paper. Slit into strips they afford a most durable material for weaving into mats, baskets, window-blinds, and even the sails of boats. Finally, the larger and thicker truncheons are exquisitely carved by the Chinese into beautiful ornaments. It is however more especially for building purposes that the bamboo is important. According to Marsden, in Sumatra the frame-work of the houses of the natives is chiefly composed of this material. In the floorings, whole stems, four or five inches in diameter, are laid close to each other, and across these stems laths of split bamboo about an inch wide are fastened down with filaments of the rattan-cane. The sides of the houses are closed in with the bamboo opened, and rendered flat by splitting or notching the circular joints on the outside, chipping away the corresponding divisions within, and laying it in the sun to dry, pressed down with weights. Whole bamboos often form the upright timbers, and the house is generally roofed in with a thatch of narrow split bamboos, six feet long, placed in regular layers, each reaching within two feet of the extremity of that beneath it, by which a treble covering is formed. Another and most ingenious roof is also formed by cutting large straight bamboos of sufficient length to reach from the ridge to the eaves, then splitting them exactly in two, knocking out the partitions, and arranging them in close order with the hollow or inner sides uppermost; after which a second layer, with the outer or convex sides up, is placed upon the other in such a manner that each of the convex pieces falls into the two contiguous concave pieces, covering their edges; the latter serving as gutters to carry off the rain that falls upon the upper or convex layer.

The different species of *Bambusa* may be conveniently distributed in three sections.

I. *Asiatic Bamboos, with the Flowers either in Spikes or Panicles.*

1. *B. arundinacea*, Roxburgh. Spiny. Leaves very narrow, covered with asperities on the margin and upper surface. (Called *Bans* in Bengal.) Common in rich, moist soil, among the mountains of India. The stems grow in clusters, from 10 to 100, from the same root-stock, and are straight for 18 or 20 feet. When in flower it is usually destitute of leaves, and as the extremity of every ramification is covered with blossom, the whole tree seems one entire immense panicle. Its seeds are used as rice. Tabasheer is found in its joints.

2. *B. stricta*, Roxb. Somewhat spiny. Flowers in extremely compact whorls. Said to be a smaller species than the last: it grows in a drier situation, has a much smaller cavity, and is very straight. Its great strength, solidity, and straightness render it much fitter for many uses. From this the shafts of lances are made in India.

3. *B. vulgaris*, Wendl. Not spiny; leaves very narrow, covered at the edge and on the upper surface with asperities. Found in the East Indies, whence it is thought to have been carried to the West. Its stems are from 20 to 30 feet long, and as thick as a child's arm.

4. *B. spinosa*, Roxb. Strongly armed with both single and compound spines; leaves very narrow, rarely more than six inches long. (*Behor Bans*, in Bengal.) Common about Calcutta, and in the south of India, forming an impenetrable jungle; also often cultivated round Indian villages. It has a smaller hollow than most of the others, and is consequently stronger than many of them. Dr. Roxburgh describes it as rising in such dense tufts as to appear like a single trunk at some

distance; and by help of their spiny branches so bound together that it is a most arduous task to cut down an old clump of them. The stems are from 30 to 50 feet long.

5. *B. Tulda*, Roxb. Not spiny; leaves broad, rounded or heart-shaped at the base. (*Tulda Bans* in Bengal; *Peka Bans* of the Hindoos.) Common all over Bengal. Its growth is so rapid that the stems, which are sometimes as much as 70 feet long and 12 inches in circumference, rise to their full height in about 30 days. Before their lateral shoots are formed, they are described as resembling fishing-rods of immense size. The young thick shoots, when about two feet high, are tender, and form an excellent pickle. It is chiefly used for scaffolding and for covering the houses of the natives; it is found to last much longer if steeped in water some time before being used. Of this species Dr. Roxburgh mentions several varieties. *Jowa Bans* is a larger variety, with longer and thicker joints; *Basini Bans* has a larger cavity, and is chiefly used to make baskets. *Behoor Bans* is of a small size, very solid and strong, much bent to one side, and armed with numerous strong thorns. A staff of it is placed in the hand of every young Brahmin when invested with the sacerdotal robe. It is probably a distinct species.

6. *B. Balcooa*, Roxb. Not spiny; leaves narrow, heart-shaped at the base. (*Balcoo Bans* in Bengal.) A native of Bengal, and even more gigantic than the last. It is reckoned by the workers in bamboo the very best for building purposes. Previously to being used, it is immersed in water for a considerable time. Two varieties are distinguished: *Dhooli Balcoo*, the larger, and *Balcoo Bans*, which is smaller and stronger, with a less cavity.

7. *B. Blumeana*, Schultes. Armed with triple recurved spines: leaves very narrow, quite smooth, suddenly tapering into a short stalk. A native of Java. Stems about as thick as a child's arm.

8. *B. agrestis*, Poir. Stems crooked, at the lower part very spiny; leaves narrow, small, smooth. On mountains, and in dry and desert places in all China and Cochin China; it is common also in various islands in the Malay Archipelago. Its crooked sometimes creeping stems and rugged aspect distinguish it. The trunk is a foot thick, and the joints (we presume near the base) a foot and a half long, and often nearly solid.

9. *B. Thouarsii*, Kunth. Stems very much branched. Found wild in Madagascar, where however it is not believed to be indigenous.

10. *B. mitis*, Poir. Stems perfectly unarmed; leaves very narrow, and clasping the stems at their base. Cultivated in the fields and hedges of Cochin China, and found wild in Amboyna, where several supposed varieties exist. Its stems grow 30 feet long, and are said by Rumphius to be the strongest of all the species, although its sides are thin. It is sometimes as thick as a man's leg.

11. *B. maxima*, Poir. Stems very straight, branching only near the summit, and densely covered with spines. The most gigantic of all the species, from 80 to 100 feet high, and sometimes as thick as a man's body. Its wood is however very thin. It is found wild in Cambodia, Bally, Java, and various islands of the Malayan Archipelago.

12. *B. aspera*, Schultes. Stems covered all over with a sort of white mealy down. Found at the foot of mountains in Amboyna, with stems from 60 to 70 feet high, and as thick as a man's thigh. It does not branch, but emits little hard spine-like roots at its nodes.

13. *B. apus*, Schultes. Leaves very large, taper-pointed, and gradually narrowing to the base, extremely scabrous at the edge. Another gigantic species, with the dimensions of the last, growing on Mount Salak, in Java.

14. *B. Bitung*, Schultes. Leaves very large, taper-pointed, narrowed at the base into a sort of bristly very short stalk, very scabrous at the edge and on the upper surface. Found in Java with the last, and remarkable for its extremely broad and scabrous leaves. Its dimensions are not stated.

15. *B. nigra*, Loddiges. Not spiny. Stems slender, swelled at the nodes, dark-brown, and polished, not more than a man's height. Leaves narrow, very smooth, rounded and narrowed at the base into a short stalk; ligule with long stiff fringes. A native of the neighbourhood of Canton, where its beautiful slender stems are cut for the handles of parasols, walking-sticks, &c. It is by far the most patient of cold, having been living for several years without protection in a morass in the garden of the London Horticultural Society, and is no doubt capable of being acclimated in the south-west of England or on the west coast of Ireland.

16. *B. aristata*, Loddiges. Stems slender, smooth, not spiny. Leaves very smooth, narrowed gradually at the base into a short stalk; with downy fringed sheaths. Ligules divided into very long coarse fringes. Nodes mealy when young. Native of the East Indies. A very elegant species, related to the last.

17. *B. nana*, Roxb. A native of China. It makes most beautiful close hedges.

18. *B. pubescens*, Loddiges. Not spiny. Young shoots, leaf-sheaths, and leaves on the under side, covered with short down. A very remarkable species, obtained by the English from the collections of France. Its native country is unknown. The stems are 30 feet long, and an inch and a half in diameter.

19. *B. striata*, Loddiges. Not spiny. Stems slender, polished, yellow with green stripes. Leaves narrow, rather glaucous on the under side, tapering into a short stalk at the base, quite smooth, except a few short black hairs on the sheaths. A native of China. Often cultivated in the hot-houses of England on account of its beautiful variegated stems. Grows about 20 feet high.

20. *B. glauca*, Loddiges. Not spiny. Stems very slender, pale green. Leaves very small, not downy, taper-pointed, almost heart-shaped at the base, covered on the under surface with very close bright glaucous bloom. Leaves scarcely above an inch long, and not more than two lines broad. A native of India, whence it was procured by the Messrs. Loddiges. A very remarkable species, not growing above 2 feet high, with entangled branches.

II. *Asiatic Bamboos, with the Flowers not Panicled, but in simple Terminal Whorled Spikes.*

21. *B. verticillata*, Willd. Leaf-sheaths covered with stinging hairs. Stems whitish. Fifteen or sixteen feet high, and when full-grown of a pale colour, which becomes nearly white in drying. The hairs of the leaves occasion so much itching, that this kind is troublesome to collect. It is the *Leleba alba* of Rumphius, who says the edges of its leaves are so sharp as to wound the gatherers. It is found in Amboyna.

22. *B. atra*. Leaf-stalks covered with stinging hairs. Stems black and shining. Very like the last, and found also in Amboyna. It chiefly differs in the colour of the stems. It is the *Leleba nigra* of Rumphius.

23. *B. prava*. Leaves very large, stiff, and broad, extremely hispid with stinging hairs. The most common in Amboyna, forming large woods, which come down to the coast. It flourishes equally in dry and moist situations, and is readily known from the others of this section by its very large leaves, which are as much as 18 inches long and 3 or 4 inches broad.

24. *B. picta*. Joints very long, variegated with white and green. Leaves narrow and not very hairy. Common in Cerama, Kelanga, Celebes, and some other Malayan islands. Its joints are as much as 4 feet long and about 2 inches thick: the wood is thin, and it is consequently used principally for light walking-sticks; it is however extremely strong.

25. *B. Amahussana*. Joints short. Leaves with stinging hairs on the upper part of the stem, but smooth near the ground. Less straight, and more short-jointed than any of the preceding species of this section. Its wood is very thick. In Amboyna and Manipa.

26. *B. multiplex*, Lour. Stems long-jointed, not spiny. Leaves stingless, narrow, and clasping the stems at their base. Cultivated in the north of Cochin China for hedges. Its leaves are very narrow, and of a brownish-green. The stems are about 12 feet long and an inch thick.

27. *B. tabacaria*, Poir. Stems slender, very straight, of nearly equal thickness, branched; with very long rough joints. Wild in the black and argillaceous soil of Amboyna, Manipa, and Java, in the plains and moister parts of the mountains. Its stems are nearly solid, and excessively tough and hard. The joints are 3 or 4 feet long, and not thicker than the little finger. When polished they make the finest pipe-sticks. The outside is so hard, that it emits sparks of fire when struck by the hatchet. The species runs very much at the root.

III. *American Bamboos.*

28. *B. Guadua*, Humb. Leaves very narrow, covered with asperities at the edge and on the under-surface. Found in warm and temperate places, on the western side of the Cordilleras of New Granada and Quito, growing like a tree 30 or 40 feet high, with a knotted, shining trunk 16 inches in diameter. The leaves, which are 6 or 7 inches long, are not more than 5 lines broad.

29. *B. latifolia*, Humb. Leaves narrow, but oblong; extremely smooth. About 25 feet high, drooping at the point, with shining joints 2 feet long and about 4 inches thick. The leaves are the same length as in the last, but thrice as broad. It is found in the damp shady woods on the banks of the river Cassiquiare in tropical America.

30. *B. Tagoara*, Nees. Leaves oblong-lanceolate, rounded at the base, and then narrowed into a very short stalk. Stems 20 to 30 feet long, and 4 to 6 inches in diameter, with joints from 6 to 18 inches long; the leaves are 9 or 10 inches long and full 2 inches wide. Found by Von Martius in woods 1800 feet above the sea, on the mountain called Serra do Mar, towards Guarantinqueta, in the province of St. Paul's, Brazil.

31. *B. parviflora*, Schultes. An obscure species, found on the mountains of Peru, in Huanoco, by Hænke. The stem is said to be branched, and the leaves lance-shaped, taper-pointed, with a scabrous edge.

There can be no doubt that many other species of this curious genus are to be found in the tropical parts of Asia and America. It is also not improbable that some of the foregoing may be repetitions. Travellers who have opportunities of procuring wild specimens of bamboos should dry a small branch with the leaves, and if possible the flowers, and should, at the same time, put by a portion of the lower part of the stem, 6 or 7 feet long, marked so as to correspond with the dried specimen.

(Roxburgh, *Flora Indica*, vol. ii.; Rumphius, *Herbarium Amboinense*, vol. iv.; Römer and Schultes, *Systema Vegetabilium*, vol. vii.)

BAMLITE, a mineral of a white or grayish-white colour. It is columnar; has a hardness=6 and specific gravity=2·98. It occurs in Norway, and consists of—

Silica	59·6
Alumina	42·0
Peroxide of Iron	1·0

BANCHUS, a genus of Insects belonging to the order *Hymenoptera*.

BAND-FISH. [CEPOLA.]

BANDICOOT (*Perameles*, Geoff. St. Hilaire), a genus of Marsupial Mammals, which appears to occupy, in Australia, the situation which the Shrews, Tenrecs, and other *Insectivora* fill in the Old World.

The species of *Perameles* called Bandicoots by the colonists (a name which properly belongs to the Great Rat of India, *Mus giganteus*, but which, from a vague resemblance in size and appearance, the early colonists of Sydney applied to the animals at present under consideration), though they agree in the most prominent characters of their dentition with some of the *Marsupiata*, and in the form of their extremities and the number of their toes with others, yet differ essentially from all in their habits and economy. [MARSUPIATA.] In the number, form, and arrangement of their canine and molar teeth they agree in all respects with the Opossums of America and the Dasyures of Australia; that is to say, that they have 2 canines and 14 molars in each jaw; but they differ widely in the number of their incisors, and in this respect offer a unique combination which is found in no other known genus of mammals. Of the incisor teeth there are 10 in the upper jaw, and only 6 in the lower; and the external on each side, particularly in the upper jaw, is insulated, and stands apart both from the canine and from the other incisors; it is likewise much larger than the intermediate incisors, and its form is that of an ordinary canine tooth, of which indeed it appears to exercise all the functions.

The hind legs are considerably longer than the fore, and the number and form of the toes are in all respects similar to those of the kangaroos. It was this similarity that induced M. Geoffroy St. Hilaire to suppose that the pace of the Bandicoots also resembled that of the kangaroos. This, however, is far from being the case. The disproportion between their anterior and posterior extremities is by no means so great as to compel the Bandicoots to hop upon the hind legs only, like the kangaroos, though it is certainly sufficiently so to prevent them from walking like ordinary quadrupeds. Their actual pace resembles that of the hare, and consists of a succession of leaps from the hind to the fore feet, but it is not very rapid, nor can they maintain it for any great length of time. On the fore feet there are five toes, of which the three middle are long and stout, but the lateral ones are so short that they do not touch the ground, and are consequently useless in walking, though they may be of great service in burrowing. The hind feet have but four toes each, and of these the third is the largest of all, whilst the two internal are united under the same skin, and appear externally like a single toe armed with two claws.

This is precisely the arrangement and form which we find in the kangaroos; but the feet of the Bandicoots differ, in being provided with broad powerful claws, which enable them to burrow with astonishing facility, and to scratch up the ground in search of roots. They likewise differ from the kangaroos in having a small fleshy tubercle, in lieu of a thumb, upon the hind feet, and in having the last or ungual phalange of all the toes divided in front by a small incision, as in the pangolins and ant-eaters, a structure which gives a much firmer attachment to the claw, and vastly increases their power of burrowing. In other respects the Bandicoots are chiefly characterised by their long attenuated muzzles, short upright ears, lengthened bodies, and moderate rat-like tails, which are not prehensile, as is the case with many genera of this order, nor have these animals the power of ascending trees. With regard to the period of gestation, the number of young, and the mode of their introduction into the abdominal pouch, it is only known that they resemble the other marsupials in the premature production of their young, and in nourishing them for some time afterwards in the abdominal pouch of the mother, and that this pouch contains the mammary organs for that purpose.

Three or four of the species are well made out, but with regard to the rest there is still some doubt.

1. *P. nasuta* (Geoff. St. Hilaire), the Long-Nosed Bandicoot, measures about a foot and a half in length from the extremity of the muzzle to the origin of the tail; the head is 4 inches long, the tail 6 inches, the hind legs also 6 inches, and the fore legs only 3 inches. The ears are erect, pointed, and covered with short hair; the eyes are particularly small; the nose remarkably long, pointed, and naked at the extremity; and the tail attenuated, and, though better covered with hair, bearing some resemblance to that of a large rat. This organ is not used by the Bandicoot to support the body in a sitting posture, like that of the kangaroo, as has been imagined by M. Geoffroy St. Hilaire, to whom we owe the first description of this species as well as the establishment of the present genus; neither are the progressive movements of these animals similar to those of the kangaroos, as the same eminent zoologist conceived, from the form and proportions of the extremities, that they might be. The pace of the Bandicoot as already observed resembles that of our hares and rabbits, which certainly approximates more nearly to the saltigrade

Long-Nosed Bandicoot (*P. nasuta*).

pace of the kangaroos, gerboas, and helamys, than any other kind of locomotion with which we are acquainted. So far M. Geoffroy's conjecture was well founded, and he has certainly good reason in his observation that analogous structures rarely deceive us in reasoning upon their functions. The external coat of the Long-Nosed Bandicoot is composed of coarse bristly hair, in colour very nearly resembling that of the common Rat (*Mus decumanus*), except that it is of a more sandy shade on the upper parts of the body, and of a more clear silvery white beneath; under this long outer hair there is an interior coat of soft ash-coloured wool or fur, which protects the animal from the cold and variations of temperature, for it appears to be an inhabitant of the mountainous parts of Australia, principally if not exclusively. The tail is of a rather darker colour than the body, and the whole animal, except in the great length and pointed form of the nose, has much the appearance of an overgrown rat. The form and characters of its teeth would lead us to suppose that it fed upon insects and other similar animal substances. In the neighbourhood of human habitations they frequently enter into the granaries, and do as much mischief to the corn as the rats and mice of our own country.

2. *P. obesula* (Geoff.), the Blunt-Nosed Bandicoot, first described by Dr. Shaw under the names of the Porcupine Opossum and *Didelphys obesula*, is readily distinguished from the last species by the shortness and bluntness of its snout, and by the broad round form of its ears. The arrangement of the teeth also differs in some degree from that of the Long-Nosed Bandicoot. The external incisors are more nearly in contact with the canines and central incisors on each side of them; the molars immediately succeeding the canines, and answering to the false molars of the carnivora, are contiguous to one another and of a triangular form; and the posterior molars are more flattened on the crowns. This latter character would seem to intimate that the present species was more purely herbivorous than the last, and future observation may probably confirm this conjecture. The colour and quality of the hair and fur are the same as in the Long-Nosed Bandicoot.

3. *P. Gunnii* is a native of Van Diemen's Land, where it is very generally diffused. It lives principally on bulbs, but also eats insects. *P. lagotis*, of Reid, is of a gray colour, and as large as an opossum. It has been described by Professor Owen under the generic name *Phalacomys*. [MARSUPIATA.]

BA'NKSIA, an Australian genus of plants belonging to the natural order *Proteaceæ*. It was named in compliment to Sir Joseph Banks. It consists of bushes or less frequently of small trees, with their branches growing in an umbellate manner. The leaves are hard and dry, and in young plants always cut at the edges, but in old specimens undivided. They have a dull green colour on their upper side, and are usually white, or very pale green, on the lower. The flowers are long, narrow, tubular, coloured calyxes, without corolla, and with only four stamens lodged in their concave points. They are collected into oblong heads, often consisting of 600 or more, closely arranged, and do not fall off when the blooming is over, but wither, become brown, and adhere to the axis of the head. Very few of them are fertile; the greater part are altogether abortive, and form a sort of coarse fibrous covering to the singular 2-valved fruit, which is thick and woody, contains two black-winged seeds, and when it sheds them opens like an oyster, or any other bivalve shell.

These plants are found in sandy forest-land, or on rocks, over the whole known continent of Australia, but chiefly beyond the tropic. They are called by the colonists Honeysuckle-Trees, and are considered in New South Wales as evidence of bad land; but in the Swan River colony they occupy the most fertile tracts. Many species are now cultivated in the conservatories of Europe, where they are much esteemed for their handsome foliage and singular heads of flowers.

Banksias.

The plant in the foreground is the *Red Banksia* of King George's Sound, and the other the *Yellow Banksia* of the Gulf of Carpentaria, from sketches made on the spot.

None of them appear to be of much value for timber, although they make good fire-wood. *B. compar* and *B. serrata* (which last is said to grow 30 feet high, with a stem measuring a foot and a half in diameter) are the largest species which have been mentioned by travellers on the east coast. On the west coast, in Swan River colony, *B. grandis* reaches 50 feet in height, with a trunk 2½ feet in diameter.

A considerable quantity of honey is secreted by their flowers, and collected by the natives of King George's Sound, who are extremely fond of it.

BANSTICKLE. [GASTEROSTEUS.]

BANXRING, the Sumatran name of a small arboreal animal, discovered by the late Sir Stamford Raffles, which is intermediate in its nature and habits between the Shrews and Squirrels. [TUPAIA.]

BAOBAB. [ADANSONIA.]

BAPTA, a genus of Insects belonging to the order *Lepidoptera* and family *Geometridæ*. The species of this genus are among the thin-bodied day-flying Moths. Mr. Stephens, in his 'Illustrations of British Entomology,' confines this genus to two species: *Bapta bimaculata*, White Pinion-Spotted Bapta, which is of a beautiful white colour, and has two brown spots on the front edge of each of the anterior wings; and *Bapta punctata*, Clouded-Silver-Bapta. This differs from the first principally in having the tips of the anterior wings clouded with brown. Both species are occasionally met with in woods in the neighbourhood of London.

BARB, the name of a noble breed of horses reared by the Moors of Barbary and Marocco, and introduced into Spain during their dominion in that country, where however it has been suffered to degenerate greatly since their expulsion. The noble race of Barbary horses which we commonly call Barbs are of rare occurrence even in their own country, where the tyranny of the governors holds out no inducement to private individuals to rear an animal of which they may be deprived without scruple or compensation by the first man in power who happens to fancy it. It is only among the wild nomadic tribes of the desert, whose roving habits and inhospitable country place them beyond the control of the ordinary powers of the state, that this breed exists in perfection. The common horse of Barbary is a very inferior animal, which, if originally derived from the same source as the noble race of Barbs, has greatly degenerated. In the beauty and symmetry of their forms however even the latter are far from excelling: their valuable qualities—and in these they are perhaps unequalled by any other breed in existence—are, unrivalled speed, surprising bottom, abstinence, patience and endurance under fatigue, and gentleness of temper. Their points would not please the critical eye of a member of the Jockey Club: the head is large and clumsy; the neck short and thick; the chest broad and powerful; yet the body and legs are so long and slender as to resemble those of a greyhound, and form a perfect contrast to the rest of the animal. But the Moors do not regard the external appearance of their horses so much as their temper, speed, and capability to endure fatigue; and the animals which possess these valuable qualities are cherished with all the kindness and attention that are bestowed on children. Their mode of treatment is very different from that practised in Europe. They are very early accustomed to the saddle, are mounted at two years old, and have their manes and tails cropped till the age of six, under the supposition that it adds to their strength and bottom. After this period they are never dressed, nor are their manes and tails combed; if dirty they are washed in the next stream, and some are even said to be offended by Europeans patting their horses with the palm of the hand, from an apprehension of its injuring their coat. They are never castrated, nor have the Moors the bad taste to seek to improve upon nature by cropping the ears and tails of their horses, as is practised by some nations; a Mussulman will neither mutilate nor sell the skin of 'the beast of the prophet,' the noblest of animals. The horses alone are used for the saddle, the mares being kept for breeding, except among some of the predatory tribes of the Desert, who find that the neighing of the horses is apt to betray their approach, and give notice of their coming to the caravans which are the objects of their attack. Walking and galloping are the only paces which these animals are allowed to practise; and it is even considered vulgar to trot or canter. Generally speaking, the Moors avoid giving their horses violent exercise, or overheating them, except upon extraordinary occasions; and among the Desert tribes it is only in their cavalry exercises, such as throwing the lance, &c., that their speed is at all put forth. On these occasions however they are not spared, and it is surprising with what rapidity and precision they perform the different evolutions. These indeed are not so complicated as the tactics of more civilised nations, but they are much more severe upon the cattle, and would soon break down the best of our European breeds. The great exercise of the Moorish cavalry consists in galloping their horses at the very height of their speed for the distance of about a quarter of a mile, and then making them stop suddenly short, while the rider delivers his spear or fires his musket; and of this amusement the people are so excessively fond, that they frequently continue it for hours together without a moment's intermission to breathe or change their horses. Yet notwithstanding such violent exercises, very little care is afterwards taken of the horses; still they are said to be long-lived and remarkably free from diseases. Such distempers as farcy and glanders are unknown; spavin and mullender are of very rare occurrence.

The Moors never make hay, but feed their horses upon chopped straw and barley, which they eat out of a nose-bag put over their heads, as is the custom in England; in spring they are chiefly fed upon grass. In the stables there are no mangers, but the horses are fastened by means of two iron pins driven into the ground, one before and the other behind, to which the fore and hind legs are respectively fastened in such a manner as to prevent the animal from moving more than a foot either backwards or forwards: their collar is also made fast to the front pin, which is provided with a ring for that purpose, and they eat their provender off the ground. Formerly it was the practice for the Moors, in shoeing their horses, to cut off the front part of the hoof; a flat shoe of a triangular shape was then put on, with one of the sides in front, and the other two nearly meeting in an acute angle behind the frog: but this unnatural mode of disfiguring these noble animals was put an end to about the year 1700, by an order of the Emperor Muley Ishmael, who commanded that thenceforth all his subjects should upon pain of death, shoe their horses with round shoes. The Berbers and Kabyles, the aboriginal inhabitants of the country between the Sahara and the shores of the Mediterranean, and who are now for the most part confined to the mountainous and most inaccessible districts of North Africa, never shoe their horses at all; yet so hardy are these animals, and so much tougher are their hoofs than those of our own horses, that Windus, who in the beginning of the last century accompanied a British embassy to the court of the emperor of Marocco, and who has left an interesting account of his journey, assures us that he saw one of them which had travelled 50 miles without resting, and that though he had been twice during the journey obliged to cross a mountain full of rocks, yet it was not perceived that he had the least crack in his hoof, nor any apparent injury of his feet.

There is a particular breed of the noble Barbs, called *Sh'rubah Er'reeh* (literally Wind-Sucker), or the Desert Horse, which is only found among the tribes of the Sahara, and which, when transported beyond the sands of the Desert, soon languishes and dies. The fleetness, temperance, and endurance of this animal, if we are to believe half the stories related by travellers, almost surpass the bounds of credibility. "When thou shalt meet a sh'rubah er'reeh," says a Moorish proverb, "and say to his rider, 'Salam Alikum,' before he can answer 'Alikum Salam,' he will be far from thee, for his speed is like the whirlwind." By the assistance of this animal, or of the *Heirie*, or Desert-Camel, the Arab can upon an emergency cross the Sahara in a short time. The Sh'rubah Er'reeh, however, is neither so useful nor so economical an animal as the desert-camel; it is true that his speed is greater, but he is neither so abstemious nor so enduring. The Heirie will travel for 15 or 20 successive days, and requires but a handful of dried dates in the morning, and a supply of water every third day; upon an extraordinary emergency he can even travel for six or seven days without this important element; but the desert-horse must have a feed of camel's milk once a day, and for this purpose there must be a couple of female camels wherever he goes. Camel's milk is his only sustenance; and indeed it would be difficult to find him any other in the parched and arid deserts which he inhabits; he does not like wheat, hay, straw, or any other kind of food, and if forced to live upon these substances, soon loses all his valuable qualities. In his native country the desert-horse is principally employed for the purpose of hunting the ostrich and gazelle, at which sports he is amazingly expert, nor is there any other being that can equal these animals in speed. When brought to Marocco, as is sometimes the case, these horses soon decline under the change of food and climate. "Alkaid Omar ben Daudy," says Jackson in his 'Account of the Empire of Marocco,' "when governor of Mogodor, had two Saharawan horses in his stables; but finding it inconvenient to feed them constantly upon camel's milk, he resolved to try them on the usual food given to Barbary horses. He accordingly had their food gradually changed, and in a short time fed them altogether with barley, and occasionally with wheat and straw; they grew fat, and looked better than before, but they lost their speed, and soon afterwards died, as if nature had designed them to be appropriated solely to that district whose arid and extensive plains render their use essentially necessary."

BARBA'REA (from a former name, Herb St. Barbara), a genus of plants belonging to the natural order *Cruciferæ*. It has a terete 2-edged pod, the valves convex, with a prominent longitudinal nerve; the stigma capitate, the seeds in a single row. *Barbarea* belongs to the first sub-order of *Cruciferæ*, *Siliquosæ*, which possess a linear or linear-lanceolate pod opening by two valves. The species of *Barbarea* are perennial herbs, with fibrous roots and erect stems. The flowers are yellow, arranged in racemes; the pedicles without bracts.

B. vulgaris, Common Yellow Rocket, Common Winter Cress, Herb St. Barbara, has the lower leaves lyrate, upper pair of lobes as broad as the large roundish subcordate terminal lobe, the uppermost leaf undivided, toothed; young pods obliquely erect; seeds scarcely longer than broad. It is a native, in damp moist places, of Great Britain, and throughout Europe; also of North America. This plant has a bitter nauseous taste, and is sometimes cultivated as a spring salad. In Sweden the leaves are boiled and eaten. It is often cultivated in gardens, especially a double variety, which forms a handsome border-plant.

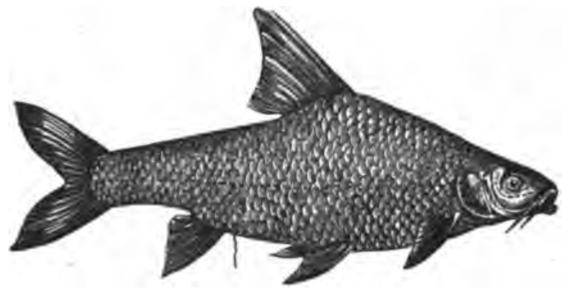
B. præcox, Early Winter Cress, has the lower leaves lyrate, upper pair of lobes as broad as the roundish subcordate terminal lobe, uppermost leaf pinnatifid, with linear oblong entire lobes. It is a native of France and Great Britain; abundant in North America. It is called in Germany Amerikanischer Kraut; in French, Cresson d'Amérique; in England, American Cress, Black American Cress, French Cress, and Belle-Isle Cress. It is used as a salad, and is more bitter than the common Water-Cress. It can be raised for eating all the year round. In cultivating, it should be grown from seeds, a quarter of an ounce of which will serve for sowing 10 feet of drill.

B. arcuata and *B. stricta* are two species described by Babington, and lately added to the British Flora. A few others are found in the northern parts of Europe and America. With the exception of the Double Yellow Rocket, none of the species are worth cultivating as ornamental. This plant may be propagated by cuttings, suckers, or dividing the plants at the root.

(Don, *Gardener's Dictionary*; Babington, *Manual*.)

BARBEL (*Barbus*, Cuvier), a genus of Abdominal Malacopterygious Fishes, belonging to the Carp Family (*Cyprinidæ*), and distinguished by the shortness of their dorsal and anal fins, by a strong spine, which replaces the second or third ray of the dorsal, by four beards or fleshy tentacula, which grow from the lips, two at the nose, and the other two at the corners of the mouth, and by having but three branchiostegous rays. Like the great majority of the abdominal soft-finned fishes, the Barbels are a freshwater genus, and certainly among the least carnivorous of the whole class. They feed almost entirely upon aquatic plants and roots, to obtain which they bore into the banks of the ponds and rivers in which they reside, using their snout for that purpose like a hog.

Barbus vulgaris, the Common Barbel, sometimes measures 3 feet in length, and weighs from 15 to 18 pounds. The section of its body forms an elongated ellipse; its scales are small, its head smooth, its eyes large and contiguous to the nostrils, and the lateral line straight and nearly parallel to the back. Its pectoral fins are of a pale brown colour, its ventral and anal tipped with yellow; the tail is slightly bifurcated, and of a deep purple, and the general colour of the scales is pale gold, edged with black on the back and sides, and silvery-white on the belly. The dorsal fin is armed with a strong serrated spine, with which it sometimes inflicts dangerous wounds on the hands of the fishermen, and does considerable damage to their nets. The barbel is found only in deep and still ponds, and in sluggish rivers which have little or no current. In the hot summer months the barbels abandon for a time the deep pools and ponds which had protected them from the severe winter frosts, and make excursions into the shallower parts of the stream in search of food. Their habits are nocturnal, and they are fond of the society of their own species, being generally found together in large companies. Their flesh is extremely coarse and unsavoury, and their roe in particular is said to produce vomiting,



Common Barbel (*Barbus vulgaris*).

purging, and slight swellings in those who incautiously eat it. The barbel is a very common fish in the Thames, where it is taken rather on account of the sport for the angler than the goodness of the fish.

The Binny, or Barbel of the Nile, is so like the Common Barbel of our European rivers, that it might readily be mistaken at first sight for that fish; but a little observation will show that it is proportionally shorter and thicker, its back more arched, and it is particularly distinguished by having the first three rays of the dorsal fin so closely united as to have the appearance of almost forming but one single spine. The Binny is very common in the Nile; it grows to a large size, sometimes weighing, according to Bruce's statement, upwards of 70 pounds, and is described as being a firm, delicate, and well-flavoured fish. The traveller just mentioned gives an interesting account of the methods which the Egyptians employ for the capture of the Binny, and for preserving it alive till they require to dress it, or have an opportunity of disposing of it. Having kneaded together a quantity of oil, clay, flour, and honey, with some chopped straw or other similar material to unite the different parts of the composition, the whole is formed into a mass, in size and appearance resembling a Cheshire cheese, round the sides of which, in different parts, are stuck small pieces of dates saturated in honey. Seven or eight stout hooks, each having a separate line of strong whip-cord, and baited with a date steeped in honey, are concealed in the centre of the cake. The fisherman then, bestriding his inflated goatskin, paddles himself and his burden out into the middle and deepest part of the stream, where, having sunk the whole mass, he carries the cords attached to the hooks on shore, and fastens each of them separately to the branch of a palm stuck firmly into the ground, and having a small bell suspended from the top of it. He then goes off about his work, which, upon such occasions, is always contiguous to the river, and within hearing of the bells. In a short time the action of the water begins to dissolve the mass of paste at the bottom of the river, and the small pieces of dates getting detached from it float down the river, and are greedily caught and devoured by the Binnies. These naturally ascend the stream in the direction from which they perceive their favourite food to proceed, and having arrived at the mass of composition, begin, as is their custom, to root and bore into it, till they at length arrive at the dates inside, which they ravenously swallow, and are of course caught by the hook concealed within. In its struggles to escape the fish necessarily pulls the line and the palm branch to which it is made fast on shore, when the ringing of the bell gives notice to the fisherman.

"The fisherman," says Bruce, "runs immediately to the bell, and finding thereby the particular line, hauls his prisoner in, but does not kill him: the hook being large, it generally catches him by the upper jaw, which is considerably longer than the under. He then pulls him out of the water, and puts a strong iron ring through his jaw, ties a few yards of cord to it, and returning the fish to the river, fastens him to the shore: so he does with the rest, for very rarely is there a single hook empty. Those who want fish at Girgé, a large town opposite, or at Achmim itself, come thither as to a fish-market, and every man takes the quantity he wants, buying them alive. Fish when dead do not keep in Egypt, which makes that precaution necessary. We bought two, which fully dined our whole boat's crew; the fisherman had 10 or 12 of them fastened to the shore, all of which he pulled out and showed us."

BARBERRY. [Berberis.]

BARBERRY-BLIGHT. [Æcidium.]

BARBETS, the English name for a family of birds of the order *Scansores*, or Climbers; Les Barbus of the French, and the genus *Bucco* of Brisson and Linnæus. They are distinguished by their large conical beak, which appears swollen, as it were, or puffed out at the sides of its base, and is bearded (whence their name) with five tufts of stiff bristles directed forwards. One of these tufts is behind each nostril, one on either side of the lower mandible, and the fifth is under the symphysis.

Their short wings and heavy proportions do not admit of swift flight; and their prey consists of insects and young birds, which they surprise, and also of fruits. Their nests are generally built in the holes of trees. The Barbets are divided into the three following sub-genera:

Sub-genus *Pogonias*.

Pogonias (Illiger) is furnished with one or two strong teeth on each side of the upper mandible, and the beard is very strong. Africa and the Indies are the places where they are found, according to Cuvier, who says that the species of this sub-genus feed more on fruits than any of the others. *Pogonias hirsutus* (Swainson), an African species, is a good example.

Pogonias hirsutus.

Sub-genus *Bucco.*

Bucco (Cuvier), *Capito* (Vieillot), embraces the true Barbets, which have the conical bill slightly compressed and a little elevated in the middle. Their plumage is, generally speaking, gay; and they are to be found both in Africa and Asia. During the breeding season they go in pairs, but congregate in small flocks during the remainder of the year. The Buff-Faced Barbet (*Bucco Lathami*) affords an example of the true Barbets.

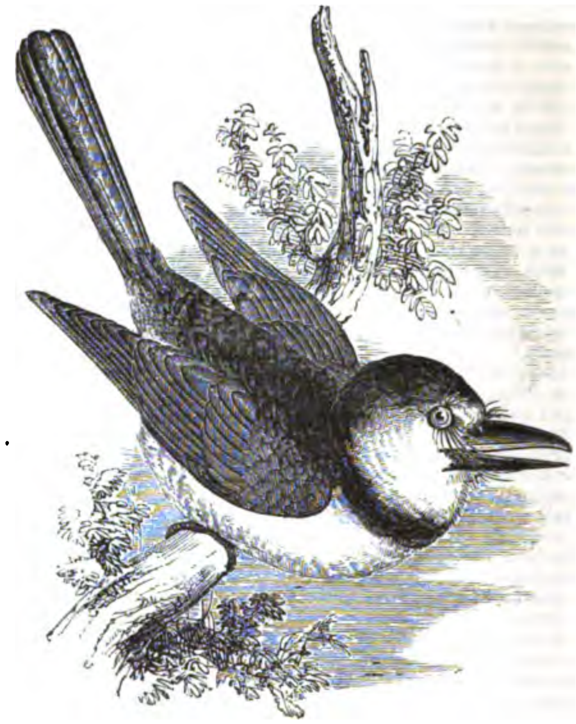
Buff-Faced Barbet (*Bucco Lathami*).

Latham refers to a specimen in the British Museum, and says that its native place is uncertain.

Sub-genus *Tamatia.*

Tamatia (Cuvier), the name by which one of these birds is known in Brazil according to Marcgrave, comprises those species which have the bill a little more elongated and compressed, and slightly curved at the extremity. The great head, short tail, and large bill of these Puff-Birds, as they are called, give them, as Cuvier observes, an air of stupidity, which their melancholy and solitary habits do not lessen. They are said to feed entirely on insects, and all the recorded species are American. In Paraguay, according to Azara, they are called Chacurus. Temminck affixes the name *Capito* to this sub-genus.

Tamatia macrorhynchos (Swainson), which that author obtained from southern Brazil, and which he is disposed to consider a variety of the



Tamatia macrorhynchos.

greater Pied Barbet of Latham, will give a good idea of the character of these birds.

Swainson gives the following interesting account of their habits:—"There is something very grotesque in the appearance of all the Puff-Birds, and their habits in a state of nature are no less singular. They frequent open cultivated spots near habitations, always perching on the withered branches of a low tree, where they will sit nearly motionless for hours, unless indeed they descry some luckless insect passing near them, at which they immediately dart, returning again to the identical twig they had just left, and which they will sometimes frequent for months. At such times the disproportionate size of the head is rendered more conspicuous by the bird raising its feathers so as to appear not unlike a puff-ball; hence the general name they have received from the English residents in Brazil, of which vast country all the species, I believe, are natives. When frightened, this form is suddenly changed by the feathers lying quite flat. They are very confiding, and will often take their station within a few yards of the window. The two sexes are generally near each other, and often on the same tree."

The length of this species is about eight inches. Plumage black and white, except the belly and vent, which are tinged with buff.

BARBUS. [Barbel.]

BARCKHAUSIA, the name of a genus of plants belonging to the natural order *Compositæ*, the tribe *Cichoraceæ*, and the sub-tribe *Lactuceæ*. It has many-flowered heads, a double involucre, the inner of one row, the outer of short lax scales; the fruits 4-cornered, all (or the inner ones only) gradually contracted into a long beak. This genus has several European species, two of which only are natives of Great Britain. The flowers are yellow or pale purple. Some of the species are cultivated in gardens, where they form a pretty and easily cultivable border-plant. The British species are—*B. taraxacifolia*, with rough runcinate-pinnatifid leaves, erect heads, bristly and downy involucre covering half the pappus, its outer scales ovate-lanceolate with a membranous margin, herbaceous bracts, the fruits all equally beaked. *B. fœtida*, with hairy runcinate-pinnatifid leaves, nodding unopened heads, hairy and downy involucre as long as the pappus, its outer scales lanceolate, acute, downy; the marginal fruits slightly beaked, shorter than the involucre, central ones with long beaks equalling it. The first species has a stem one or two feet high, yellow flowers, purple beneath, and is found in limestone districts. The second has a stem from six to twelve inches in height, with yellow flowers. It grows in chalky places in England, but is a rare plant.

B. setosa, a German species, has been lately found in several districts of Great Britain, but it appears most probable that this species has been introduced by means of clover and other seeds used for agricultural purposes.

(Koch, *Flora Germanica;* Babington, *Manual of British Botany; Phytologist,* vol. i.)

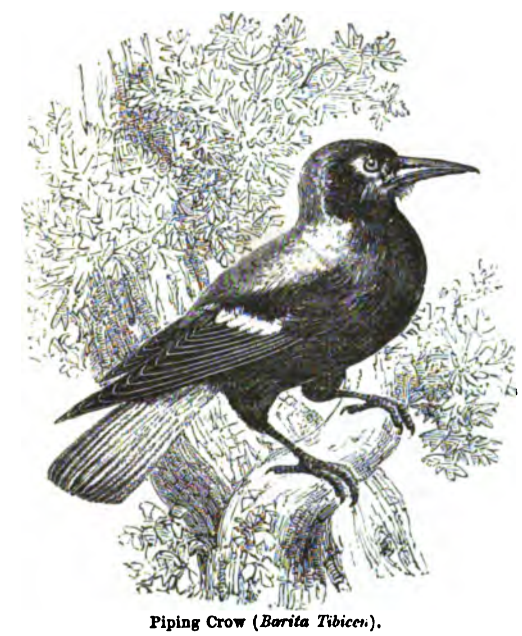
BARI'DIUS, a genus of Insects of the order *Coleoptera* and family *Curculionidæ.* These are cylindrical little beetles which feed upon aquatic plants. They are generally of a black colour, and more or less covered with a whitish down.

BARIS, a genus of Insects belonging to the order *Coleoptera* and family *Curculionidæ.* The species of this genus feed upon the dead parts of trees. One of the species, *Baris lignarius,* feeds upon the elm tree, both in the larva state and that of the perfect insect. When the little beetle is about to lay its eggs it generally selects the interior of a hollow tree for that purpose, and bores a hole with its short snout in the dead wood where it is still tolerably sound; this being accomplished it enters the hole, hinder part first, deposits its eggs, and dies: the hole being only just the size of its cylindrical body, it thus forms a protection for its young by stopping the hole so that no other insect can enter. It is not known that it ever attacks any other wood but that part where the sap has ceased to flow, and consequently the tree can receive no injury from this little weevil.

BARI'TA, the name given by Cuvier to a genus of Birds which he places among the Shrikes, but which Vigors considers to belong to the family of Crows.

The following are the characters of *Barita*:—Bill hard, long, and strong, convex above, slightly hooked at the extremity, near which both mandibles are notched; nostrils lateral, and longitudinal near the base; legs stout; outer toe joined to the middle one as far as the first joint; inner toe entirely free; hind toe elongated; claws strong and curved.

Barita Tibicen, the Piping Crow, common in New South Wales, where Quoy and Gaimard, the able naturalists attached to Freycinet's Expedition, saw numbers of them on the Blue Mountains, living gregariously in small troops, will serve as an illustration of the genus.

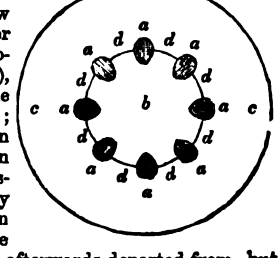


Piping Crow (*Barita Tibicen*).

The bird brought home by Freycinet reached France alive, and by its good-natured and amusing manners became a great favourite while on ship-board. It was a skilful mimic, and clucked and cackled like a hen; but its imitation of a young cock was complete. It had been trained to whistle airs at Port Jackson, and some of these it appeared to forget, but recollected them on being prompted.

BARK, in Vegetable Physiology, is the external coating of the stem and branches of plants, ensheathing the wood. In woody *Exogens* it separates spontaneously from the wood in spring and summer, and in herbaceous plants of the same class it may be easily removed with a little care; but in *Endogens* and *Acrogens* it is so continuous with the central part of the stem that it can never be divided except by violence, and by lacerating the tissue which lies immediately below it. This difference arises from the manner in which the plants of these three great natural classes respectively grow. Exogens add annually new matter to the inside of their bark and the outside of their wood, which renders it necessary that a spontaneous separation of wood and bark should take place in order to make room for the newly-generated substance; but Endogens, which grow by addition to their centre, and Acrogens, by elongation of their point, require no such separation. [EXOGENS; ENDOGENS; ACROGENS.]

Bark may be considered to originate thus:—When a plant is in the state of embryo, that part which finally develops into a stem and root, or, as botanists say, into the axis of growth, is something like two cones applied to each other by their bases, but it will simplify our ideas if we consider it as a cylinder. In a dormant state it consists of nothing but cellular substance; but in Exogens, as soon as the cotyledons, or seed-leaves, are roused into growth, woody matter is generated in the form of a number of little bundles, which are arranged in a circle (a a) about half way from the centre to the circumference, thus forming a sort of hollow cylinder within the first. The cylinder so commenced cuts off the cellular substance into two parts: one central (b), which finally becomes pith, and the other external (c), which becomes bark; the two maintaining their connection by means of the passages (d d) between the woody bundles (a a). These passages ultimately become the medullary processes. The direction thus given in the beginning to the several parts in the interior of an exogenous stem is never afterwards departed from, but all the additions which are subsequently made are moulded, as it were, upon this original form. The woody bundles (a a) increase in size by growing outwards, and consequently the medullary processes are extended; the bark continues to grow and give way to the pressure of the wood from within, till at last a year's increase has been accomplished. Up to this time no separation between the wood and the bark has taken place; but in a second year, as it is necessary for the new matter to be added to the outside of the wood and to the inside of the bark (at d d), a spontaneous separation of the two takes place over the whole surface of the wood, the medullary processes softening, stretching, and growing externally, in order to admit of such a separation. But Endogens and Acrogens always retain their bark in the same connection with the wood as it is in Exogens at the end of the first year, there being no necessity for a separation between the two in order to admit of subsequent growth.



In its anatomical structure bark consists of a mass of cellular tissue pierced longitudinally by woody matter, which is composed entirely of woody tubes without any trace of vessels, but which is sometimes accompanied by long fistular cavities, in which resinous, or milky, or juicy, or other secretions are lodged.

In the first year of its existence bark is a cylinder, the woody matter of which is a continuation of that of the wood itself. In Endogens and Acrogens it undergoes no material increase or alteration subsequently, unless it be that the parts are increased in quantity without shifting their position. But in Exogens, in consequence of their wood being annually augmented by external additions, as before stated, the bark undergoes annual changes. Corresponding with the annual additions to the wood are annual additions to the inside of the bark, consisting of a cellular layer overspreading the whole of the inside, and then a layer of woody matter, which answers to the spaces of wood included between the medullary processes. These annual additions, which are called the *liber* (whence books which were written upon such layers, properly prepared, were called *libri*), must therefore be exactly the same in number as the annual layers of wood, and would be arranged with equal regularity if the bark were not affected by any disturbing cause. But in consequence of the wood's perpetual increase in diameter there is an incessant lateral strain upon the liber, so that after the first year there is little trace of regularity to be discovered in the structure of the bark. It soon becomes a mere confused mass of woody tubes and cellular tissue, in which all trace of annual concentric formation has disappeared. The manner in which it was originally generated is however said to be detected in some plants by the facility with which the bark will peel into layer after layer; but it may be doubted whether this phenomenon is not more connected with the original arrangement of the tissue of which the bark is composed than with the annual formations. These layers are sometimes so numerous that as many as 150 have been separated on a single tree.

When the bark of an Exogenous tree is examined, it will be found to consist of four parts or layers, which to a greater or less extent can be made out in every tree. These layers have been technically called the *Epidermis,* the *Epiphlœum,* the *Mesophlœum,* and the *Endophlœum.*

The *Epidermis* is but a continuation of that layer of condensed cellular tissue which is found on the external surface of every part or organ of the plant. It varies in thickness as well as compactness in almost every tree. It is frequently split up by the growth of the layers which lie beneath it, and with the next layer is separated from the stem in large pieces, as is the case in the common Birch (*Betula alba*). Like the epidermis on the leaves, it possesses stomates, which in the case of plants, as the *Cactaceæ,* seem to possess the power of performing the functions of the same organs on the leaf. The epidermis is variously coloured as well as affected by the colour of the layer immediately beneath it.

The *Epiphlœum* is the outermost layer of bark; it is composed of cellular tissue, and when cut through presents under the microscope a tabular appearance indicative of pressure above and below. This layer is very variable in its development. Sometimes it grows to a very remarkable extent, as is seen in the Cork Oak (*Quercus Suber*), in which the layer of the bark used for making corks, &c., is the endophlæum. On this account it has been called the Suberous Layer. It occurs in other plants besides the *Quercus Suber*, and constitutes a very pretty variety of the common elm, in which, in consequence of the growth of the suberous layer, the stem becomes quite altered in character.

The *Mesophlœum* lies immediately beneath the epiphlæum; it consists of a layer of polyhedral cellular tissue, and in the cells of which it is composed the colouring matter of the bark is deposited. It is in these cells that chlorophyle is deposited in the stems of most young plants, which give to them their green and fresh appearance. Even when the epidermis has assumed another colour the epiphlæum often appears quite green, as is the case in the common Elder (*Sambucus nigra*).

The mesophlæum, with the epiphlæum above it, is often split by the growth of the endophlæum beneath, giving to trees the rough broken surface which they often present. The mesophlæum and epiphlæum are occasionally thrown off from the same cause as the epidermis. The under layers grow rapidly, and the union between them and the upper layers being maintained by no organic matter, the latter is thrown off. This takes place in the Plane (*Platanus*), in which large masses of the epiphlæum are constantly flaking off. New cellular layers in this case are formed below, and it is supposed that this process explains the reason of the tolerance which the planes exhibit of a London atmosphere. In other trees the function of the bark is interfered with by the particles of carbon and perhaps gases affecting the function of the bark, whilst the plane, constantly renewing the outer layers of its bark, is not liable to this interruption. Whether this explanation be the true one or not, it is certainly very remarkable, that of all trees the plane flourishes best in the squares of the metropolis.

The *Endophlœum*, or *Liber*, is the inner layer of the bark, and consists of woody fibre as well as cells, that is, of vascular as well as cellular tissue. The vascular tissue grows here in the form of bundles, as it does in the wood itself. Its fibrous character is made manifest during the growth of many trees. In the vine it is thrown off with the layers above it by the growth of the wood underneath. In the Lace-Bark Tree (*Lagetta Lintearia*), the growth of the wood beneath the bark causes such an arrangement of the fibres that they are separated from one another, but making junctions where they cross, they form a natural kind of net-work, which has been employed as a substitute for artificial net-work in the construction of ornamental clothing. The liber of the bark of plants is much less dense than the wood; hence, where pliable materials are required, it is often made use of, as in the construction of mats from the bark of a species of *Tilia*, and the use of the bark of various trees in different parts of the world as a substitute for cordage.

The bark is nourished in the same manner as the wood of the tree, by sap carried into the stem from the roots below. The cellular and vascular tissue of which it is composed, as long as they live, are capable of producing new cells, by which a new and increasing growth is ever supplied.

(Schleiden, *Principles of Scientific Botany*; Lindley, *Introduction to Botany*; Balfour, *Manual of Botany*.)

BARLE'RIA, a genus of plants belonging to the natural order *Acanthaceæ*, and characterised by the spiny processes of its bracts, the large size of the upper and lower sepals, and its funnel-shaped corolla, which is often so twisted that the upper segment becomes lowest. The species are natives of various parts of the East Indies. A few of them have been introduced to our gardens, of which *Barleria lupulina*, with its large bracts resembling hops, and *B. Prionitis*, a common swamp-plant in Java, are the most remarkable. They all require to be cultivated in a hot-house, and are propagated readily by cuttings.

BARLEY. [HORDEUM.]

BAROLITE, a synonym of *Witherite*, the native carbonate of Barytes. [BARYTES.]

BA'ROMETZ, a singular vegetable production, of which, under the name of Scythian Lamb, many fabulous stories are told. It was said, among other things, to be part animal, part vegetable, and to have the power of devouring all other plants in its vicinity. It is in reality nothing but the prostrate hairy stem of a fern called *Aspidium Barometz*, which, from its procumbent position and shaggy appearance, looks something like a crouching animal, just as the hairy tawny end of the *Trichomanes Canariensis* looks like a hare's foot, whence its English name of Hare's Foot Fern. [ASPIDIUM.]

BARREN FLOWERS, in Botany, are either those which bear only stamens without a pistil, or which have neither stamens nor pistil. Flowers of the former description are very common: those of the latter kind are chiefly found in Grasses and Sedges, where they often consist of nothing more than a deformed scale.

BARRIS, a name given on the coast of Guinea to two very different animals, the Chimpanzee or African Ape (*Pithecus Troglodytes*), and the Mandrill (*Cynocephalus Mormon*), a large and formidable species of baboon. [APE; BABOON; CHIMPANZEE.]

BARSOWITE, a mineral occurring in massive and in granular distinct concretions. Its colour is snow-white; fracture splintery or imperfectly foliated; hardness 5·5; lustre of the compact varieties dull; of the granular, feebly pearly; translucent on the edges. The specific gravity is 2·740. It occurs at Barsowskoj, in the Ural Mountains. It has the following composition:—

Silica	49·08
Alumina	32·76
Lime	18·16

BARTSIA (in honour of John Bartsch, M.D., a friend of Linnæus), a genus of plants belonging to the natural order *Scrophulariaceæ*. It has a bell-shaped 4-fid calyx, a tubular ringent corolla, a pointed many-seeded capsule, the seeds compressed at the hilum, with winged ribs on the back. There is but one British species, the *B. alpina*, which has ovate, opposite, bluntly-serrate, slightly-clasping leaves. It is a rare plant, and only found in alpine pastures. The *B. Odontites* of Smith's 'English Flora' is now referred to the genus *Euphrasia*, as *E. Odontites*. [EUPHRASIA.] *B. alpina* is found in subalpine regions throughout Europe.

B. maxima has a branched stem, opposite lower leaves, alternate superior ones, oblong, bluntly and coarsely toothed; lower lip of corolla longer than the upper one, segments of the lower lip obtuse, equal in size. It is a native of Candia, and attains a height of one and a half or two feet. *B. Trixago* is a native of the south of Europe and Asia. *B. acuminata* is found in America. *B. viscosa* of Smith is now *Trixago viscosa*. It has opposite leaves, the upper ones alternate, ovate-lanceolate, sessile, acutely serrate. The genus *Trixago* differs from *Bartsia* in its seeds being slightly angular, very minutely crenate-ribbed, with a basal hilum. Babington and Koch both adopt the genus *Trixago*, but the latter refers *B. viscosa* of Smith to the genus *Euphrasia*.

(Don, *Gardener's Dictionary*; Koch, *Flora Germanica*; Babington, *Manual*.)

BARYTES, or BARYTA, the *Oxide of Barium*. The Oxide of Barium is found in the earth in combination with acids, principally the sulphuric and carbonic.

Native *Sulphate of Barytes*, known by the name of *Heavy Spar*, also *Hepatite* and *Bologna Spar*, presents itself in various forms, as crystalline, fibrous, saccharoid, compact, and earthy. The crystals are usually tabular, in modified rhombic and rectangular prisms. Its degree of hardness is from 3 to 3·5, and the specific gravity from 4·3 to 4·7. Some varieties are fetid when rubbed. It is composed of sulphuric acid 34, and barytes 66. It decrepitates before the blowpipe, and fuses with difficulty. It is distinguished by its heavy specific gravity from *Celestine* and *Arragonite*, and from the various carbonates by not effervescing with acids. *Heavy Spar* is often associated with the ores of other metals.

This substance is much used in the arts. It is ground up and used as white paint, and also for adulterating white lead. Mixed with equal parts of white lead, it is sometimes called *Venice White*; and another variety, with twice its weight of barytes, is called *Hamburgh White*; and another, one-third white lead, is called *Dutch White*. The barytes in these mixtures seems to prevent the white lead from being tarnished by sulphuretted hydrogen, and they are therefore preferred for some kinds of painting. The variety called *Bologna Spar* is highly phosphorescent after calcination. *Allomorphite* is a synonym of *Heavy Spar*. *Cawk* is a massive variety. *Dreelite* is a sulphate of barytes and lime.

Native *Carbonate of Barytes*, *Witherite*, *Barolite*, is remarkable for its high specific gravity, being 4·3. It is prismatic, and occurs generally in 6-sided prisms, or modified rhombic prisms, very imperfectly cleavable. It is also found in globular botryoidal shapes, showing a prismatic structure. It is brittle, and decrepitates before the blowpipe, fusing easily into a transparent globule, which becomes opaque on cooling. It effervesces with nitric acid, and is composed of barytes, 77·6, and carbonic acid, 22·4. It is found chiefly at Alston Moor in Cumberland, and Anglesarke in Lancashire, and also in Styria.

Witherite is a poisonous mineral, and is used for killing rats. It is also employed in pyrotechny for making the nitrate which gives a yellow colour, and it is used as a water-colour. *Baryto-Calcite* and *Bromlite* are varieties, the former from Alston Moor in Cumberland, the latter from Bromley Hill. They consist of the carbonate of lime and baryta. *Sulphato-Carbonate of Barytes* is a variety containing the sulphate of barytes.

(Dana, *Manual of Mineralogy*.)

BARYTO-CALCITE. [BARYTES.]

BARYTO-CELESTINE, a sulphate of Barytes and Strontia. [STRONTIA, *see* SUPP.]

BARYTO-STRONTIANITE, a carbonate of Barytes and Strontia. [STRONTIA, *see* SUPP.]

BASALT, a hard dark-coloured rock of igneous origin. The chemical composition is variable, as appears from different analyses, two of which, by Beudant and Phillips, are as follows:—

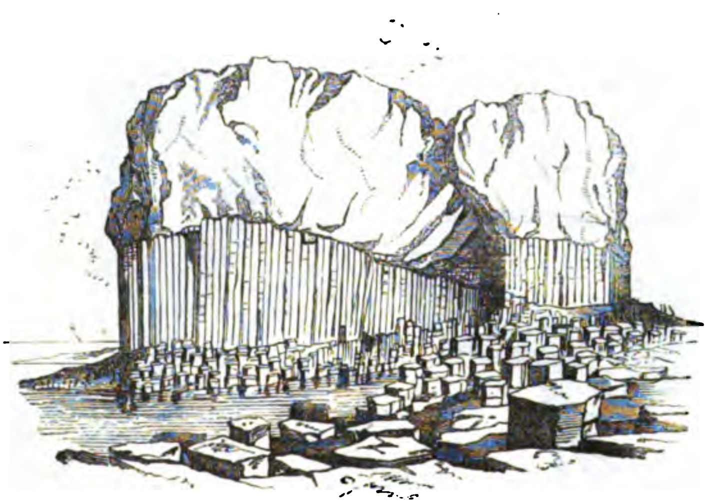
	Beudant. Beaulieu.	Phillips. Saxony.	Difference.
Silica	59·5	44·50	15·00
Alumina	11·5	16·75	5·25
Lime	1·3	9·50	8·20
Magnesia	0·0	2·25	2·25
Soda	5·9	2·60	3·30
Potash	1·6	0·00	1·60
Oxide of Iron	20·2	20·00	0·20
Oxide of Manganese	0·0	0·12	0·12

True Basalt has been regarded as composed of Augite, Felspar, and oxide of iron; but this definition is far too limited for either theoretical or practical purposes, unless the constituent minerals be considered of variable chemical compositions, as appears to be the case. Since Augite and Hornblende may, from the researches of Rose, be regarded as the same mineral, it follows that a very fine-grained Greenstone, containing a considerable per-centage of oxide of iron, can, even under this definition, be considered a true Basalt. There can indeed be little doubt that the same igneous rock has been termed Greenstone when the grains of Felspar and Hornblende were sufficiently distinct, which, when exceedingly fine-grained, has been named Basalt. Basalt can only be considered as one variety of that mass of melted rock which has been ejected at various periods from beneath the crust of the globe, and to which various names have been assigned, according to the characters which circumstances have impressed upon different portions of it.

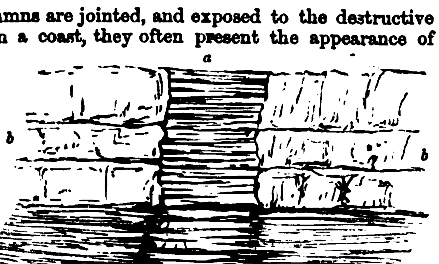
Like others of the same class, Basalt occasionally passes into many rocks which have been in a state of fusion beneath the surface of the earth, and subsequently ejected. Dr. Hibbert notices a passage of Basalt into Granite in the Shetland Islands. (Brewster's 'Edinburgh Journal of Science,' vol. i. p. 107.) When however we view the mass of igneous rocks generally, it appears that Basalts are the products of comparatively late geological epochs. We may therefore infer that during the earlier states of our planet, conditions were not favourable to their production, or at least to their propulsion to the surface; though probably some varieties of Hornblende Rock, particularly when impregnated with much oxide of iron, do not differ materially from Basalt in their chemical contents. The mode of occurrence of these rocks and of Basalts is however very different.

Basalt is a rock of very extensive occurrence on the surface of the earth, and is very frequently detected in the vicinity of volcanoes, both extinct and active. The greatest mass of Basalt yet observed is that noticed by Colonel Sykes in the Deccan, constituting the surface of many thousand square miles of that part of India. This immense mass of Basalt is either massive, prismatic, or globular, occurs in horizontal beds, and is traversed by dykes [DYKE] of Basalt, which sometimes cross each other. There is no trace of any crater in this basaltic region; and indeed this is the case with numerous other districts of Basalt, whence it has been inferred that such tabular masses have not been ejected from a conical vent similar to those of volcanoes, but that the Basalt of which they are formed rose through cracks and fissures while in a highly liquid state, spreading out in sheets of melted matter over the adjacent rocks.

As Basalt is frequently columnar, it is a rock which has excited much popular attention, and travellers have been sometimes induced to describe rocks as basaltic merely because they were columnar, which however is a character that this rock possesses in common with many others of igneous origin. When Basalt occurs in horizontal tabular masses, and is columnar, the columns are generally perpendicular, as in the annexed figure. When Basalt forms the substance of a perpendicular dyke, cutting through other rocks, and is columnar, the columns are usually horizontal, in the manner represented beneath, *a* being the basaltic dyke, and *b b* the rocks through which the dyke passes. Basaltic columns are sometimes also curved, and of this mode of occurrence there is a beautiful example in the island of Staffa.



When basaltic columns are jointed, and exposed to the destructive action of breakers on a coast, they often present the appearance of some great ruined work of art. Such deceptive appearances are however not confined to coasts, for in some countries, and especially in India, masses of Basalt rise suddenly from the plains, and the broken columns, shooting upwards, may readily at a distance be mistaken for buildings. When viewed from above, the heads of a number of basaltic columns, if unbroken, appear like a pavement composed of numerous polygonal pieces of stone fitted into each other, as in the following figure.



According to Mr. Gregory Watt the columnar structure of Basalt is due to the pressure of numerous spheres or spheroids on each other during the cooling of the rock, such spheres or spheroids being produced in planes of refrigeration or absorption. This author took seven cwts. of an amorphous Basalt named Rowley Rag, kept it in fusion for more than six hours, and cooled it so gradually that eight days elapsed before it was taken from the furnace. The shape of the mass was uneven, and while the thinner portion was, in consequence of more rapid cooling, vitreous, the thicker was stony, the one state passing into the other. It was observed that numerous spheroids had been formed, sometimes two inches in diameter. They were radiated with distinct fibres, the latter also forming concentric coats when circumstances were favourable to such an arrangement. When the temperature had been sufficiently continued, the centres of the spheroids became compact before they attained the diameter of half an inch. When "two spheroids came into contact no penetration ensued, but the two bodies became mutually compressed and separated by a plane, well defined, and invested with a rusty colour," and when several met they formed prisms.

The following are Mr. Gregory Watt's inferences from these facts:— "In a stratum composed of an indefinite number in superficial extent, but only one in height, of impenetrable spheroids, with nearly equidistant centres, if their peripheries should come in contact in the same plane, it seems obvious that their mutual action would form them into hexagons; and if these were resisted below, and there was no opposing cause above them, it seems equally clear that they would extend their dimensions upwards, and thus form hexagonal prisms, whose length might be indefinitely greater than their diameters. The farther the extremities of the radii were removed from the centre, the greater would be their approach to parallelism; and the structure would be finally propagated by nearly parallel fibres, still keeping within the limits of the hexagonal prism with which their incipient formation commenced; and the prisms might thus shoot to an indefinite length into the undisturbed central mass of the fluid, till their structure was deranged by the superior influence of a counteracting cause." ('Observations on Basalt, &c.;' 'Phil. Trans.,' 1804.)

According to this theory, which is certainly the best hitherto framed to account for the columnar structure of Basalt, the irregularity of the prisms would obviously depend upon the unequal distances of the centres of the spheroids, and the consequent unequal pressure; and it is further inferred that the joints sometimes observable in basaltic columns correspond with the concentric coats noticed above. Two of the most beautiful examples of columnar Basalt hitherto discovered are found in the British Islands, one forming the Giant's Causeway, on the north coast of Ireland, and the other at Staffa, among the Hebrides. The largest columns yet observed are found at Fairhead at the former place, where, according to the accurate measurement of some by the Ordnance Trigonometrical Survey of Ireland, they are 317 feet in height, the sides of these enormous prisms occasionally measuring 5 feet.

Some non-columnar Basalts present no trace of any particular arrangement of parts, while others show a globular structure, so that when the rock becomes more decomposed it has the appearance of numerous bombshells and cannon-balls cemented together by a ferruginous substance. This globular structure is sometimes also apparent when the decomposition of the rock has not been considerable, being well exhibited in the concentric arrangement of coats of Basalt round centres at variable distances from each other.

Other Basalts are amygdaloidal, containing a variety of substances, such as Agates, Onyxes, and other minerals, which have been infiltrated into cavities formed by bubbles of gas or vapour while the rock was in a state of fusion. As these bubbles have sometimes been lengthened by the flow of the rock before it finally cooled, the infiltrated contents filling such lengthened cavities have the appearance of almonds sticking in the mass of the rock, whence the name amygdaloid. When, as sometimes occurs, a great tabular mass of Basalt is composed of superimposed beds, some columnar, some amorphous and others amygdaloidal, these characters are sufficient to authorise a conclusion that the whole mass has not been produced at one upburst of Basalt, but that there were several flows of melted matter to which different conditions gave different characters; the amygdaloidal structure particularly pointing to the absence of very considerable pressure upon the Basalt so characterised, before it became solid.

BASANITE, a variety of Jasper.

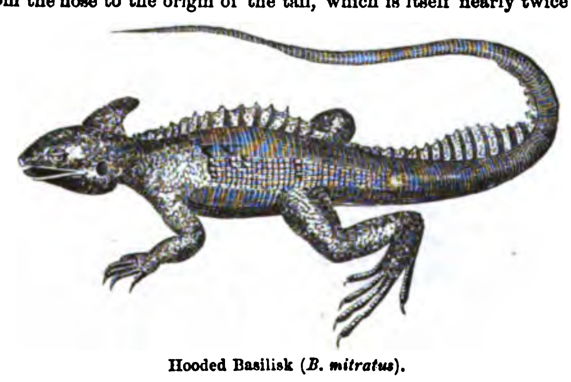
BASICERINE, a hydro-fluoride of Cerium.

BASIL. (CALAMINTHA.)

BA'SILISK (*Basiliscus*, Daudin), a genus of Saurian Reptiles, belonging to the Iguanian Family. It is to be observed that the Basilisk of modern Erpetology is a very different animal from the Basilisk (βασιλίσκος) or Royal Serpent of antiquity, the *Tsepha* or *Tsiphoni* of the Hebrews, which is translated *Cockatrice* in our English version of the Scriptures, and which was formerly the subject of so many fabulous narrations. [COCKATRICE.]

The Basilisks are distinguished from other genera of the Iguanian Reptiles by the absence of the lax and dilatable skin under the throat, by the want of thigh pores, and still more particularly by the elevated crest or fin which, like the dorsals of some fishes, runs along the whole length of the back and tail, and is supported by the spinous processes of the dorsal and caudal vertebræ. To the occiput is attached a membranous bag, which the Basilisk has the power of distending with air, or emptying, as its occasions require, and which appears to supply in this genus the absence of the dilatable skin on the throat, with which nature has furnished the guanas, either as a reservoir to contain a quantity of fresh air to supply their necessities while diving, or by enlarging their magnitude without adding to their weight, to assist them in the actions of swimming and in keeping the head above water, or perhaps for both these purposes. In the particular case of the Basilisks, their aquatic habits are still more powerfully increased by the vertical fin of the back, which, like that on the tail, is capable of being erected or depressed at the will of the animal, and consequently, whilst it does not impede its motions on the dry land, greatly facilitates its power of swimming and moving about in the water. In short, these animals may be said to carry about with them a portable swimming apparatus, which is of the utmost service to them as aquatic animals, without encumbering them at other times,—a beautiful provision of nature to supply the deficiency of palmated or webbed feet, which, as in the case of all other palmated animals, would have reduced the progression of the Basilisks on land to a slow and awkward gait, and rendered it altogether impossible for them to ascend trees or move securely among their branches. Yet their whole organic structure, the length of their limbs, and the division and flexibility of their toes, all announce the rapidity of movement and arboreal habits of these animals, in which are united, by the most simple means, functions and habits the most directly opposed to one another. The genus *Ophryessa* of authors exhibits much of the same structure, though perhaps not quite so strongly developed, nor is it easy to conceive any just grounds for separating these animals from the Basilisks. Two species only are usually referred to this genus.

1. *B. mitratus* (Daudin), the Hooded Basilisk, measures 7 or 8 inches from the nose to the origin of the tail, which is itself nearly twice as



Hooded Basilisk (*B. mitratus*).

long again, being 19 or 20 inches in length. This animal is easily recognised by the generic characters already described, and more especially by the bag or hood of the occiput, which may be said to be in a manner peculiar to it, since it is but slightly indicated in the other species; this bag, when distended with air, is about the size of a pullet's egg. The general colour is a mixture of vinous and sandy brown, slightly marbled on the back and sides with different shades of blue, and silvery-white on the belly. Transverse bands of a deep-brown colour, but broken and irregular, pass down the sides from the dorsal fin to the flanks; two small whitish bands pass over the eyes and from the corners of the mouth, and are prolonged upon the sides of the neck; and the tail is so remarkably attenuated towards the extremity, as to show the articulations of the vertebræ beneath. This species inhabits Guyana and the tropical parts of South America generally. Its habits have been sufficiently noticed in speaking of the general characters of the genus.

2. *B. Amboinensis* (Daudin), the Crested Basilisk, a large species, upwards of 3 feet in length, is of a green colour, marked with white lines on the head and neck, brown on the back and tail, and silvery-white on the belly, irregularly dotted with numerous white points. This species, as its scientific name imports, is an inhabitant of Amboyna and the islands of the Indian Archipelago generally. It keeps in the vicinity of rivers and fresh-water ponds, where it loves to bask on the branches of the trees which overhang the stream. On the first appearance of danger it drops into the water, and conceals itself beneath some rock or stone, whence it may be taken with the naked hand, or with a noose, for it is a stupid and timid animal. It is caught for the sake of its flesh, which is white and as tender as chicken; in taste it is said to resemble venison. The female deposits her eggs in the sand, and leaves them to be hatched by the sun, paying no attention afterwards to her young progeny.

BASILOSAURUS, the generic title proposed by Dr. Harlan for a large fossil animal, of which the remains were collected in Tertiary Strata on the river Washita in Louisiana. The animal was probably 70 feet long. Professor Owen has referred it to the Cetaceans, under the title of *Zeuglodon Cetoides*.

BASIN. In Geology, depressions of the strata occasioned by synclinal dips are thus designated, especially such as are on a large scale. Thus the Tertiary Basins of London, Hampshire, and Paris, resting on Chalk; the Coal-Basin of South Wales, resting on Old Red-Sandstone; and, in a larger sense, the European Basins between the Ural, the Scandinavian chains, and the Pyrenees, Alps, &c. Some of these Basins are due to the original circumstances of deposition; others have acquired their configuration from elevations and depressions of particular geographical areas.

BASSE, a Fish. [LABRAX.]

BA'SSIA, a genus of plants belonging to the natural order *Sapotaceæ*. It has a calyx of four or five leaves, a monopetalous fleshy corolla, with its border generally 8-parted, and a great number of stamens. The ovary terminates in a long taper style, and contains from six to eight 1-seeded cells. The fruit has a pulpy rind, with not more than three or four cells, the remainder being abortive.

The species are found in the East Indies and in Africa, where they are of great economical importance on account of the abundance of a sweet buttery substance which is yielded by their seeds when boiled.

B. butyracea, the Indian Butter-Tree, the Fulwa, or Phulwara-Tree, is found wild on the Almora hills in India, where it grows to a

Indian Butter-Tree (*Bassia butyracea*).

considerable size, its trunk sometimes measuring 50 feet in height, and 5 or 6 feet in circumference. It has broad, oval, long-stalked leaves, from 6 to 12 inches long, smooth on their upper surface, hairy on their under. The flowers, which are large and pale-yellow, hang down near the tips of the branches, from the axils of the leaves, and generally grow three together. They are succeeded by smooth, pulpy fruits, about as large as a pigeon's egg, usually containing two or three roundish light-brown seeds. From these is produced a fat-like substance, which is a kind of vegetable butter, concerning which we find the following information in the 'Asiatic Researches,' by Dr. Roxburgh:—"On opening the shell of the seed or nut, which is of a fine chestnut colour, smooth and brittle, the kernel appears of the size and shape of a blanched almond. The kernels are bruised on a smooth stone, to the consistency of cream, or of a fine pulpy matter, which is then put into a cloth bag, with a moderate weight laid on, and left to stand till the oil or fat is expressed, which becomes immediately of the consistency of hog's-lard, and is of a delicate white colour. Its uses are in medicine, being highly esteemed in rheumatism and contractions of the limbs. It is also much valued, and used by natives of rank as an unction, for which purpose it is generally mixed with an *utr* (aromatic oil) of some kind. Except the fruit, which is not much esteemed, no other part of the tree is used. After the oil has been expressed, the dregs are employed by the poor as food. This Phulwara Butter will keep many months in India without acquiring any bad colour, taste, or smell, and might no doubt be substituted advantageously for animal butter. The timber is of no value, being nearly as light as that of the Semul, or Cotton-Tree (*Bombax heptaphyllum*)."

B. longifolia, the Indian Oil-Tree, is a large tree, a good deal like the last, but its leaves are narrower, and its flowers much more fleshy. It is a native of the peninsula of India, and is found in plantations along the southern coast of Coromandel, where it is called the Illupie-Tree. Its fruit is yellowish, and yields by pressure a valuable oil, which is used by the poorer natives of India for their lamps, for soap, and, instead of better oil, for cookery. The flowers also are roasted and eaten by the Indian peasants, or bruised and boiled to a jelly, and made into small balls, which are sold or exchanged for fish, rice, and various sorts of small grain. The wood is as hard and durable as teak, so that this is one of the most generally useful trees found on the continent of India.

B. latifolia, the Mahwa, Madhaca, or Madhooka-Tree, has oblong leaves, and a corolla with a very protuberant tube. It is a native of the mountainous parts of the Circars and of Bengal, where it forms a middling-sized tree. Its wood is hard and strong, and proper for the naves of wheels; its flowers are eaten raw by the natives and by jackals, and they yield by distillation a strong intoxicating spirit. From their seeds a considerable quantity of greenish-yellow oil is obtained, which is found useful for the supply of lamps; it is, however, inferior to that of the last species. It is curious that this oil stains linen or woollen cloth as animal oil does, while the fatty substance of the *B. butyracea* possesses no such property, but when rubbed on cloth leaves no trace behind.

A fourth species has been named *B. Parkii* and is believed to be the Shea-Tree, or African Butter-Plant, which is so very important an article of African internal commerce; and which it would apparently be extremely desirable to introduce into the West Indies and Bengal, as a new source of internal wealth. This is the plant which is frequently spoken of by Park in his 'Travels in Africa':—

"The people were everywhere employed in collecting the fruit of the shea-trees, from which they prepare a vegetable butter, mentioned in the former part of this work. These trees grow in great abundance all over this part of Bambarra. They are not planted by the natives, but are found growing naturally in the woods; and in clearing woodland for cultivation, every tree is cut down but the shea. The tree itself very much resembles the American oak, and the fruit, from the kernel of which, first dried in the sun, the butter is prepared by boiling the kernel in water, has somewhat the appearance of a Spanish olive. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides the advantage of its keeping the whole year without salt, is whiter, firmer, and to my palate of a richer flavour than the best butter I ever tasted made of cow's milk. The growth and preparation of this commodity seem to be amongst the first objects of African industry in this and the neighbouring states, and it constitutes a main article of their inland commerce."

Duncan has also given an account of this tree, and expressed his conviction that it might become an important article of commerce between Europe and Africa, as it is available for all the uses for which the hard oils are used in the arts and manufactures.

BASSUS, a genus of Insects, belonging to the order *Hymenoptera*, and the family *Braconidæ*. These are four-winged flies, with long and narrow bodies. They frequent the flowers of umbelliferous plants.

BAT. [CHEIROPTERA.]

BATA'RA, D'Azara's name for the Bush-Shrikes, forming the genus *Thamnophilus* of Vieillot. Mr. Swainson considers the typical group to consist of the species with long tails; and of this division, *Thamnophilus Vigorsii* (Such), *Vanga striata* (Quoy and Gaimard), may be taken as an illustration.

Dr. Such states this to be the largest species yet known, and gives 18 inches as the length of the body. The bill is black, and very much compressed. In the male (which is the sex here figured) the back, wings, and tail are black, broadly banded with fulvous, and the under part of the body is a dirty whitish-brown. On the head is a rufous crest which is blackish at the apex. In the female the bands are whitish and the crest blackish, and the under part of the body ash-colour.

Thamnophilus Vigorsii.

Thamnophilus nævius, the Spotted Shrike of Latham, is an example of the round and comparatively short-tailed division.

Spotted Shrike (*Thamnophilus nævius*).

Leach thus describes it from a specimen in the British Museum:—"Black; back and belly ash-coloured; the former anteriorly spotted with white; quills of the wings externally, and the tips of those of the tail, white; under part of the body ash-colour, of which colour the back partakes in a considerable degree."

BATA'TAS, the Malayan name of a Convolvulaceous plant, the root much eaten in the south of Europe before the cultivation of the potato, which both became a substitute for it, and appropriated its name. It has generally been considered a species of *Convolvulus;* but Professor Choisy in his recent classification has erected it and a few others into a peculiar genus, distinguished by having an ovary with four cells, in each of which there is only one seed.

The only species of any general interest is the *Batatas edulis*, the *Convolvulus Batatas* of authors, the Sweet Potato. This plant, originally found wild in the Malayan archipelago, has been gradually dispersed over all the warmer parts of the world, where it is still an object of culture for the sake of its roots, which, when roasted or boiled, are mealy, sweet, and wholesome, but slightly laxative. It is a perennial plant, with long creeping stems, leaves variously lobed and angled, and pale purple flowers about an inch long. It is impatient of cold, and consequently unfit for cultivation in the northern parts of the

Sweet Potato (*Batatas edulis*).

world; but it is a productive agricultural plant in many warm countries. It is partially cultivated in the south of Spain and of France, whence its roots are sent to the markets of Madrid and Paris, where they are held as a delicacy. They however have the great fault of keeping badly, being very apt to become mouldy and to decay, unless extraordinary pains are taken to preserve them dry. They are sometimes raised in the hothouses of the curious in this country. *B. Jalapa* has none of the properties of the plant after which it is named. [CONVOLVULACEÆ.]

BATOLI'TES, a genus of Fossil Shells established by Montfort, and placed by him among his *Coquilles Univalves Cloisonnées*. Montfort states that these shells acquire a very great length, and that they constitute masses of rock in the High Alps. [BIROSTRITES; HIPPURITES.]

BATRA'CHIA, FOSSIL. The number of Fossil Reptilia referrible to this division is gradually enlarging, though still very small. To the Anourous Batrachians we must, with Jäger and Professor Owen, refer the Labyrinthodons of the New Red-Sandstone Series of Warwickshire and Wirtemberg (which include the *Cheirotheria* whose foot-prints ornament the Red-Sandstones of England and Germany); while the tertiary fossil of Oeningen (which Scheuchzer imagined to be a human skeleton) is determined by Cuvier to be analogous to the Newt of Europe and the *Menopoma* of North America. Remains of Frogs and Salamanders occur in the Tertiary Brown Coal-Beds of the Rhine Valley. [AMPHIBIA.]

BATRACHITE, a mineral, which is a variety of *Olivine*.

BATRACHOSPERMEÆ, a tribe of plants referred by some writers to the order *Fucaceæ*. It is regarded by Harvey as an aberrant group of *Chlorospermeæ* leading through *Ectocarpaceæ* to *Melanospermeæ*. [ALGÆ.] The species have a polysiphonous frond composed of a primary thread, surrounded by parallel accessory ones. The vesicles are terminal or lateral and clustered.

The principal genus of this family is *Batrachospermum*, which have got this name from Βάτραχος, a frog, and σπέρμα, a seed, on account of their gelatinous fronds giving them the appearance of the ova of the *Amphibia*. The species are flexible, and have a gelatinous character. The surface is covered with innumerable little hairs, looking like cilia, which give them a very beautiful appearance under the microscope. They mostly inhabit pure and running waters where the force of the stream is not considerable. On removing them from the water the hairs, which are expanded whilst immersed, collapse, and they appear like masses of jelly without any traces of organisation.

Several species of this genus have been described by Dr. Hassall as inhabiting streams in the neighbourhood of London. *B. moniliforme* is figured in Lindley's 'Vegetable Kingdom,' p. 20; and Hassall has figured some of his new species in his 'British Fresh-Water Algæ.'

BATRACHOSPERMUM. [BATRACHOSPERMEÆ.]

BATTUS, the generic title proposed by Dalman to replace the name *Agnostus* which Brongniart gave to some minute trilobate *Crustacea* which occur in the Silurian Limestones of Norway, Wales, &c.

BAUHI'NIA, a genus of plants belonging to the natural order *Leguminosæ*. Linnæus applied the name very happily to commemorate the merits of the two Bauhins, for the genus is remarkable for its leaves being generally divided into two twin lobes.

The species are usually twining plants, found in the woods of hot countries, and often stretching from tree to tree like living cables, forming with other plants an almost insurmountable obstacle to the traveller who would penetrate the recesses of a tropical forest. Some of them however are small trees, as for example *B. porruta*, which in Jamaica is called Mountain Ebony, because its wood is sheathed with black. Their flowers are often very beautiful, for which reason they have long been cultivated in the hot-houses of Europe; but they are too impatient of the wretched treatment they usually receive in stoves to flourish and pro-

duce their noble blossoms. So long as these plants are cramped in earthern pots we must not hope to see in Europe those noble flowers which are described by the travellers who have visited the forests of America and India.

The bark of *B. racemosa* and *parviflora* has been employed in making ropes. A brownish-coloured gum is said by Roxburgh to be yielded by *B. retusa*. A gum is also collected from *B. emarginata* in the Deyra Doon, which is called Sem-ke-gond. The flowers and buds of *B. tomentosa* are dried, and used in India as remedies in dysentery. Their astringency is probably due to the presence of tannin, and one species, *B. variegata*, has a sufficient quantity of this substance in its bark to render it useful in tanning. The leaves of various Bauhinias are used in Brazil under the names of Unha de Boy, or Ox-Hoof, as demulcent remedies.

BDE'LLIUM, commonly called a gum, but in reality a gum-resin, the origin of which has been a subject of doubt. It would appear that there are several kinds of Bdellium, the source of two of which seems now to be ascertained; the others are matters of controversy. The Bdellium of the ancients, said by Pliny (xii. 9) to be brought from Bactria and other parts of Asia, still comes from Asia. The Bdellium of Africa is yielded by the *Balsamodendron Africanum*. Dr. Royle says that Indian Bdellium is produced by a species of *Balsamodendron*, called by Dr. Roxburgh *Amyris Commiphora* ('Fl. Ind.' ii., p. 244), *Amyris Agallocha* ('Calcutta Catalogue,' p. 28), the native name of which is Googul. (Royle, 'Illustrations of the Flora of the Himalayah,' part vi., p. 176.) The opinion of its being obtained from a palm, either the *Lontarus domestica* (Gaertn.) or the *Borassus flabelliformis*, is very improbable. This substance occurs in masses of variable size and shape, sometimes as large as a walnut, in oblong or angular pieces of a yellow, red, or brownish colour. The clearest pieces are transparent; the odour is weak and peculiar; the taste bitter, balsamic, and resembling myrrh or Venice turpentine. It is tolerably brittle at the ordinary temperature of the atmosphere, but with a slight increase of heat the finer kinds may be kneaded between the fingers. Its specific gravity is 1·371.

Resembling myrrh in appearance, it also resembles it in its effects upon the human system, and is often fraudulently substituted for it; it is however weaker, while it is more disagreeable and acrid. [BALSAMODENDRON.] It was formerly used in many compounds and plasters, such as Diachylon. It is now disused in Britain; but is to be found intermixed with gum-Arabic.

The Sicilian Bdellium is produced by the *Daucus Hispanicus* (Decand.), the *D. gummifer* of Lamarck, or perhaps the *D. gingidium* (Linn.), according to Boccone ('Museo di Piante Rare della Sicilia,' &c., tom. xx.), which grows on the islands and shores of the Mediterranean.

The Egyptian Bdellium is conjectured to be produced by the *Borassus flabelliformis* (Linn.), the *Chamærops humilis*, or the *Hyphæne cuciphera* (Pers.)

The Bdellium mentioned in the second chapter of Genesis is obviously a mineral, and has no reference to the substances above mentioned.

BEACHES, RAISED, a term introduced into modern Geology to characterise a very numerous class of gravelly, sandy, and shelly deposits, which have been once parts of the sea-bed, and have been raised to constitute dry land in very modern geological periods. It is scarcely possible to assign exactly the limits of these formations, even by the aid of the organic remains which they contain; for while some raised beaches contain only species now living in the adjoining sea, others include one or more extinct species, and thus conduct by insensible gradations from the almost modern shell-beds of the raised shores of the Forth and the Clyde, and the variously elevated shell-accumulations of Uddewalla and other points of Sweden, to the still richer and more ancient (though still to be called Newer Pleiocene) deposits of Sicily. The term Pleistocene (meaning 'most recent') which has come into use, meets this difficulty but feebly, and in fact only draws an arbitrary or epochal line, instead of the soft gradations of long periods which really appear in nature. Nearly all the British, Irish, and European shores furnish examples in abundance: as the shores of the Forth and Clyde, the coasts of Yorkshire and Lancashire, the coasts of Cornwall and Devon, of Wexford, Normandy, Sweden, and the Mediterranean.

BEAD-TREE. [MELIA.]

BEAGLE, a small well-proportioned hound, slow but sure, having an excellent nose and most enduring diligence, formerly much in fashion for hunting the hare, but now comparatively neglected, its place being occupied, where hare-hunting is patronised, by the Harrier. [HARRIER.]

The Beagle.

These were the little hounds so much prized by 'the good old English gentleman;' for at a trifling expense, and greatly to the delight of the neighbouring rustics who followed on foot, he could keep his ten or eleven couple, not more than so many inches high individually, and, mounted on his easy pad, would generally make certain of killing his hare, though it frequently cost him two or three hours to perform the feat. During this protracted chase he had ample leisure for enjoying the sight of his admirably-matched pack running so well together that 'they might have been covered with a sheet,' and for gratifying his ears with their tuneable cry.

The hare distanced them immeasurably at first, and in the course of the run she might be observed to sit and listen 'sad on some little eminence,' but

—— "In louder peals, the loaded winds
Brought on the gathering storm"—

and after exhausting all her speed, shifts, and doublings, she almost always fell a victim to their persevering and destructive instinct.

A well-bred beagle of the proper size, which should not exceed that above mentioned, is a very pretty and symmetrical variety. This symmetry (the term is used in relation to the purposes for which the dog is employed) was the result of much care among amateurs, who spared no efforts to bring it to what they considered the standard of perfection.

Some prided themselves on the diminutive but still effective size of their packs. Daniel and others have not forgotten to commemorate Colonel Hardy's 'cry of beagles.' They amounted to ten or eleven couple, and were always carried to and from the field in a pair of panniers upon a horse's back. Small as they were, they rarely failed, though they could never get near enough to press the hare in the early part of the run, to stick to her and worry her to death at last.

Such diminutive hounds are sometimes called Lap-Dog Beagles and Rabbit Beagles.

The fairy pack above alluded to had a little barn for their kennel, where also their panniers were kept. The door was one night broken open, and every hound, panniers and all, stolen; nor could the disconsolate owner ever discover either the thieves or their booty.

BEAM-TREE. [PYRUS.]

BEAN. [FABA; PHASEOLUS; DOLICHOS; VICIEÆ.]

BEAN-GOOSE. [DUCKS.]

BEAR, the English name for a family of *Plantigrade Mammalia*, forming a natural group, with six incisor teeth and two canine teeth in each jaw, twelve molars in the upper and fourteen in the lower jaw; pentadactyle or five-toed feet, armed with strong claws; and a short tail. The Bears exhibit but a comparatively small carnivorous development; for notwithstanding their strength, their dentition, particularly in the form of the crowns of their molar teeth, indicates a propensity bordering on the frugivorous exclusively. Aristotle well knew this, and thus described the habits of the Bear ('Nat. Hist.,' viii. 5):—"But the bear is an omnivorous animal, and by the suppleness of its body climbs trees and eats the fruits and also legumes. It also devours honey, having first broken up the hives; crabs too and ants it eats, and also preys upon flesh." Aristotle then describes how the animal attacks the stag, the boar, and even the bull.

The ranger in the 'Tour on the Prairies' notices the honey-seeking propensity in language which, though not quite classical, is truly nomadic:—"The bear is the knowingest varmint for finding out a bee-tree in the world. They'll gnaw for a day together at the trunk, till they make a hole big enough to get in their paws, and then they'll haul out honey, bees, and all." And indeed it appears that although they are omnivorous, they for the most part rarely devour flesh unless pressed by necessity. Their claws too, though formidable weapons, are not retractile, and are more calculated for digging and climbing than for tearing prey. It is their general characteristic to lay themselves up in caves or hollows for the winter, which they pass in a dormant state, and without taking food. The female produces her young at this season.

European Bears.

Ursus Arctos (Linn.), the Brown Bear, Ἄρκτος of Aristotle, the *Ours* of the French, *Orso* of the Italians, *Bär* of the Germans, *Björn* of the Swedes. This appears to have been the only species certainly known to Linnæus; and though zoologists are not without their suspicions as to some of the species since recorded, the number of those which can no longer be considered doubtful will prove how much this department of Natural History has been enriched since his time. The Brown Bear is widely diffused. The mountainous districts of Europe, from very high latitudes (Arctic Circle) in the north, to the Alps and Pyrenees in the south; Siberia, Kamtchatka, and even Japan, to the eastward, and a portion of the northern regions of America, form the range of its geographical distribution. Africa and the Moluccas have been added; but it is far from improbable that these localities have been assigned to it by travellers who have taken some other species for it.

To the Kamtchatkans this Bear seems to give the necessaries and even the comforts of life. The skin, we are told, forms their beds and their coverlets, bonnets for their heads, gloves for their hands, and collars for their dogs; while an overall made of it, and drawn over the soles of their shoes, prevents them from slipping on the ice. The flesh and fat are their dainties. Of the intestines they make masks or covers for their faces, to protect them from the glare of the sun in the spring, and use them as a substitute for glass, by extending them over their windows. Even the shoulder-blades are said to be put in requisition for cutting grass.

The Laplanders hold it in great veneration, and, according to Leems, called it the Dog of God; for it appears that among the Norwegians there had long been a proverb, that it had the strength of ten men and the sense of twelve. They never, says the same author, presume to call it by its proper name of Guouzhja, lest it should revenge the insult on their flocks; but make mention of it as Moedda-Aigja, or the Old Man with a Fur-Cloak ('senem cum mastrucâ').

The Brown Bear is a solitary animal. Its retreat during the period of hybernation is the natural hollow of a tree, or some cavern; and if these are not to be found the animal constructs a habitation for itself, sometimes by digging, sometimes by forming a rude kind of hut or den with branches of trees, lined with moss. Here it retires when fat with the summer's food, and remains dormant, without taking any sustenance, till the ensuing spring. Cuvier makes the period of gestation about seven months, stating that they couple in June, and that the birth takes place in January; and the same number of months is assigned in the article in the old French 'Encyclopédie,' taken from observations of the bears kept at Berne. The cubs when first born are not much larger than puppies. They are long-lived, for it appears that one of the Berne bears had been confined there 31 years; and another, born there, is spoken of at the age of 47 in the menagerie at Paris. They are excellent swimmers, notwithstanding their uncouth appearance. Mr. Lloyd, in his 'Field Sports of the North of Europe,' gives a very interesting account of the habits of this species, and of his adventures in hunting it.

That the Brown Bear was at one time common in the British Islands there can be no doubt. The Caledonian bears (another name for British with the Romans) were imported to make sport for the Roman people, to whom the excitement of witnessing the suffering of man and beast in its most distressing shape seems to have been but too welcome. From the well-known lines of Martial, descriptive of the dreadful punishment of the malefactor Laureolus, it appears that they were sometimes used as instruments of torture:—

Nuda Caledonio sic pectora præbuit urso,
Non falsâ pendens in cruce Laureolus.*

Ray quotes authority for the Brown Bear having been one of the

* We are quite aware that some commentators are of opinion that Martial is here speaking of a mimic scene, and that the verses which follow those above

Welsh beasts of chase, and Pennant adduces the places which retained the name of Pennarth, or the Bear's Head, as evidence that it existed in that principality. In the 'History of the Gordons' it is stated that one of that family, so late as the year 1057, was directed by the king to carry three bears' heads on his banner, as a reward for his valour in slaying a fierce bear in Scotland.

For many years it has been swept away from our islands so completely that we find it imported for baiting, a sport in which our nobility, as well as the commonalty, of the olden time—nay, even royalty itself—delighted. A bear-bait was one of the recreations offered to Elizabeth at Kenilworth, and in the Earl of Northumberland's 'Household Book' we read of 20*s.* for his bear-ward :—"Item. My lorde usith and accustomyth to gyfe yerly when his lordshippe is at home to his bar-ward, when he comyth to my lorde in Cristmas with his lordshippe's beests, for makynge of his lordshippe pastime, the said xij days, xxs." In Southwark there was a regular bear-garden, that disputed popularity with the Globe and the Swan theatres on the same side of the water. Now however, so much do tastes alter (in this instance certainly for the better), such barbarous sports are banished from the metropolis. (Stat. 3 Wm. IV. cap. 19, sec. 29.)

The firm support afforded by the well-developed sole of the foot enables the Bears to rear themselves with comparative facility on their hind feet, and this has been taken advantage of to teach the animal to dance in an erect position. The discipline put in force to produce this accomplishment is said to be so severe that it is never forgotten.

Baron Cuvier, in his 'Ossemens Fossiles,' distinguished the Black Bear of Europe under the title of *Ursus niger Europœus*, observing that the frontal bone was flattened, and that the well-marked depressions and ridges of the skull, for the reception of the strong muscles of the lower jaw, were evidence of its being more decidedly carnivorous than the Brown Bear; but in the last edition of his 'Règne Animal' he confesses his doubts about the data on which he had come to this conclusion, and it is probably a variety only. The usual size of the Brown Bear is about 4 feet in length by about 2½ feet in height. The claws are 2 inches long, very much curved and nearly equal.

Common Brown Bear (*Ursus Arctos*).

F. Cuvier has figured the bear of the Pyrenees and of the Asturias, whose fur in its youth is of a yellowish white colour. The hair of the feet is an intense black. This is most probably only a variety, though perhaps a distinct one, of *Ursus Arctos*. The Barren-Ground Bear of America Sir John Richardson is inclined to believe now is a variety of this, and not of the next species, as he at one time was inclined to think.

American Bears.

U. Americanus, American Black Bear, or Musquaw.—Pallas first described this species (the Sass of the Chippewayan Indians and the Musquaw of the Crees), whose general proportions are smaller than those of *U. Arctos*. The head of the American Black Bear is narrower, the ears more distant, and the muzzle more prominent, and it wants the depression above the eyes. The fur is composed of soft smooth hairs, which are of a glossy black for the greater part of their length, instead of possessing the shaggy and woolly character of the comparatively grizzled fur of the Brown Bear, except on the muzzle, which is clothed with short thick-set hairs, brown on the upper part and paler on the side. The tail is apparently more prominent, and the sharper and more curved claws are nearly hidden in the hair.

quoted are not genuine; but the expression 'non falsâ cruce' is pretty strong; and if the rest of the verses are allowed to be Martial's, there is no doubt that he here describes a real spectacle. Whichever be the truth, the horrible use to which these bears were occasionally put in the arena is but too evident.

The Black Bear inhabits every wooded district of the American continent from the Atlantic to the Pacific, and from Carolina to the shores of the Arctic Sea. It still occurs, though not very often, in the Blue Ridge, in Virginia. Its southern boundary is placed at the Isthmus of Panama. Man has however gradually driven it from its haunts to make way for his works, and has compelled it to take refuge in the mountains and the immense inland forests. In Canada it is still abundant, and it is tolerably numerous on the western coast as far as California.

Black Bear (*Ursus Americanus*).

It is smaller than the other American bears, the total length of an adult seldom exceeding five feet. Its favourite food appears to be berries of various kinds, but when these are not to be procured it preys upon roots, insects, fish, eggs, and such birds or quadrupeds as it can surprise. It does not eat animal food from choice, for when it has abundance of its favourite vegetable diet it will pass the carcass of a deer without touching it. It is rather a timid animal, and will seldom face a man unless it is wounded, or has its retreat cut off, or is urged by affection to defend its young. This bear when resident in the fur countries almost invariably hybernates, and about 1000 skins are annually procured by the Hudson's Bay Company from Black Bears destroyed in their winter retreats. It generally selects a spot for its den under a fallen tree, and, having scratched away a portion of the soil, retires to it at the commencement of a snow-storm, when the snow soon furnishes it with a close warm covering. Its breath makes a small opening in the den, and the quantity of hoar frost which occasionally gathers round the aperture serves to betray its retreat to the hunter. In more southern districts, where the timber is of a larger size, bears often shelter themselves in hollow trees. The Indians remark that a bear never retires to its den for the winter until it has acquired a thick coat of fat; and it is remarkable that when it comes abroad in the spring it is equally fat, though in a few days thereafter it becomes very lean. The period of the retreat of the bears is generally about the time when the snow begins to lie on the ground, and they do not come abroad again until the greater part of the snow is gone. At both these periods they can procure many kinds of berries in considerable abundance. In latitude 65° their winter repose lasts from the beginning of October to the first or second week of May; but on the northern shores of Lake Huron the period is from two to three months shorter. In very severe winters great numbers of bears have been observed to enter the United States from the northward. It is not however true that the Black Bears generally abandon the northern districts on the approach of winter, as has been asserted, the quantity of bear-skins procured during that season in all parts of the fur-countries being a sufficient proof to the contrary. The females bring forth about the middle of January; and it is probable that the period of their gestation is about 15 or 16 weeks, but it has not been precisely ascertained. The number of cubs varies from one to five, probably with the age of the mother, and they begin to bear long before they attain their full size.

It will be observed that the period of gestation attributed to the Brown Bear is seven months. Cuvier says that they couple in June, and produce their young in January. Sixteen weeks is the probable time allotted to the American Black Bear for the same purpose by Sir John Richardson, from whom we give the above account, and who had the best opportunities of collecting evidence on the subject. The bears kept in the fosse at Berne furnished the proof of gestation for seven months; but it is so characteristic of the family for the females to conceal themselves, that in a state of nature little evidence to be depended on for its accuracy can be obtained. "No man," according to Brickell, "either Christian or Indian, ever killed a she-bear with young;" and Sir John Richardson's numerous inquiries among the Indians of Hudson's Bay ended in the discovery of only one hunter who had killed a pregnant bear.

The value attached to the skin of the Black Bear—a value very much decreased, for the skin that once fetched from 20 to 40 guineas is now hardly worth more than from 20 to 60 shillings—and the high esteem in which the Indians held their flesh, caused great havoc among them. The importation into England in 1783 amounted to 10,500 skins, and ascended gradually to 25,000 in 1803, since which time there appears to have been a considerable decline, as in a table of exports and imports of skins in Great Britain, published in the Catalogue of the Great Exhibition (vol. ii., p. 529), the number of bear-skins is 9500; of these 8000 are again exported, so that the consumption in Great Britain is only 1500 annually. It is nevertheless used for military purposes in this country, as for caps, pistol-holsters, rugs, &c. It is hence called often the Army Bear.

The Black Bear is regarded with much superstition by the Indians. The following account is given by Mr. A. Henry :—"In the course of the month of January I happened to observe that the trunk of a very large pine-tree was much torn by the claws of a bear, made both in going up and down. On further examination I saw that there was a large opening in the upper part, near which the smaller branches were broken. From these marks, and from the additional circumstance that there were no tracks in the snow, there was reason to believe that a bear lay concealed in the tree. On returning to the lodge I communicated my discovery; and it was agreed that all the family should go together in the morning to assist in cutting down the tree, the girth of which was not less than three fathoms. The women at first opposed the undertaking, because our axes being only of a pound and a half weight were not well adapted to so heavy a labour; but the hope of finding a large bear, and obtaining from its fat a great quantity of oil, an article at the time much wanted, at length prevailed. Accordingly in the morning we surrounded the tree, both men and women, as many at a time as could conveniently work at it; and there we toiled like beavers till the sun went down. This day's work carried us about half-way through the trunk, and the next morning we renewed the attack, continuing it till about two o'clock in the afternoon, when the tree fell to the ground. For a few minutes everything remained quiet, and I feared that all our expectations would be disappointed; but as I advanced to the opening there came out, to the great satisfaction of all our party, a bear of extraordinary size, which I shot. The bear being dead all my assistants approached, and all, but particularly my old mother (as I was wont to call her), took the head in their hands, stroking and kissing it several times; begging a thousand pardons for taking away her life; calling her their relation and grandmother; and requesting her not to lay the fault upon them, since it was truly an Englishman that had put her to death. This ceremony was not of long duration, and if it was I that killed their grandmother they were not themselves behindhand in what remained to be performed. The skin being taken off, we found the fat in several places six inches deep. This being divided into two parts loaded two persons, and the flesh-parts were as much as four persons could carry. In all, the carcass must have exceeded five hundred-weight. As soon as we reached the lodge the bear's head was adorned with all the trinkets in the possession of the family, such as silver arm-bands, and wrist-bands, and belts of wampum, and then laid upon a scaffold set up for its reception within the lodge. Near the nose was placed a large quantity of tobacco. The next morning no sooner appeared than preparations were made for a feast to the manes. The lodge was cleaned and swept, and the head of the bear lifted up, and a new Stroud blanket which had never been used before spread under it. The pipes were now lit, and Wawatam blew tobacco-smoke into the nostrils of the bear, telling me to do the same, and thus appease the anger of the bear on account of my having killed her. I endeavoured to persuade my benefactor and friendly adviser that she no longer had any life, and assured him that I was under no apprehension from her displeasure; but the first proposition obtained no credit, and the second gave but little satisfaction. At length the feast being ready, Wawatam made a speech resembling in many respects his address to the manes of his relations and departed companions; but having this peculiarity, that he here deplored the necessity under which men laboured thus to destroy their friends. He represented however that the misfortune was unavoidable, since without doing so they could by no means subsist. The speech ended, we all ate heartily of the bear's flesh; and even the head itself, after remaining three days on the scaffold, was put into the kettle."

The Cinnamon Bear is a variety of this species. There is a specimen in the Zoological Gardens, Regent's Park, which was presented in 1829, so that he is now at least 24 years old. His mate died in 1849. The Yellow Bear of Carolina, and the Ours Gulaire (*Ursus gularis* of Geoffroy), with a white throat, are also varieties.

U. ornatus (F. Cuvier), the Spectacled Bear, inhabits the Cordilleras of the Andes in Chile. Its fur is smooth, shining, and black, with the following exceptions :—Its short muzzle is of a dirty yellow or buff colour, and there are two semicircular marks of the same hue, reminding the observer of a pair of spectacles, above the eyes; the under parts of the throat and neck and the upper part of the breast are whitish.

U. ferox (*Danis ferox*, Gray), the Grizzle Bear of Umfreville, Grisly Bear of Mackenzie, Grizzly Bear of Warden, *Ursus cinereus* of Desmarest, *Ursus horribilis* of Say, Meesheh Musquaw or Meechee Musquaw of the Cree Indians, and *Ursus ferox* (Lewis and Clarke, who first accurately described the animal, calling it often the White Bear), is nearly double the size of the Black Bear. Cuvier however,

Spectacled Bear (*Ursus ornatus*).

in spite of its size, regarded it as a variety of *U. Arctos*. Lewis and Clarke give the measurement of one as 9 feet from the nose to the tail, and state that they had seen one of larger dimensions. Eight hundred pounds is reported to be the weight to which it attains. The length of the fore foot in one of those measured by the travellers above quoted is given as exceeding 9 inches, that of the

Grisly Bear (*Ursus ferox*).

hind foot at 11¾ without the talons, and the breadth 7 inches. The claws of the fore feet, which are a good deal longer and less curved than those of the hind feet, measured in another individual more than 6 inches. This part of its organisation is well adapted for digging, but not for climbing, and the adult Grisly Bear is said not to ascend trees. The muzzle is lengthened, narrowed, and flattened, and the canine teeth are highly developed, exhibiting a great increase of size and power. The tail is very small, and so entirely lost in the hair which covers the buttocks, that it is a standing joke among the Indian hunters, as Sir John Richardson observes, when they have killed a Grisly Bear, to desire any one unacquainted with the animal to take hold of its tail. The fur, or rather hair is abundant, long, and varying through most of the intermediate gradations between grey and blackish brown, which last is prevalent and more or less grizzled. On the muzzle it is pale and short, on the legs it is darker and coarser. The eyes are small and rather sunk in the head.

Unwieldy as this animal appears, it is capable of great rapidity of motion, and its strength is overpowering. The bison contends in vain with the Grisly Bear. The conqueror drags the enormous carcass (weighing about 1000 lbs.) to a chosen place, digs a pit for its reception, and repairs to it till the exhausted store compels him to renew the chase. And yet he will be satisfied with fruits and roots; and on his diet depends the aggravated or mitigated ferocity of his disposition. This animal is very tenacious of life. The long claws are strung into necklaces, and highly prized by the Indians as trophies of their prowess.

The following account of the habits of the Grisly Bear is given by Sir John Richardson:—"A party of voyagers who had been employed all day in tracking a canoe up the Saskatchewan had seated themselves in the twilight by a fire, and were busy in preparing their supper, when a large grisly bear sprang over the canoe that was tilted behind them, and seizing one of the party by the shoulder carried him off. The rest fled in terror, with the exception of a metif named Bourasso, who, grasping his gun, followed the bear as it was retreating leisurely with its prey. He called to his unfortunate comrade that he was afraid of hitting him if he fired at the bear, but the latter entreated him to fire immediately, without hesitation, as the bear was squeezing him to death. On this he took a deliberate aim, and discharged his piece into the body of the bear, who instantly dropped its prey to pursue Bourasso. He escaped with difficulty, and the bear ultimately retreated to a thicket, where it was supposed to have died; but the curiosity of the party not being a match for their fears the fact of its decease was not ascertained. The man who was rescued had his arm fractured, and was otherwise severely bitten, but finally recovered. I have seen Bourasso, and can add that the account which he gives is fully credited by the traders resident in that part of the country, who are best qualified to judge of its truth from their knowledge of the parties. I have been told that there is a man now living in the neighbourhood of Edmonton-house who was attacked by a grisly bear, which sprang out of a thicket, and with one stroke of its paw completely scalped him, laying bare the skull, and bringing the skin of the forehead down over the eyes. Assistance coming up, the bear made off without doing him further injury, but the scalp not being replaced the poor man has lost his sight, although he thinks his eyes are uninjured. Mr. Drummond, in his excursions over the Rocky Mountains, had frequent opportunities of observing the manners of the grisly bears, and it often happened that in turning the point of a rock or sharp angle of a valley he came suddenly upon one or more of them. On such occasions they reared on their hind legs, and made a loud noise like a person breathing quick, but much harsher. He kept his ground, without attempting to molest them; and they on their part, after attentively regarding him for some time, generally wheeled round and galloped off; though, from their known disposition, there is little doubt but he would have been torn in pieces had he lost his presence of mind and attempted to fly. When he discovered them from a distance he generally frightened them away by beating on a large tin-box in which he carried his specimens of plants. He never saw more than four together, and two of these he supposes to have been cubs; he more often met them singly, or in pairs. He was only once attacked, and then by a female, for the purpose of allowing her cubs to escape. His gun on this occasion missed fire, but he kept her at bay with the stock of it until some gentlemen of the Hudson's Bay Company, with whom he was travelling at the time, came up and drove her off. In the latter end of June, 1826, he observed a male caressing a female, and soon afterwards they both came towards him, but whether accidentally or for the purpose of attacking him he was uncertain. He ascended a tree, and as the female drew near fired at and mortally wounded her. She uttered a few loud screams, which threw the male into a furious rage, and he reared up against the trunk of the tree in which Mr. Drummond was seated, but never attempted to ascend it. The female in the meanwhile retiring to a short distance, lay down, and as the male was proceeding to join her Mr. Drummond shot him also. From the size of their teeth and claws he judged them to be about four years old. The cubs of a grisly bear can climb trees, but when the animal is fully grown it is unable to do so, as the Indians report, from the form of its claws."

The Rocky Mountains, and the plains to the eastward of them, particularly, according to Mr. Drummond, the districts which are interspersed with open prairies and grassy hills, are the chief haunts of the Grisly Bears. To the north they have been observed as far as 61° of latitude, and it is supposed that they are to be found still farther. To the south it is said that they extend as far as Mexico. There are three young specimens of this animal at present (1853) in the Gardens of the Zoological Society, Regent's Park.

Asiatic Bears.

Ursus collaris (F. Cuvier), the Siberian Bear, approaches closely to the Brown Bear (*Ursus Arctos*), and is at best a doubtful species. The hair in quality and colour is much the same with that of the Brown Bear, with the distinction of a large white collar which passes over the upper part of the back and the shoulders, and is completed upon the breast.

U. Thibetanus (*Helarctos Tibetanus*), the Tibet Bear.—M. Duvaucel discovered this species in the mountains of Sylhet, and Dr. Wallich found it in those of Nepaul. The Tibet Bear has the neck remarkably thick, and the head flattened, the forehead and muzzle forming almost a straight line. The ears are of a large size. Its clumsy limbs support a compact body, and the claws are comparatively weak. Its general colour is black; but the lower lip is white, and there is a large mark of the same colour, somewhat in the form of the letter Y, supposing the stem of the letter to be placed in the middle of the breast, and the forks to pass up in front of the shoulders. In bulk it is about intermediate between the Sloth Bear (*Prochilus labiatus*) and the Malayan Bear (*Ursus Malayanus*). Mr. Bennett, in his 'Tower Menagerie,' gives a figure and description of one which was brought

Siberian Bear (*Ursus collaris*).

from Sumatra, and could not be prevailed on to touch flesh either raw or cooked, bread and fruits forming his only food. In his disposition he was moderately tame, and particularly fond of play.

U. Isabellinus, Isabella-coloured Bear.—Dr. Horsfield first described this species from a skin forwarded from the mountains of Nepaul. The skull had been removed, but the front teeth in both jaws and the claws remained.

Tibet Bear (*Ursus Thibetanus*).

"Our animal," says Dr. Horsfield, "is of a habit decidedly different from that of several species of *Ursus* from the same part of the world, which have been recently added to the systematic catalogues, namely, the *Ursus Thibetanus*, the *Ursus labiatus*, and the *Ursus Malayanus*. All these have a jet-black fur, a semilunar mark of a white colour on the breast, and other peculiarities affording types of sub-genera, among which *Prochilus* and *Helarctos* have been defined. Our animal, on the contrary, appears to resemble the European bears in its structure, as far at least as can be determined from the parts which have been preserved in the specimen. Among these, the claws afford the best means of comparison; they are small, obtuse, and straight, while those of the Asiatic bears above mentioned are large, strongly curved, acute, and fitted for climbing." A living specimen of this species is now to be seen in the Zoological Gardens, Regent's Park. It is a native of the whole Himalayan range, and is so light-coloured as to have led to the supposition that it was another form of the White Bear.

Ursus Syriacus, the Syrian Bear.—The she-bears which came out of the wood, "and tare forty and two" of the mockers of Elisha (2 Kings ii. 23, *et seq.*), are probably the first bears on record. These bears of Syria may be occasionally traced in subsequent history. Thus Matthew Paris, in his 'England,' relates how Godfrey (Dux Godefridus), as he was riding for recreation in a neighbouring wood during the siege of Antioch (*Antiochiam Minorem*), saw a poor stranger, who was loaded with a bundle of dry wood, flying from an enraged bear, whereupon Godfrey gallantly went to the rescue, and the bear turning upon him he was unhorsed, the horse being wounded by the bear, and fought on foot, when, after a severe struggle, in which he received a most dangerous wound ("vulnus fere letiferum"), he buried his sword up to the hilt in his savage adversary, and killed him. The historian, in continuation, relates the great joy of the army at Godfrey's recovery. ('Hist. of England,' tom. ii. p. 34, folio, London, 1640.)

Syrian Bear (*Ursus Syriacus*).

The Syrian Bear frequently preys on animals, but for the most part feeds on vegetables. The fields of *Cicer arietinus* (a kind of chick-pea), and other crops near the snowy region, are often laid waste by it.

The skin is sometimes fulvous brown, and, as has been stated, sometimes fulvous white, varied with fulvous spots. These changes are supposed to have been occasioned by the abrasion of the long hair, whereby the woolly fur beneath and that of the head become exposed. Two very fine specimens of this species, a male and female, are living in the Zoological Gardens, Regent's Park.

U. labiatus (*Melursus Lybius*, Meyer), Labiated Bear or Sloth Bear. This uncouth animal, on its arrival in Europe about sixty years ago,

Sloth Bear (*Ursus labiatus*).

was taken for a Sloth and obtained the name of ***Bradypus pentadactylus*** and *Ursinus*, Five-Fingered Sloth, Sloth Bear, or Ursine Sloth. By the two last names it was formerly shown in menageries; and Bewick gave an excellent portrait of it in his 'Quadrupeds,' as "an animal which has hitherto escaped the attention of naturalists." Meyer called it a *Melursus*; and Fischer a *Chondrorhynchus*. It is the *Bradypus ursinus* of Shaw (though it bears no relation to the true sloths either in structure or habits); the *Ursus labiatus* of De Blainville; and the *Ursus longirostris* of Tiedemann; the Ours Paresseux and Ours Jongleur of the French. The short limbs, the depressed air of the head, surmounted by the hillock of a back, and the whole contour of the apparently unwieldy mass, give the idea of deformity, and make it a favourite with the Indian mountebanks or jugglers, who rely much on the attraction of its ugliness.

The cartilage of the nose is capable of extension, and the lips of considerable protrusion, as may be seen if the spectator hold a morsel of fruit or biscuit at a proper distance for exciting the animal to exert this faculty. The muzzle is elongated, and, with the ends of the feet, is whitish or yellowish. The forehead rises almost abruptly from the muzzle. The fur, with the exceptions above noticed and that next mentioned, is deep black, with here and there some brown spots, and is rather long, particularly round the head in old individuals. Upon the under side of the neck and breast is a white mark resembling the letters V or Y. In bulk it is about the size of the Brown Bear.

The food of this species in a state of nature is said to consist of fruits, honey, and the white ants, which are so destructive. It inhabits the mountainous parts of India, where its retreat is stated to be in some cavern. Major (now Colonel) Sykes noticed it in Dukhun (Deccan).

In captivity it appears to be mild, but melancholy. A pair were kept for some time in the garden of the Zoological Society. They lived very sociably, and often lay huddled together, uttering a kind of rattling but low whine, or purring, which was continuous and monotonous, but not entirely unmusical: indeed, by more than one who heard it, it was termed their song. The paw was generally at the mouth when they made this noise. A living specimen is still to be seen in the Zoological Gardens.

U. Malayanus, Raffles (*Helarctos Malayanus*, Horsfield), the Malayan Bear, the Bruang of the Malays, is jet-black, with the muzzle of a yellowish tint, and has a semilunar white mark upon the breast. Dr. Horsfield observes, that the largest prepared specimen which he had examined measured 4 feet 6 inches along the back.

Malayan Sun-Bear (*Ursus—Helarctos—Malayanus*).

The sagacity of the Malayan Bear is said to be great, and its liking for delicacies extreme. The honey of the indigenous bees of its native forests is supposed to be a favourite food; and certainly the extreme length of the tongue is well adapted for feeding on it. Vegetables form the chief diet of this bear, and it is said to be attracted to the vicinity of man by its fondness for the young shoots of the cocoa-nut trees, to which it is very injurious; indeed Sir Stamford Raffles found those of the deserted villages in the Passumah district of Sumatra destroyed by it. It has not unfrequently been taken and domesticated.

In confinement it is mild and sagacious. Sir Stamford Raffles thus describes the manners of one which appears to have been deservedly a great favourite:—

"When taken young," he says, "they become very tame. One lived for two years in my possession. He was brought up in the nursery with the children; and, when admitted to my table, as was frequently the case, gave a proof of his taste by refusing to eat any fruit but mangosteens, or to drink any wine but champagne. The only time I ever knew him to be out of humour was on an occasion when no champagne was forthcoming. It was naturally of an affectionate disposition, and it was never found necessary to chain or chastise him. It was usual for this bear, the cat, the dog, and a small blue mountain bird or lory of New Holland, to mess together, and eat out of the same dish. His favourite playfellow was the dog, whose teasing and worrying was always borne and returned with the utmost good humour and playfulness. As he grew up he became a very powerful animal, and in his rambles in the garden he would lay hold of the largest plantains, the stems of which he could scarcely embrace, and tear them up by the roots."

There are several specimens in the gardens of the Zoological Society, Regent's Park.

U. Euryspilus (*Helarctos Euryspilus* of Horsfield), the Bornean Bear, differs from the Malayan Bear principally in having a large orange-coloured patch, deeply notched at its upper part, upon the chest. In

Bornean Bear (*Ursus—Helarctos—Euryspilus*).

size it is supposed to be rather less than the last. The individual which was exhibited in the Tower of London, and from which Dr. Horsfield wrote his description, measured along the back from muzzle to tail 3 feet 9 inches. It was obtained in Borneo when very young, and during the voyage was the constant associate of a monkey and other animals. In confinement its manners greatly resembled those of the Malayan Bear. Its habits in a state of nature do not appear to be known, but are most probably similar to those of the Malayan species. Dr. Horsfield, speaking of its habits in captivity, says—"The *Helarctos* readily distinguishes the keeper, and evinces an attachment to him. On his approach it employs all its efforts to obtain food, seconding them by emitting a coarse but not unpleasant whining sound. This it continues while it consumes its food, alternately with a low grunting noise; but if teased at this time, it suddenly raises its voice and emits at intervals harsh and grating sounds. Our animal is excessively voracious, and appears to be disposed to eat almost without cessation. When in a good humour, it often amuses the spectators in a different manner. Calmly seated in its apartment, it expands the jaws, and protrudes its long and slender tongue as above described. It displays on many occasions not only much gentleness of disposition, but likewise a considerable degree of sagacity. It appears conscious of the kind treatment it receives from its keeper. On seeing him it often places itself in a variety of attitudes to court his attention and caresses, extending its nose and anterior feet, or suddenly turning round exposing the back, and waiting for several minutes in this attitude with the head placed on the ground. It delights in being patted and rubbed, and even allows strangers to do so; but it violently resents abuse and ill treatment, and having been irritated, refuses to be courted while the offending person remains in sight."

The individual whose manners are here described fell a victim to its voracity. During the hot weather of the summer of 1828 it over-gorged itself one morning, and died within ten minutes after the meal. Its skin is preserved in the Museum of the Zoological Society.

African Bears.

The existence of bears in Africa has been more than doubted. Even Cuvier, who saw the weak points of the negative evidence on this subject, says, "the existence of bears in Africa is not so indisputable."

Pliny (viii. 36) observes, that it was recorded in the Annals that Domitius Ænobarbus, the curule Ædile, in the consulship of M. Piso and M. Messala (B.C. 62) exhibited a hundred Numidian Bears, and as many Æthiopian hunters in the circus, and adds his wonder that the bears should have been called Numidian, as it was evident that no bears were produced in Africa. In the 57th chapter of the same book he makes the broad assertion that in Africa there are neither boars, nor stags, nor goats, nor bears.

"Prosper Alpinus," says Cuvier, "attributes bears to Egypt, but which were assuredly no bears at all, for he states that they are of the size of a sheep, and of a white colour. Never did one of the naturalists of our expedition see there any true bears." Bruce says positively, that there is no bear in any part of Africa.

The inclination of Cuvier's mind, seems to have been against the existence of bears in Africa; and yet the record of the annalist quoted by Pliny, and the numerous passages concerning Lybian Bears in Herodotus, Virgil, Juvenal, Martial, and others, make a strong case for their existence.

It was reserved for Ehrenberg to solve these doubts in great measure. Writing on this subject, he says—"Moreover, we ourselves have seen in the mountains of Abyssinia, and therefore in Africa itself, an animal most like to a bear (nay, why had I not said—a bear?) and hunted it repeatedly, but in vain. It is called by the natives *Karrai.*" He then goes on to state, that he can give to those who are interested in the geographical distribution of the bear, true tidings of a blackish plantigrade wild beast most like unto a bear, in the mountains of Abyssinia, though neither Bruce nor Salt make mention of it; and that, according to the description of the inhabitants, the mountains of Arabia Felix are inhabited by a similar or the same blackish bear, said to be remarkable for its lengthened muzzle. He adds, "Forskal moreover has brought tidings of an indigenous Arabian bear."

Marine Bear.

U. maritimus, Linn. (*Thalarctos maritimus*, Gray), the Polar Bear, or Ice Bear.—Martens was one of the first who distinguished this

Polar Bear (*Ursus—Thalarctos—maritimus*).

species from actual observation. The Brown Bear, as has been stated, appears to have been the only species known to Linnæus. It is not indeed till his 10th edition that he shows any suspicion that the Polar Bear was distinct; and in his last he only ventures to say, in a notice appended to the description of *Ursus Arctos*, "Ursus *maritimus* albus major arcticus. Martens. *Spitzb.* 73. t. o. f. c. forte distincta species est. nobis non visa, capite longiore, collo angustiore."

The habits, and many parts of its organisation adapted to those habits, of the Polar or Sea Bear, l'Ours Polaire of the French, *Ursus maritimus* of Erxleben, *Ursus marinus* of Pallas, *Ursus albus* of Brisson, *Thalarctos maritimus* of Gray, according to the testimony of all zoologists, have confirmed the accuracy of Martens.

An inhabitant of the dreary regions which surround the North Pole with eternal frost, and of those coasts which are rarely free from ice, the Polar Bear is almost entirely carnivorous, in a state of nature. Animals of the land and of the sea, birds and their eggs, the dead and the living, are alike devoured. An admirable swimmer and diver, and of great strength, he chases the seal with success, and is said to attack the walrus itself. Cartwright relates an anecdote in proof of his agility in the water. He saw a Polar Bear dive after a salmon, and the bear dived with success, for he killed his fish. Captain Lyon gives the following account of its hunting the seal:—"The bear on seeing his intended prey, gets quietly into the water, and swims until to leeward of him, from whence, by frequent short dives he silently makes his approaches, and so arranges his distance, that at the last dive he comes to the spot where the seal is lying. If the poor animal attempts to escape by rolling into the water, he falls into the bear's clutches; if on the contrary he lies still, his destroyer makes a powerful spring, kills him on the ice, and devours him at leisure." The same author informs us that this bear not only swims with rapidity, but is capable of making long springs in the water. Sabine states that he saw one about midway between the north and south shores of Barrow's Straits, which are 40 miles apart, though there was no ice in sight to which he could resort for rest.

The floating carcasses of whales and other marine animals form a considerable part of its food, and the smell of the burning kreng often brings it to the whale ships. Sir John Richardson says, that it does not disdain, in the absence of other food to seek the shore in quest of berries and roots. The Polar Bear moves faster on firm ground than might be supposed from his appearance. Captain Lyon describes its pace when at full speed, as "a kind of shuffle, as quick as the sharp gallop of a horse."

This species is of a more lengthened form than that of the others, the head is very much elongated and flattened, the ears and mouth comparatively small, the neck very long and thick, and the sole of the foot very large. The fur is silvery-white tinged with yellow, close short and even on the head, neck, and upper part of the back; long fine and inclined to be woolly on the hinder parts, legs, and belly. The sole of the foot exhibits a beautiful instance of adaptation of means to an end, for it is almost entirely covered with long hair, affording the animal a firm footing on the ice. The claws are black, not much curved, thick and short. Captain Lyon's crew found none of the terrible effects (skin peeling off, &c., &c.) from eating the flesh, ascribed to it by some of the earlier voyagers.

The accounts given of the size, strength, and ferocity of this animal by the early navigators are appalling; but the accuracy of modern investigation has dissipated a good deal of the awe with which it was regarded, and has gone far to prove, that the excited imagination of some of the narrators has led them beyond the truth.

The gallant adventurers who conducted the modern northern expeditions penetrated far beyond the points formerly reached, and had opportunities of observing numbers of Polar Bears. The greatest length from nose to tail, recorded by Captain Phipps, is 7 feet 1 inch, the weight of the beast being 610 pounds. Sir John Ross records the measurement of 7 feet 10 inches, and the weight of 1160 pounds; and Captain Lyon states, that one which was unusually large measured 8 feet 7½ inches, and weighed 1600 pounds. The greater number of full grown individuals are spoken of as far inferior to these in dimensions and weight.

Two very fine specimens are at present living in the gardens of the Zoological Society, Regent's Park.

Pennant states that Polar Bears are frequent on all the Asiatic coasts of the Frozen Ocean, from the mouth of the Obi eastward, and that they abound in Nova Zembla, Cherry Island, Spitzbergen, Greenland, Labrador, and the coasts of Baffin's and Hudson's bays, but that they are unknown on the shores of the White Sea. Sir Edward Parry saw them within Barrow's Straits as far as Melville Island; and, during his daring boat-voyage, beyond 82° N. lat. Sir John Richardson says, that the limit of their incursions southward on the shores of Hudson's Bay and of Labrador, may be stated to be about the 55th parallel. Sir John Franklin learnt from the Esquimaux to the westward of Mackenzie River, that they occasionally, though rarely, visited that coast. Captain Beechey did not meet with any in his voyage to Icy Cape.

As the Polar Bear resides principally on the fields of ice, he is frequently drifted far from the land. "In this way," says Sir John Richardson, "they are often carried from the coast of Greenland to Iceland, where they commit such ravages on the flocks that the inhabitants rise in a body to destroy them."

The Esquimaux account of the hybernation of this species is thus related by Captain Lyon:—

"At the commencement of winter the pregnant she-bears are very fat, and always solitary. When a heavy fall of snow sets in, the animal seeks some hollow place in which she can lie down, and then remains quiet while the snow covers her. Sometimes she will wait until a quantity of snow has fallen, and then digs herself a cave: at all events, it seems necessary that she should be covered by and lie amongst snow. She now goes to sleep, and does not wake until the spring sun is pretty high, when she brings forth her two cubs. The cave, by this time, has become much larger, by the effect of the animal's warmth and breath, so that the cubs have room enough to move, and they acquire considerable strength by continually sucking. The dam at length becomes so thin and weak, that it is with great difficulty she extricates herself, when the sun is powerful enough to throw a strong glare through the snow which roofs the den. The Esquimaux affirm, that during this long confinement the bear has no evacuations, and is herself the means of preventing them by stopping all the natural passages with moss, grass, or earth. The natives find and kill the bears during their confinement by means of dogs, which scent them through the snow, and begin scratching and howling very eagerly. As it would be unsafe to make a large opening, a long trench is cut, of sufficient width to enable a man to look down, and see where the bear's head lies, and he then selects a mortal part into which he thrusts his spear. The old one being killed, the hole is broken open, and the young cubs may be taken out by hand, as, having tasted no blood, and never having been at liberty, they are then very harmless and quiet. Females which are not pregnant roam throughout the whole winter in the same manner as the males. The coupling time is in May."

That part of these accounts which relates to the non-hybernation of some of these bears is corroborated by Sir Edward Parry, who saw them roaming in the course of the two winters which he passed on the coast of Melville Peninsula.

That the Polar Bear will subsist on vegetable diet was proved in the case of two which lived and throve for years in the French menagerie without being allowed to touch animal food. The individual kept in the Tower in the reign of Henry III. seems to have been indulged in diet and recreation more congenial to its habits, for there are two of the king's writs extant in choice Latin, directing the sheriffs of London to furnish four-pence a day for "our white bear in our Tower of London, and his keeper," and to provide a muzzle and iron-chain to hold him when out of the water, and a long and strong rope to hold him when he is fishing in the Thames. (Madox, 'Exchequer Writs.')

Fossil Bears.

The fossil remains of these animals, when first found, ministered, as might have been expected from the spirit of the age, to the speculations of the lovers of the marvellous, and figured in the medical prescriptions of the time. The caverns of the neighbourhood of the Harz were ransacked for them; and their supposed virtue as medicines, under the title of fossil Unicorns' Bones, procured a ready sale. In the 'Protogæa' of Leibnitz, there is a figure of one of these fossil unicorns, the product of an imagination sufficiently lively.

But it was not till the year 1672, as Cuvier observes, that any notice, truly osteological, appeared on the subject, when Hayn gave some representations of their bones brought from a cave of the Carpathians, as those of dragons; and, by way of helping the evidence, informed his readers that there were still to be found in Transylvania dragons alive and flying.

These were the remains of the extinct Bear of the Caves (*Ursus spelæus*), an animal which must have been the largest species of the genus. Rosenmüller, in 1794 and 1795, gave the figure of a cranium from Gailenreuth; and John Hunter, in the 'Philosophical Transactions' (1794), described the bones found there; and the Margrave of Anspach the caves.

Blumenbach distinguished the skulls found in the caverns as those of two distinct species, and gave them severally the names of *Ursus spelæus* and *Ursus arctoideus*, which Cuvier adopted, expressing however his opinion that they were only varieties of the same species. Goldfuss described a species as *U. priscus* from the same remains.

The principal caverns in which these remains have been found are those of Scharzfeld and Baumann, the latter of which owes its name (Baumann's Höhle) to a wretched miner, who in 1670 lured by the hope of finding ore sought its recesses. There he wandered, alone and in darkness, three days and three nights. At length he found his way out, but in so exhausted a condition, that he only returned to the light of day to die.

The caverns of the Carpathians supplied the dragons' bones above mentioned.

In Franconia, near Muggendorf, the caves are numerous, and abound in bones. Here are the caverns of Gailenreuth, Rabenstein, Kühloch, &c.

The south-west border of the Thuringerwald has those of Glücksbrunn and Leibenstein, near Meinungen, and Westphalia those of Klüterhöhle and Sundwick.

In England the remains of Bears have been found in the largest numbers in Kent's Hole, near Torquay. They have also been found in Tertiary deposits at Grays in Essex, Bacton in Norfolk, in the valley of the Severn near Tewkesbury, the Manea Fen in Cambridgeshire, at Newbourn in Suffolk, and in other places. Professor Owen, in his 'History of British Fossil Mammals,' refers these remains to *U. Arctos*, *U. priscus*, and *U. spelæus*. He doubts the existence of the fossil species *U. arctoideus* and *U. planus*. Dr. Buckland ('Reliquiæ Diluvianæ') thus describes the scene in the cavern of Kühloch:—"It is literally true, that in this single cavern (the size and proportions of which are nearly equal to those of the interior of a large church) there are hundreds of cart-loads of black animal dust, entirely covering the whole floor, to a depth which, if we multiply this depth by the length and breadth of the cavern, will be found to exceed 5000 cubic feet. The whole of this mass has been again and again dug over in search of teeth and bones, which it still contains abundantly, though in broken fragments. The state of these is very different from that of the bones we find in any of the other caverns, being of a black, or, more properly speaking, dark umber-colour throughout, and many of them readily crumbling under the finger into a soft dark powder, resembling mummy powder, and being of the same nature with the black earth in which they are imbedded. The quantity of animal matter accumulated on this floor is the most surprising and the only thing of the kind I ever witnessed; and many hundred, I may say thousand, individuals must have contributed their remains to make up this appalling mass of the dust of death. It seems, in great part, to be derived from comminuted and pulverised bone; for the fleshy parts of animal bodies produce, by their decomposition, so small a quantity of permanent earthy residuum, that we must seek for the origin of this mass principally in decayed bones. The cave is so dry, that the black earth lies in the state of loose powder, and rises in dust under the feet: it also retains so large a proportion of its original animal matter, that it is occasionally used by the peasants as an enriching manure for the adjacent meadows." The following is added by Dr. Buckland in a note:—" I have stated, that the total quantity of animal matter that lies within this cavern cannot be computed at less than 5000 cubic feet. Now, allowing two cubic feet of dust and bones for each individual animal, we shall have in this single vault the remains of at least 2500 bears, a number which may have been supplied in the space of 1000 years, by a mortality at the rate of 2½ per annum."

The remains of *Ursus spelæus* have been found near Steyer, in Upper Austria. Necker de Saussure found them also in the clefts of the rocks containing iron ore at Kropp, in Carniola.

The remains of bears have been detected generally in the ossiferous caverns of the south of France. The bones found in the largest proportion at the Grotte d'Echenoz, on the south of Vesoul, by M. Thirria, and examined by Cuvier, were those of *Ursus spelæus*. Bones of bears have been also found in the osseous breccia at Pisa, Nice, &c.

Ursus spelæus (Blumenbach), Great Cavern Bear. The skull of this extinct species is considerably raised above the root of the nose, so that the forehead, which presents two convex elevations, is a good deal curved. Its size is about one-fifth larger than the largest of those of the Brown Bear (*Ursus Arctos*), or of the Polar Bear.

U. priscus (Goldfuss), has a smaller skull, and differs less from the crania of living bears than that of the preceding species.

We ought not perhaps to conclude this article without referring to those hybrids which were supposed to be the offspring engendered between a dog and a bear. Even at the present day there is an inclination to believe in the existence of such animals, but we need hardly observe that it is extremely improbable, to use no stronger term, that two animals differing so widely in their dentition and general structure, in the periods of gestation and in their habits, should produce a mule. An account of such a creature is given in the 'Histoires Prodigieuses extraictes de plusieurs Fameux Auteurs, Grecs et Latins, sacrez et prophanes, divisées en Cinq Tomes, le Premier par P. Boaistuau, Tome Premier, Paris, 1582.' A drawing of the animal is also given, of which we present a copy.

This animal the author states he saw in England in the reign of Elizabeth, but the probability is that the author was deceived by the English bear-wards and dog-fighters of Elizabeth's time, and that some dog, selected for its bear-like appearance in certain points, an appearance aided by cropping the ears and tail, and other skilful artifices, was palmed upon him and upon others as a hybrid engendered between a dog and a bear. [*See* SUPPLEMENT.]

BEAR-BERRY. [ARCTOSTAPHYLOS.]

BEAR'S FOOT. [HELLEBORUS.]

BEARDIE. [COBITIS.]

BEAUMONTITE, a mineral, a hydrous crenato-silicate of Copper, containing 15·8 per cent. of crenic acid. It is of a bluish-green to greenish-white colour, and pulverulent when dry. It is found at Chessy, dep. of Rhône, in France. (Dana, *Manual of Mineralogy*.)

BEAVER, the English name for the genus *Castor* (Cuvier), one of the order of rodent or gnawing animals (*Rodentia*, Cuvier, *Glires*, Linnæus), with 2 incisors, or cutting teeth, and 8 molars in each jaw, 20 in all; and particularly distinguished from all the rest of that order by a broad horizontally-flattened tail, which is nearly oval, and covered with scales. There are five toes on each of the feet, but those of the hinder ones only are webbed, the webs extending beyond the roots of the nails. The second toe of these last is furnished with a double nail, or rather with two, one like those of the other toes, and another beneath it, situated obliquely with a sharp edge directed downwards. There is also, as Sir John Richardson observes, a less perfect double nail on the inner toe of the hind feet.

The incisor teeth of the Beaver are broad, flattened, and protected anteriorly by a coat of very hard orange-coloured enamel, the rest of the tooth being of a comparatively soft substance, whereby a cutting chisel-like edge is obtained; and indeed, no edge tool, with all its combinations of hard and soft metal, could answer the purpose better. In fact, the beaver's incisor tooth is fashioned much upon the same principle as that followed by the tool-maker, who forms a cutting instrument by a skilful adaptation of hard and soft materials till he produces a good edge.

But the natural instrument has one great advantage over the artificial tool; for the former is so organised that as fast as it is worn away by use a reproduction and protrusion from the base takes place, and thus the two pairs of chisel-teeth working opposite to each other are always kept in good repair, with their edges at the proper cutting angle. When injury or disease destroys one of these incisors, its antagonist, meeting with no check to resist the protrusion from behind, is pushed forward into a monstrous elongation. So hard is the enamel, and so good a cutting instrument is the incisor tooth of the Beaver, that when fixed in a wooden handle, it was, according to Sir John Richardson, used by the Northern Indians to cut bone, and fashion their horn-tipped spears, &c., till it was superseded by the introduction of iron, when the beaver-tooth was supplanted by the English file.

The power of these natural tools is well described by Lewis and Clarke, who saw their effects on the banks of the Missouri. "The ravages of the beaver," say they, "are very apparent; in one place the timber was entirely penetrated for a space of three acres in front on the river, and one in depth, and great part of it removed, although the trees were in large quantities, and some of them as thick as the body of a man."

Sir John Richardson thus speaks of this part of their operations:— "When the beaver cuts down a tree it gnaws it all round, cutting it however somewhat higher on the one side than the other, by which the direction of its fall is determined. The stump is conical, and of such a height as a beaver sitting on his hind quarters could make. The largest tree I observed cut down by them, was about the thickness of a man's thigh (that is 6 or 7 inches in diameter), but Mr. Graham says that he has seen them cut down a tree which was 10 inches in diameter." Beavers have no canine teeth.

Castor Fiber of Linnæus (*Castor Americanus* of F. Cuvier), the American Beaver, is the animal of whose sagacity, and even social polity, such wonderful tales have been told. The best account of this animal is that given by Hearne:—

American Beaver (*Castor Fiber*).

"The beaver," he says, "being so plentiful, the attention of my companions was chiefly engaged on them, as they not only furnished delicious food, but their skins proved a valuable acquisition, being a principal article of trade, as well as a serviceable one for clothing. The situation of the beaver-houses is various. Where the beavers are numerous they are found to inhabit lakes, ponds, and rivers, as well as those narrow creeks which connect the numerous lakes with which this country abounds; but the two latter are generally chosen by them when the depth of water and other circumstances are suitable, as they have then the advantage of a current to convey wood and other necessaries to their habitations, and because, in general, they are more difficult to be taken than those that are built in standing water. They always choose those parts that have such a depth of water as will resist the frost in winter, and prevent it from freezing to the bottom. The beavers that build their houses in small rivers or creeks, in which water is liable to be drained off when the back supplies are dried up by the frost, are wonderfully taught by instinct to provide against that evil by making a dam quite across the river, at a convenient distance from their houses. The beaver-dams differ in shape according to the nature of the place in which they are built. If the water in the river or creek have but little motion the dam is almost straight; but when the current is more rapid it is always made with a considerable curve, convex towards the stream. The materials made use of are drift-wood, green willows, birch, and poplars, if they can be got; also mud and stones intermixed in such a manner as must evidently contribute to the strength of the dam; but there is no other order or method observed in the dams, except that of the work being carried on with a regular sweep, and all the parts being made of equal strength. In places which have been long frequented by beavers undisturbed, their dams, by frequent repairing, become a solid bank, capable of resisting a great force both of water and ice; and as the willow, poplar, and birch generally take root and shoot up, they by degrees form a kind of regular planted hedge, which I have seen in some places so tall that birds have built their nests among the branches.

"The beaver-houses are built of the same materials as their dams, and are always proportioned in size to the number of inhabitants, which seldom exceeds four old and six or eight young ones; though by chance I have seen above double the number. Instead of order or regulation being observed in rearing their houses, they are of a much ruder structure than their dams; for, notwithstanding the sagacity of these animals, it has never been observed that they aim at any other convenience in their houses than to have a dry place to lie on; and there they usually eat their victuals, which they occasionally take out of the water. It frequently happens that some of the large houses are found to have one or more partitions, if they deserve that appellation, but it is no more than a part of the main building left by the sagacity of the beaver to support the roof. On such occasions it is common for those different apartments, as some are pleased to call them, to have no communication with each other but by water; so that in fact, they may be called double or treble houses, rather than different apartments of the same house. I have seen a large beaver-house built in a small island that had near a dozen apartments under one roof; and, two or three of these only excepted, none of them had any communication with each other but by water. As there were beavers enough to inhabit each apartment, it is more than probable that each family knew their own, and always entered at their own doors, without any further connection with their neighbours than a friendly intercourse, and to join their united labours in erecting their separate habitations, and building their dams where required. Travellers who assert that the beavers have two doors to their houses, one on the land side and the other next the water, seem to be less acquainted with these animals than others who assign them an elegant suite of apartments. Such a construction would render their houses of no use, either to protect them from their enemies, or guard them against the extreme cold of winter.

"So far are the beavers from driving stakes into the ground when building their houses, that they lay most of the wood crosswise, and nearly horizontal, and without any other order than that of leaving a hollow or cavity in the middle. When any unnecessary branches project inward they cut them off with their teeth, and throw them in among the rest, to prevent the mud from falling through the roof. It is a mistaken notion that the wood-work is first completed and then plastered; for the whole of their houses, as well as their dams, are, from the foundation, one mass of mud and wood mixed with stones, if they can be procured. The mud is always taken from the edge of the bank, or the bottom of the creek or pond near the door of the house; and though their fore paws are so small, yet it is held close up between them under their throat: thus they carry both mud and stones, while they always drag the wood with their teeth. All their work is executed in the night, and they are so expeditious that in the course of one night I have known them to have collected as much as amounted to some thousands of their little handsful. It is a great piece of policy in these animals to cover the outside of their houses every fall with fresh mud, and as late as possible in the autumn, even when the frost becomes pretty severe, as by this means it soon freezes as hard as a stone, and prevents their common enemy, the wolverene, from disturbing them during the winter; and as they are frequently seen to walk over their work, and sometimes to give a flap with their tail, particularly when plunging into the water, this has without doubt given rise to the vulgar opinion that they use their tails as a trowel, with which they plaster their houses; whereas that flapping of the tail is no more than a custom which they always preserve, even when they become tame and domestic, and more particularly so when they are startled.

"Their food consists of a large root, something resembling a cabbage-stalk, which grows at the bottom of the lakes and rivers. [*Nuphar lutea*, according to Sir J. Richardson, the common yellow water-lily.] They also eat the bark of trees, particularly those of the poplar, birch, and willow; but the ice preventing them from getting to the land in the winter, they have not any barks to feed on in that season, except that of such sticks as they cut down in summer, and throw into the water opposite the doors of their houses; and as they generally eat a great deal, the roots above mentioned constitute a principal part of their food during the winter. In summer they vary their diet by eating various kinds of herbage, and such berries as grow near their haunts during that season. When the ice breaks up in the spring the beavers always leave their houses, and rove about until a little before the fall of the leaf, when they return again to their old habitations, and lay in their winter-stock of wood. They seldom begin to repair their houses till the frost commences, and never finish the outer coat till the cold is pretty severe, as hath been already mentioned. When they erect a new habitation they begin felling the wood early in the summer, but seldom begin to build until the middle or latter end of August, and never complete it till the cold weather be set in.

"Persons who attempt to take beaver in winter should be thoroughly acquainted with their manner of life, otherwise they will have endless trouble to effect their purpose, because they have always a number of holes in the banks, which serve them as places of retreat when any injury is offered to their houses, and in general it is in those holes that they are taken. When the beavers which are situated in a small river or creek are to be taken, the Indians sometimes find it necessary to stake the river across, to prevent them from passing; after which they endeavour to find out all their holes or places of retreat in the banks. This requires much practice and experience to accomplish, and is performed in the following manner:—Every man being furnished with an ice-chisel, lashes it to the end of a small staff about four or five feet long; he then walks along the edge of the banks, and keeps knocking his chisel against the ice. Those who are acquainted with that kind of work well know by the sound of the ice when they are opposite to any of the beavers' holes or vaults. As soon as they suspect any, they cut a hole through the ice big enought to admit an old beaver, and in this manner proceed till they have found out all their places of retreat, or at least as many of them as possible. While the principal men are thus employed, some of the understrappers and the women are busy in breaking open the house, which at times is no easy task, for I have frequently known these houses to be 5 or 6 feet thick, and one in particular was more than 8 feet thick in the crown. When the beavers find that their habitations are invaded, they fly to their holes in the banks for shelter; and on being perceived by the Indians, which is easily done by attending to the motion of the water, they block up the entrance with stakes of wood, and then haul the beaver out of its hole, either by hand, if they can reach it, or with a large hook made for that purpose, which is fastened to the end of a long stick. In this kind of hunting, every man has the sole right to all the beavers caught by him in the holes or vaults; and as this is a constant rule, each person takes care to mark such as he discovers by sticking up a branch of a tree, by which he may know them. All that are caught in the house are the property of the person who finds it. The beaver is an animal which cannot keep under water long at a time, so that when their houses are broken open, and all their places of retreat discovered, they have but one choice left, as it may be called, either to be taken in their house or their vaults; in general they prefer the latter, for where there is one beaver caught in the house, many thousands are taken in the vaults in the banks. Sometimes they are caught in nets, and in summer very frequently in traps.

"In respect to the beavers dunging in their houses, as some persons assert, it is quite wrong, as they always plunge into water to do it. I am the better enabled to make this assertion from having kept several of them till they became so domesticated as to answer to their name, and follow those to whom they were accustomed in the same manner as a dog would do, and they were as much pleased at being fondled as any animal I ever saw. In cold weather they were kept in my own sitting-room, where they were the constant companions of the Indian women and children, and were so fond of their company that when the Indians were absent for any considerable time, the beaver discovered great signs of uneasiness, and on their return showed equal marks of pleasure by fondling on them, crawling into their laps, lying on their backs, sitting erect like a squirrel, and behaving like children who see their parents but seldom. In general during the winter they lived on the same food as the women did, and were remarkably fond of rice and plum-pudding; they would eat patridges and fresh venison very freely, but I never tried them with fish, though I have heard they will at times prey on them. In fact there are few graminivorous animals that may not be brought to be carnivorous."

Mr. Broderip, in his 'Note-Book of a Naturalist,' p. 1, gives an interesting account of the manners and habits of a pet Beaver during its captivity. It manifested the same instincts, though exercised upon very different materials, as those described so graphically in the above passage from Hearne.

Little need be said of the value of the fur of the Beaver in commerce, a value greatly heightened by the proclamation of Charles I. in 1638, expressly prohibiting the use of any materials except beaver-stuff or beaver-wool in the manufacture of hats, and forbidding the making of the hats called 'demi-castors,' unless for exportation. This proclamation was an almost exterminating death-warrant to the poor beavers. They were speedily swept away from the more southern colonies, and the traffic became for the most part confined to Canada and Hudson's Bay. The havoc made amongst them, even at that period, may be imagined by an inspection of the imports of 1743. In that year the Hudson's Bay Company offered for sale 26,750 beaver-skins, and in the same year 127,080 were imported into Rochelle. These, it will be remembered, are only the legal returns, making no allowance for smuggling. In 1788 upwards of 170,000 were exported from Canada, and in 1808 126,927 were sent from Quebec alone to this country. The value of these last has been estimated at 118,994*l.* 1*s.* 3*d.* sterling, at an average of 18*s.* 9*d.* for each skin. These numbers, as might be expected, could not be kept up without almost total extermination; and we find, accordingly, that in 1827 the importation into London from a fur country of more than four times the extent of that which was occupied in 1743 was but little beyond 50,000. At the present time (1853) about 60,000 beaver-skins are annually imported into this country, of which 12,000 are again exported. Many other materials are now employed for making hats.

The Beaver, although some have considered it another species, is an inhabitant of Europe. The earliest notice of the European Beaver (κάστωρ) is in Herodotus (book iv. c. 109), who describes it as inhabiting a large lake in the country of the Budini, a nation whom he places on the east side of the Upper Don (iv. 21). He says that the skin was used for clothing. Aristotle (book viii. c. 5) mentions the European

Beaver under the name of κάστωρ, but only mentions it; while Pliny (viii. 30, and xxxii. 3, &c.) well describes it, and is diffuse on the subject of the celebrated Castoreum, so much valued as a medicine among the ancients, and which long held a high place in the Materia Medica of the moderns, causing the persecution of this unfortunate animal before its fur became an object of traffic. Pliny points out the frauds of dealers, but shows that he did not know what the castoreum really was. "Castorea testes eorum," writes Pliny (book xxxii. c. 3), and the ancients inform us that the animal used to bite off the part when hunted, well knowing that with the possession of the desired castorea the persecution would cease. This however is untrue, as it would be utterly impossible for the animal to do so if it wished. Cuvier gives the following account of the organs which secrete this substance:—"De grosses poches glanduleuses qui aboutissent à leur prépuce produisent une pommade d'une odeur forte, employée en médicine sous le nom de castoreum." Sir John Richardson thus speaks of this substance: "I have not had an opportunity of dissecting a beaver, but I was informed by the hunters that both males and females are furnished with one pair of little bags containing castoreum, and also with a second pair of smaller ones betwixt the former and the anus, which are filled with a white fatty matter, of the consistence of butter and exhaling a strong odour. This latter substance is not an article of trade; but the Indians occasionally eat it, and also mingle a little with their tobacco when they smoke. I did not learn the purpose that this secretion is destined to serve in the economy of the animal; but from the circumstance of small ponds when inhabited by beavers being tainted with its peculiar odour, it seems probable that it affords a dressing to the fur of these aquatic animals. The castoreum in its recent state has an orange-colour, which deepens as it dries into bright reddish-brown. During the drying, which is allowed to go on in the shade, a gummy matter exudes through the sack, which the Indians delight in eating. The male and female castoreum is of the same value, ten pairs of bags of either kind being reckoned to an Indian as equal to one beaver-skin. The castoreum is never adulterated in the Fur Countries."

The same traveller says that the call of the beaver in the pairing season is a kind of groan, and gives the following as the dimensions of a full-grown beaver killed at Great Slave Lake, and now in the museum of the Zoological Society:—

	Inches.	Lines.
Length of head and body	40	0
" head alone	7	3
" tail, scaly part	11	6
Distance from tip of nose to anterior part of eye	2	10
Distance from the posterior part of the orbit to anterior part of the ear	2	5

He also gives the following account of the flesh, which, as much has been said of its delicacy as food, is interesting:—"The flesh of the beaver is much prized by the Indians and Canadian Voyageurs, especially when it is roasted in the skin, after the hair has been singed off. In some districts it requires all the influence of the fur trader to restrain the hunters from sacrificing a considerable quantity of beaver fur every year to secure the enjoyment of this luxury; and Indians of note have generally one or two feasts in the season, wherein a roasted beaver is the prime dish. It resembles pork in its flavour, but the lean is dark-coloured, the fat oily, and it requires a strong stomach to sustain a full meal of it. The tail, which is considered a great luxury, consists of a gristly kind of fat, as rich but not so nauseating as the fat of the body."

Pennant says that the geographical range of the American Beaver commences in latitude 60° or about the River of Seals, in Hudson's Bay, and terminates in latitude 30° in Louisiana; but Say places their limit at the confluence of the Ohio and Mississippi, about seven degrees farther to the northward of Pennant's southern boundary. Richardson observes that their most northern point is probably on the banks of the Mackenzie (the largest American river that falls into the Polar Sea, and the best wooded, owing to the quantity of alluvial soil by which it is bordered), as high as 67½° or 68° N. lat.; and that they extend east and west from one side of the continent to the other, with the exception of the barren districts. He further states that they are pretty numerous to the northward of Fort Franklin, and that, from the swampy and impracticable nature of the country, they are not likely to be soon eradicated there.

The following varieties of the American Beaver have been noticed:—

Var. α. *C. F. nigra*, the Black Beaver.

Var. β. *C. F. varia*, the Spotted Beaver. They have a large white spot on their breasts.

Var. γ. *C. F. alba*, the White Beaver. This variety is an albino.

The Little Beaver is the *Castor Zibethicus* of Linnæus, *Fiber Zibethicus* of Cuvier, *Ondatra* of Lacépède, the Musk-Rat of Canada, and Musquash of the Cree Indians. [MUSQUASH.]

F. Cuvier has pointed out some slight differences in the skulls of the European and American beavers which he had examined for the purpose of showing that they are distinct. Baron Cuvier, in the last edition of his 'Règne Animal,' expresses his uncertainty, notwithstanding scrupulous comparison, whether the beavers which live in burrows along the banks of the Rhône, the Danube, the Weser, and other rivers, are especially different from those of America, or whether their vicinity to man is the cause that hinders them from building. He does not appear to have been aware of the colony described by M. de Meyerinck in the 'Transactions of the Berlin Natural History Society' for 1829, as having been settled for more than a century on the small river Nuthe, a short distance above its confluence with the Elbe in a lonely canton of the Magdeburg district. This little association, it appears, amounted in 1822 to 15 or 20 individuals only; but they were co-operative and industrious beyond what might have been expected from their numbers. Burrows of thirty or forty paces in length on a level with the river, having one opening beneath the surface and another on land; huts eight or ten feet high, formed of branches and trunks of trees laid irregularly and covered with earth; and a dyke of the same materials, so well wrought that it raised the water more than a foot, were the results of the persevering and ingenious labours of the little band.

The American Beaver near the settlements at the present day is sad and solitary like the European Beaver; his works have been swept away, his associations broken up, and he burrows in the same manner. Such beavers are called Terriers. Pennant indeed mentions them as a variety which wants either the sagacity or the industry of others; but he is much nearer the truth when he says, in the same paragraph, "Beavers which escape the destruction of a community are supposed often to become Terriers." They are also called Old Bachelors.

The following anecdote, related by Geoffroy St. Hilaire in the 12th volume of the 'Mémoires du Muséum d'Histoire Naturelle,' shows that the European Beaver has the same sagacity as its transatlantic brethren. One of these beavers from the Rhône was confined in the Paris menagerie. Fresh branches were regularly put into his cage, together with his food, consisting of legumes, fruits, &c., to amuse him during the night, and minister to his gnawing propensity. He had only litter to shield him from the frost, and the door of his cage closed badly. One bitter winter-night it snowed, and the snow had collected in one corner. These were all his materials, and the poor beaver disposed of them to secure himself from the nipping air. The branches he interwove between the bars of his cage, precisely as a basket-maker would have done. In the intervals he placed his litter, his carrots, his apples, his all, fashioning each with his teeth so as to fit them to the spaces to be filled. To stop the interstices he covered the whole with snow, which froze in the night, and in the morning it was found that he had thus built a wall which occupied two-thirds of the doorway.

That the Beaver was formerly an inhabitant of the British Islands there is no doubt. Giraldus Cambrensis gives a short account of their manners in Wales; but, even in his time (he travelled there in 1188), they were only found on the river Teify. "Two or three waters in that principality," says Pennant, "still bear the name of Llyn yr Afange, or the Beaver Lake. * * * I have seen two of their supposed haunts; one in the stream that runs through Nant Francon, the other in the river Conwy, a few miles above Llanrwst; and both places, in all probability, had formerly been crossed by beaver-dams. But we imagine they must have been very scarce even in earlier times. By the laws of Howelda the price of a beaver's skin was fixed at 120 pence—a great sum in those days."

The Beaver also appears to have existed in Scotland. Boethius enumerates the Beavers, 'fibri,' among the animals which abounded in and about Loch Ness, and whose furs were in request for exportation towards the end of the 15th century. Dr. Walker, in his 'Mammalia Scotica,' states, on the authority of Giraldus, that Beavers formerly existed in Scotland. Tradition refers the name and arms of the town of Beverley in Yorkshire to the fact of Beavers having abounded in the neighbouring river Hull. (Owen, 'British Fossil Mammals.')

Fossil Beavers.

M. Gothelf de Fischer was the first to announce the existence of the remains of an extinct animal allied to the Beaver. These remains, consisting of a fossil cranium, were discovered on the sandy borders of the Sea of Azof. Cuvier admitted the specific distinctness of this animal, and adopted the name *Castor trogontherium*. Professor Owen, in his history of 'British Fossil Mammals,' describes the structure of the teeth in this animal from a specimen in the collection of John Hunter in the Royal College of Surgeons of England, which was found in Walker's Cliff, Norfolk, and from a specimen in the possession of Sir Charles Lyell found in the Norwich Crag at Cromer. From an examination of these specimens Professor Owen was enabled to add considerably to the details of our knowledge of the structure of this animal. On this ground he proposes to constitute for this species a new subgenus, and to call it *Trogontherium Cuvieri*. From the character of the remains of the *Trogontherium*, Professor Owen concludes that it must have been much larger than the European Beaver. That the European Beaver is distinct, and not the degenerate descendant of the great *Trogontherium*, is proved by the fact that the remains of beavers in no respect differing either in size or in anatomical characters from the *Castor Fiber* of the present day co-existed with the *Trogontherium*.

Remains of the Common Beaver have been discovered by Mr. Green, in company with the extinct Mammoth, in the lacustrine formations at

Bacton. Remains of the Beaver have also been found in the cliffs at Mundesley, and in the oyster-bed at Happisburg in Norfolk; also in the fluvio-marine crag at Thorpe in Suffolk, and from a formation earlier still in the fluvio-marine crag at Sizewell Gap near Southwold, Suffolk. M. Fischer also received the remains of another Beaver with those of *Trogontherium* from near the lake of Rostoff, in the department of Jarosslow, and which he called *Trogontherium Werneri*, but which Cuvier recognised as the remains of the Common Beaver.

BECCAFI'CO, the Italian name for *Beccafigo*, or Fig-Eater; *Becfigue* of the French; *Ficedula* of the Romans; and Συκαλὶς of the Greeks. Prince Bonaparte, in his 'Specchio Comparativo,' observes that this name is applied to different birds of the genus *Sylvia* (Sylvan Warblers), whenever they are fat, and in a good state for the table. They are generally fruit-eaters in the season; but the true *Beccafico*, with its 'carne squisita,' is, according to the Prince, the *Sylvia hortensis* of Bechstein. [SYLVIA.]

BECHERA, a genus of Fossil Plants proposed by Count Sternberg. *Bechera Charæformis* occurs in the strata of Coalbrookdale. In this genus Sternberg included the *Gyrogonites*, or fossil *Charæ* of the Tertiary Strata of the Isle of Wight.

BECKER, or *Braize*, a Fish. [PAGRUS.]

BEDSTRAW. [GALIUM.]

BEE, the name common to all the species of a very numerous tribe of Insects of the order *Hymenoptera*.

In England alone about 250 species have been discovered. Kirby, in his beautiful monograph, 'Apum Angliæ,' divides them into two great groups—*Apis* and *Melitta*, which differ principally in the proboscis. In *Apis* the tongue (*fig.* 3, *c*), or central part of the proboscis, is generally long, and the proboscis itself has two joints, one near the base, and another about the middle; that at the base directing it outwards, and that in the middle directing it inwards: when folded, the apex of the tongue points backwards. In *Melitta* the tongue (*fig.* 1, *a*) is short, and the proboscis has but one fold, which is near the base; and when folded the apex of the tongue points forwards. These two groups are also subdivided by Kirby, and the character of each subdivision is given in detail; but he did not think proper to give names to these smaller groups. It has however since been thought necessary to consider the smaller groups as genera; and hence they have all been named, the greater portion of them by Latreille. When the smaller groups were considered genera, the greater ones became families, and are named *Apidæ* and *Andrenidæ* by Dr. Leach.

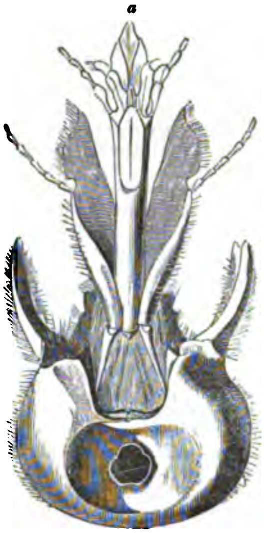


Fig. 1.—The under side of the Head of one of the *Andrenidæ* (*Melitta*, Kirby), showing the proboscis. *a*, the tongue.

The species of *Andrenidæ*, which are very abundant during the spring months, frequent grassy banks; the males are generally seen flying about hedges. The females usually construct their nests underground; for which purpose they generally select a bank in a southern aspect: some species choose sandy situations, while others prefer a heavier soil. The female having fixed upon a convenient spot, excavates a cylindrical hole, from five or six inches to a foot in depth, and only just large enough to allow her to enter; at the bottom it is slightly increased in width, and rendered smooth by being lined with a glutinous substance. The labour of forming these cells is considerable, for the soil is removed grain by grain, and deposited round the entrance of the hole, so that a little hillock is formed. The cell being completed, her next object is to furnish it with pollen; this is collected from flowers, and carried on the tibiæ of the hinder legs, which are thickly furnished with tolerably long hair, among which the pollen is carried until she arrives at the cell. When a sufficient quantity of pollen is collected, and made into a kind of paste by the addition of a portion of honey, it is formed into a little ball, in which an egg is deposited; the mouth of the cell is then carefully closed, to prevent the entrance of other insects. The egg soon hatches, and becomes a larva, which feeds upon the pollen until it is all consumed; the larva then turns to a pupa, and the pupa to the perfect insect. It is remarkable that the *Andrenidæ* seldom make their appearance after the spring months and early part of the summer, although the eggs laid at that time have undergone all their metamorphoses (in many instances) by the autumn. The newly-disclosed insect remains all the intermediate time in a torpid state. We believe that the species only live one year, for in the autumn we have found many of them on the ground dead, and the inner part of their body devoured: this is probably done by a spider which is found in the same situations.

The habits of the species of *Apidæ* are more variable: many excavate their cells in wood; some, like the cuckoo, make use of the nests of other species; others again do not excavate cells, but make use of any hole already formed, or of some other situation convenient for that purpose. Of this last description a species of the genus *Anthidium* has afforded a remarkable instance. This bee is nearly the size of the Hive-Bee, but is broader in proportion, and is easily distinguished from all the hitherto-discovered British species, by having a series of bright yellow spots on each side of the abdomen. A female of this species has been known to build her nest in the lock of a garden gate. The nest consists of a number of cells formed of down collected from the *Anemone sylvestris*, and probably from other woolly-leaved plants, scraped off by the bee with its jaws.

The flight of this insect is exceedingly swift; but when it has discovered a flower on which it intends to settle (generally that of the blind nettle), it stops suddenly, poises itself in the air for a few seconds, and then darts upon the flower, dislodging any bee which may have settled upon it before.

Sometimes it appears more anxious to dislodge other bees, and to prevent their gathering honey, than to collect for itself, for it flies about from flower to flower, and pounces upon all it meets with.

Anthophora retusa is another bee, which in its flight very much resembles the one just described. This bee is considerably larger than the Hive-Bee: the male is brown, sometimes inclining to an ochre colour, and is remarkable for the three long tufts of hair which are attached to the middle leg, two of them to the tip of the tibiæ (that on the posterior part being very long), and another to the tip of the tarsus. The female of this species is so much unlike the male, that it has been thought by many to be a distinct species. It is entirely black, except the outer side of the hinder tibiæ, which is covered with red hairs: it is without the tufts on the intermediate leg. This species constructs its cells in the sides of banks, generally choosing those which are perpendicular.

It is to this same family that the Hive-Bee belongs, to the history and economy of which we shall confine ourselves.

The *Apis mellifica*, Hive-Bee, or Honey-Bee, has for many ages justly claimed the attention and study of naturalists. Among the earliest of its observers may be enumerated Aristotle and Virgil; also Aristomachus of Soli in Cilicia, and Philiscus the Thasian. Aristomachus, we are told by Pliny, attended solely to bees for fifty-eight years; and Philiscus, it is said, spent the whole of his time in forests, investigating their habits. (Plin. xi. 9.) Both these observers wrote on the Bee. In modern times the labours of Swammerdam, Réaumur, Bonnet, Schirach, Thorley, Hunter, Huber, and others, have added greatly to our knowledge of this interesting species.

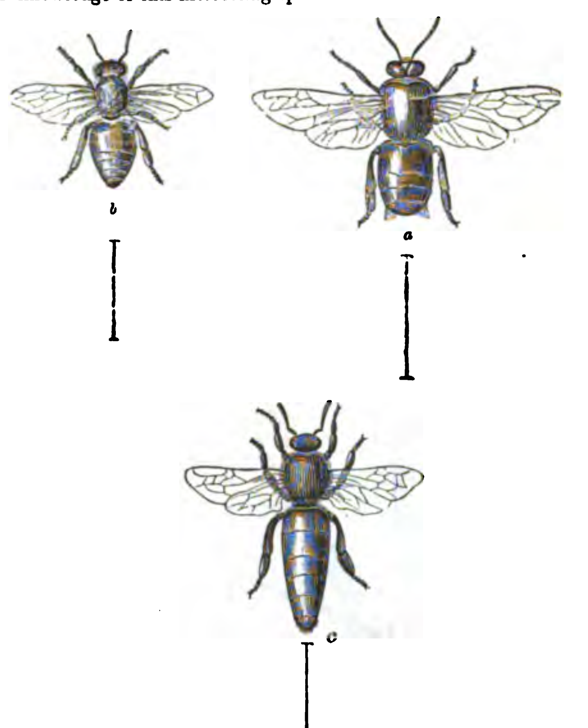


Fig. 2.—The three descriptions of Bees of a Hive.
a, the Male or Drone; *b*, the Neuter or Worker; *c*, the Female or Queen.
The lines denote the natural length of each.

The Honey-Bee always lives in society with many of its own species. In its natural state it generally constructs its nest in hollow trees;

but throughout Europe it is now rather a rare occurrence to find it otherwise than domesticated.

Each society or swarm is composed of three descriptions of Bees—the Male, or Drone; the Neuter, or Worker; and the Female, or Queen.

The *Drone*, or *Male Bee*, in general form, is almost cylindrical, the separation between the thorax and abdomen being much less distinct than in the females or neuters. The head is large, rather narrower than the thorax: the eyes are very large, and meet at the vertex of the head, but divide as they approach the forehead; close to the point of separation there are three stemmata. The antennæ are 13-jointed. The thorax is thickly covered above and beneath with short pale brown hairs resembling velvet. The length of the abdomen is scarcely greater than is its breadth, and it is terminated obtusely: it has only four segments visible from the upper side, the anal segments being hidden beneath the others. The basal and apical segments are each thickly covered with pale hairs. The colour of the abdomen is black above, having the edge of each segment of a light brown colour; the underside of the body is also pale. The legs are black; the inner side of the hinder legs is covered with pale down. All the claws are divided, the inner part being nearly equal in length to the outer part. The wings are large, and rather longer than the body; the anterior wings are rather acute at the apex.

The Drone may be readily distinguished from the queen and workers by its greater breadth, large eyes (which meet at the top of the head), and the abdomen having only four segments visible from the upper side. The wings are much longer in proportion than those of the worker or the queen, for in this sex they reach beyond the extremity of the abdomen.

The number of drones in a hive is remarkably irregular, varying from 600 or 700 to 2000; but the proportion is not regulated by the number of bees contained in the hive, for a small swarm will sometimes possess as many drones as a large one.

The time required to complete the metamorphosis of the drone is as follows. In three days after the deposition of the egg the larva makes its appearance: about the middle of the seventh day from this time, the larva, having then arrived at its full growth, spins its cocoon, a silken substance with which it lines the interior of its cell: this is accomplished in about a day and a half. It then turns to the pupa, and ultimately to the perfect insect, having been about 24 days from the laying of the egg to the coming forth in the winged state.

The *Neuter*, or *Worker*, is of a dark-brown colour, approaching to black; the head and thorax resemble those of the female, but the head has black hair on the vertex. The abdomen is conical, and composed of six distinct segments: the basal one is thickly covered with hair, the other segments are sparingly clothed. The legs are black: the plantæ of the hinder legs are transversely striated on the inner side. The wings when closed nearly reach to the apex of the abdomen.

In about four days after the egg of the Worker has been deposited the larva is hatched, and in five or six days more (according to the weather) it is full grown; it is then sealed up in its cell by the nurse bees with a covering of farina mixed with wax. As soon as the larva is inclosed it spins its cocoon, which operation requires about 36 hours: it then turns to the pupa, and in about eight days more to the perfect insect; having been 21 days in existence, that is, from the time the egg was laid until the insect has attained its perfect state. The numbers of workers in a well-stocked hive is about 15,000 or 20,000. The occupation of these bees is to collect honey, pollen, and propolis; to build the combs, and to attend upon the young.

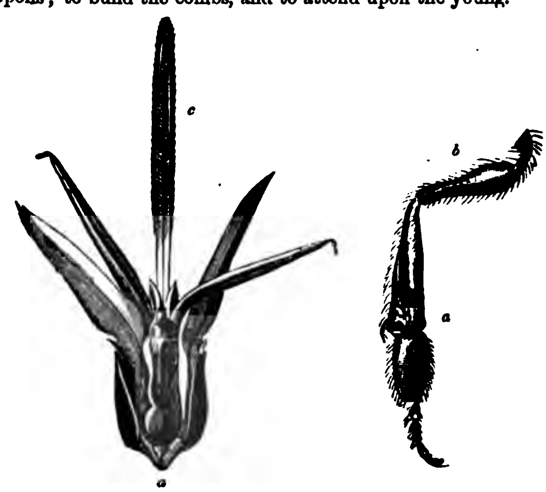


Fig. 3.—*a*, the proboscis of the Hive-Bee; *c*, the tongue; *b*, the hinder leg of the Worker-Bee; *d*, the part on which the pollen is carried.

Honey is collected by means of the proboscis. To a common observer this instrument appears to be a single tube, through which it is thought the honey is conveyed to the stomach by suction; but if we examine the proboscis through a lens of very moderate power, we find that it is composed of five very distinct parts, a central stalk and four lateral ones, two on each side. The central part is that which is principally used in collecting honey: this part is not perforated, but is a flat cartilaginous substance, and is used as a tongue in lapping up the honey, which is then conveyed to the pharynx, and is afterwards disgorged into the cells of the comb, part being used for the purpose of feeding the young, and the remainder stored up for the winter's consumption.

Pollen is collected from the anthers of flowers, and is carried on the outer surface of the tibiæ, or middle joint of the hinder leg: this part of the leg is very broad; on one side it is concave, and furnished with a series of strong curved hairs on its margins, forming a natural basket admirably adapted to the purpose for which it is used. This substance mixed with honey forms the food of the larvæ, for which purpose alone it is collected.

In many instances it is only by the bees travelling from flower to flower that the pollen or farina is carried from the male to the female flowers, without which they would not fructify. One species of bee would not be sufficient to fructify all the various sorts of flowers, were the bees of that species ever so numerous, for it requires species of different sizes and different constructions. "M. Sprengel found, that not only are insects indispensable in fructifying different species of *Iris*, but that some of them, as *I. Xiphium*, require the agency of the larger humble bees, which alone are strong enough to force their way beneath the stile flag; and hence, as these insects are not so common as many others, this *Iris* is often barren, or bears imperfect seeds."

Propolis is a resinous unctuous substance, of a reddish colour, and is collected from the buds of trees: it is not only used in lining the cells of a new comb, but it is sometimes kneaded with wax and used in rebuilding weak parts. It is also used in stopping all the crevices in the interior of a hive. The workers which arrive laden with this substance are relieved of their burden by others; these in their turn distribute it among many, who employ it for the purposes above mentioned.

Nature has provided checks to prevent the too rapid increase of the various species of insects. Among those of the Hive-Bee, the hornet and wasp, and two or three species of moths, commit great devastation. Wasps frequently take possession of a hive, and after destroying, or causing their weaker neighbours to desert the hive, consume all the honey it contains, and sometimes even construct their own nests in the hive. *Acherontia atropos*, the Sphinx, or the Death's-Head Hawk-Moth, which is almost as large as our common bat, sometimes makes its way into hives, and consumes much of the bees' stores. This insect has the power of emitting a peculiar sound, not unlike that of the queen-bee: this sound is supposed to have the same effect (that of rendering the workers motionless) as that emitted by the queen.

Two other moths commit great devastation in hives: these are small species (*Galleria alvearia*, and *G. melonella*—the Honey-Moth, and the Honeycomb-Moth, which, in spite of the guards constantly kept at the entrance of hives, gain admittance, and deposit their eggs in the combs. The larvæ hatched from these eggs form passages through the comb in all directions, spinning a silken tube as they proceed, which it appears is too strong for the bees to destroy, and of course they cannot sting the larvæ. These larvæ generally oblige the bees to desert the hive after a short time.

In attending upon the young the labour of the workers appears to be divided: a certain number always remain brooding over the cells and feeding them, while others are employed in collecting honey. It is these last that are the principal secreters of wax, and are called Wax-Workers: the former are called Nurse-Bees.

The *Queen-Bee* is of a dark-brown colour: the head is thickly furnished with yellow hairs, except on the forehead, where the hair is nearly black; on the vertex there are three small convex simple eyes, or stemmata. The antennæ are yellow beneath and brown above, and composed of twelve joints, the basil joint is more than one-third of the whole length, the remaining joints are bent forwards, and at an angle with the first. The thorax is covered with pale-brown hairs. The abdomen is the shape of an elongated cone, and nearly smooth, exhibiting six distinct segments above: the under side of the body and the base of each segment above are of a paler colour than the remaining parts. The legs are of a brownish yellow: the femora and tibiæ of the anterior legs and the base of the femora of the posterior legs are brown. All the claws of the tarsi are divided, the inner division being much shorter than the outer one. The wings are short and small in proportion, scarcely reaching more than half the length of the abdomen.

This sex is furnished with a bent sting; in the neuter the sting is straight; the male has no sting. The Queen-Bee resembles the worker in the shape of the head and thorax; but the great length of the abdomen and the paler colour of the legs and antennæ are its chief distinguishing characteristics. There is but one queen in a hive, who is treated with the greatest attention by all the other bees. It might be wondered how they can distinguish the queen from any other bee, the interior of the hive being quite dark: in this the antennæ are their sole guide, for if the workers be prevented touching her occasionally with the antennæ they proceed as if she were lost. This has been satisfactorily proved by some ingenious experiments by Huber. If by accident the Queen be killed, or if she die, her dead body is still treated with attention, and for a time even preferred to any other queen.

The Queen being accidentally or intentionally removed from a hive, her absence is soon discovered and great disorder follows; but this is only temporary, for in a few hours preparation is made to replace her loss. The larvæ of neuters from two to three days old are selected for this purpose: the cells containing them are each enlarged by sacrificing three adjoining cells, and in this space the workers build a cylindrical tube which surrounds the young larvæ, which are then supplied with the same food as that given to the ordinary royal larvæ, and which is more pungent than that given to common larvæ. In about three days' time a perpendicular tube is constructed and joined to the mouth of the cell just described; into this the larva gradually makes its way, moving in a spiral direction. It then remains two days in a perpendicular position, the head being downwards, after which it turns to the pupa and then to a queen. As several hatch nearly at the same time, the strongest stings the others to death, and becomes ruler of the hive. From this it is evident that the worker-bees are imperfect females, requiring only a slight difference of treatment in the larva state to become queens or fertile females.

If the Queen be removed from a hive, and a stranger be immediately introduced, she is surrounded and kept prisoner until she dies of hunger; for the workers never sting a Queen. If, however, 18 hours have elapsed since the loss of the former queen, the stranger is better received, for although she is at first surrounded, she is ultimately set at liberty, and treated with all the usual attention; but if 24 hours have elasped before the strange queen be introduced, she is at once admitted to the sovereignty of the hive.

While the Queen remains in a hive, the introduction of a strange queen will occasion a disturbance, somewhat similar to that which takes place when two or three young queens escape from their cells at the same time: both the stranger and the reigning queen are surrounded by the workers, and the escape of either being thus prevented, they are soon brought into contact. A battle ensues, which ends in the death of one of them, and the other then becomes ruler of the hive.

The sole occupation of the Queen is to lay eggs in the various cells prepared by the workers for that purpose, for she takes no care of the young herself. Until she is about eleven months old, the eggs laid are nearly all such as will turn to workers, but at the completion of that period, which most frequently happens in the spring time, the queen commences the great laying of the eggs of males; at this time the queen will lay from 2000 to 3000 eggs, sometimes from 40 to 50 a day being laid during the months of March and April. There is also another laying of the eggs of males in the autumn, but this is not so considerable. In the interval, the eggs of workers are almost exclusively laid.

There seems to be a relation between the laying of the eggs of males and the construction of royal cells, for the workers always commence the construction of the latter at the time that the female is laying the eggs that are to turn to drones.

The royal cells are very different from those of the male or worker, and are generally suspended from the edges or sides of the comb: their number varies from two or three to twenty, though the latter is a very unusual number. In form they are very much like a pear, having the thickest end joined to the comb, the other end, at which part the mouth or entrance of the cell is situated, hanging downwards.

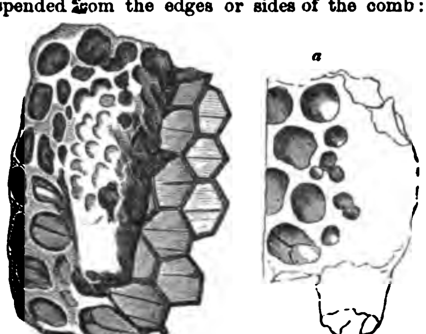


Fig. 4.—The Queen's Cell; *a*, side view of the same.

In these cells the queen deposits the eggs of future queens, at intervals of at least a day, and always during the period of laying the eggs of males. When the Queen is about to lay, she thrusts her head into a cell to ascertain its fitness; she then inserts her abdomen, and in a few seconds withdraws it, leaving an egg at the bottom of the cell fixed in an upright position by a glutinous substance at one of its ends.

The egg is about one-twelfth of an inch long, and of a cylindrical form, with rounded ends. When the larva emerges from the egg, it is immediately supplied with food by the nurse-bees. This larva may be seen lying in a curved position at the bottom of the cell, where it continues to grow until it has completely filled up the space; when it is full grown it lies horizontally with its head towards the entrance. The food given to the larva is a mixture of farina, honey, and water, which is converted into a whitish jelly by elaboration in the stomachs of the nurse-bees: the proportions of farina and honey vary according to the age of the young, and we believe that the food is not given directly to the larva, but disgorged into the cell, so that the insect is surrounded with it. But when the larva is nearly full grown, its food is sweeter (probably containing a greater proportion of honey), and is applied by the nurse-bees directly to its mouth, somewhat in the manner of a bird feeding its young.

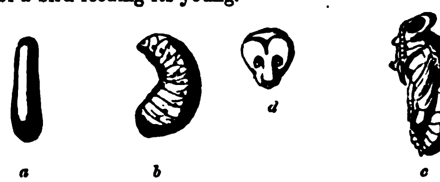


Fig. 5.—*a*, the Egg; *b*, the Larva; *c*, the Pupa of the Worker-Bee; and *d*, the head of the Larva magnified.

The drone and worker-bees are of a grayish colour when they first leave their cells, and several days elapse before they are strong enough to fly; but the queen is kept prisoner in her cell for some time after she has assumed the imago state. The reasons for this imprisonment we shall presently show.

When the larvæ in the queens' cells are about to change into pupæ the old queen begins to exhibit signs of agitation—running carelessly over the cells, occasionally thrusting her abdomen into some of them as if about to lay, but withdrawing without having done so, or perhaps laying them on the side of the cell instead of at the bottom. She is no longer surrounded by her usual circle of attendants, and her agitation being communicated to all she passes, at length a general confusion is created, till at last the greater portion of the bees rush out of the hive with that queen at their head. It is thus that the first swarm quits the hive, and it is invariably conducted by the old queen.

At any other time the queen would have been unable to fly, the great number of eggs contained in her abdomen rendering her too heavy; this however is sufficiently reduced after the great laying just described to enable her to fly with ease.

An unerring instinct obliges the Queen to leave the hive at this time, for two sovereigns never can co-exist in the same community; and had she not left it the young queens (now just about to quit their cells) would inevitably have been killed by her. Let us now observe what is going on in the hive which has just been deserted by its queen. It would seem as if it were too much reduced by the departure of the swarm, but it must be borne in mind that this event never occurs except in the middle of the day and during very fine sunny weather, when a large portion of the bees are abroad gathering honey and pollen; and if the hive contain a numerous colony, these on their return, together with those which have not been disturbed during the general confusion, and a considerable number of young brood continually hatching, form a sufficient stock, and perhaps even enough to send off another swarm.

In two or three days' time from the leaving of the first swarm perfect order is restored in the hive, and the nurse-bees continue to attend upon the young, carefully watching the queens' cells, and working at the outsides by removing the wax from the surface. It is said that the wax is removed in order to facilitate the exit of the young queen; but although the removal of it may thus be of service, we are not inclined to think it is done for that purpose.

The eggs are laid in the royal cells at intervals of at least a day, and it consequently follows that the completion and closing of these cells must take place at different times: we say completion, for at the time the queen lays the eggs the cells are only half formed, and resemble the cup of an acorn. When the cells have been closed about seven days the young queen cuts away with her jaws the part of the silken covering at the mouth of the cell, and if permitted would make her escape; but the bees guarding the cells solder the covering with some particles of wax, and keep her prisoner about two days, in which time she obtains sufficient strength to be able to fly immediately on quitting her prison. It is difficult to imagine by what means the bees guarding the royal cells can judge of the fitness of the inclosed female for liberation. The most probable conjecture is, that they judge by the quality of the sound emitted by the prisoner at this time. This sound consists of a number of monotonous notes so rapidly repeated as almost to appear one continuous sound. The sound is produced by the vibration of the wings, and probably becomes sharper and more audible as the bee acquires strength.

The young queen upon being liberated immediately approaches the remaining royal cells, and would destroy their contents by tearing them open and mortally wounding her rivals with her sting; but this is not permitted, for so long as there is a sufficient number of guards they bite and drive her away. She has the power however of arresting this ill-treatment for awhile by emitting a peculiar sound, which has such an effect on the sentinels that they remain motionless; and she sometimes takes advantage of this to make an attack upon the royal cells. But as the sound ceases when she moves the charm is dissolved, her guards recover their power, and she is again driven back.

After a time the young queen, owing to her strong desire to attack the royal cells and the constant repulses she meets with, becomes extremely agitated, and by running quickly over the cells and groups of workers communicates her disorder to a great portion of the bees, so that a large number quit the hive and cluster about the outside, and after a short time the young queen leaves the hive with a swarm. Thus it is that the second swarm is thrown off. It seldom happens that a hive sends off more than two or three swarms; after which, unless the hive be an extremely populous one, there are so few bees left that there is not a sufficient number to keep proper guard over the royal cells. The young queens consequently make their escape, two or three at a time, in which case a contest takes place between them, and the strongest remains queen of the hive, after destroying all the royal larvæ and pupæ that remain.

But if the hive be an unusually populous one there may be four or five swarms sent off, all accompanied by the same circumstances as those just related. In case a hive is poorly stocked at the time of the great laying of male eggs no royal cells are built, and consequently no swarms leave. After the swarming a general massacre of the drones takes place: these defenceless individuals (for the male has no sting) are stung to death by the neuters.

When a swarm quits a hive it usually clusters on a tree or bush in the neighbourhood, and if it be not hived it will shortly leave this situation, and take possession of an old tree or part of an old building. It is said that bees send out scouts before leaving the hive to search for a convenient situation for their new abode, and that they may be seen going backwards and forwards to the spot fixed upon some little time before the swarm departs. The clustering of the swarm probably proceeds from a desire in the bees to be congregated together prior to their last flight. As soon as the bees have taken possession of a new abode, or have been hived, they commence building the comb.

It has been stated that the first swarm is always conducted by an old queen, and the following swarms by the young queens as they are successively hatched. The latter are in a virgin state, but not so the former, nor do these require farther intercourse with the male. About two or three days after quitting her cell, and the fifth day of her existence in the winged state, the young queen quits the hive, and after reconnoitring its exterior and making herself acquainted with its situation by flying from it and returning several times, she then soars high in the air, forming spiral circles as she ascends. This ascent is generally preceded by a flight of drones, and it is at this time (whilst on the wing) that the sexual intercourse takes place. The queen is never observed to quit the hive but at this time, and hence it is supposed that this one intercourse is sufficient to fertilise all the eggs she may ever lay. Huber decidedly ascertained that it was sufficient for two years. We think it very improbable that a queen would live much beyond that time. In about 46 hours after the intercourse with the male has taken place, at which time a part of the comb would be constructed in the new hive, the queen commences laying her eggs; those first deposited being such as will turn to workers, as before described.

The Construction of the Comb.—In the 'Introduction to British Entomology' by Kirby and Spence, after referring to the various accounts of ancient and modern writers on this subject, it is observed, "Still the construction of the comb of the bee-hive is a miracle which overwhelms our faculties." John Hunter, who was the first to discover the true origin of wax, imagined that the waxen scales (which we shall hereafter mention) bore some proportion to the different parts of the cells in the formation of which they were used, and thus furnished a guide to their construction. Some naturalists have conjectured that the antennæ, mandibles, and other parts of the body were used to measure the work, and from this they have endeavoured to account for the accuracy of their proceedings. The latter conjecture appears incompatible with instinct, while the well-authenticated mode of proceeding in the construction of the comb throws great doubt on the former.

Upon examination of various combs, the partitions between all the ordinary cells (both at the sides and bottoms) are found to be exactly the same in thickness, and the cells hexagonal with angular bottoms. Exceptions to this general rule are occasionally found, and it is by observing these exceptions with attention—by observing the various modifications of the work under extraordinary circumstances, that some idea of the principles which guide the bee in its operations may be formed. The royal cell is a remarkable exception; its form we have already described. In the original construction of this cell, a profusion of material is always disposed of, particularly at the junction of the cell with the comb. The extra quantity of wax in this part, and on the surface of the cell (which is also unusually thick) is, however, soon reduced by numerous circular excavations, the depth of which varies according to that of the wax, and in the mass nearest the comb they actually become cells, though in most instances unfit for use. These cells are invariably cylindrical, with concave bottoms, except they come in contact with others, in which case the wax is always removed from the interstices thus formed, either at the sides or at the bottoms; and the partitions are thus reduced to the same thickness as those between the cells constructed in the ordinary way. Hence we frequently find, in these parts, cells with one side circular and the other angular; the situation of the angles being invariably determined by the position of those cells with which they are in contact.

To work in circles or segments of circles appears most compatible with animal mechanism acted upon by instinct, for we observe that the works of almost all insects (perhaps we may say almost all animals) proceed in circles or segments of circles. The cells of almost all the various species of bees are of this construction, and we find that, under peculiar circumstances, those of the hive-bee are so likewise, as in the case of the queen's cell, and in some of those cells close to it, and sometimes in other parts of the comb, in cases where an accident has been repaired.

If some hive-bees could be made to work in a large solid mass of wax, the first cell formed would most probably be cylindrical, with a hollow circular bottom; this would also be the form of the following cells unless they came in contact with each other; and, in this case, supposing the circumferences of three cylinders were to touch, the bees working in each of these cylinders would cut away the wax at *a*, *a*, *a*, (*fig.* 6). But supposing the wax block were excavated on one of its sides, into the greatest number of equal-sized cylinders that it would admit of, it would then follow that each cylinder would be surrounded by six others, this being the only number of equal-sized circles which may be placed round one of the same magnitude; by the same rule of removing the wax from the interstices, each of these cylinders would become hexagons.

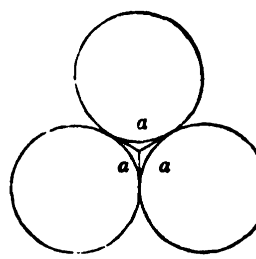


Fig. 6.

Again, supposing this block to be a flat mass of equal thickness in all parts (the ordinary thickness of a comb), this block being cut into cylinders of equal diameter on both sides, and the base of each cylinder being exactly over parts of three opposing ones (as represented in *fig.* 7), when the wax is cut away at the interstices, as at the sides, it follows that the bottoms of the cells will be each composed of three equal rhombus-shaped pieces. Hence we have cells exactly like those of the hive-bee, but not constructed in the ordinary way, though upon such principles as analogy points out (a circular form being the basis of the work), and in such a way as we have observed, they do occasionally proceed. If we allow that the basis of the work of the hive-bee be circular, the royal cell forms no exception to the general rule, so far as the principle of its construction is concerned.

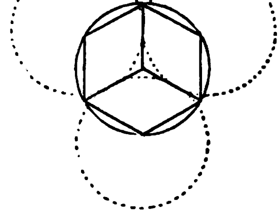


Fig. 7.

Let us now examine the construction of the comb in its usual way of proceeding:—

The first operation is the formation of wax; this is not, as many have supposed, the farina collected from flowers, but is secreted by the insect at the time of building the combs. For this purpose the wax-workers suspend themselves in festoons from the top of the hive. Those which first reach the top fix themselves by the claws of the fore legs to the roof, and are followed by others which attach themselves to them, until an inverted cone or festoon of bees is formed, each end of which is attached to the roof of the hive. Before the commencement of the new comb, the interior of a hive presents a series of festoons of this description, intersecting each other in all directions, the bees remaining in perfect repose.

At this time the wax is secreted and makes its appearance in little scales which exude between the segments on the under side of the abdomen, eight scales being visible in each bee. The wax being secreted, one of the bees commences the comb; having detached itself from the festoon, it makes its way to the roof of the hive, and after clearing a space by driving away the other bees, it detaches one of the scales from the abdomen by means of its hinder legs: this is then conveyed by the fore legs to the mouth, where it is masticated, and impregnated with a frothy liquid by the tongue, in which process it obtains a whiteness and opacity which it did not before possess. The particles of wax are then applied to the roof of the hive. Another scale undergoes the same process, and is attached to the first. The bee thus continues labouring until all its scales are disposed of; it then quits its situation and is followed by another bee, which proceeds with its scales in the work already begun, depositing the wax in a straight line with the former deposition. The same operation is performed by many other bees, until a considerable block is deposited. This block is generally about five or six lines long (a line is equal to one-twelfth of an inch), the height two lines, and the thickness half a line; and it is upon this that the formation of the cells commences.

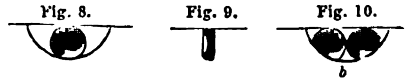
We have seen that the foundation of the block is the work of one bee, so likewise is the commencement of the cells;—the former is the work of what is called the wax-workers, which, we are informed by Huber, do not possess the power of sculpturing the cells:—the cells are made by the sculpturer-bees, who are smaller than the wax-workers. No sooner is the block large enough to admit a sculpturer-bee between the wax-workers, than the excavation commences. There seems to be an instinctive desire to perform the work of excavation wherever there is room, even though there may not be sufficient to form a perfect cell; for we never observe a solid piece of wax in any part of a comb. On the contrary, if by any accident there has been space unoccupied by cells, we find that the wax has been excavated at that part as much as was practicable.

The bee, impelled by instinct to deposit wax and to excavate, and also guided by an acute sense of feeling in the antennæ (probably through the elasticity of the wax) as to the degree to which the excavation should proceed, forms the comb; and in so doing it seems to act, not from choice, but from a necessity imposed upon it by two antagonist principles,—one causing it to deposit and excavate wax, and the other acting through the antennæ, and limiting the degree of excavation.

It is to this desire for performing the work of excavation that we attribute the small excavations about the royal cells, which are said to be for the purpose of facilitating the exit of the young queen. If the wax were removed for that purpose, we do not see why the operation should not be confined to that part through which she makes her escape. On the other hand, if from the wax of the royal cells being thicker than it is in other parts of the comb, the workers are induced to make excavations, and desist only upon the thickness being reduced to that of the ordinary partitions, it follows that it will at last become uniformly thin, as described by Huber; the reason here given differing from Huber's, but we think more in accordance with the habits and economy of the animal.

In forming the cells, a hollow is first excavated on one side of the wax-blocks; this excavation is rather less than the width of a cell, and is immediately followed by two of a similar description on the opposite side of the block. The particles of wax removed in excavation are kneaded by the jaws of the bee and deposited on the edges of the intended cells; the two latter excavations (*b*, *b*, *fig.* 12) are necessarily on each side of the first (*a*, *fig.* 12), though close to it. In placing the two last-mentioned cells, the bees avoid the opposite part on account of the thinness of the wax, and the size of the wax-block will not admit of their being remote from the first.

Fig. 8. Fig. 9. Fig. 10.



Front. Side. Back view.

The front, side, and back views of the block on which the first excavations for the cells are made.

Fig. 11.

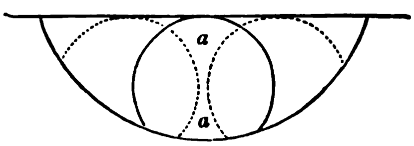


Fig. 12.

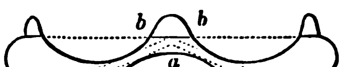


Fig. 11, Front view magnified. Fig. 12, Transverse section through the same.

The above are representations of the block and its excavations at this period. Supposing the parts at which the circles nearly come in contact with each other to be of the thickness proper for the partitions of the cells, the parts marked *a* in the front view and section (*figs.* 11 and 12) being more than the necessary thickness, the bees will (according to the instinctive principle before mentioned) naturally remove what there is superfluous, thus forming an angle, determined by two intersecting vertical planes at the bottom of the cell, inasmuch as at the same time the parts marked *b*, in the back view and section (*figs.* 10 and 12), will also be removed. The partition between these two last-mentioned cells thus becomes perpendicular and of equal thickness, and is exactly opposed to the angle at the bottom of the first cell.

By this time the necessary secretion of wax has taken place in all the bees composing the festoons, and they are all anxious to dispose of their scales of wax. The sculpturer-bees are also active, consequently more wax is added to the margins of the original block, and more excavations are formed. Supposing the block to have increased to double its original length and width, there would then be room for parts of four more excavations, on the side on which the first was made (*fig.* 13).

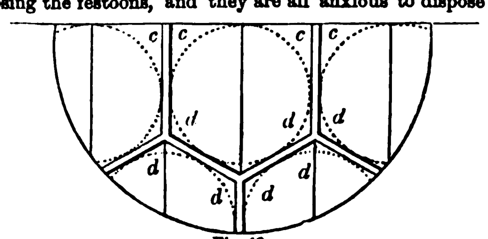


Fig. 13.

The same operation of reducing the wax in the thick parts marked *c* having taken place, the sides of the first cell also become straight and perpendicular, and by reducing the wax at the parts *d* to the proper thickness in all the cells, the bottom of the first cell, and upper parts of the two cells beneath, in the diagram, become two-sided. The work on the opposite side of the comb being in the same state of forwardness (for after the commencement it proceeds equally at all parts), will appear thus—

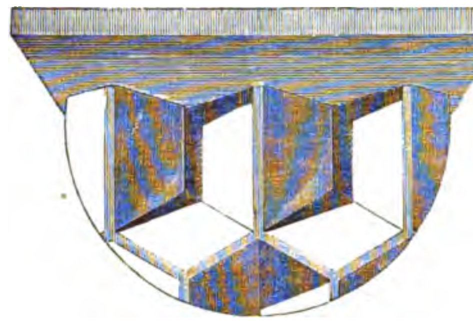


Fig. 14.

In the above figure the angles at the bases of the cells are cut into the partitions of the opposing cells, and hence it is clearly seen that, from the position of those cells, the perpendicular partitions of the cells on this side must be longer than those of the other, and that the cells themselves must have three quadrilateral plates for their bases.

In carrying up the sides of the cell, the form is regulated by the intersection of the surrounding circles, as represented in *fig.* 15. But the circles described in *fig.* 15, parts of which are shown in most of the other figures, represent those which are inclosed by the hexagons; whereas we believe the natural circumference of each cell (supposing it to be cylindrical) is that by which the hexagon is inclosed; hence it will be necessary to imagine the circles partly intersecting each other.

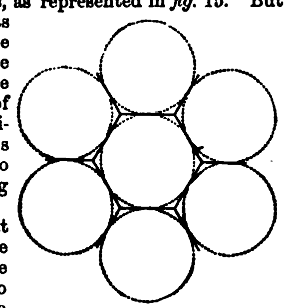


Fig. 15.

It has now been demonstrated that the cells of the first tiers on each side are pentagonal; that the bases of those on one side are each composed of two plates, while those of the other side are each composed of three plates; and that, according to the laws laid down, they could not have been otherwise: now as this accords with all the accounts given of the proceedings in the construction of the comb, it seems to prove that the laws which we have laid down, as guiding their formation, are correct.

We have now followed the progress of the work until the commencement of the second tiers of cells: it is unnecessary to describe the formation of these and the following tiers. It is shown that, according to certain laws, the first tiers of each side of the comb become pentagonal, and according to the same laws it is clear that the second and following tiers must become hexagonal; for the two sides forming the lower boundary of each cell of the first tier, also form the upper boundaries (or partitions) of two cells of the second tiers. As the upper part of the first tier is determined by the roof of the hive (represented by the horizontal line in diagram 13), so is the upper portion of the cells of the second tier determined by the lower portion of those of the first tier; thus, the upper portion of each cell of the second tiers being composed of two planes meeting at an angle, and the work continuing, as in the progress of the first tier, four more planes will be constructed to form the lower portion, and complete the hexagon. It is thus that all the ordinary cells of a comb are hexagonal, and we believe it is clearly shown that they could not be otherwise, according to the mode of proceeding in their construction. Their form depends entirely upon the commencement of the work, which necessarily throws the cells in such a position that each cell must be surrounded by six others, and consequently have six sides, each side being the common partition of two cells; and so long as the cells are of equal diameter they must each be opposed to parts of three other cells on the opposite side of the comb, in such a way that supposing the external surface of the bottom of each cell were hemispherical (which would be the case were the wax not removed from the interstices), each hemisphere would touch three others; but the wax being removed from the interstices and reduced to an equal thickness at all parts, and the bases of the sides of a cell not being all in the same plane, the bottom of each cell is thus formed into three equal rhomboidal pieces in three different planes, the three angles at their junction being respectively the lowest parts or the farthest removed from the mouth of the cell.

In working the cells, the wax is always found a little thicker on the edges, thus giving additional strength to them. It has been asserted that this extra thickness is added upon the completion of the cells; but as we have never observed a cell, even though in a state of progress, without it, we think the more probable conjecture is, that the bees, in working the sides of the cells, desist upon arriving near the top, and thus leave that part thick, as it is found to be.

The ordinary cells of a comb are of two sizes; those designed for the male larvæ being rather larger than those of the ordinary size in which the neuter larvæ are reared. The width of the former cells is about $3\frac{1}{3}$ lines, and that of the latter $2\frac{2}{5}$. A comb is always commenced with the small-sized cells. Hence, when the larger cells are constructed, instead of being opposed to three others they encroach upon a fourth, and their bases are consequently composed of four plates instead of three: at first a minute lozenge-shaped piece is visible at the top of the basal part (*fig.* 16, *a*); this gradually increases in size as the one on the opposite side decreases (*fig.* 16, *b*).

When the full size of the cell is attained, the top and bottom pieces (*fig.* 16, *c*, *c*) are equal; but as soon as a sufficient number of the larger cells is formed, the lower lozenge gradually decreases, while the upper one (*fig.* 16, *e*, *e*) increases in size until there are but three plates again visible (*fig.* 16, *d*, *d*).

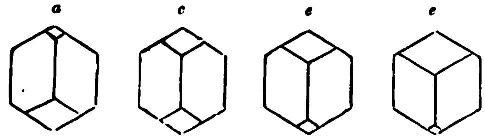


Fig. 16.

It is almost always found that the excavations for cells, formed by different insects, in whatever situations they may be, are exactly proportioned to their size. Hence it is extremely difficult to account for the enlargement of the cells of the bees, as just described. We will however venture an opinion, in hopes of calling attention to the subject.

In the former part of this account it has been stated that no sooner is a portion of the comb finished than the queen deposits eggs in the various cells, and that the cells first formed are always those of the smaller size, which are excavated by what are termed the sculpturer-bees, or nurses, which are less than the wax-workers.

We imagine that when the eggs hatch, the small bees, or nurses, are more particularly engaged in attending upon the young; and that the large-sized workers then commence the excavation of the cells themselves, and thus make cells of a larger diameter than those made by the nurses.

Huber states that the description of bees called wax-workers have not the power of sculpturing the cells; but at the same time he owns that he was unable to follow the proceedings in the construction of a comb for any considerable time after the commencement. During the time of his observations, however, he invariably found that the smaller bees were the sculpturers.

The interior of a hive consists of a number of combs arranged perpendicularly; these are fixed to the roof of the hive, and are parallel to each other, the space between them being about half an inch. When the first comb has advanced in size, so as to consist of two or three rows of cells, two other combs are commenced, one on each side of it, the work proceeding as in the first; these again are followed in their turn by two others. As the comb advances in size it assumes a form nearly circular, and is still joined to the roof of the hive only; the work proceeds by adding wax to the margin of the comb exactly at the junction of the opposing cells, and this is no sooner deposited than it is cut away and worked into cells. These cells are not equally deep throughout the comb, but their depth gradually decreases as they approach the margin: a comb in its progress has the form of a double convex lens.

The form of the comb, as above described, is that of a new one; but in the honey-storing season the sides of the comb are joined to those of the hive, to give strength to hold the additional weight; the cells are also lengthened, so that the surface of the comb then becomes even. The cells are not quite horizontal, the orifice being generally a little higher than the base, most commonly four or five degrees, but sometimes considerably more. When a comb is first completed, it is of a dull white colour and of a weak substance; it is however soon strengthened by adding propolis to the margin of the cells, and lining their interior with threads of the same material.

The cells of a comb are used for the purposes of storing up honey for the winter, and in them the larvæ are reared. Pollen, or bee-bread, is also stored up in some of the cells. Many larvæ may be reared in the same cell, and as each spins a cocoon or web on its sides which is never cleared out, it thus becomes at last too contracted to contain larvæ; it is then used for one or both of the other purposes above mentioned. When a hive is well stored with combs having empty cells, the workers disgorge the honey into these receptacles; but in case cells are wanted they retain the honey, and wax is secreted for the purpose of building more combs.

Honey is never consumed but in cases of the greatest necessity; but as soon as a cell is filled it is sealed up with a waxen covering.

During the progress of a comb in building, the slightest interruption is likely to alter its form; and as the space between each is always kept exactly the same, it frequently happens that the whole of the combs are affected by any accident happening to one. *Fig.* 17 illustrates an instance of this sort, which we have seen—

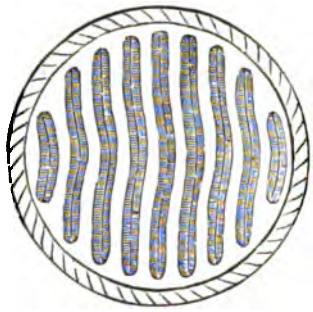


Fig. 17.


Fig. 18.

but it also frequently happens that an interruption in one comb is corrected in those that follow. A curious instance of this nature we have also observed (*fig.* 18).

In both these instances the form of the comb was affected by a stick being placed across the middle of the hive, to enable the owner (as we believe) to remove the hive with less danger of the combs giving way.

The latter case is so ingenious that at first it appears more like an operation of reason than instinct: it is nevertheless to be accounted for upon the instinctive principles with which these animals work. The course of the first comb being altered, the two adjoining ones would naturally follow its line; but if those next beyond them on each side were in a state of forwardness, the workers would be obliged to discontinue the two former, as shown in the figure, to avoid coming in contact with the two latter; for it appears to be a law in the construction of new combs that a certain space should be always left at the margins as well as between them.

In addition to the construction of the comb, the bees when in danger of attacks from their enemies barricade themselves. Sometimes the entrance of the hive is nearly blocked up with wax and propolis, and at others a wall of that substance is constructed just behind that part; this wall is perforated with holes only just large enough to admit of the egress and ingress of the bees themselves. The fortifications are occasionally much more ingenious and complicated. Weak hives are sometimes exposed to the attacks of strange bees, and in such cases fortifications would be constructed; but it is more particularly to prevent the ravages of the *Acherontia atropos* that this care is taken. As this moth only makes its appearance in the autumn, these fortifications are removed in the spring, a time when they would be of the greatest inconvenience, as the hive is then extremely populous. Huber states that "the entrances formed in 1804 were destroyed in the spring of 1805. The Sphinx (*Acherontia atropos*) did not appear that year; but it returned in great numbers in the autumn of 1807. By speedily barricading themselves, the bees prevented their threatened ravages; but before the departure of swarms in May, 1808, they demolished the fortifications, whose narrow passage prohibited free egress to the multitude."

The principal authors who have written upon the habits of bees are as follows:—Aristotle, *History of Animals*, book v.; Pliny, *Natural History*, book xi.; Swammerdam; a translation into English, from the Dutch and Latin original edition of his work, has been made by Thomas Floyd, entitled, *The Book of Nature, or the History of Insects*; Réaumur, in the fifth volume of his *Mémoires pour servir à l'Histoire des Insectes*, 1734–42; Schirach, *Histoire Naturelle de la Reine des Abeilles*, 1771; Riem, *Contemplation de la Nature*; Bonnet, tom. v., 4to ed., and tom. x., 8vo.; John Hunter, *Philosophical Transactions for* 1792; Thorley, *Female Monarchy: being an Inquiry into the Nature, Order, and Government of Bees*; Wildman, *A Complete Guide for the Management of Bees*, 1819; Huber, *Nouvelles Observations sur les Abeilles*: a translation into English of this work was published in the year 1821, entitled, *New Observations on the Natural History of Bees*; Edward Bevan, M.D., *The Honey-Bee, its Natural History, Physiology, and Management*, 1827; Kirby and Spence, *Introduction to Entomology*; T. Rymer Jones, *Natural History of Animals*, vol. ii.; *Insect Architecture*, in *Library of Entertaining Knowledge*.

BEE-EATER, the vernacular name for a species of bird belonging to the genus *Merops*, Linn., one of the family *Meropidæ*, and of the Syndactylous Tribe, which have the external toe nearly as long as the middle one, and both joined together up to the penultimate articulation.

The birds of this genus take their prey, consisting of wasps, bees, &c., like the swallows, while on the wing; and, as Cuvier observes, it is remarkable that they are not stung by them. The species are numerous, and many are figured by Levaillant. Their nests are formed in the banks of rivers, where they dig deep holes; and their geographical distribution is over the warmer regions of the old continent, Java, &c., and Australia (Paramatta), none of the genus having been found in America, where their place appears to be supplied by the Motmots (*Prionites*, Illiger). Their brilliant plumes, of colours which change according to exposure to light, the prevalent hues being azures and greens, remind the observer of the kingfisher's gorgeous dress. A familiar example of the genus occurs in the bird whose English name is at the head of this article—the Guèpier vulgaire of the French, the Mangia-Api and Lupo d'Api of the Italians, the Μέροψ of the Greeks, and *Merops Apiaster* of Linnæus.

Bee-Eater (*Merops Apiaster*).

In the south of Europe it is frequent in the summer. Sicily, Sardinia, Italy, the south of France, and Germany possess it, and on the southern border of Russia it is numerous. It is found in Turkey and in the Grecian Islands, and in autumn migrates towards Egypt. It breeds in holes in the banks of the Don and the Volga, laying from five to seven white eggs in a nest composed of moss, &c. Hasselquist says that it is found in the plains of Galilee, and that it is called Varuar by the Arabs; and Temminck, that the individuals found at the Cape of Good Hope differ in nothing from those killed in Europe. Ray, in his edition of Willughby, observes, "It is not unfrequent in the Campagn of Rome: for that we saw it there to be sold in the market more than once. It is not found in England that we know of. Bellonius writes that it is so common in Candy that it is seen everywhere in that island. Aristotle tells us that it feeds upon bees, whom all other writers of the history of animals do therein follow. But it feeds not only upon bees, but also upon *Cicadæ*, beetles, and other insects. Yea, as Bellonius relates, upon the seeds of the nipplewort, bastard parsley, turnip, &c., not abstaining from wheat and other grain. From its exact agreement in the shape and make of its body, bill, and feet with the kingfisher, we suspect that it likewise preys upon fish.

"Bellonius, in the first book of his observations, writes thus concerning the *Merops*. Flying in the air it catches and preys upon bees, as swallows do upon flies. It flies not singly but in flocks, and especially by the side of those mountains where the true thyme grows. Its voice is heard afar off, almost like the whistling of a man. Its singular elegance invites the Candy boys to hunt for it with *Cicadæ*, as they do also for those greater swallows called Swifts, after this manner:—Bending a pin like a hook, and tying it by the head to the end of a thread, they thrust it through a *Cicada* (as boys bait a hook with a fly), holding the other end of the thread in their hand. The *Cicada* so fastened flies, nevertheless, in the air, which the *Merops* spying, flies after it with all her force, and catching it, swallows pin and all, wherewith she is caught."

The passage in Aristotle, mentioning the *Merops* as one of the enemies most destructive to bees, is in the 40th chapter of the 9th book of his 'History of Animals;' and there are others in the 1st chapter of his 6th book, and in the 13th chapter of his 9th, wherein he notices the peculiarity of its making its nest in holes in the earth.

The species, although not common, may be considered as an occasional visitant to this country. The first record of its appearance is in the third volume of the 'Transactions of the Linnæan Society,' from which it appears that on "July 2, 1794, the president communicated an account of *Merops Apiaster*, the Bee-Eater, having been shot (for the first time in Great Britain) near Mattishall, in the county of Norfolk, by the Rev. Mr. George Smith. The identical specimen was exhibited by permission of Mr. Thomas Talbot, of Wymondham. A flight of about twenty was seen in June, and the same flight probably (much diminished in number) was observed passing over the same spot in October following." Since then four or five specimens have been recorded to have been shot in the counties of Suffolk and Norfolk, one in Dorsetshire, three in Devonshire, one in Cornwall and one in Ireland. (Yarrell, *British Birds*.)

BEECH. [FAGUS.]

BEESHA, a genus of Grasses nearly allied to *Bambusa*, with which it is actually combined by some botanists, but from which it differs, according to the concurrent testimony of all authors, in the otherwise incredible circumstance of its seeds being inclosed in a fleshy pericarp.

Two species are known, both of which have the aspect of the spineless bamboos. Of these *Beesha baccifera* is found on the mountains of Chittagong in India, where it is called Pagu Tulla, growing in dry places on the sides of hills, where the upper stratum of soil is sandy. According to Roxburgh's 'Flora Indica,' the circumference of the stems near the base is 12 or 13 inches, and their height from 50 to 70 feet—"beautifully erect, and without the least flexure or inequality of surface; bare of branches, except near the extremity. It perishes after yielding its fruit. It yields more or less Tabasheer, of a silicious crystallisation; sometimes it is said the cavity between the joints is nearly filled with this, which the people call Choona, or Lime." ('Flora Indica,' ii. 197.)

Beesha Fax is a smaller species, not above 18 feet high. It is found in Amboyna and other parts of the Malayan Archipelago, where it is applied to many useful purposes. It is the *Arundarbor cratium* of Rumphius's 'Herbarium of Amboyna.'

BEET. [BETA.]

BEETLE. This term has frequently been used as the name common to the species of the family *Scarabæida*, but it is more commonly and properly used to designate those insects which are covered by a strong horny substance, the abdominal part of the body being protected by two sheaths under which the wings are folded. Hence the term is synonymous with *Coleoptera*. [COLEOPTERA.]

BEGONIA. [BEGONIACEÆ.]

BEGONIA'CEÆ, *Begoniads*, a natural order of Exogens, consisting of three genera, *Begoina*, *Eupetalum*, and *Diploclinium*. The species are 159, and are found exclusively in the dampest parts of the tropics in both the New and Old World, particularly in Asia and America. They have perfectly unisexual flowers, with a superior calyx, generally coloured pink, consisting in the sterile flowers of from 2 to 4 pieces, and in the fertile flowers of from 5 to 8 pieces. The stamens are numerous; the

Begoniaceæ.

1, A sterile flower; 2, a fertile one; 3, the same in bud; 4, the half-grown ovary and stigmas; 5, fruit; 6, the same cut through horizontally; 7, seeds the natural size; 8, one seed magnified; 9, the same cut through to show the embryo in its natural position in the albumen; 10, an embryo separate.

style simple; the stigmas three, often forked, and having a wavy or twisted appearance. These latter originate from a 3-cornered 3-celled ovary containing a multitude of little seeds, which changes to a thin-sided capsule with 3 extremely unequal wings. The leaves are always more or less unequal-sided, and have highly-developed membranous stipules at their base.

It is very difficult to say with what other natural order this has most affinity. By Link it has been stationed near *Umbelliferæ*, a most unintelligible association. Jussieu, attracted by its highly-developed stipules, and apparently apetalous flowers, together with the acid flavour which is so prevalent in the order, suspected its near alliance with *Polygonaceæ;* while Lindley, with a greater degree of probability, now makes it constitute a member of the Cucurbital alliance of his Epigynous subclass of Exogens with polypetalous flowers.

All the species of the genus, *Begonia*, of which the order principally consists have irregular fleshy leaves, often richly coloured with crimson, succulent stems, and neat-looking pink flowers growing in few-flowered panicles. Most of the species at present described may be procured in a living state in the gardens of Europe.

The roots of the various species of *Begonia* are astringent and slightly bitter. *B. Malabarica* and *B. tuberosa*, with others, are used as potherbs in the countries where they grow. Endlicher says that some of the Mexican species are drastic purgatives.

BELEMNITE'LLA. The group of *Belemnites* which occurs in the Chalk Formation, and which is marked on the anterior and ventral face by a long narrow fissure, is thus named generically by D'Orbigny. To this group belong *B. mucronatus*, *B. granulatus*, *B. mammillatus*, &c., in Europe, and *B. Americanus* in the United States, if this last be really distinct from *B. mucronatus*.

BELEMNITES (from the Greek βέλεμνον, a dart or arrow), Pfeilstein and Donnerstein of the Germans, Pierre de Foudre of the French, a genus of extinct *Cephalopodous Mollusca*, whose conical remains were for a long time utterly misunderstood. Before the geological history of this extinct marine animal was well made out, few natural productions ministered more largely to the superstitious feelings of man. The ancients, it was said, had a legend that they came from the lynx, and called them Lapides Lyncis and Lyncuria. They were also, from being found on Mount Ida, and from their supposed resemblance to those organs, called Idæi Dactyli, or Petrified Fingers. This idea was too much in unison with the gloomy imagination of the northern nations to be lost: we accordingly find the term Devil's Fingers bestowed on them, and not unfrequently that of Spectre-Candles.

Afterwards came the age of Thunder-Stones and Picks, when this fossil was alleged to be the produce of electricity, and was called by the learned *Lapis fulminans*. They were also called Arrow-Heads.

Subsequently, and at the period when organic remains were almost universally regarded as *lusus naturæ*, formed by the plastic power of the earth, the Belemnite was considered, even by those who had adopted more correct opinions upon the subject of many fossil shells, to be strictly mineral,—to be a stalactite or a crystal; and by some who found it in the sandy parts of Prussia, where amber also occurs, it was supposed to be that substance petrified.

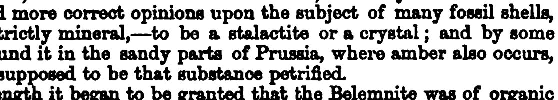
At length it began to be granted that the Belemnite was of organic animal origin, and the conical cavity at its broader end caused it to be looked upon as the tooth of some unknown creature; while some pronounced it to be a spine, like those of an *Echinus*, and others gave way to various conjectures not worth recording. Then arrived the dawn of Von Tressau, Klein, Breynius, Da Costa, Brander, and Plot, who allowed the fossil to be of testaceous origin, but knew nothing of its relative position. At last, the increasing light of science placed the Belemnite in a comparatively clear point of view.

A substance with which fable had been so busy was not likely to have been overlooked in the old Materia Medica: we accordingly find that it was administered in a powdered state as a remedy for the night-mare, and for the stone. Dr. Woodward states, that in Gloucestershire the powder was blown into the eyes of horses affected with watery humours; and in Prussia it is said to have been used when pulverised in dressing wounds.

The true place of the Belemnite is among the *Cephalopoda*. Cuvier and Lamarck had arrived at this conclusion, and they also believed that it was an internal shell. It forms the first genus of the first family (*Orthocerata*) of Lamarck's first division of the *Cephalopoda*, namely, the Polythalamous, or Many-Chambered, division.

Miller, in a paper in the 'Transactions of the Geological Society,' gives the following as the generic character:—

"A cephalopodous (?) molluscous animal, provided with a fibrous spathose conical shell, divided by transverse concave septa into separate cells, or chambers connected by a siphuncle; and inserted into a laminar, solid, fibrous, spathose, subconical or fusiform body extending beyond it, and forming a protecting guard or sheath."



Belemnites canaliculatus.

Since Miller's paper was written many important facts have been added to our knowledge of the structure of Belemnites.

In addition to the circumstances attending the discovery at Solenhofen of some traces of the general form of the animal, of which the remains ordinarily found are a part, and of the ink-bag and horny laminæ at Lyme and Whitby, an almost complete restoration of the Belemnite animal was made from specimens laid open in the cutting of the Great Western Railway, near Chippenham in Wiltshire. The Oxford Clay here excavated afforded to Mr. Pratt and the late Marquis of Northampton admirable specimens of the phragmacones and laminar plates, outlines of some of the soft parts of the body and arms, and the form and arrangement of the hooked appendages of the arms. Indeed one of Mr. Pratt's specimens reveals the place and size of the eyes, the funnel or breathing-tube, the tendinous parts of the mantle, and the lateral fins, the ink-bladder, and ink-duct. (Owen, 'Hunterian Lectures,' 1843.) Professor Owen, to whom the finest specimens of these discoveries were submitted, has found a strong resemblance between the fossil animal and the group of recent Sepioid Animals called *Onychoteuthis*, on whose arms are not the usual cusps, but slender horny hooks. The arms, eight in number, were equal, slender, and furnished with hooks through all their length, alternating in a double row. The fins appear round, and a little behind the middle of the body, as in *Sepiola;* the caudal extremity pointed, inclosing the fibrous guard, the anterior extremity of the laminar plate, under which the ink-bag is placed, nearly transverse, and not arched so as from analogy with the sepiosteum might have been expected. The Belemnitic Animal—a dibranchiate eight-armed Cuttle—must in some instances, to judge from specimens of the fibrous conical extremity, have reached (arms included) four or more feet in length, and its figure appears favourable for swift motion. In the Lias deposits whole shoals of some of the species appear to have perished together, and there are found about the cones many indications of the presence of animal substances.

The geological distribution of the Belemnites has been largely examined. In 1835 Professor Phillips presented to the British Association at Dublin a full account of the structures and mode of occurrence of the British species: assigning names and characters to the principal groups which occur in the Cretaceous, Upper Oolitic, Lower Oolitic, and Liassic Strata. M. d'Orbigny also published results perfectly accordant, derived from a full investigation, especially of the species occuring in France. It thus appears that in the first place *Belemnites* are confined as a group to the Mesozoic Strata; that many species allied to the *B. compressus* of Voltz, *B. penecillatus* of De Blainville, and *B. paxillosus* of Schlottheim, belong to the Lias; that others allied to *B. ellipticus* of Miller, *B. quinquesulcatus* of De Blainville, *B. Aalensis* of Voltz, belong to the Lower Oolite series; that others allied to *B. sulcatus* of Miller, *B. Altdorfensis* of Schlottheim, abound in the period of the Oxford Clay; while *B. mucronatus*, *B. quadratus*, *B. Listeri*, *B. attenuatus*, and others now ranked as *Belemnitella* by D'Orbigny, characterise the Cretaceous Strata. The investigations entered into on this subject are yet incompletely published; but the reader may refer with advantage to the Treatises of De Blainville and Voltz, to Buckland's *Bridgewater Treatise*, D'Orbigny's *Palæontologie Française*, and to Owen's *Hunterian Lectures*. Figures illustrating several points will be found in Mantell's *Medals of Creation*, vol. ii.

BELL-FLOWER. [CAMPANULA; SPECULARIA; WAHLENBERGIA.]

BELLADO'NNA, the Deadly Nightshade, a violently poisonous wild plant. [ATROPA.]

BELLADO'NNA LILY (literally *Fair-Lady Lily*), a species of *Amaryllis*, so called on account of its beauty and delicate blushing flowers. It is found wild at the Cape of Good Hope, has become naturalised in the ditches of Madeira, and is not uncommon in the gardens of England, where it lives for many years without shelter, if planted on a sunny border well protected from wet in winter. Its stems are about 18 inches high, of a rich purplish green, with a dense violet bloom spread over them. The flowers grow in a cluster at the top of the stem, are of a funnel shape, with six divisions curving backwards at the points, and not less than three inches long; their colour is a rich but not deep rose, which varies in intensity in different varieties. They appear in August and September, without their leaves, and give an extremely rich and very exotic appearance to the borders in which they appear. The bulbs may be procured in any quantity from Madeira.

BELLE DE NUIT, a name given by the French to various kinds of Bind-Weeds. In tropical countries these plants occur in great abundance, expanding their large fragrant and delicate flowers of white, or blue, or lilac, in such magnificence that they may well be called the 'glory of the night.' The species to which the name is more particularly applied is what botanists call *Ipomœa*, or *Calonyction Bona Nox*, whose white flowers have a diameter of five or six inches, and open at sunset in the woods of the East and West Indies, drooping at daylight.

BELLE'ROPHON, a Fossil Shell, the animal of which is unknown. Denys de Montfort established the genus, but he placed it among the Polythalamous, or Chambered, Shells. De France cut in half the very specimen which belonged to De Montfort, and thus proved that it was unilocular, like *Argonauta*. It is rich in species, which occur exclusively in the Palæozoic Formations, as the Silurian Strata, Devonian Rocks, and Mountain Limestone. It has been generally referred to the *Cephalopoda*, and considered analogous to *Argonauta*. D'Orbigny has however given reasons for ranking it with the *Heteropodous Mollusca*, and compares it with *Carinaria*.

Bellerophon hiulcus.

BELLIS (from *bellus*, pretty), a genus of plants belonging to the natural order *Compositæ*, and to De Candolle's suborder *Corymbiferæ*, tribe *Astoroideæ*, subtribe *Asterineæ*, division *Astereæ*, and subdivision *Bellideæ*. It has a receptacle without scales, flowers of the ray ligulate, pistilliferous in one row, those of the disk hermaphrodite tubular, the involucre composed of two rows of equal obtuse scales, the receptacle conical, the fruit compressed without pappus. De Candolle enumerates five species belonging to this genus. One of them, the *B. perennis*, is the Common Daisy, and is a native of Great Britain and throughout Europe. It has obovate-spathulate single-ribbed crenate-dentate leaves. It is an exceedingly common plant on banks and in pastures in Europe. It blossoms nearly all the year round, and is constantly found with opened flowers from March to October. It is subject in its wild state to varieties; sometimes all the florets are found ligulate, more rarely they are all tubular. There are several varieties of the Common Daisy cultivated in gardens. There is a double variety called Large-Double, another Double-Quilled, and a proliferous variety known by the name of Hen-and-Chickens. These varieties assume various colours from deep red to pink and white. They are easily cultivated, and form pretty plants for edges and borders, and continue in blossom a long time.

B. sylvestris and *B. annua* are natives of Europe, but are not cultivated.

The genus *Bellium* closely resembles *Bellis*; it differs however in possessing a pappus surrounding its fruits. The species are found in the south of Europe, and appear like small species of *Bellis*.

(Babington, *Manual*; Loudon, *Cyclopædia of Plants*.)

BELLIUM. [BELLIS.]

BELLOWS-FISH. [CENTRISCUS.]

BELO'NE, a genus of Fishes belonging to the family *Esocidæ* of the *Abdominal Malacopterygii*. It has a head and body greatly elongated, the latter covered with minute scales; both jaws very much produced, straight, narrow, and pointed, and armed with numerous small teeth; the dorsal fin placed over the anal fin. The species are remarkable for the green colour of their bones.

One species, the *Belone vulgaris*, is common on the British coast. It is known by various names, but more especially that of Gar-Fish. It was placed by Linnæus in the genus *Esox*, and being an inhabitant of the sea, it got the name of Sea-Pike. From the fact of its leaving the deep water in spring to deposit its ova near the shore in the months of April and May, and thus preceding the mackerel in their annual visit to shallow water for the same purpose, it has received the name of Mackerel-Guide. Its other English names according to Yarrell are Greenbone, Horn-Fish, Long-Nose, Gorebill, and Sea-Needle. The usual length of this fish is about 24 inches. It has elongated jaws, beset with numerous minute teeth. The eye is large. The body is uniform in depth to the anal fin, thence tapering to the tail. The dorsal and anal fins begin and end nearly on the same plane. The ventral fins are small. The tail is forked; the external long rays are nearly as long again as those of the centre. The upper part of the head and back is of a dark greenish blue; the sides and belly are silvery white; the pectoral, ventral, and anal fins white. This fish is taken off the coast of Berwick during the Mackerel season, and Dr. Johnston says it is not unfrequently called a Sword-Fish. It is taken also on the Devonshire and Cornish coasts. The fish are brought into the London markets in the spring, and eaten in considerable quantities. The flesh has the flavour of mackerel, but it is drier. Great numbers are said to be caught off the coast of Holland, but they are only used there as bait. Mr. Couch says of the Gar-Fish, that it "swims near the surface at all distances from land, and is seen not unfrequently to spring out of its element; its vivacity being such that it will for a long time play about a floating straw, and leap over it many times in succession. When it has taken the hook it mounts to the surface, often before the fisherman has felt the bite; and then with its slender body half out of the water, it struggles with the most violent contortions to wrench the hook from its jaws. It emits a strong smell when newly taken." In the Ionian Islands, according to Mr. Tonna, it is caught by attaching several lines with floats to a raft. In this way a large number are taken in a very short time. Specimens of this fish have been exhibited in the Aquavivarium of the Zoological Society, in the Gardens, Regent's Park.

There are several other species, some of which are said to attain a length of 8 feet, and to bite very severely. Their flesh generally is wholesome. (Yarrell, *British Fishes*; Cuvier, *Règne Animal*.)

BELONO'STOMUS, a genus of Fossil Fishes established by Agassiz. The British species occur in the Lias, Oolite, and Chalk; the foreign in the Oolite of Pappenheim.

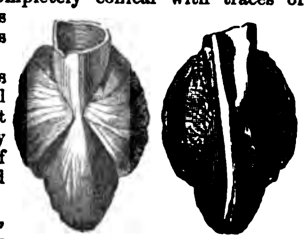
BELO'PTERA, a genus of Fossil *Mollusca*, established by Deshayes and described by De Blainville as an animal entirely unknown, containing in the back part of its muscular envelope a symmetrical calcareous or bony shell formed of a thick solid summit very much loaded behind, and a front tube more or less complete, the cavity of which is conical and annular, the shell or bone having wing-shaped appendages without any anterior shield-like prolongation.

De Blainville divides the genus into two sections. The first consists of species whose wing-shaped appendages are united below the summit, and whose cavity is somewhat in the shape of a scuttle (*hotte*). Of this section *Beloptera sepioidea* is given as an example.

Side view. End view. Internal cavity.

Beloptera sepioidea.

The second includes species whose wing-shaped appendages are distinct, and whose cavity is completely conical with traces of chambers and of a siphon. Of this division *Beloptera belemnoidea* is given as an illustration.



Beloptera belemnoidea.

De Blainville observes that this genus ought to be placed at the end of the *Sepiadæ*, or Cuttles; and that the first of the species is evidently very much allied to the bones of those animals, while the second approaches the *Belemnites*.

After all, the probability is, that these bodies are only portions of the bones of some of the Cuttle-Fishes; and this appears to have been the opinion of Cuvier.

If a perfect bone of the common species of our coasts be closely examined, a structure very analogous to the conical circularly-grooved cavity of *Beloptera*, although in a more expanded form, will be observed. These fossils have been found in the London Clay, and other beds above the Chalk.

Voltz, in his Memoir on Belemnites, makes *Beloptera sepioidea* a distinct genus under the name of *Belosepia*.

BELO'PTERA (De Blainville), the shelly portion of a Fossil Cephalopod, intermediate between *Belemnites* and *Sepia*. It occurs in the French Tertiary Strata, and includes *B. Cuvieri*, *B. compressa*, and *B. Belemnitoidea* (De Blainv.). Mr. Morris adds *B. anomala* and *B. longirostrum*, from the English Tertiaries.

BELOSE'PIA (Voltz). In this genus M. Voltz ranks two of the species (*B. Cuvieri* and *B. compressa*) which form part of the *Beloptera* of De Blainville.

BELVISIA'CEÆ, *Napoleon-Worts*, a small natural order of plants, comprehending only two genera. One of these was discovered in the kingdom of Oware, by Palisot de Beauvois, who called it *Napoleona* in honour of Napoleon I. It was subsequently named *Belvisia* after its discoverer. It has been figured under the name of *Napoleona imperialis* in the 'Flora of Oware and Benin,' where we find the only account of it. It was discovered in the neighbourhood of the town of Oware, growing to the height of seven or eight feet, and loaded with large broad bright-blue flowers, sitting close upon the branches. They are remarkable for having a superior calyx of five pieces, together with a double monopetalous corolla, of which the outer forms a flat crenellated disk, and the interior is divided into a great number of regular narrow segments. The stamens are only five, or rather perhaps ten, united by pairs into five parcels, resembling so many petals. The stigma is peltate with five angles, and covers over the anthers. The fruit is said to be a berry, with a single cell, containing a parcel of seeds lying in pulp. From such an account it will be evident to the botanical reader that this must be one of the greatest curiosities in the vegetable kingdom.

Palisot de Beauvois, its discoverer, considered it the type of a new natural order allied to the Gourds; Brown, we believe, suspects its relation to the Passion-Flowers; Lindley originally stationed it near *Styraceæ*; in his 'Nixus,' he placed it near the Campanulas, but in his 'Vegetable Kingdom' places it between *Myrtaceæ* and *Rhizophoraceæ*. The other genus belonging to this order is *Asteranthos*, which is said by Desfontaines to be a Brazilian genus, but this is doubtful. This order has only four species.

Belvisia cœrulea.

1, Calyx viewed from above; 2, the same in profile; 3, the outer corolla; 4, the inner corolla; 5, the stamens seen from above; 6, one of the stamens separate; 7, an ovary cut through.

BE'LYTA, a genus of Insects belonging to the order *Hymenoptera*, and family *Proctotrupidæ*. The species of this genus are minute four-winged flies, having the antennæ 14- or 15-jointed, filiform in the males, and thickened towards their extremity in the females. They frequent sandy situations.

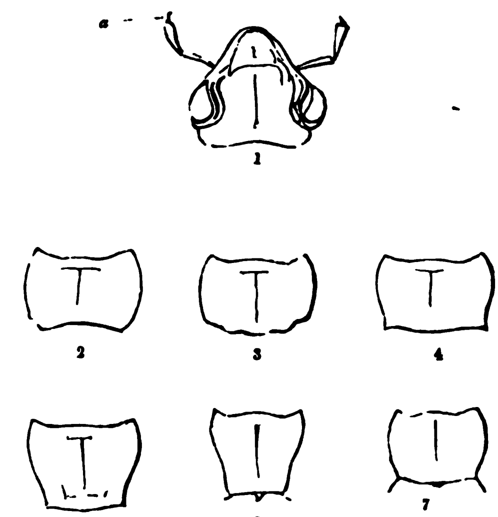
BE'MBEX, a genus of Hymenopterous Insects, forming the type of the family *Bembicidæ* of Leach. The chief generic characters are as follows:—Palpi very short; maxillary palpi 4-jointed; labial 2-jointed; mandibles with a single tooth internally; the anterior wings have three submarginal cells (the third extending to the apex of the marginal), and two recurrent nervures both springing from the second submarginal; labium and mandibles prolonged into a rostrum, or beak; body smooth, nearly conical, but rather flat beneath —in the male frequently furnished with two or more spines at the apex. Legs, in the female spinose, anterior tarsi strongly ciliated. This genus connects *Monedula* with *Philanthus*. The species are peculiar to hot climates, and, in some instances, very much resemble wasps, both in size and colour. The female forms oblique cylindrical burrows in sandy banks, with a cell at the end of each. Her next object is to collect flies, such as the species of *Syrphidæ* and *Muscidæ*, as food for her young. In the excursions made for this purpose, she is exceedingly rapid in her motions, and produces a loud buzz in flying. Having furnished a cell with five or six flies, she deposits a single egg in it, and after having carefully closed its mouth, proceeds in the same manner with another cell. When hatched from the egg, the larva devours these flies, and changes into the pupa state, and shortly after to the perfect insect. Although these insects are not strictly social, as the bees and wasps, yet generally the burrows of many of the same species are formed in the immediate neighbourhood of each other.

Upon leaving her burrow, the female takes great precaution to secure its entrance from her enemies, by stopping the mouth with sand. No precaution, however, is sufficient to protect it from the intrusion of its parasites. Among others, the beautiful *Panorpes carnea* is enabled, by the spined structure of its legs, to make its way through the sand-protected entrance—which it takes the opportunity of doing during the absence of the female *Bembex*. Entering with the tail foremost, it deposits an egg, which hatches in the following spring. The larva of the *Bembex* then becomes food for that of the *Panorpes*.

BEMBIDI'IDÆ, a family of Coleopterous Insects belonging to the division *Geodephaga* of M'Leay. They are minute carnivorous Beetles, which generally frequent damp situations, such as the margins of rivers, ponds, and ditches. They are usually of a bright blue or green metallic colour, having two or four pale yellow spots on the elytra. It is doubtful whether this family can hold the same rank in the *Geodephaga* as those of the *Carabidæ*, *Harpalidæ*, &c.: the species, however, may be easily distinguished by the minute terminal joint to the palpi. The characters of the several genera contained in this group are as follows:—

A. Body depressed and linear.
- a. Antennæ with the third and fourth joints equal . . . . *Lymnæum*.
- b. Antennæ with the fourth joint longer than the third . . . . *Cillenum*.

B. Body rather ovate.
- a. Thorax transverse, not truncate, heart-shaped:
  - *a*. Posteriorly rounded:
    - 1. Whole . . . . *Tachys*.
    - 2. Emarginate . . . . . . *Philocthus*.
  - *b*. Posteriorly acute . . . . . *Ocys*.
- b. Thorax truncated, heart-shaped:
  - *a*. The posterior angles very acute and prominent:
    - 1. Antennæ with the third, fourth, and fifth joints long . . . . *Peryphus*.
    - 2. Antennæ with the third, fourth, and fifth joints short . . . . *Notaphus*.
  - *b*. The posterior angles slightly acute-deflexed:
    - 1. Eyes moderate:
      - *Thorax rather remote from the abdomen at the base . . . . *Lopha*.
      - **Thorax closely united to the abdomen . *Tachypus*.
    - 2. Eyes large . . . . *Bembidium*.



1, Head of one of the *Bembidiidæ*, showing the form of the Palpi—*a*, the terminal joint; 2, Thorax of *Tachys*; 3, Thorax of *Philocthus*; 4, Thorax of *Ocys*; 5, Thorax of *Peryphus*; 6, Thorax of *Lopha*; 7, Thorax of *Tachypus*.

BEN-NUTS, the fruit of *Moringa pterygosperma*, from which Ben-Oil, much used in perfumery, is obtained. [MORINGA.]

BENCAO DE DEOS. [ABUTILON.]

BENINCASA, a genus of plants named by Savi, in honour of Count Benincasa, an Italian nobleman. It belongs to the order *Cucurbitaceæ*, and has but one species, *B. cerifera*. The fruit is described as covered with hairs and a glaucous bloom. It grows in the East Indies. Lindley, in the 'Vegetable Kingdom,' calls it the White Gourd, and says it is identical with *Cucurbita pepo*. Ainslie says that in the East it is presented at every native marriage feast, and is supposed to ensure prosperity to the married pair.

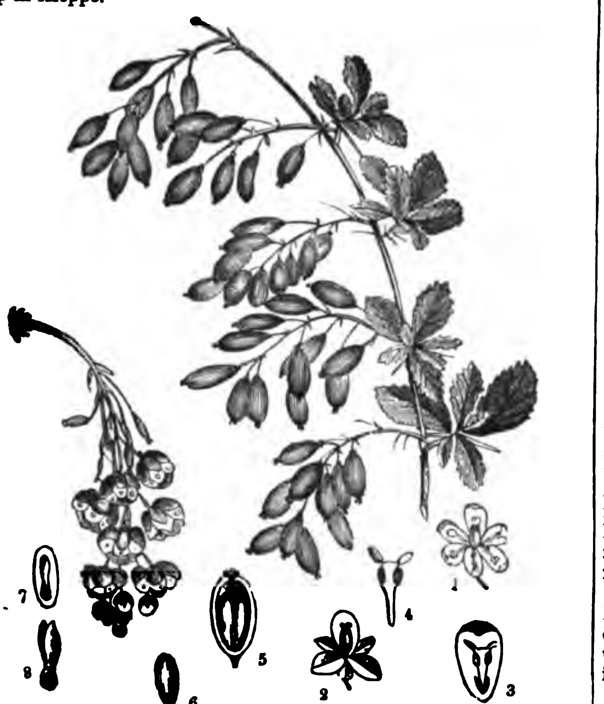
BENT GRASS. The species of *Agrostis* have this name. [AGROSTIS.]

BENTI'VI, or BIENTI'VEO, the Brazilian name for the *Tyrannus sulphuratus* of Vieillot. [SHRIKES.]

BENZOIN, the name of a resin yielded by a species of Styrax. [STYRAX.] Benzoic Acid is procured from this substance. The word *Benzoin* has also been given by Hayne to the plant which yields the resin.

BERAUNITE, the name of a phosphate of the peroxide of Iron which has a hyacinth-red colour, becoming darker on exposure to the atmosphere. (Dana, *Mineralogy*.)

BERBERIDA'CEÆ, *Berberids*, the Barberry Tribe, a natural order of plants belonging to the class of Exogens or Dicotyledons. It is readily known by three characters:—1, Its anthers open by reflexed valves; that is to say, the face of each cell of the anther peels off except at the point, where it adheres as if it were hinged there. 2, Its stamens are opposite the petals. 3, Its flowers are usually formed upon a ternary plan, there being three or six sepals, and a like number of petals and of stamens. This last character is more liable to exception than the two others. The remarkable structure of the anther is found in no European plants except *Berberidaceæ* and the Laurel Tribe [LAURACEÆ]; and as the latter has neither petals nor a ternary arrangement of the parts of the flower, it can never be mistaken for these. The relations of this order are with *Fumariaceæ*, *Vitaceæ*, and *Ranunculaceæ*. The present order consists of bushes or herbs, extremely dissimilar to each other in appearance, inhabiting the cooler parts of the world, being unknown in the tropics except on the tops of lofty mountains. They are not met with in Africa or the South Sea Islands. Their juice usually stains yellow, and their bark or stems if not woody are bitter and slightly astringent. The bitter leaves of *Epimedium alpinum* are said to be sudorific. The seeds of *Caulophyllum Thalictroides* have been employed as a substitute for coffee. The leaves of *Bougardia chrysogonum* are eaten in the East like sorrel. The tubers of *B. Rauwolfii* are eaten in Persia. *Leontice Leontopetalum* contains in its roots a sufficient quantity of alkali to render it a substitute for soap in Aleppo.



Common Barberry (*Berberis vulgaris*).

1, An expanded flower; 2, the calyx without the petals; 3, a petal, with a stamen in front of it; 4, a stamen by itself, with the valves of its anther reflexed; 5, an ovary cut through, showing the position of the ovules; 6, a ripe seed; 7, a section of the latter, showing that the embryo lies in albumen; 8, an embryo separated from the seed.

BE'RBERIS, a genus of plants belonging to the natural order *Berberidaceæ*, among which it is immediately known by its shrubby habit, berried fruit, and the presence of glands upon its petals. It is also remarkable for the irritability of its stamens, which, when the filament is touched on the inside with the point of a pin or any other hard instrument, bend forward towards the pistil, touch the stigma with the anther, remain curved for a short time, and then partially recover their erect position: this is best seen in warm dry weather. After heavy rain the phenomenon can scarcely be observed, owing, in all probability to the springs of the filaments having been already set in motion by the dashing of the rain upon them, or to the flowers having been forcibly struck against each other. This irritability of the filament is affected differently by different noxious substances. It has been found by Messrs. Macaire and Marcet, that if you poison a Barberry with any corrosive agent, such as arsenic or corrosive sublimate, the filaments become rigid and brittle, and lose their irritability; while, on the other hand, if the poisoning be effected by any narcotic, such as prussic acid, opium, or belladonna, the irritability is destroyed by the filaments becoming so relaxed and flaccid that they can be easily bent in any direction. This property is also lost under the influence of the vapour of ether and chloroform. This motion seems to depend on the same property which gives to the free cells of the lower plants so great a power of motion.

The species of this genus are interesting both for their utility and beauty. The value of the bark and root of the Common Barberry for dyeing leather and linen of a yellow colour is well known. Dr. Royle has shown that this property exists in the species of India, especially in *Berberis aristata*; and it has been ascertained by Vauquelin that a plant found on the Nilgherries of Hindustan (*B. tinctoria*) is inferior to few woods for dyeing yellow. The acid quality of the fruit has rendered all the species more or less esteemed; that of *B. aristata* and *B. Nepalensis* is dried by the mountaineers of India as raisins, and sent to the plains for sale. The bitterness and astringency of the bark has caused them to be received into the list of useful medicinal plants; and it has been ascertained by Dr. Royle that the Λύκιον Ἰνδικόν (Lycium Indicum) of Dioscorides, concerning which so much doubt has always existed, was an Indian species of Barberry now called *Berberis Lycium*. (Royle's 'Illustrations of the Botany of the Himalayan Mountains,' &c. p. 63.)

The species of *Berberis* are obviously divided into two great groups, of which the first has undivided leaves like the Common Barberry, and the others are pinnated, after the manner of the leaf of an ash-tree. Botanists call the latter Mahonias. Ash-Barberry may be taken as their English designation.

Section I. *Leaves simple.*—TRUE BARBERRIES.

1. *Leaves thin, deciduous; Flowers solitary.*

B. Sibirica, Siberian Barberry.—Leaves obovate, obtuse, deeply and irregularly toothed; flowers solitary, shorter than the leaves; spines deeply divided into from three to seven shining partitions. A small shrub found on exposed rocks on the hills and lower mountains of Altaic Siberia, where it is very common. The berries are, according to Pallas, obovate, and of a red colour. This species does not thrive in England, but is always a scrubby bush of inelegant appearance.

2. *Leaves thin, mostly deciduous; Flowers in racemes.*

B. Cretica, Candian Barberry.—Spines in three or more divisions; leaves small, obovate, acute, nearly free from toothings; flowers in very short compact racemes. Not uncommon on the mountains of Candia and Greece, whence it has been brought to our gardens. It is a dwarf scrubby bush, looking like a starved specimen of the Common Barberry. Its berries are said to be black, ovate, 2-seeded, and austere rather than acid.

B. vulgaris, Common Barberry.—Spines in three deep divisions; leaves obovate, with fine spiny toothings; flowers in drooping racemes, which are longer than the leaves. This common species appears to inhabit equally the north of Europe, Asia, and America, in woods and thickets, especially in limestone countries. De Candolle remarks that it extends in Europe from Candia to Christiania, and that while in northern latitudes it is a valley plant, it becomes in the south exclusively a mountaineer, climbing so high on Mount Ætna as to be the most alpine of the shrubs of the sterile belt of that mountain at the height of 7500 feet. Like all such plants it has in the course of ages formed numerous varieties; these are however chiefly confined to the fruit, there being a great similarity in the foliage of all except one.

This species is usually a bush from four to six feet high; but in Italy it becomes as large as a plum-tree, living a couple of centuries or more. The wood is hard but brittle, and is chiefly employed by the dyers for staining yellow. The acid qualities of this fruit render it unfit to eat raw, but it makes one of the most delicious of preserves.

B. Canadensis, Canadian Barberry.—Spines divided into three equal lobes; branches covered with little elevated points; leaves oblong, distantly and coarsely toothed; flowers in corymbose racemes, nodding. Found in the northern states of North America. It is generally considered the same as *Berberis vulgaris*, because the specimens called *B. Canadensis* both in gardens and herbaria certainly are so; but this, the true plant of Miller and others, appears to differ from the common species in the characters here assigned to it; its leaves are moreover of a thicker texture.

B. cratægina, Hawthorn Barberry.—Spines simple; leaves oblong, strongly netted, with a straggling serrature here and there; flowers in dense, drooping, many-flowered racemes, which are scarcely longer than the leaves. Described by De Candolle from specimens collected in Asia Minor.

B. Iberica, Iberian Barberry.—Spines often simple, but sometimes 3-cleft; leaves nearly undivided; flowers in loose nearly erect racemes, much longer than the leaves. A native of Spain. The berries are dark purple.

B. Sinensis, Chinese Barberry.—Spines 3-parted or none; leaves lanceolate, very acute, much netted, entire, or regularly toothed; flowers numerous, in drooping racemes, which are not much longer than the leaves. A native of the north of India and of China.

3. *Leaves leathery, evergreen; Flowers solitary, or in clusters.*

B. Wallichiana Wallich's Barberry.—Spines long, slender, 3-parted; leaves oblong, lanceolate, deep-green, sharp-pointed, finely serrated; flowers very numerous, in clusters shorter than the leaves. A native of Nepaul, and apparently of the higher part of the country. *B. atroviridis* is another name for this species.

B. dulcis, Sweet-Fruited Barberry.—Spines long, slender, simple, or 3-parted; leaves obovate, obtuse, with or without a bristly point, quite entire, glaucous on the under side; flowers solitary, on slender stalks, twice as long as the leaves. A native of the south-western part of South America, from the Strait of Magalhaens to Valdivia, where it forms a small evergreen bush. Its fruit is round, black, about as large as a pea; it is said to be sweet and well suited for making tarts or preserving.

B. heterophylla, Various-Leaved Barberry.—Spines strong, 3-parted; leaves obovate, lanceolate, acute, either entire or with from three to five spiny teeth, very deep green; flowers solitary, on stalks about twice as long as the leaves. An inelegant bush about three feet high, bare of leaves, and having nothing but its rarity to recommend it; it is a native of the Strait of Magalhaens; in the gardens it is usually called *B. ilicifolia*; there is a figure of it in Hooker's 'Exotic Flora,' vol. i., t. 14.

B. Empetrifolia, Crowberry-Leaved Barberry.—Spines slender, long, in three or five deep divisions; leaves linear, with a spiny point, rolled back at the edge, collected in bundles in the axils of the spines; flowers solitary, growing on stalks about as long as the leaves. A very curious and pretty plant, found wild from the Cordilleras of Chili to the southern point of the American continent, over the whole of which country it appears to be very common. In general aspect it is much more like a Heath than a Barberry.

Besides these species there are several of great beauty as evergreen shrubs in South America.

4. *Leaves leathery, evergreen; Flowers in racemes.*

B. floribunda, Many-Flowered Barberry.—Spines very stiff, and 3-parted; leaves oblong or oblong-lanceolate, nearly entire or toothed in various degrees, sometimes very deeply and coarsely veined; flowers in long loose slender racemes. Apparently extremely common in the whole of the north of India, where it forms a tall bush, varying considerably in the size and form of the leaves, and in the degree in which they are toothed, but always well marked by its slender, pendulous, or erect racemes of flowers, which are much longer than the leaves, and in no degree corymbose. It is to be found occasionally in the more choice collections of this country. Out of accidental variations in its mode of leafing and flowering, the spurious species called *B. affinis* and *B. ceratophylla* have been constituted.

B. Asiatica, Raisin Barberry.—Spines small and weak, simple or 3-parted; leaves oblong or obovate, acute, somewhat glaucous beneath, either entire or coarsely or even finely toothed; flowers in short compact racemes not longer than the leaves. Found in Nepaul and Kumaon very abundantly, forming a tall bush with the habit of the common European Barberry. The fruit is round, covered over with a thick bloom, and has altogether the appearance of the finest raisins. It is produced abundantly in this climate, where the plant is now not very uncommon. The very short racemes are the principal distinction of this species when in flower.

B. dealbata, Whitened Barberry. — Spines scarcely any; leaves roundish, coarsely-toothed, rather glaucous, white beneath; racemes very short and compact, pendulous. A native of Mexico. It is a tall slender evergreen bush, with deep-brown branches and scarcely any spines. The leaves are sometimes wedge-shaped and 3-toothed, but more frequently nearly round, with two or three spiny teeth on each side. It is sometimes called in the gardens by mistake *B. glauca*, which is a different species.

B. aristata, Bristle-Leaved Barberry.—Spines 3-parted, simple, or wanting; leaves obovate, acute, shining on both sides, with a few bristle-pointed teeth on either edge; racemes always more or less compound and corymbose. A native of the mountains of Hindustan, extending from the Himalayas down the Nilgherry Hills as far as Adam's Peak in Ceylon. It is a hardy sub-evergreen bush in the gardens.

Section II. *Leaves pinnated; all evergreen.*—Ash-Barberries.

B. fascicularis, Californian Ash-Barberry.—Leaflets ovate, finely-toothed, not shining; flowers in short compact clusters; stem tall and woody. Found in the moutainous parts of California and Mexico. A very handsome evergreen shrub, with pinnated leaves which are by no means shining, and of a paler green than several of the others.

Mahonia diversifolia of the gardens seems to be the same as this; and the story of its having been brought from Monte Video is probably not true.

B. Aquifolium, Holly-Leaved Ash-Barberry.—Leaflets ovate-lanceolate, flat, deeply and regularly toothed, remarkably shining; flowers in long narrow racemes; stem tall and woody. A native of North-West America from California to Nootka Sound, growing in woods, where it forms a rich and thick underwood. Its foliage is of a rich deep shining green, becoming purple in the winter; it bears fruit in some abundance, which consists of clusters of roundish black berries, having their surface covered with a rich violet bloom. They have no merit as fruit, but would probably be greedily sought by game, for the protection of which in coverts this species seems well adapted, if it could only be obtained in sufficient quantity. The difficulty of propagating it has hitherto made it a scarce plant; but seeds might be easily obtained from the Hudson's Bay Company's settlements in North-West America. It most resembles *B. fascicularis*, from which its large shining leaves at once distinguish it; and it is perfectly hardy, which that species is not: flowers in May and June. It has been figured in the 'Botanical Register,' vol. xvii., plate 1425.

B. repens, Creeping Ash-Barberry.—Leaflets few, somewhat glaucous, especially on the under side, oblong, when old rounded at the point, with shallow toothings; flowers in crowded compound erect racemes; stem very dwarf; runs at the root. Found wild on the east side of the Rocky Mountains of North America, and perfectly hardy in our gardens. Its stems do not grow above six or nine inches high, and are loaded with a profusion of rich yellow flowers, which constitute the principal beauty of the species. Its fruit is unknown. A good figure of it has been published in the 'Botanical Register,' vol. xiv., plate 1176. Nothing can be more unlike *B. Aquifolium* than this is, although the two have occasionally been most unaccountably confounded.

B. glumacea, Long-Leaved Ash-Barberry.—Leaflets numerous, ovate-lanceolate, coarsely toothed, of a dull glaucous green; flowers in long narrow erect racemes; stem very dwarf; scales of the leaf and flower-buds stiff and glumaceous. A native of North-West America, growing in shady grassy places in woods. The stem of this species does not grow more than six or eight inches high, and is in fact shorter than its leaves, which consist of about six pairs with an odd one, and are jointed at every pair of leaflets in the manner of a bamboo stem. The fruit is roundish and insipid, of a fine glaucous purple. This is less rare than *B. Aquifolium*, and is an object of curiosity more than of utility. It loves to grow in a shaded American border, where it is protected from the fiercer rays of the sun. It is figured in the 'Botanical Register,' vol. xvii., plate 1426. *Berberis* or *Mahonia nervosa* is another name for this species.

In addition to these there are the following species:—*Berberis Leschenaultii* (the *B. Acanthifolia* of some), a fine pinnated plant with round black fruit, found on the Nilgherry Mountains of India at the elevation of 8000 feet. *Berberis Nepalensis*, a native of the mountains of the north of India, where, according to Dr. Royle, it grows twelve feet high in shady places, at 5000 and 6000 feet of elevation: this is a noble species, and ought to be obtained from India at any cost, as it would in all probability succeed in this climate. *Berberis tragacanthoides*, with not more than one or two pairs of leaflets, found along the banks of the river Kur, near Tiflis; and *Berberis caraganæfolia*, a Chinese plant very like the last: both the latter have the points of the leaves hardened into spines.

BERCHEMIA, a genus of plants belonging to the natural order *Rhamnaceæ*. Two species *B. volubilis* and *B. lineata* are used in medicine.

BERENGELITE, a mineral resin from South America, soluble in alcohol.

BERENICE. [Acalephæ.]

BERENI'CEA, a celluliferous Coralline Fossil, of which *B. diluviana* is an example, in the Oolite of Wilts.

BERGAMOT. [Citrus.]

BERGERA, a genus of plants belonging to the natural order *Aurantiaceæ*. *B. Königii* possesses stomachic and tonic properties, and an infusion of the leaves is used against vomiting. The green leaves are used raw in dysentery; the bark and roots are stimulant.

BERGIA, a genus of plants belonging to the natural order *Elatinaceæ*, and named by Linnæus in honour of Peter Jonas Bergius, Professor of Natural History at Stockholm. It has a 5-parted calyx, 5 petals, 10 stamens, 5 styles, approximate capsules, 5-celled, and 5-valved. The species are insignificant weeds inhabiting moist places. *B. Ammanoides*, according to Dr. Wright, is an inhabitant of the East Indies and bears the Tamool name of Neer-mel-neripoo, or Water-Fire. Dr. Lindley calls attention to this name as resembling our Water-Pepper, a name given to the *Elatine*, the type of the order to which Lindley has referred *Bergia*. Two other species are natives of the Cape and one of Java. (Lindley, *Vegetable Kingdom*; Don, *Dichlamydeous Plants*.)

BERGKALK, in Geology, the German term for our Mountain Limestone.

BERGMEHL (Mountain Meal), a name given in Sweden to an earth which the inhabitants of the districts where it occurs have from time immemorial regarded as nutritious. It occurs in Sweden on the shores of Lake Letnaggsjohn near Urnea and mixed with flour this substance has in times of scarcity been used for bread. It was examined by Ehrenberg, who found it to contain the remains of several species of *Diatomaceæ*. He considered this fact would account for its nutritious properties. The vegetable matter however contained in the silicious frustules of these minute plants must be exceedingly small, and further evidence would be required to demonstrate that this substance really contributed to the support of those who ate it. The occurrence of the *Diatomaceæ*, owing to the indestructible nature of their frustules or skeletons, is very common. [Diatomaceæ.]

BERGYLT, the name of a Fish, also called the Norway Haddock, the *Sebastes Norvegicus* of Cuvier. [Sebastes.]

BE'RIS, a genus of Dipterous Insects, of the family *Xylophagidæ*. The species of this genus are small metallic-coloured flies, which frequent the leaves of plants. Their larvæ feed on putrescent wood. The generic characters are as follows:—Body narrow; palpi minute, the third joint thickened a little at the extremity; the two first joints of the antennæ equal, third elongate subulate; eyes pubescent; the scutellum with 4, 6, or 8 points; abdomen with 7 distinct segments; the first joint of the posterior tarsi incrassate in the male; the wings have four posterior cells, and sometimes the indication of a fifth.

The ova of one of the species of this genus (*Beris clavipes*) are said to be ejected from the ovipositor in the form of a little chain, about an inch long, consisting of a single series of oval eggs, which are glued to each other in an oblique position. Most probably the eggs of the other species are ejected in the same manner.

BERKELEYA, a genus of *Diatomaceæ*, named by Greville in honour of the Rev. M. J. Berkeley, distinguished for his researches in cryptogamic botany. It belongs to the suborder *Naviculeæ*, and is characterised by having linear frustules included within tubular sub-membranaceous filaments, which are free at one extremity, but have the other immersed in a gelatinous tubercle. *B. fragilis* is found parasitic on *Zostera marina*, and some of the smaller marine *Algæ* on the British coasts. *B. Adriatica* has been found on the coasts of the Adriatic at Trieste.

BERNICLE GOOSE or CLAKIS, the vernacular name for the *Bernicla* of Ray, *Anser Bernicla* of Fleming; the *Bernicle, Bernacle Goose*, and *Barnacle Goose* of authors. This bird affords an instance of the credulity with which those who in their generation were held wise and learned, accepted the most absurd traditions, and handed them down to posterity with the additional weight of their authority. A cirrhiped, a marine testaceous animal, the *Pentelasmis anatifera* of Leach, *Anatifa lævis* of Bruguière, *Lepas anatifera* of Linnæus, the Duck Barnacle of collectors, was long asserted to be the parent of the Bernicle Goose. This common shell is fixed to a long fleshy peduncle, and is frequently found attached to floating timber and even sea-weed. The tentacula, which proceed from the anterior opening of the valves, have an appearance that recalls to the mind of a casual inaccurate observer the recollection of a feather, and hence, in all probability, the fable took its origin. "Some," writes Nuttall, "even described these supposed embryos as fruits, in whose structure already appeared the lineaments of a fowl, and which, being forthwith dropped into the sea, turned directly into birds. Munster, Saxo Grammaticus, and Scaliger even, asserted this absurdity. Fulgosus affirmed that the trees which bore these wonderful fruits resembled willows, producing at the ends of their branches small swelled balls containing the embryo of a duck, suspended by the bill, which when ripe fell off into the sea and took wing. Bishop Leslie, Torquemada, Odericus, the Bishop Olaus Magnus, and a learned cardinal, all attested to the truth of their monstrous generation. Hence the bird has been called the Tree Goose, and one of the Orkneys, the scene of the prodigy, has received the appellation of Pomona."

Not to weary the reader with names, and some of great reputation might be added, we will proceed to trace the fable as told by Gerard, merely adding by the way, that one of the other worthies is recorded to have opened 100 of the goose-bearing shells, and to have found in all of them the rudiments of the bird completely formed. Gerard, then, as if determined that no sceptic should have the slightest ground whereon to rest a doubt, thus gives his evidence in his 'Herbal':—

"But what our eyes have seene and hands have touched we shall declare. There is a small island in Lancashire, called the Pile of Foulders, wherein are found the broken pieces of old and bruised ships, some whereof have been cast thither by shipwracke, and also the trunks and bodies with the branches of old and rotten trees, cast up there likewise; whereon is found a certaine spume, or froth, that in time breedeth unto certaine shells, in shape like those of the muskle, but sharper pointed, and of a whitish colour; wherein is contained a thing in form like a lace of silke finely woven as it were together of a whitish colour; one end whereof is fastened unto the inside of the shell, even as the fish of oisters and muskles are; the other end is made fast unto the belly of a rude masse or lumpe, which in time commeth to the shape and form of a bird; when it is perfectly formed the shell gapeth open, and the first thing that appeareth is the foresaid lace or string; next come the legs of the bird hanging out, and as it groweth greater it openeth the shell by degrees, till at length it is all come forth and hangeth only by the bill; in short space after it commeth to full maturitie, and falleth into the sea, where it gathereth feathers, and groweth to a fowle bigger than a mallard and lesser than a goose, having blacke legs and bill or beake, and feathers blacke and white, spotted in such manner as is our mag-pie, called in some places a pie-annet, which the people of Lancashire call by no other name than a tree-goose; which place aforesaid, and all those parts adjoining, do so much abound therewith, that one of the best is bought for three-pence. For the truth hereof, if any doubt, may it please them to repaire unto me, and I shall satisfie them by the testimonie of good witnesses." This edifying deposition is illustrated by a cut of the goose and of its parent shell.

Now, after this, can we wonder at the melancholy catalogue of human beings who have expiated the supposed crime of witchcraft at the stake on the testimony of their deluded and deluding prosecutors? Here is a man of learning and of considerable accuracy in many points, the author of a valuable work containing much information, who gravely and deliberately, on the authority of two of the most acute of his senses, asserts a downright falsehood and courts investigation. He may moreover be acquitted of any intention to deceive; but his mind was filled with previous assertions and preconceived opinions, and his excited imagination, like that of the majority of the witnesses against the unfortunate witches, gave a colour and a form to all he saw and felt.

Gerard published this celebrated romance in 1636. If we now turn to Ray's edition of Willughby, published in 1678, we shall see what a progress had been made towards truth, even in that short space of time. "What is reported concerning the rise and original of these birds, to wit, that they are bred of rotten wood; for instance, of the masts, ribs, and planks of broken ships, half putrified and corrupted, or of certain palms of trees [the catkins of the willow] falling into the sea; or lastly, of a kind of sea-shells, the figures whereof Lobel, Gerard, and others have set forth, may be seen in Aldrovand, Sennertus in his 'Hypomnemata,' Michael Meyerus, who hath written an entire book concerning the tree-fowl, and many others. But that all these stories are false and fabulous I am confidently persuaded. Neither do these want sufficient arguments to induce the lovers of truth to be of our opinion, and to convince the gainsayers. For in the whole genus of birds (excepting the phœnix, whose reputed original is without doubt fabulous) there is not any one example of equivocal or spontaneous generation. Among other animals indeed, the lesser and more imperfect, as for example many insects and frogs, are commonly thought either to be of spontaneous original, or to come of different seeds and principles. But the greater animals and perfect in their kinds, such as is among birds the goose, no philosopher would ever admit to be in this manner produced. Secondly, those shells in which they affirm these birds to be bred, and to come forth by a strange metamorphosis, do most certainly contain an animal of their own kind, and not transmutable into any other thing, concerning which the reader may please to consult that curious naturalist Fabius Columna. These shells we ourselves have seen, once at Venice, growing in great abundance to the keel of an old ship; a second time in the Mediterranean Sea, growing to the back of a tortoise we took between Sicily and Malta. Columna makes the shell-fish to be a kind of *Balanus marinus*. Thirdly, that these geese do lay eggs after the manner of other birds, sit on them and hatch their young, the Hollanders in their northern voyages affirm themselves to have found by experience."

Here we see the clouds that had obscured the subject nearly cleared away, though there is still a little lingering error in the tacit admission of the spontaneous generation of the frogs and insects.

It is no small praise to Belon and some others that, even in their early time, they treated this fable of the duck-bearing tree with contempt. There has been much confusion in the nomenclature of this bird. Linnæus considered it as the male of *Anser erythropus* (White-Fronted Wild-Goose), and treated *Anser Brenta* (the Brent-Goose), and *A. Bernicla* as synonyms. Succeeding writers continued the mistake till Temminck and Bechstein, instead of restoring the name given to it by the older ornithologists, called it *Anser leucopsis*, but did not refer the specific name *Erythropus* to the *Anas albifrons* of Gmelin and Latham.

Bernicle-Goose (*Anser Bernicla*).

Dr. Fleming, in his 'History of British Animals,' set this right, and has properly described the Bernicle-Goose as *Anser Bernicla*, and the White-Fronted Wild-Goose as *Anser erythropus*.

The summer haunts of the Bernicle reach high into northern latitudes. Iceland, Spitzbergen, Greenland, Lapland, the north of Russia and of Asia, and Hudson's Bay, are recorded as its breeding places. Sir John Richardson notes it as accidental on the Saskatchewan (53° 54′ N. lat.) as a passenger in spring and autumn, and gives the southern states of the North American Union as its winter quarters. It visits Britain in the autumn, appearing in great numbers on the north-western coasts, and in the north of Ireland. On the eastern and southern shores of Britain it is comparatively rare, and the Brent-Goose occupies its place.

The weight of a Bernicle is about five pounds, the length rather more than two feet, and the breadth about four and a half with the wings spread. The bill, about an inch and a half long, is black, with a reddish streak on each side, and between it and the eyes is a small black streak. Irides brown; head (to the crown), cheeks, and throat white; the rest of the head, neck, and shoulders black. Upper part of the plumage marbled with blue, gray, black, and white; belly and tail coverts white; tail black; flanks ashy gray; legs and feet dusky.

The eye-streak is much broader in the young of the year than in the adult; the under parts are not of so pure a white, and the upper plumage is darker.

The flesh is excellent.

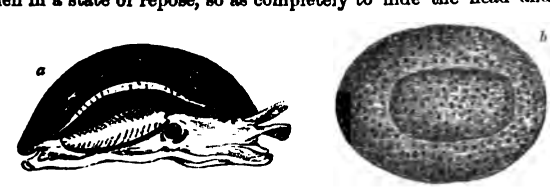
BE'ROE, a genus of marine animals established by Müller, belonging to the *Ciliograde Acalephæ*. Some of the species, as the common *B. Pileus*, are now referred to *Cydippe*. The species, which are gelatinous, transparent, and either oval or globular, float in the ocean, where they are widely diffused. Lamarck says that they are very phosphoric, and that they shine at night like lamps suspended in the sea, their brilliancy becoming vivid in proportion to the rapidity of their motions. Their breathing is carried on by means of cilia, which extend longitudinally and at equal distances along the surface from the mouth to the inferior opening. Fabricius observed minute crustaceans in the digestive organs, and that when one of these animals was broken to pieces those pieces still continued to live and swim about by the action of the cilia, which was still continued. The Beroes have a rotatory motion, and Bosc observed that they also had another, produced by an alternate contraction and dilatation.

Messrs. Audouin and Milne Edwards have given a description of the organisation of the globular *Beroe* (*Beroe Pileus*, Lam.; *Pleurobrachia* of Fleming; *Eucharis* of Péron and of De Blainville), and Dr. Grant, in the 'Transactions of the Zoological Society,' has given an account of its structure. Cuvier mentions it as being common in the north—where it is said to be one of the aliments of the whale (*Balæna*)—and in the channel on the French coast. It is found very commonly on the British coasts. Dr. Grant found it in the harbour of Sheerness, in which latter locality he says "the boatmen, who seemed to be familiar with it under the name of the spawn of the sea-egg (*Echinus*), which it somewhat resembles in its globular and ribbed form, assured me that often in hot and calm weather the water swarms with the little medusæ in such numbers as to cover the surface in all this part of the æstuary of the Thames. The animal has a regular oval form, with its longest diameter from the mouth to the anus, about six lines, and its breadth about four lines. The general texture of the body is quite transparent and colourless." [ACALEPHÆ.]

BERO'SUS, a genus of Coleopterous Insects belonging to the family *Hydrophilidæ* (Leach). These beetles inhabit ponds, in which they may often be seen swimming in an inverted position. They most probably feed upon vegetable substances. The common colouring of the species is dusky yellow varied with markings of a black or dark metallic bronze hue; their form is nearly oval, and the principal generic characters are, eyes prominent, clypeus entire, antennæ nine- (?) jointed, thorax narrower than the elytra.

BERRY, in Botany, a term confined to such soft and succulent fruits as have their seeds lying loosely among pulp. The gooseberry, the currant, and the grape are therefore genuine berries; but plums, rose-heps, haws, &c., in which the seeds do not lie among the pulp, are excluded from the definition, although they are all comprehended under the same name in common language. [FRUITS.]

BERTHELLA, a genus established by De Blainville for a Marine Mollusk, found though rarely on the British coasts. It is the *Pleurobranchus plumula* of Montague, and is thus defined by De Blainville:—Body oval, sufficiently protuberant (*bombé*) above, and recurved below, when in a state of repose, so as completely to hide the head and the



Berthella porosa.
a, side view; *b*, view of back, to show internal shell.

foot, which last is large and oval, but much less than the mantle. There is a kind of veil at the anterior border of the head, prolonged on each side into a sort of appendage cleft laterally. The two tentaculiform occipital auricules are cleft and striated within at their termination, and approach each other very nearly at their base, which is thinned out as it were. The eyes are sessile, placed upon the posterior root of the tentacula. There is but one pectiniform branchia, which is lateral, attached anteriorly, and in great measure free behind. The organs of generation terminate in one large tubercle, situated before the root of the branchia; the shell is internal, very delicate, and oval, with a summit hardly to be distinguished. Forbes and Hanley, in the 'History of British Mollusca,' place it in the family *Pleurobranchidæ* of the *Gasteropoda*. Although seldom taken it appears to have a wide range. It has been found at Exmouth, Guernsey, Salcombe Bay, Milford Haven, Isle of Man, Sound of Skye, Scarborough, coast of Northumberland, and Malbay on the west coast of Ireland.

BERTHIERITE. [ANTIMONY.]

BERTHOLLE'TIA, a genus of plants belonging to the natural order *Lecythidaceæ*, and named after Berthollet the celebrated chemist. The only species is a tree of large dimensions, and forms vast forests on the banks of the Oronoco. Its stem averages 100 feet in height and two feet in diameter, not branching till near the top, whence its boughs hang down in a graceful manner. Its leaves are undivided, arranged alternately upon the branches, about two feet long and five or six inches wide, of a brilliant green. Its flowers are yellowish white, with a calyx having a deciduous border divided into two pieces, a corolla of 6 unequal petals joined together at the base, and a very great number of white stamens joined into a thick fleshy ring. The fruit is figured and described by Humboldt as a spherical case as big as a man's head, with four cells, in each of which are six or eight nuts; its shell is rugged and furrowed, and covered with a rind of a green colour. The nuts are irregularly triangular bodies, having a hard shell, which is very much wrinkled, and which is fixed to a central placenta by their lower end; their seed, as is well known, is a firm oily almond of a pure white colour. They are sold in the shops of London under the name of Brazil Nuts.

"The Portuguese of Para," says Humboldt, "have for a long time driven a great trade with the nuts of this tree, which the natives call Iuvia and the Spaniards Almendron; they send cargoes to French Guyana, whence they are shipped for England and Lisbon. The kernels yield a large quantity of oil well suited for lamps." The same traveller describes himself and his companion Bonpland as having found these nuts a great luxury when they were following the course of the Oronoco. For three months they had lived upon bad chocolate, rice boiled in water, always without butter, and generally without salt, when they met with a store of Bertholletia nuts. It was in the course of June, and the Indians had just gathered in their harvest of them. The kernels were found delicious when fresh, but unfortunately they are apt to become rancid on account of the great quantity of oil which they contain.

Fruit and Seeds of *Bertholletia excelsa*.

BERYL, a mineral, among the varieties of which are found two of the most beautiful and costly gems with which we are acquainted, namely, the *Emerald* and the *Precious Beryl*.

They belong to the rhombohedral system of crystallisation, usually occurring in regular hexagonal prisms which occur variously modified, sometimes by the truncation of the lateral edges of the prism, at other times by the simple truncation of the terminal edges; but the prism is sometimes terminated in a much more complicated manner, of which a remarkable instance has presented itself in a crystal in the possession of Professor Naumann of Freiberg, who has observed in them the faces of no less than six other forms of the rhombohedral system. Its general aspect is always that of a hexagonal prism, and when the terminal edges are modified there will generally be found a plane inclined to the lateral planes of the prism under an angle of 119° 58′.

The crystals admit of cleavage in the four directions parallel to the faces of the regular prism, that parallel to the terminal plane being perfect, the others imperfect and more difficult to be obtained. The fracture is conchoidal and uneven; the lustre is vitreous, and it possesses various degrees of transparency. According to Mohs the hardness varies from 7·5 to 8, the specific gravity from 2·678 to 2·732. The following are its chemical characters before the blow-pipe, as stated by Berzelius.

Alone it is not easily acted upon, but when thin fragments are for a long time submitted to a powerful flame the edges become rounded, and a colourless vesicular scoria is produced. The transparent varieties become milky.

With borax it forms a clear and generally colourless glass, which effect is also produced by soda. With the phosphor salt it is with difficulty dissolved without the formation of a silicious skeleton.

Of this mineral we possess several analyses, of which the following are three: the first being an Emerald from Peru, by Klaproth; the second a Beryl from Siberia, by the same chemist; and the third a Beryl from Broddbo, near Fahlun, in Sweden:—

	Emerald.	Beryl. Siberia.	Beryl. Broddbo.
Silica	68·50	66·45	68·35
Alumina	15·75	16·75	17·60
Glucina	12·50	15·50	13·13
Oxide of Iron	1·00	0·60	0·72
Oxide of Columbium	0·00	0·00	0·27
Oxide of Chromium	0·30	0·00	0·00
Lime	0·25	0·00	0·00

This species contains several varieties, of which the two known among lapidaries under the name of Emerald and Aquamarine, or Precious Beryl, are the most worthy of attention. These varieties, though distinguished by some mineralogists as forming distinct species, differ however only in colour, the term Emerald being applied to those possessing the peculiar rich deep green so well known as the emerald-green, while all the other varieties are comprehended under the name of Beryl; those which are clear, transparent, and possess a good colour, present various shades of sky-blue or mountain-green, being the Aquamarine or Precious Beryl. The colour of the Emerald is attributed to the small quantity of green oxide of chromium which has been found in the specimens from Peru; while the varieties in the tints of Beryl may be considered to be produced by admixtures of the oxides of iron, the yellow being the colour of the peroxides of iron, and the mountain-green and the various shades of blue being the effect of varying quantities of the protoxide, to the presence of which the common bottle-glass owes its tint.

The following localities produce the finest Emeralds:—The mines in the Tunca Valley, situated in the mountains between New Granada and Popayan, and not far from the town of Santa Fé de Bogota, where, according to Humboldt, they are found in veins traversing clay-slate, hornblende-slate, and granite; the Heubach Valley, in the district of Pinzgau, Salzburg, where they occur imbedded in mica-slate, and are inferior in colour to those from Peru; varieties have also been lately found in some old mines in Mount Zabarah, in Upper Egypt, from which spot the ancients are supposed to have derived their emeralds.

The varieties known by the name of Beryl are found principally in Siberia and Brazil: in the former country it occurs in the granite district of Nertschinsk and also in the Uralian and Altai Mountains, sometimes in very large crystals, prisms having been found upwards of a foot in length. In the granitic mountains of Odon Tchelon, in Daüria, three very interesting mines occur at different elevations in the mountain; in the lowest are found, irregularly disseminated through a mass of semi-decomposed granite mixed with ferruginous clay and nodules of Wolfram, prismatic crystals of Beryl of a greenish-yellow colour, rarely exceeding one inch in length. Some hundred feet higher occurs the second mine in a vein of micaceous clay, from which the most valuable crystals are obtained; their colour is of a pale but pure green, and their size frequently considerable. The third mine is situated in a vein of white indurated clay on the summit of a mountain; in this mine the varieties are usually of a pale greenish-blue, but sometimes they are found of a pure but pale sky-blue. They are here remarkably transparent. Imbedded crystals and massive varieties are also found at Limoges, in France; near Zwiesel, on the Rabenstein, in Bavaria; at Fimbo and Broddbo, near Fahlun, in Sweden; and likewise in some of the tin-mines in Saxony and Bohemia.

An enormous specimen is also described in Silliman's 'Journal' as having been found at Acworth in New Hampshire, United States. Its dimensions are stated to be 4 feet in length and 5½ inches across the lateral planes, and the weight to be 238 pounds.

Specimens of Beryl have also been found in several of the primary districts of Ireland; those from the granite of the Mourne Mountains, in the county of Down, are the finest. In this locality they are associated with topaz, black quartz, felspar, and mica. In Scotland it is found in the granite at Rubieslaw quarry, near Aberdeen, and also in broken pieces in the sand of the rivers of that county.

The value of the Emerald depends not only on its size, colour, and brilliancy, but also on its being free from flaws, by which this gem is frequently greatly deteriorated in the eye of the jeweller. The following is the rate at which varieties of a fine colour and free from fissures may be procured, as stated by Beudant:—

A stone of 5 grs. from 100 to 120 francs.
" 8 " 240 francs.
" 15 " 1500 "
" 24 " 2400 "

BE'RYX, a genus of Fishes of the order *Acanthopterygii*, and belonging to a little group of the family *Percidæ*, in which the species possess more than seven branchial rays, whereas all the other genera included in the first division of this order (in which division the cheeks are not defended by indurated plates) possess seven or less.

Cuvier, in his 'Règne Animal,' mentions three other genera belonging to this group: namely, *Holocentrum*, *Myripristis*, and *Trachichthys*.

The other characters of Beryx are as follows:—Ventral fins, with one spine and ten soft rays; the back furnished with but one slightly-extended fin, and some indistinct small spines on its anterior edge.

Several species are fossil. *B. ornatus* occurs in the Chalk of Sussex. Mantell figured it, under the title of *Zeus Lewesiensis*, in the 'Geology of Sussex.' Two other species occur in the British Chalk.

BESHAN, a name given to the Balm of Mecca, the produce of *Balsamodendron Opobalsamum*. [BALSAMODENDRON.]

BE'TA, a genus of plants belonging to the natural order *Chenopodiaceæ*, among which it is known by its having large succulent roots, and a green calyx united halfway to a hard rugged nut. The species are found in Europe, the north of Africa, and the western parts of Asia; four are cultivated as esculents, the others are mere weeds.

B. vulgaris, Common Beet, is said to be found in a wild state along the whole of the sea-coast of the Mediterranean, and in Egypt; it is however chiefly known as a plant cultivated in gardens, for its carrot-like sweet and tender roots. Several sorts are mentioned by writers on gardening, varying in the size, form, colour, and sweetness of their roots: of these however two are much more worth cultivating than the others, namely, the small red variety and the long yellow variety; they are the most delicate, the sweetest, and have the richest colour when served at table.

B. altissima, Mangel Wurzel, is a much larger and coarser plant than the Common Beet, from which it is principally known by its roots being marked internally with zones of red and pink or white. Its native country is unknown; by some it is reckoned a mere variety of the Common Beet, but this is scarcely probable, considering that it is permanently reproduced from seed; others state that it is a hybrid between the Common and Chard Beet, our third sort, of which however there is neither proof nor probability. Mangel Wurzel is an object of extensive cultivation for feeding cattle; its leaves afford a very nutritious food for all kinds of live stock, and the roots, from their extreme sweetness, are by many farmers considered the most valuable of all the agricultural plants upon which cattle are fed in winter. Independently of their use for cattle, Mangel Wurzel roots have been extensively employed in the manufacture of sugar. They are still employed in France in the manufacture of sugar; and an attempt has lately been made in Ireland to use them for the same purpose. For this, the common red and white Mangel Wurzel will perhaps be found best suited in this country, in consequence of its hardiness, and the great weight per acre which it will afford; but the French have preferred a perfectly white kind, which is said to exceed the former in nutritive properties, in the proportion of two to one; they also grow a sort with white roots and a purple crown, and another white within, and yellow on the outside. The yellow Field-Beet, which has been a good deal cultivated in this country, is apparently a variety of *B. vulgaris*, and is too unproductive in most situations to bear comparison with the others.

B. cycla, Chard Beet, is inferior to the two last in the size of its roots, but is remarkable for the thickness of the ribs of its leaves, which are white, yellow, green, orange coloured, or deep crimson, in different varieties. It is cultivated like the Common Beet, but the leaves only are used in soups, or their ribs are cut out and stewed like sea-kail. They have however an earthy taste, which is not in the power of cookery wholly to remove, on which account they are little esteemed. The French call this species Poirée à Cardes. It is said to have been introduced to France from Portugal; but its native station is unknown.

B. maritima, Sea-Beet, unlike the three last, is a prostrate plant, with numerous entangled branches and a tough woody root. It is found abundantly on many parts of the southern coast of England, and is a common European shore-plant, preferring a chalky soil. Its leaves are small, ovate, deep green, crenelled, rather sharp-pointed, flat, succulent, and placed on long stalks. Its flowers are green and arranged in spikes, each being subtended by a small leafy bract. It is a perennial, and one of the most valuable plants known for spinach; its leaves when dressed are extremely delicate and well-flavoured, and easily reduced into that pulpy substance which constitutes the great merit of good spinach. It thrives in a garden without any sort of care, and is rather a handsome plant when growing among rubbish, for its leaves are a particularly rich green, and not liable to be scorched by the sun, or to be injured much by insects. It is increased by seeds, which it yields in abundance. [BEET, in ARTS AND SC. DIV.]

BETEL, the leaf of an intoxicating kind of pepper. [PIPER.]

BETEL-NUT PALM. [ARECA.]

BETHY'LUS, a genus formed by Cuvier, and placed by him under his second order of Birds (*Les Passereaux*), in the first tribe (*Dentirostres*), and in the first family (*Laniadæ*). He says that there is but one species known (*Lanius Leverianus* of Shaw, *Lanius picatus* of Latham), and that the Great Shrike (*Lanius corvinus* of Shaw) approaches it, though *L. corvinus* has the bill more compressed.

Vieillot has changed the generic name to *Cissopis*, and Illiger makes it a *Tangara*.

The genus is thus characterised by Vieillot:—Bill short, robust, swollen, a little compressed towards the end; upper mandible notched and curved at the point: gape ciliated; the third and fourth quills longest; outer toes united at their base.

Le Vaillant has figured this bird (plate 60) under the name of Pie Pie-Greiche. White and black are the only colours of its plumage, distributed like those of the magpie which it is said to resemble in miniature in Guyana and Brazil, where it is a native.

BETHY'LUS, a genus of Hymenopterous Insects of the family *Proctotrupidæ*. Its principal distinctive characters are—antennæ geniculated, 13-jointed in both sexes; the head is depressed and the prothorax very elongate and almost triangular. The wings have only one large marginal cell, not closed; abdomen conical; legs short, femora thick.

These little four-winged flies, which are remarkable for their large depressed heads, are not very unlike ants in their appearance, and are found in flowers and sometimes on the leaves of shrubs, to which they resort in search of small caterpillars, which they store up in cells to nourish their future progeny. The principal haunts of these insects are dry sandy situations.

BETONICA. [BETONY.]

BETONY, the common name of the *Stachys Betonica* [STACHYS], which was formerly described under the name of *Betonica officinalis*.

BE'TULA, a genus of trees or shrubs, belonging to the natural order *Betulaceæ*. It is characterised by its flowers growing in catkins, the scales of which are thin and three-lobed, and by the scales subtending three flat fruits, each furnished with two styles, and expanded into a thin wing on either side; these fruits are what are vulgularly called birch-seeds. The species are, with one exception, found beyond the tropic in the northern hemisphere; the species of the southern hemisphere is a little evergreen plant called *B. antarctica*, of which little is recorded except that it inhabits Tierra del Fuego.

The more remarkable species of this genus may be conveniently disposed according to their prevailing geographical distribution.

European Birches.

B. alba, the Common Birch. Branches erect, when young covered with a short close down never smooth, and warted; leaves with a somewhat rhomboidal form, ovate, generally doubly serrated, with downy footstalks, acute, but not tapering to the point; catkins pendulous. A native of Europe from the most northern to the most southern countries, in the latter however not appearing except on mountains at a considerable elevation; on Ætna it does not occur below 4762 feet above the sea, according to Philippi. It is also found eastward in Asia, as far at least as the Altai Mountains. Although this species is not much valued for its timber, it is extremely useful for many other purposes. Russia skins are said to be tanned with the empyreumatic oil of its bark, from which the peculiar odour of such leather is derived. Cordage is obtained from it by the Laplanders, who also prepare a red dye from it; the young shoots serve to nourish their cattle, and vinegar is obtained from the fermented sap. The inhabitants of Finland use the leaves for tea, and both in Lapland and Greenland strips of the young and tender bark are used as food. From the timber are manufactured hoops, yokes for cattle, bowls, wooden spoons, and other articles in which lightness without much durability is sufficient; baskets and hurdles are often made of parts of its shoots; and from its rising sap, extracted by means of openings cut into its alburnum in the spring, and fermented, a kind of wine is obtained which is of an agreeable quality, but will not keep. During the siege of Hamburg by the Russians in 1814, almost all the birch-trees of the neighbourhood were destroyed by the Bashkirs and other barbarian soldiers in the Russian service, by being tapped for their juice.

The Birch naturally grows in poor sandy soil, on which it thrives fully as well as in that of a more fertile kind. It is said to attain sometimes the height of 70 feet, with a diameter of 2 feet; in England it does not acquire such considerable dimensions. As it approaches both its northern and southern limits it gradually decreases in size, conformably to the laws which regulate vegetable development. Its bark is said to be very durable.

B. pendula, the Weeping Birch. Branches drooping, when young perfectly smooth, and marked with little pearly specks; leaves with a somewhat rhomboidal form, ovate, either doubly or singly serrated, acute, but not tapering to the point, sometimes slightly hairy; catkins pendulous. Very common in different parts of Europe, along with the last, in the properties of which it appears to participate, and with which it is often improperly confounded. It differs from the Common Birch not only in its weeping habit, but also in its young shoots being quite smooth, bright chestnut brown when ripe, and then covered with little white warts. The *Betula pontica* of the nurseries is a slight variety, with a few straggling hairs on the leaves and leafstalks, and a less drooping habit.

Common Birch (*Betula alba*).

1, The inside of a barren scale, with the anthers attached; 2, inside of a fertile scale, with the ovaries attached; 3, an ovary cut through perpendicularly; 4, inside of a scale, with three ripe fruits; 5, a ripe fruit of the natural size; 6, the same magnified; 7, a transverse section, and 8, a perpendicular section of the same; 9, a ripe seed; 10, an embryo.

B. pubescens, the Downy Birch. Branches erect, covered all over with very close down; leaves heart-shaped, ovate, taper-pointed, doubly and sharply serrated, very downy. A smaller species than the first, found in the bogs of Germany: a variety of it is called *Betula urticifolia* in gardens.

B. nana, the Dwarf Birch. Leaves orbicular, crenated, with strongly marked veins on the under side; catkins upright. A small bush, found in Lapland and the mountainous parts of other northern countries; it even stretches across the whole continent of Asia as far as Unalaschka. To the people of the south this plant has no value, but to the Laplanders it affords a large part of their fuel; and its winged fruits are reported to be the favourite food of the ptarmigan. The place of this is occupied in America by a species called *Betula glandulosa*.

Asiatic Birches.

B. Bhojpattra, Indian Paper Birch. Leaves oblong, acute, with nearly simple serratures, somewhat heart-shaped at the base; their stalks, veins, and twigs hairy; ripe catkins, erect, cylindrical, oblong; bracts smooth, woody, two-parted, blunt, much longer than the fruit, which has narrow wings. A tree found on the Alps of Gurwal and Kumaon, where it was discovered by Dr. Wallich, who informs us that its thin delicate bark furnishes the masses of flexible laminated matter, of which great quantities are brought down into the plains of India for lining the tubes of hookahs. The Sanscrit name of the substance is Boorja. (Wall. 'Plant. As. Rar.,' vol. ii. p. 7.) The bark of this species is of a pale cinnamon colour. It is nearly allied to *B. papyracea*.

B. acuminata, the Tapering-Leaved Birch. Leaves ovate, lanceolate, somewhat simply serrated, taper-pointed, smooth, dotted beneath, leafstalks and twigs quite smooth; ripe catkins, very long, pendulous, cylindrical, crowded; their rachis and the bracts, which are auricled at the base, downy. Found on many of the mountains of Nepaul, and in the great valley of that country, following the course of rivers.

B. nitida, Shining Birch.

B. cylindrostachya, Cylindrical Spiked Birch. These two last species are found in Kumaon.

American Birches.

B. populifolia, the Poplar-Leaved or White American Birch. Catkins pendulous; branches perfectly hairless, drooping, very much covered with resinous warts; leaves triangular, taper-pointed, doubly-toothed, on long weak stalks. This species is more an object of ornament than of utility. It rarely grows more than 20 or 25 feet high, except in very rich soils, when it is said to become somewhat taller. It is a native of the northern parts of North America, from the lower parts of New York, New Jersey, and Pennsylvania, to Canada. Michaux says that its bark cannot be divided into thin plates like that of the Paper-Birch or common European species. It is very like the European *B. pendula*, from which the characters we have assigned it are sufficient to distinguish it.

B. nigra (*B. rubra*, Michaux; *B. lanulosa*, A. Mich.), the Red Birch. Branches covered closely with a short thick down, which they do not lose till the second year; leaves angularly rhomboidal, very deeply doubly serrated, acute, with the axils and veins of the underside of the leaf downy; stipules narrow-ovate, membranous, smooth, soon dropping off. A native of the borders of rivers, where it grows associated with planes, maples, and willows, in the southern provinces of the United States, delighting as much in heat, according to Michaux, as many other species do in cold, and therefore the best adapted for planting in the southern parts of Europe. It is a handsome species, growing as much as 70 feet high, and from 2 to 3 feet thick, and is remarkable for its bark not being white and shining, but brown, dotted with white, and slightly wrinkled. The limbs of the tree are large, and the branches terminate in long flexible pendulous twigs. Cask hoops are manufactured from its shoots when about an inch in diameter; and all the brooms used in the streets of Philadelphia, which are far better than those of Europe, are prepared from its tough and elastic twigs. In this country it is generally called *B. angulata*.

B. excelsa (*B. lutea*, Mich.), the Yellow Birch. Catkins erect, short, thick, nearly sessile; branches exceedingly downy when young; leaves rhomboidal, acute without any tapering, finely and regularly serrated, or nearly entire; on very downy stalks; stipules large and membranous. Found chiefly in the coldest parts of North America along with the Paper-Birch; south of the Hudson River it becomes rare. Michaux states that it is principally in good alluvial soil that it thrives, in company with black and hemlock spruces and ashes; its greatest height is from 60 to 70 feet, with a diameter of something more than 2 feet. It is said to be a handsome tree, with a straight trunk, often clear of branches as far as 30 or 40 feet from the ground. It is remarkable for the bright golden yellow of its bark, which shines as if it had been varnished. It is most like *B. nigra*, from which its thicker and more hairy catkins and simply serrated leaves distinguish it, independently of other characters.

B. papyracea, the Paper or Canoe-Birch. Catkins thick, pendulous, on long stalks; branches generally more or less downy when young, sometimes hairy; leaves ovate, occasionally heart-shaped, regularly or irregularly serrated, smooth or downy. This, the most valuable of all the species of Birch, is a native of North America, where it grows in great quantities, not extending beyond 73° to the north nor 43° to the south, according to Michaux. The slopes of hills and valleys, where the soil is of good quality, are said to be its favourite stations: in such places it often acquires the height of 70 feet.

Its wood is sometimes used in North America for cabinet makers' work; but it is not of much value for exposure to the weather, as it soon decays if subjected alternately to damp and dryness. Its bark is the part which is the most esteemed; this part is said to be so durable that old fallen trees are stated to be frequently found with their form so well preserved that one would think them perfectly sound, but upon examining them it is found that the whole of the wood is rotted away, and nothing is left but the sound and solid case of bark. This part is used for a number of useful purposes; log-houses are sometimes thatched with it; little boxes, cases, &c., and even hats are manufactured from it; but its great value is for making canoes. For the purpose of obtaining pieces sufficiently large for such a purpose, we are informed by Michaux that the largest and smoothest-barked trees are selected. In the spring two circular incisions at the distance of several feet are made, and a longitudinal incision on each side; then by introducing a wedge of wood between the trunk and bark, the latter is easily detached. With threads prepared from the fibrous roots of the White Spruce-Fir (*Abies alba*), the pieces of bark are sown together, over a light frame-work of wood, and the seams are caulked with the resin of the Balm of Gilead Fir. Canoes of this sort are so light as to be easily transported on the shoulders of men. It is said that one capable of carrying four persons and their baggage only weighs from 40 to 50 pounds.

B. lenta (*B. carpinifolia*, A. Mich.), the Soft, Black, or Cherry-Birch. Catkins short, erect; branches quite smooth; leaves thin, cordate, oblong, tapering to a point, simply or doubly serrated, downy when young, smooth afterwards; stipules very large and membranous. None of the American birches produce timber so valuable as this; whence one of its American names is Mountain Mahogany. Its wood is hard, close-grained, and of a reddish brown; it is imported into this country in considerable quantity, under the name of American birch, for forming the slides of dining-tables, and for similar purposes. It is abundant in the midland states, as in New York, New Jersey, and Pennsylvania, but more to the south it only appears on the summits of the Alleghanies. Deep rich soil is what it prefers; and when it attains its greatest dimensions, which are as much as 70 feet of height, and 3 feet of diameter, it is a handsome tree, budding remarkably early in the spring, when its leaves are covered with a short thick coat of down; this disappears later in the season, and leaves them of a bright and lively green. It grows with unusual rapidity. It is rarely seen in this country, although it is perhaps one of the best suited to our climate. The thinness of its leaves, combined with their oblong figure, distinguishes this from all the other species.

BETULA'CEÆ, *Birchworts*, the Birch Tribe, a natural order of Apetalous Dicotyledonous plants. It was formerly comprehended, along with other groups, in what were called *Amentaceæ*, because it bears its flowers in amenta, or catkins; but it is distinguished from all those which agree with it in this particular, by its flat, one-seeded, two-celled, membranous fruit, and pendulous ovules. All the species are either trees or shrubs, with the fertile flowers in one catkin and the barren in another, and they have in general the main lateral veins of their leaves running straight from the midrib to the margin, without curving inwards. They are found in the colder parts of the world, or in mountainous regions in hot countries. The only genera belonging to this order are *Alnus* and *Betula*. [ALNUS; BETULA.] Lindley places the order between *Myricaceæ* and *Altingiaceæ*.

BEUDANTITE, a black mineral, with a resinous lustre and rhombohedral crystals. It contains oxides of lead and iron. It is found at Horhausen on the Rhine.

BEWICK'S SWAN, the *Cygnus Bewickii*. [CYGNINÆ.]

BIAPHO'LIUS (Leach), a genus of Bivalve Shells, indistinctly known, and which Rang considers to be identical with the genus *Hiatella* of Daudin. [PYLORIDIA.]

BIB, a Fish. [MORRHUA.]

BI'DENS, a genus of plants belonging to the natural order *Compositæ*, the suborder *Corymbiferæ*, tribe *Senecionideæ*, subtribe *Heliantheæ*, division *Bidentideæ*. It has monogamous discoidal heads, sometimes radiant; the florets of the ray neuter ligulate, of the disk, hermaphrodite, tubular; the receptacle flat; the involucre of two rows, the outer row spreading; the branches of the style surmounted by short cones; the fruit compressed, angular, rough at the edges, the angles terminating in 2-5 stiff retrorsely hispid bristles. The genus has been named *Bidens* from the two bristles which most frequently surmount the teeth. A great number of species belonging to this genus have been described, but they are generally inconspicuous weeds. They have been found in Europe and North and South America. Two are natives of Great Britain in marshy and watery places, *B. bipartita* and *B. cernua*. The latter is the *Coreopsis Bidens* of Linnæus. (Babington, *Manual*; Lindley, *Natural System*.)

BIGBONE LICK, a place in Kentucky (United States), where great numbers of fossil mammalia occur in a dark-coloured marshy soil, covered by gravel and resting on blue clay. The bones of *Elephas primigenius* and *Mastodon maximus* are very numerous. With them lie bones of *Magalonyx Jeffersonii*, *Bos bombifrons*, *Bos Pallasii*, and *Cervus Americanus*. (Rogers, *On American Geology*; *British Association Reports for* 1834.)

BIGENERI'NA, D'Orbigny's name for a genus of *Foraminifera*, which he originally described as minute Cephalopoda. There are two subgenera; the first consisting of the *Bigenerinæ* properly so called, with a central opening, and the other of the *Gemmulinæ* (D'Orbigny) with a marginal opening. [FORAMINIFERA, *see* SUPPLEMENT.]

BIGNO'NIA, a genus of plants named by Tournefort after the Abbé Bignon, librarian to Louis XIV. It forms the type of the monopetalous order of Exogens, *Bignoniaceæ*. It has a campanulate 5-toothed rarely entire calyx; the corolla with a short tube, a campanulate throat, and a 5-lobed bilabiate limb; the stamens four, didynamous, with the rudiments of a fifth; lobes of the anther divaricate; stigma bilamellated; capsule siliqui-formed, 2-celled, with the dissepiment parallel with the valves; the seeds in two rows, imbricate, transverse, with membranous wings. Nearly 100 species of this genus of elegant plants have been described. They are usually climbing shrubs furnished with tendrils, having opposite, single, conjugate, ternate, pinnate, or digitate leaves. The flowers are mostly in terminal or axillary panicles. The corollas are trumpet-shaped, and are coloured variously, white, yellow, orange, purple, violet, or rose.

All the species of this genus are splendid plants while in blossom, and deserve a place in every collection. Most of them are climbers, and adapted for training up rafters and pillars, but they only grow freely in stoves. A mixture of loam and peat is best adapted for their growth, and cuttings will strike readily under a hand-glass in heat, either in mould or sand. The species known by the name of this genus which is most abundant in our gardens is the *Bignonia radicans*. This and some other species of *Bignonia* are now referred to the genera *Spathodea* [SPATHODEA] and *Tecoma* [TECOMA]. It is one of the few species capable of living in the open air against a wall in this country.

B. æquinoxialis has square glabrous branches, glabrous conjugate leaves, oblong lanceolate leaflets, simple axillary tendrils, 2-flowered peduncles, terminal ones racemose, follicles linear. It is a native of Guyana. It is applied by the negroes to swellings of the feet, with which they are troubled.

B. leucoxylon is a tree, and has quinate leaves; ovate-lanceolate, acuminate, glabrous leaflets; terminal, solitary, or twin flowers. This plant is a native of Jamaica, on the banks of rivers. It has white flowers, not unlike those of *Datura Stramonium*, which come out before the leaves. The wood is of a green or yellow colour, and is sometimes brought into the market under the name of ebony. It is said to be an antidote to the poison of Manchineel.

B. Chica is a climbing plant, and has abruptly-bipinnate leaves; conjugate elliptic-ovate, acuminate, deeply-cordate, glabrous leaflets; axillary pendulous panicles. It grows on the banks of the Orinoco. A red matter is extracted from its wood by the Indians, with which they paint their bodies. It is called Chica, and has been used in this country as a dye.

B. alliacea has tetragonal branches, conjugate leaves, coriaceous elliptic leaflets, simple tendrils, axillary 5-flowered peduncles, a 5-toothed calyx. It is a native of Guyana and the West Indies. It has large white flowers, and is distinguished from all the other species by its peculiar garlic odour; hence the French name Liane à l'Ail.

(Don, *Gardener's Dictionary;* De Candolle, *Prodromus;* Burnett's *Outlines; Cyclopædia of Plants.*)

BIGNONIA'CEÆ, *Bignoniads*, the Bignonia Tribe, are Monopetalous Dicotyledonous plants, with irregular flowers, a pod-like fruit, winged seeds without albumen, and usually a climbing habit. They are mostly shrubs, inhabiting the hotter parts of Asia, Africa, and America, and unknown in Europe except in a cultivated state; some of them are trees of considerable size. They generally are remarkable for the large size and rich or delicate colouring of their trumpet-shaped flowers. No sensible properties of much importance have been recognised among them. Several are valuable for their timber, which possesses extreme hardness. According to Lindley the number of genera in this order is 44, and the species 450. They are allied to *Gesneraceæ* and *Crescentiaceæ*. [BIGNONIA; ECCREMOCARPUS; CATALPA; TECOMA; JACARANDA.]

Bignoniaceæ—Bignonia lectiflora.

1, A corolla slit open; 2, a cup-shaped disk, out of which the ovary often grows, together with the style and stigma; 3, a young ovary; 4, a ripe pod; 5, a seed; 6, an embryo extracted from the integuments of the seed.

BIKH, or BISH, is the name given amongst the Hindoos to a most powerful and destructive vegetable poison. Dr. Wallich refers the plant to the *Aconitum ferox*. [ACONITUM.] It is also called Vish, Visha, or Atavisha.

BILBERRY, a berry-bearing shrub, found on the moors of most countries in Europe. [VACCINIUM.]

BILE, an animal fluid of a greenish colour, viscid consistence, and bitter taste.

The organ by which the bile is secreted is the liver. The liver is distinguished by two peculiarities: first, it is the largest gland in the body; and secondly, it is provided with two distinct sets of veins. The veins that receive the blood from the viscera of the abdomen, that is from the organs more immediately concerned in the process of digestion, unite together into a large trunk named the vena portæ. This vein penetrates into the substance of the liver, and ramifies through it in the manner of an artery; at the same time the liver receives a large quantity of arterial blood by the hepatic artery. [LIVER.] The ultimate branches of the vena portæ terminate partly in a set of vessels termed the hepatic ducts, which contain the bile, and partly in a set of vessels termed the hepatic veins, by which a large portion of the blood of the vena portæ is transmitted by the ordinary course of the circulation into the vena cava, the great vein that returns the blood from all parts of the body to the right side of the heart. [CIRCULATION OF THE BLOOD.]

This arrangement is peculiar. There is no other gland in the body in which the disposition of the blood-vessels is at all analogous: there is no other instance in which a vein is sent to a gland and distributed to it in the manner of an artery. This peculiarity has naturally led physiologists to infer that the vein in this case performs the ordinary functions of an artery; that it carries on the process of secretion, and eliminates its product, the bile, out of venous blood.

But whatever doubts physiologists may entertain by which of the two great vessels of the liver the bile is secreted, the consent is universal that the liver is the gland by which this fluid is formed. When duly elaborated in this organ, the bile is received from the secreting vessels by exceedingly minute tubes, the union of which constitutes the excretory duct of the gland, which is termed the hepatic duct. The hepatic duct passing on towards the duodenum, which, physiologically considered, is a second stomach [DUODENUM], communicates with a small membranous cyst or bag, called the gall-bladder, a reservoir for the bile. The duct of the gall-bladder, called the cystic duct, unites with the hepatic duct, and both together form a single tube, termed the choledoch duct, which pierces the duodenum. Thus the hepatic duct, carrying the bile away from the liver, either conveys it into the gall-bladder by means of the cystic duct, or transmits it immediately into the duodenum by means of the choledoch duct. The bile which flows immediately into the duodenum is called the hepatic bile; that which is contained in the gall-bladder is called the cystic bile. There is a striking difference in the external characters of the two, cystic bile being of a much deeper colour, and much more viscid, pungent, and bitter than hepatic bile; but the difference in their chemical properties, if there be any, has not been ascertained: hepatic bile, on account of the difficulty of collecting it in sufficient quantity, has not been analysed, while some portion of bile is generally found in the gall-bladder after death.

From actual experiment it would appear that the secretion of bile is continually going on in the living system. In whatever circumstances an animal is placed—if the orifice of the choledoch duct be laid bare—the bile is always seen to be flowing drop by drop into the intestine. It is observed to flow much faster during the process of digestion than when the stomach is empty; and there is reason to believe that, during the digestive process, the hepatic bile is secreted in much larger quantity than when the stomach is empty, and that it is then conveyed directly into the duodenum. The gall-bladder fills when the stomach is empty, and when the stomach is full the gall-bladder becomes comparatively empty. The gall-bladder, however, is seldom if ever completely emptied. Vomiting contributes more perhaps than any other action of the system to the expulsion of its contents. Magendie states that he has often found it completely empty in animals that died from the effects of an emetic poison.

The physical characters of the bile are as follows:—In colour it is always a deep brown, but when seen in thin layers it has a brownish-yellow tint. It is very fluid, being viscid only in new-born infants. The specific gravity varies from 1.032 to 1.040. On examining with the microscope bile from the gall-bladder, with which of course a certain amount of mucus is mixed, there are observed:—1, Transparent or grayish round vesicles, about the 700th of a line in diameter; they disappear on the addition of alcohol or ether, and are removed by filtration. 2, Conical yellow bodies, about the 140th of a line in length, and about the 300th or 400th of a line in breadth, apparently devoid of nuclei; these are epithelial cells from the gall-bladder. 3, Here and there irregular dark granules, which disappear on the addition of a solution of potash, apparently pigment cells. 4, Occasionally minute crystals of cholesterin, occurring as colourless rhombic tablets.

Chemically the bile is composed of several elements which have a tendency to arrange themselves during chemical analysis in very various forms. Not only are the four organic elements, carbon, hydrogen, oxygen, and nitrogen present, but also sulphur, phosphorus, sodium, potassium, calcium, and iron. The union of the organic elements in different proportions will account for the various substances such as picromel, bilin, choleic acid, colic acid, taurine, &c., which chemists have described in their analyses of biles. According to Dr. Kemp the organic portion of ox-bile may be represented by the formula 48 carbon, 42 hydrogen, 13 oxygen, and 1 nitrogen. The following analyses of ox-bile and human bile, by Thenard and Berzelius, will serve to show the nature of bile as well as the progress of chemical inquiry on this subject when contrasted with more recent analyses. According to Thenard the composition of bile is as follows:—

Ox-Bile.

Water	700
Picromel and Resin	84·3
Yellow matter	4·5
Soda	4
Phosphate of Soda	2
Muriate of Soda	3·2
Sulphate of Soda	0·8
Phosphate of Lime	1·2
Oxide of Iron	a trace.
	800·0

Human Bile.

Water	1000
Yellow insoluble matter	2 to 10
Albumen	42
Resin	41
Soda	5·6
Salts the same as in Ox-Bile	4·5

According to Berzelius, the following is the composition of Human Bile:—

Water	908·4
Picromel	80
Albumen	3
Soda	4·1
Phosphate of Lime	0·1
Common Salt	3·4
Phosphate of Soda with some Lime	1·0
	1000·0

It will be seen from these analyses that the chief part of the organic elements was found in the form of picromel. It was in the year 1838 that Demarçay announced that bile consisted essentially of an organic acid combined with soda. He termed the acid choleic, and obtained it in the following manner: bile, from which the mucus had been precipitated by alcohol, was evaporated on the water-bath, and 10 parts of the dried residue were dissolved in 100 parts of water, to which 10 parts of hydro-chloric acid had been added. Allowing evaporation at a moderate temperature to proceed, it was observed that a dark green oil collected on the surface, while at the same time the fluid became turbid. On removing the oil and allowing the fluid to rest for some time, it gradually became clear, with the precipitation of a green deposit. This dark green bitter precipitate is Demarçay's choleic acid, and is regarded by him as constituting nine-tenths of the solid constituents of the bile. It is still mixed with margaric acid, cholesterin, pigment, &c. After their removal it forms a yellow spongy matter, which rapidly absorbs oxygen from the atmosphere, is very bitter, slightly soluble in ether, soluble in water, and very soluble in alcohol. The choleate of soda, obtained by adding an alcoholic solution of soda to an alcoholic solution of choleic acid, and then passing a current of carbonic acid through it to remove the excess of soda, possesses all the characters of bile; it yields on evaporation a brown resinous mass, and is soluble in water and in alcohol.

When choleic acid is boiled with hydrochloric acid it yields ammonia, taurine, and choloidic acid; the latter being insoluble is deposited. The formulæ usually assigned to choleic acid, taurine, and choloidic acid differ only slightly from the formula given above for the organic portion of ox-bile.

But it has been recently shown by Redtenbacher that taurine contains as much as 25 per cent. of sulphur.

As an instance of modern chemical analysis we give the two following analyses. The bile in these cases was obtained from healthy men, killed by severe accidents:—

	1.	2.
Water	86·00	85·92
Solid constituents	14·00	14·08
Choleate of Soda	10·22	9·14
Cholesterin	0·16	0·26
Margarin and Olein	0·32	0·92
Mucus	2·66	2·98
Chloride of Sodium	0·25	0·20
Tribasic Phosphate of Soda	0·20	0·25
Basic Phosphate of Lime / " " Magnesia	0·18	0.28
Sulphate of Iron	0·02	0·04
Peroxide of Iron	traces	traces

Platner succeeded in obtaining choleic acid and choleate of soda in a crystallised form. Sugar has also been recently demonstrated to exist in the bile. Gmelin and Strecker have also obtained from dried bile an acid which they call choleic, and other substances have been procured from the bile of lower animals.

One of the uses which the bile serves in the economy is to produce a specific change upon the aliment in a certain stage of the digestive process. The first change which the food undergoes after it has been swallowed is the reduction of it by the stomach into a fluid mass, the appearance of which varies considerably according to the nature of the food. This fluid mass is termed chyme, which when accumulated in a certain quantity is sent from the stomach into the duodenum. In the duodenum the food undergoes a further change, and is converted from chyme into the substance called chyle. These two fluids are distinguished from each other by specific characters. [DIGESTION.] That the bile is the main agent in producing the change by which chyme is converted into chyle is proved by a decisive experiment performed by Sir B. Brodie.

This physiologist applied a ligature around the choledoch duct of an animal so as completely to prevent the bile from entering the duodenum, and then noted the effects produced on the digestion of the food immediately before and immediately after the operation. The experiment was repeated several times, and the result was uniform. The production of the chyme in the stomach took place as usual, but the conversion of the chyme into chyle was immediately and completely interrupted. Not the smallest trace of chyle was perceptible either in the duodenum or in the vessels which take up the chyle when formed, namely, the lacteals.

It was at one time supposed that after the bile had performed this function that its compounds were thrown off from the system by the bowels. But that the bile is not merely an excrementitious fluid, intended to remove effete matter from the blood, but a secretion essential to the animal economy, was rendered almost certain by the experiments of Berzelius, Theyer, and Schlosser, which showed that the human fæces contained much too small a quantity of a substance resembling bile, to justify the idea that it was evacuated in this manner. A further proof that the bile is absorbed and not excreted is afforded by an examination, made by Enderlin, of the ash yielded by the contents of the different portions of the intestinal canal of a hare. He found that the ash from the contents of the duodenum alone effervesced on the addition of an acid, thus showing that the choleate of soda (which yields the carbonate on incineration) is absorbed before reaching the jejunum. Schwann also established this opinion beyond a doubt, by a series of well-devised experiments on dogs. He tied the ductus choledochus, and at the same time formed a fistulous opening in the gall-bladder, by which the bile escaped externally. His most important conclusions are—1st, that when the bile does not get into the bowel its absence is generally perceptible in dogs about the third day by a marked diminution in weight; and, 2nd, that unless the channel for the conveyance of bile to the duodenum is re-established, symptoms of deficient nutrition, wasting, debility, &c., ensue, and death is the ultimate consequence.

Upon this ground it was suggested by Liebig that probably all the carbonaceous substances of the food were converted into bile before being again taken up into the circulation and converted into carbonic acid for the supply of animal heat. It is however certain that a portion of the bile, in the form of colouring matter, passes off through the intestines, and also that in certain diseases it is thrown off in considerable quantities with the contents of the bowels. It can also be shown that the quantity of biliary matter formed in the liver does not contain more than one-sixth or one-eighth of the quantity of carbon that is thrown off from the lungs in the form of carbonic acid.

(Simon, *Animal Chemistry;* Lehmann, *Physiological Chemistry;* Carpenter, *Manual of Physiology;* Gregory, *Hand-Book of Organic Chemistry; Cyclopædia of Anatomy and Physiology*, article '*Bile*'; Liebig, *Animal Chemistry*.)

BILIMBI, the Malayan name of the acid fruit of a species of *Averrhoa*. [AVERRHOA.[

BILLARDIE'RA, a genus of plants named after Jean Jacques Julien Labillardière, a French botanist, who visited Syria, and afterwards Australia, in D'Entrecasteaux's Expedition, and wrote the 'Novæ Hollandiæ Plantarum Specimen,' in two vols., 4to. The genus belongs to the natural order *Pittosporaceæ*, and has a calyx of five acuminate sepals, five petals with approximate claws, which are convoluted at their edges, forming a campanulate flower; an ellipitical berry terminated by a style. The species are called Apple-Berries; and George Don enumerates eight. They are climbing shrubs, natives of Australia and Van Diemen's Land. The fruit which they bear is eatable.

B. longiflora has climbing branches, the younger ones scarcely pubescent; the leaves lanceolate, entire; the pedicles 1-flowered, glabrous, one half shorter than the flower; the berries almost globose, torose, glabrous. This plant is "a fast grower and abundant flowerer; and when in fruit its fine blue berries make a handsome appearance." (Loudon.)

The other species are desirable shrubs for the conservatory. They thrive well when planted in an equal mixture of loam and peat. Cuttings will readily root in sand under a bell-glass. They may be also raised from seed, which they produce in abundance.

(*Cyclopædia of Plants;* G. Don, *Gardener's Dictionary*.)

BILLBERGIA, a genus of plants belonging to the natural order *Bromeliaceæ*, named after Billberg, a Swedish botanist. Several species are cultivated in our stoves. They are all natives of South America. One of the species, *B. tinctoria*, yields a colouring matter, which is used for dyeing in Mexico.

BILLY-BITER, a local name for the Blue Tit. [PARUS.]

BILOCULI'NA (D'Orbigny), the name of a genus of *Foraminifera*, Les Milioles of Ferrussac.

BIMANA, the first order of the class *Mammalia*, which includes the single genus and species *Homo sapiens*—Man. [MAN.]

BIND-WEED. [CONVOLVULUS.]

BINNY. [BARBEL.]

BINO'CULUS, Geoff., Leach, a genus of Entomostracous *Crustacea; Apus*, Scop., Cuv., Latr.; *Limulus*, Müll., Lam.; *Monoculus*, Linn., Fabr. Of these names *Apus* is that now generally adopted. The species of this genus are gregarious, and occur often in innumerable quantities. Sometimes whole swarms are swept away by violent winds, and have been seen to fall like rain. The spring and the commencement of summer are the seasons when they are most commonly found; and they often appear suddenly in great numbers in accidental rain-water puddles where they never have been before seen, as well as in ponds. The generic name *Binoculus* appears to be unnecessary, and that given by Scopoli should be restored: the true *Limuli* form a marine genus, making a natural group of different form and habits. Linnæus's genus *Monoculus* comprehends *Apus*, *Limulus*, and other crustaceans. The species figured is *Apus productus*, Latreille (*Lepidurus productus*, Leach; *Monoculus Apus*, Linn.). Only one species occurs in England, *A. cancriformis* the Shield-Shrimp. It is about $2\frac{1}{4}$ inches long, and $1\frac{1}{4}$ inch in diameter; it is of a brownish-yellow colour, clouded with marks of a deeper hue. The segments of the abdomen are each studded over with numerous short stout hooked spines of a dark brown colour; while the long caudal appendages are furnished with numerous short hairs, or setæ. It is a rare creature, and only a few localities for it have been recorded. [ENTOMOSTRACA.] (Baird's *History of the British Entomostraca.*)

Apus productus.

BIPAPILLA'RIA, a genus of Marine Molluscs established by Lamarck upon a species figured and described in the manuscript notes of Péron.

BIPES, a genus of Reptiles belonging to the order *Saura*, or Lizards. Cuvier dissected one of the species *Bipes lepidopodus* of Lacépède), and found that, though its posterior and only apparent pair of feet had the external form of two oblong and scaly plates or processes, the integument covered a femur (thigh-bone), a tibia and fibula (leg-bones), and four metatarsal, or finger-bones, but no phalanges (terminal finger-bones). He also states that one of the lungs is less by one-half than the other.

This genus is an example of one of those gradations by which nature glides from one type of form into another, and is a link between the Saurians (lizards) and the Ophidians (serpents).

The *Bipes lepidopodus* of Lacépède is now referred to the genus *Pygopus*, of which the following characters are given: scales of the back keeled; preanal pores numerous; the hinder limbs elongated; the pupil circular.

Pygopus lepidopodus.

Lacépède describes the body and tail of *P. lepidopodus* as being nearly cylindrical, very slender, and a little like those serpents called by the French Orvets, of which our common Blind-Worm or Slow-Worm (*Anguis fragilis*, Linnæus) is an example; and which, though without limbs, have some of the rudiments of such members in the skeleton. The upper part of the head of *P. lepidopodus* is covered by seven large scale-plates disposed around an eighth, which is a little larger than the others. Each eye is surrounded by small scaly globules. The gape is sufficiently large, and the teeth are equal and small. The flat long tongue is without a notch. The auditory orifice is near the commissure of the lips. The scales which cover the upper part of the body are lozenge-like, striated, and small, especially those which cover the most elevated part of the back; but the scales of the under part of the belly and the tail are hexagonal and smooth, and those of the two middle longitudinal ranks are larger than those of the lateral ranks. At each extremity of the curve formed by these tubercles is to be seen a foot, in which no finger is to be distinguished externally, and which is surrounded by very small scales on its lower part, and by scales a degree less small on its upper surface. The colour is greenish, varied with some very small black blotches.

"This reptile," says Lacépède, "like the other species of *Bipes*, ranks between the oviparous quadrupeds and the serpents; it is related to the latter by its general form, as well as by the figure, proportion, and distribution of the scales, while it approaches the former by its auditory apertures, and by the hollow tubercles near the anus." It is a native of Australia.

Dr. Gray has described a second species of *Pygopus* as *P. squamiceps*.

Bipes as an English word is applied to the *Anguis bipes* of Linnæus, the *Scelotes bipes* of Gray. It belongs to the order of Lizards, and is a native of the Cape of Good Hope.

BIPHORES, a division of the shell-less Acephalous *Mollusca*, according to the arrangement adopted in the 'Règne Animal' of Cuvier. It includes the genera *Salpa* and *Thalia*. [TUNICATA.]

BIRCH-TREE. [BETULA.]

BIRD-CHERRY, one of our native wild fruits. [CERASUS.]

BIRD-LIME, a glutinous vegetable product, also called *Biscia*, and related to Caoutchouc. It is obtained principally from the inner bark of the holly, from the berries of the mistletoe, and also other plants. It is prepared from the holly bark by bruising, long boiling in water, and fermentation; the mass is again boiled in water, and evaporated to a proper consistence. In different countries various processes are employed.

Water does not dissolve bird-lime, but separates from it some mucilage and extractive matter, and a little acetic acid. The alkalies dissolve it, and so does sulphuric ether very perfectly. Dilute acids soften it, and dissolve a portion; concentrated sulphuric acid blackens and carbonises it, while nitric acid renders it yellow, converting a part of it into oxalic and malic acids, and separates resin and wax; chlorine bleaches and hardens it; alcohol dissolves some resin and acetic acid. When heated, bird-lime melts, swells, takes fire, and burns rapidly,

It is probable that this substance results from the decomposition of the cellulose of the cells of the plant from which it is obtained. It is well known that in nearly all decompositions of cellulose, carbon remains in excess, and this agrees with the composition of viscin, which contains, according to Macaire Prinsep, Carbon 75·6, Hydrogen 9·2, Oxygen 15·2. (Schleiden, *Principles of Botany.*)

BIRD-PEPPER. [CAPSICUM.]

BIRD'S-FOOT SEA-STAR. [PALMIPES.]

BIRD'S-FOOT TREFOIL. [ORNITHOPUS.]

BIRD'S-NEST. [NEOTTIA.]

BIRD'S-NEST, YELLOW. [MONOTROPA.]

BIRDS, in Latin *Aves*, in Greek Ὄρνιθες (whence *Ornithology*), a class of Vertebrated, Oviparous, Feathered Bipeds, generally formed for flight. We say generally, because, though their mechanism is in its most perfect development designed for enabling them to support their bodies in the air and to make progress in that medium, it is also calculated for motion on the ground and for perching on trees. Some families indeed are framed entirely for moving on the ground, and others for that motion and for making their way both on the surface of the water and even for a short period below it, without the power in either case of raising themselves into the air.

Skeleton.

Skull (Cranium). The first peculiarity which strikes an observer, when comparing the skulls of birds with those of mammifers, is the absence of sutures in the former, the proper cranial bones being consolidated into one piece. The skull of birds is articulated to that part of the vertebral column called the neck by a single condyle or joint, which is situated at the front margin of the great occipital opening (foramen magnum), through which the brain, becoming elongated as it were into the spinal cord, descends into the vertebral column. It is this beautiful adaptation of structure to the wants of the animal that gives such a freedom of motion to the head, especially in a horizontal direction. Take for example the Wryneck (*Yunx torquila*), which, as those who have surprised the bird on the nest will readily admit, can writhe her head round so as to look the intruder in the face, hissing all the while like a snake; by this 'terrible show' many a birds-nesting novice is frightened away. Perfect repose in a bird seems hardly to be enjoyed without turning back the head and nestling the beak between the wings; this attitude the articulation above mentioned enables the bird to command with the least possible effort.

The orbits are very large in proportion to the skull, to which last the lower jaw is joined by a somewhat square bone (os quadratum) not far from the ear. A small bone rests on the square bone at one end, while the other end comes against the palate. When therefore the square bone is brought forward by depressing the lower jaw, and also by muscles adapted to the purpose, the small bone presses up against the palate, and this raises the upper jaw, which contrary to the rule in the structure of mammifers is in birds, with but few exceptions, thus gifted with motion.

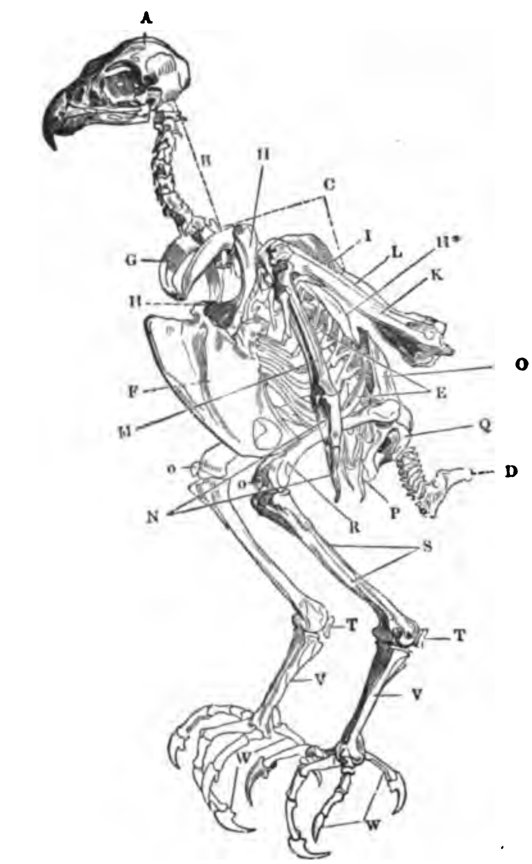
Both jaws are completely destitute of true teeth, the want of which is, as we shall presently see, amply compensated. The upper jaw is either formed of one piece distinct from the skull and articulated with it, as in the parrots; or it is connected with it by means of yielding elastic bony plates, as in most other birds. These elastic plates admirably protect the bill (the upper part of which may be considered as an elongation of the intermaxillary bones) and the skull from the shocks of the former organ when used in pecking violently against hard substances.

In a few instances the upper jaw is entirely immovable. Blumenbach gives the Rhinoceros Bird and the Cock of the Wood (*Tetrao Urogallus*) as instances.

Bones of the Neck and Trunk.—The upper limbs, or, to speak more correctly, the anterior extremities of birds are calculated for flight, and entirely useless as prehensile organs, because the bird depends principally upon its bill to gather its food. To give a greater freedom of action to this organ, it was necessary, as the bones of the back have hardly any motion (the dorsal vertebræ being often anchylosed or immovably fixed by a continuation of bony secretion), that the neck should be long and flexible; and eminently flexible it is. In the mammifers the number of cervical vertebræ (neck-bones) is seven; the Cameleopard (Giraffe) has no more, and the Elephant and Whale have no less. Cuvier indeed gives the Sloth nine. Professor Thomas Bell however has satisfactorily made out that the additional two are bones of the back, not of the neck. But, in Birds, nature has made up for the deficiency of motion in the back (a deficiency absolutely necessary to the comfortable existence of the animal, inasmuch as the back is the point of support to the wings) by the free grant of cervical vertebræ, according to the wants which the peculiar habits of particular birds require. Thus the Raven has 12 neck-bones, the Domestic Cock 13, the Ostrich 18, the Stork 19, and the Swan 23, the largest number it is believed yet detected, while the smallest amounts to 10. The articulation is so contrived as to produce the greatest mobility, and that the contrivance is complete is proved by the ability of a bird to touch every point of its body with its bill.

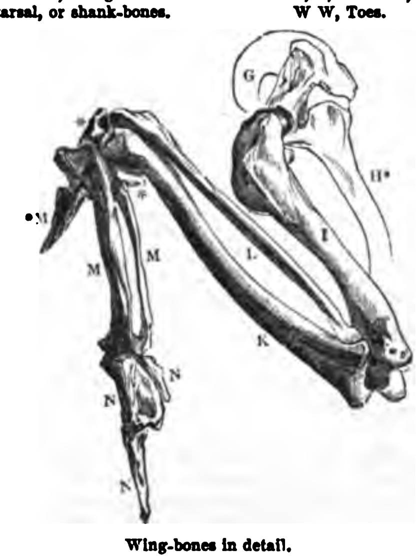
The vertebræ of the back are from 7 to 11 in number. There are no true lumbar vertebræ, for they are consolidated into one piece with the pelvis (os innominatum) which is elongated, broad, and simple; and does not unite below, as in mammifers, to form what is called the symphysis pubis, but has the lateral portions distinct from each other. This is the general rule. The pelvis of the ostrich forms an exception; for it is joined below like that of most quadrupeds. In most of the quadrupeds the rump-bone (os coccygis) is prolonged into a true-jointed tail. In birds it never is, but is very short, although it supports the large tail-feathers (rectrices).

Ten pairs of ribs are said to form the maximum among birds; these, the true ribs, are joined to the breast-bone (sternum) by small intervening bones. The false ribs (those which do not reach the breast-bone) have a forward direction. There is a peculiar flat process



Skeleton of Sparrow Hawk.

A, Cranium or Skull. B, Cervical vertebræ.
C, The dotted lines indicate the extent of the anchylosed vertebræ of the back.
D, The caudal vertebræ; the letter is placed on the ploughshare, or rump-bone.
E, Ribs. F, Sternum, or breast-bone. G, Furcula, or merry-thought.
H H, Clavicular, or coracoid-bone, } Forming the sidesman.
H*, Scapula, or shoulder-blade, }
I, Humerus, or bone of the arm.
K, Ulna, } Bones of the fore-arm: on the ulna is the place of insertion of
L, Radius, } the secondary quills.
M, Metacarpal bones, part of the hand which carries the primary quills.
N, Phalanges of the fingers.
O, Ilium, }
P, Pubis, } Bones of the pelvis.
Q, Ischium, }
R, Femur, or thigh-bone. o o, Patella, or knee-pan.
S, Tibia and fibula, or leg-bones consolidated. T, T, Os calcis, or heel-bone.
V V, Metatarsal, or shank-bones. W W, Toes.



Wing-bones in detail.

G, Outline of part of furcula; H*, outline of part of scapula; I, humerus, or bone of the arm; K, ulna; L, radius—bones of the fore-arm; on the ulna are the marks of insertion of the secondary quills; * *, carpal bones, or wrist; M M, metacarpal bones; M*, thumb; N N N, phalanges of the fingers.

directed upwards and backwards attached to the middle pairs of the true ribs.

The breast-bone (sternum), a part of the greatest consequence, being the point of attachment for the most powerful of the muscles which set the wings in action, is composed of five pieces strongly joined together, and prolonged below into a crest (crista) for that purpose. The greater or less development of this crest or keel, and the greater or less ossification of the component parts of the breast-bone, depend upon the wants of the bird. Those birds whose flight is strongest and most continuous have the crest very large, and the breast-bone pieces very firmly cemented together, as any one may see who will examine the breast-bone of a hawk, or eagle, or that of a humming-bird; while in the ostrich and cassowary this crest is entirely absent, and the breast-bone presents a uniformly arched surface, somewhat like that of a Highlander's target.

In the crane and in the male wild-swan there is a cavity in the anterior part of the breast-bone for the reception of the involuted wind-pipe (trachea). The connection of the wings with the trunk is managed by means of the two clavicles, and of that peculiar fork-like elastic bone commonly called the merry-thought (furcula). This apparatus operates as an antagonist power to the action which would bring the wings together in flight, did not these bones, especially the merry-thought, keep the shoulders asunder. The greater or less development of this bone depends on the exigencies of each particular case. In birds whose flight is long and rapid it is strong, with the branches widely arched and carried forwards on the body; in birds which do not fly at all, in the ostrich, cassowary, and emu, for instance, the bone becomes a mere rudiment. "In the ostrich," as Macartney observes, "the two branches are very short, and never united, but anchylosed with the scapula (shoulder-blade) and clavicle (collar-bone). In the cassowary there are merely two little processes from the side of the clavicle which are the rudiments of the branches of the fork. In the emu there are two very small thin bones attached to the anterior edge of the dorsal ends of the clavicles by ligaments; they are directed upwards towards the neck, where they are fastened to each other by means of a ligament, and have no connection whatever with the sternum."

The wing-bones are the homologues or representatives of the arms or upper extremities of man and of the monkeys. The following are the bones composing the wing of a bird:—The arm (os humeri); the fore-arm, consisting of two bones (ulna and radius); the wrist (carpus), formed by two bones; the metacarpus, also made up of two bones; a thumb, or rather the rudiment of one, there being but a single bone; and two fingers, the finger next the thumb consisting of two portions, and the other only of one. To this hand are attached the primaries, or greater quill-feathers; the secondaries are affixed to the fore-arms; and the arm supports feathers of inferior strength and development, called tertiaries and scapulars. The bone which represents the thumb gives rise to the bastard quills, and along the base of the quills are ranged the largest of those feathers which are denominated wing-coverts. Such is the structure of the 'sail-broad vans' which waft the condor over the Andes.

Bones of the Lower or Posterior Extremities.—These consist of a thigh-bone (femur); leg-bones (tibia and fibula), for there are two, though the fibula is very small, and becomes anchylosed to the tibia; one metatarsal bone (at the lower end of which there are as many processes as there are toes, each process furnished with a pulley for moving its corresponding toe); and the toes. Of these, three generally are directed forwards and one backwards. This back toe, or great toe, is wanting in some birds. In the swallows it is directed forwards; in the climbing birds the outer toe as well as the back toe are directed backwards. The number of joints is generally progressive; the back toe has 2, the next 3, the middle toe 4, and the outer toe 5 joints.

"The stork, and some others of the *Grallæ* (Waders)," says Macartney, "which sleep standing on one foot, possess a curious mechanism for preserving the leg in a state of extension, without any or at least with little muscular effort. There arises from the fore part of the head of the metatarsal bone a round eminence, which passes up between the projections of the pulley, on the anterior part of the end of the tibia. This eminence affords a sufficient degree of resistance to the flexion of the leg to counteract the effect of the oscillations of the body, and would prove an insurmountable obstruction to the motion of the joint if there were not a socket within the upper part of the pulley of the tibia to receive it when the leg is in the bent position. The lower edge of the socket is prominent and sharp, and presents a sort of barrier to the admission of the eminence that requires a voluntary muscular exertion of the bird to overcome, which being accomplished, it slips in with some force like the end of a dislocated bone."

Muscles of Motion and External Integuments.

"The muscles," writes Blumenbach, "in this class are distinguished by possessing a comparatively weak irritable power, which is soon lost after death; and by their tendons becoming ossified as the animal grows old, particularly in the extremities, but sometimes also in the trunk."

The pectoral muscles, as we might expect from the form of the sternum, exhibit, generally speaking, the greatest development. They are three in number, taking their rise chiefly from the ample breast-bone, and all being brought to bear on the head of the arm (humerus). Of these, the first or great pectoral is said, as a general proposition, to weigh more than all the other muscles put together. Rising from the keel or crest of the breast-bone, the merry-thought, and last ribs, it is inserted in that rough linear elevation which may be observed on the bone of the arm of most birds. This bone it strongly depresses, and so produces the rapid and powerful motions of the wing, which, acting on the surrounding air, carries the bird forward in its flight. As an antagonist to the great pectoral muscle, the middle pectoral, which lies under it, and whose office it is to elevate the wing, puts forth its tendon over the point where the merry-thought is joined to the clavicle and shoulder-blade. This point of junction acts as a pulley for the tendon which is inserted in the upper part of the bone of the arm; and by this contrivance the elevating power is situated on the lower surface of the body. The third or small pectoral, aids the great pectoral in depressing the wing. Thus some birds are enabled to dart away with the rapidity of an arrow, while others soar to a height invisible to the gaze of man.

We have already seen that the pelvis is prolonged backwards to a considerable extent. This formation furnishes room for the attachment of the muscles which set the posterior extremities in motion, and enables them to perform the functions of walking, hopping, swimming, climbing, and perching. To this end there are a set of muscles which go from the pelvis to the toes. One of the flexor or bending tendons given off from a muscle which comes from the bone of the pubis runs in front of the knee, and all the flexors go behind the heel, so that the mere weight of the bird will bend the toes. Any one may satisfy himself that this operation is purely mechanical, and not the result of muscular action, by making the experiment on a dead bird; when he will find that the flexion of the knee and heel will at once bend the toes. This admirable contrivance, useful as it generally is, shows itself in the most striking manner when brought to bear on the limbs of those birds which roost in trees. When all the voluntary powers are suspended, such a bird enjoys the most profound repose, and the most secure position on its perch, without an effort.

The integuments of birds are composed of the same parts as those of the mammifers, with the addition of feathers, the peculiar covering common to the whole class. The beak is covered with horn, and at its base, as in the birds of prey, there is a fleshy part called the cere. The lower extremities are protected above by a scaly skin, and the bottom of the foot and toes by a callous modification of the same integument. Some, the turkey for instance, are furnished with hair in certain situations. The feathers vary infinitely. When a bird has just left the egg its covering is a downy kind of hair, several little bundles taking their rise from one common bulb. This is the origin of the future feather. A dark cylinder soon makes its appearance, from the upper extremity of which the sprouting feather emerges, while the lower extremity receives the blood-vessels which supply the vascular nourishing pulp of the barrel. When this pulp has performed its office, and the stalk and other parts of the feather are fully developed, it shrivels up into the well-known substance which every one finds in a quill when he cuts it for the purpose of making a pen. The details of the development of the feathers are highly interesting, and have been described at length by F. Cuvier in the 'Mémoires du Museum,' tom. xiii., and also in the article 'Aves' in the 'Cyclopædia of Anatomy and Physiology.'

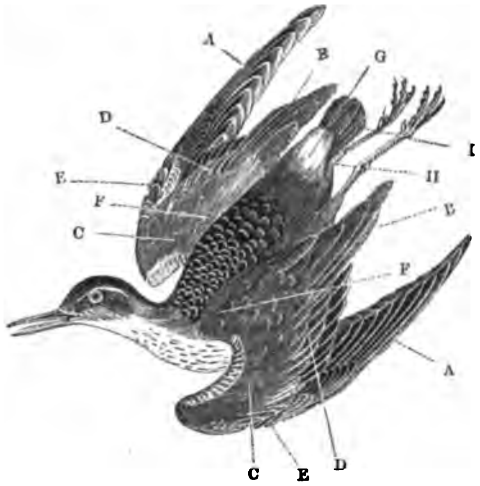
The care which nature takes for the development of that particular part of the plumage first which the wants of the particular bird demand is remarkable. A young partridge runs off as soon as it is hatched to pick up the pupæ of the ant, which the parent bird scratches up for it. Some time elapses before it is necessary that it should fly; we accordingly find that the body from the moment of its birth is protected with a close-set downy covering, while all the strength is thrown into the thighs, legs, bill, and neck. The wings are gradually developed afterwards. A young thrush or a young blackbird is hatched nearly naked, and while its body presents only a few scattered bunches of weak downy hair-like feathers, great progress may be observed in the formation of the quills and other wing-feathers; because from the habits of the bird it is necessary that it should be able to fly as soon as it leaves the nest.

As a general rule the plumage of the cock bird far exceeds in brilliancy that of the hen; and in all such cases the young at first put on the more sombre garb of the mother. When the cock and hen are without much difference in this respect, the young have a particular distinguishing plumage of their own.

Birds moult or shed their feathers. The summer dress in many species varies from that of the winter.

The mode in which the plumage changes is well described in the 'Transactions of the Zoological Society' by Yarrell; and the same able zoologist has shown in the 'Philosophical Transactions,' and in the 'Proceedings of the Zoological Society,' that the putting forth of the plumage of the male bird is not confined to the female past the age of reproduction (so many well-known instances of which are given by Dr. Butter, John Hunter, and others), but that the garb of the cock is assumed by those hen birds which from malformation or disease are rendered unable to assist in the continuation of the species.

The following three modes by which changes in the appearance of the plumage of birds are produced have been pointed out by Yarrell:—1, By the feather itself becoming altered in colour. 2, By the bird's obtaining a certain portion of new feathers without shedding any of the old ones. 3, By an entire or partial moult, in which the old feathers are thrown off and new ones produced in their places. The first two of these changes are observed generally in the spring, indicating the approach of the breeding season; the third is usually partial in the spring, and entire in the autumn. The subjoined cut is explanatory of the situation of the principal parts of the plumage, particularly those most conducive to flight.



A A, Primaries; B B, tertials; C C, lesser coverts; D D, greater coverts; E E, bastard wing; F F, scapulars; G, upper tail-coverts; H, under tail-coverts; I, tail-feathers.

That the skin and integuments of birds perform the office of emunctory organs appears not only by their moulting, but also by the quantity of mealy dust separated from the skin in many birds. The cockatoo, for instance, discharges a quantity of white mealy dust from its skin, particularly at pairing time, according to Blumenbach; and Bruce, in the appendix to his 'Travels,' gives an account of his shooting a large bearded eagle, which, on his taking it in his hands, covered him with a powder which was yellow on the breast, where the feathers were of that colour, and brown on the back, where the plumage was of the same hue. A heron too which he shot is described as having a great quantity of blue powder on the breast and back.

The glands which secrete the oil used by birds in preening and dressing their plumage are situated on the upper part of the tail. Water-birds necessarily require a larger portion of this protecting fluid, and accordingly we find the glands largest in that race. Réaumur observes, that in that variety of the common fowl which has no tail (*Gallus ecaudatus*) these glands are absent.

Digestive Organs.

The bill has a horny covering which in some degree answers the purpose of teeth, and indeed it is in many instances notched so as to represent them. The form of this important organ varies greatly, but with evidence of the most perfect design in each varied instance, according to the nature of the necessary food. Thus in birds of prey it well executes the office of a dissecting-knife; in seed-eating birds it forms a pair of seed-crackers for extricating the kernel from the husk which envelops it; in the swallows and goatsuckers it is a fly-trap; in the swans, geese, and ducks it is a flattened strainer, well furnished with nerves in the inside for the detection of the food remaining after the water is strained by that particular operation which every one must have observed a common duck perform with its bill in muddy water. In the storks and herons we find it a fish-spear; and in the snipes and their allies it becomes a sensitive probe, admirably adapted for penetrating boggy ground, and giving notice of the presence of the latent worm or animacule. The food is transmitted from the bill through the œsophagus into the stomach, which is composed of three parts, namely, the crop, which is a dilatation of the œsophagus, and lies just before the breast-bone; the membranous stomach (ventricule succenturié of the French); and the gizzard. The first of these is furnished with many mucous and salivary glands; in the next (and the structure of this may be best observed in the gallinaceous birds) there are a number of glandular bodies which pour out a copious secretion to mingle with the food as it is ground down by the powerful gizzard, which reaches its highest development in graminivorous birds. This mill is rendered still more effective by the swallowing of small hard stones by those birds with their food, a practice which is clearly instinctive, and carried sometimes to a great extent. In the museum of the College of Surgeons (London) is a large glass bottle entirely filled with pebbles, &c. taken from the stomach of an ostrich. The well-known experiments of conveying bullets beset with needles and even lancets into the stomachs of graminivorous birds, with the effect of the total destruction of those sharp instruments in a short period, need only be referred to here; but as Felix Plater's observations have not attained quite so much celebrity we shall shortly mention them. He found that an onyx swallowed by a hen was diminished one-fourth in four days, and that a louis-d'or lost in this way sixteen grains of its weight.

In such birds as nourish their young from the crop the glands swell very much at the hatching season, and secrete a greater quantity of fluid than usual. In the pigeon, which thus feeds its young, there is a spherical bag formed on each side of the œsophagus, a specimen of which may be seen in the museum of the College of Surgeons. It is not improbable that the banter about 'pigeon's milk' took its rise from this part of the economy of the bird.

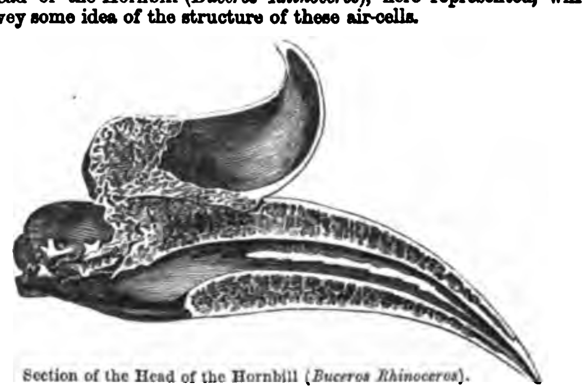
In those birds which feed on flesh, fish, or worms, and which consequently do not require so powerful an apparatus, the muscles of the gizzard are reduced to an extreme weakness, and that organ appears to make only a part of the same membranous bag with the ventricule succenturié.

The food being thus reduced into a sort of chyme passes through the remainder of the intestinal canal, where all the nutritious parts are taken into the system, and the remainder is at length expelled by the cloaca, where the urinary ducts terminate and the organs of generation are situated. It may be worth mentioning that the liver becomes much larger in domesticated birds than in wild ones (a propensity which can be increased by artificial means, as the gourmand who revels in his 'foies gras' well knows), and that the gall-bladder is entirely wanting in some birds, the parrot and pigeon for instance. Hence no doubt the saying, "He has no more gall than a pigeon." The pancreas (sweet-bread) is of considerable size in birds, but the spleen is small.

Organs of Circulation, Respiration, and Voice.

The heart in this class is of peculiar structure. Instead of the membranous valve which is present in both ventricles of the heart of mammifers, and in the left ventricle in birds, the right ventricle of the heart in the latter is furnished with a strong muscle which assists in driving the blood with greater impetuosity from the right side of the heart into the lungs; a structure rendered necessary from the want of expansion of the lungs in breathing consequent upon their connection with the numerous air-cells. The lungs are small and flattened, and adhere to the back of the chest in the intervals of the ribs, and a considerable part of the abdomen as well as of the chest is occupied by membranous air-cells with which the lungs communicate by considerable apertures. In addition to these, a great portion of the skeleton in most birds becomes a receptacle for air. Instead of marrow the larger cylindrical bones contain air, and form large tubes, interrupted only towards the ends by transverse bony fibres. The broad bones present internally a reticulated bony texture, pervaded by the same fluid, communicated from the lungs by small air-cells. The enormous bills of the toucan and of the hornbill are supplied with air from the same quarter.

The effect of this structure in lightening the body of the bird, and facilitating its motions whether in flying, swimming, or running, is obvious. Where the demand is greatest (as in birds of the highest and most rapid flight) the supply is largest. Thus, in the eagle, we find the bony cells of great size and very numerous. The section of a head of the Hornbill (*Buceros Rhinoceros*), here represented, will convey some idea of the structure of these air-cells.



Section of the Head of the Hornbill (*Buceros Rhinoceros*).

The organs of the voice in birds bear a striking resemblance to certain musical wind-instruments. The larynx is double, or rather made up of two parts: one, the proper rima glottidis, situated at the upper end of the windpipe; and the second, the bronchial, or lower larynx, which contains a second rima glottidis, furnished with tense membranes that perform in many birds (and especially in those which are aquatic) the same part as a reed does in a clarionet or hautboy, while the upper rima, like the ventage or hole of the instrument, gives utterance to the note.

The length of the windpipe and the structure of the lower larynx vary much in different species and even in the sexes, particularly among the water-birds. In the domestic or dumb swan the windpipe is straight; in the male wild swan the windpipe is convoluted in the hollow of the breast-bone, like the tube of a French horn.

The following are the conclusions of M. Jacquemin from his observations on the respiration of birds. After observing that the air enters not only into the lungs and about the parietes of the chest, but that it also penetrates by certain openings (foramina) into eight pneumatic bags or air-cells, occupying a considerable portion of the pectoro-abdominal cavity, and thence into the upper and lower extremities, he concludes:—1st, That the pneumatic bags are so situated as to be ready conductors of the air into the more solid parts of the body; and that the air, by surrounding the most weighty viscera, may support the bird in flight, and contribute to the facility of its motions when so employed. 2nd, That the quantity of air thus introduced penetrates the most internal recesses of their bodies, tending to dry the marrow in the bones and a portion of the fluids; a diminution of specific gravity is the result, the true cause of which has been, in his opinion, vainly sought in the quantity alone of permeating air. 3rd, That in birds the oxidation of the nourishing juices is not entirely effected in the lungs, but is much promoted also in the pneumatic bags above mentioned, for their contained air operates through the membranes upon the blood-vessels and lymphatics in contact with them; a more complete and speedy oxidation is the result. 4th, That not only the skeleton, but all the viscera are much more permeable by air in birds than in any of the other vertebrated animals. 5th, That the air-reservoirs are not always symmetrical, their shape and extent depending entirely upon the form and situation of the organs among which they occur; but the supply is so modified that the total quantity received into the pneumatic bags on the right side of the body is equal to that which enters into those on the left; and indeed without the maintenance of this condition the act of flying would be impossible, and that of walking difficult. 6th, That no portion of a bird's structure is impervious to air; it reaches even the last joints (phalanges) of the wings and feet, and the last caudal vertebræ, or rump-bones. The quill of the feathers is not excepted, as has been sometimes asserted. 7th, That the air within the head has a separate circulation, and does not directly communicate with the air-pipes of the rest of the body. 8th, That in no instance does the air come into direct contact with the viscera or nourishing juices, but invariably through the medium of a membrane, however fine and transparent. 9th, That the volume of air which birds can thus introduce into their bodies, and the force with which they can expel it, offer the only explanation how so small a creature as a singing-bird (the nightingale, for example) is able to utter notes so powerful, and without any apparent fatigue to warble so long and so musically.

The organs of respiration in birds, as well as their sexual organs, are, according to Purkinje and Valentin, supplied with cilia on their surface.

Brain, Nervous System, and Senses.

The brain of birds possesses the same characters which are to be found in other oviparous vertebrated animals, but its proportional volume is its distinguishing peculiarity; and this volume often surpasses the development of that organ in mammifers. Indeed, in some birds, and more particularly in some of the songsters, the brain has been said to exceed that of man when considered in reference to the size of the head and of the whole body. The following scale has been given as an example of the size of the brain in relation to that of the body:—Eagle, 1-260th of the body; sparrow, 1-25th; chaffinch, 1-27th; redbreast, 1-32nd; blackbird, 1-68th; canarybird, 1-14th; cock, 1-25th; duck, 1-257th; goose, 1-360th. In man the brain forms from 1-22nd to 1-33rd of the body; in some apes, 1-22nd; in the elephant, 1-500th; in the horse, 1-400th; in the dog, 1-161st; and in the cat, 1-94th.

The size of the brain in birds arises principally from tubercles analogous to the corpora striata of mammifers, and not from the hemispheres, which are small, smooth, and without convolutions. The cerebellum is large, almost without lateral lobes, and formed principally by the vermiform process. Several parts found in the brain of mammifers are absent in birds, and among these are the corpus callosum and pons Varolii.

Of the five senses, sight, smell, and hearing are most acute in birds.

Sight.—We have seen that the bony orbits are of great magnitude, and the organs of sight which are contained therein are proportionately large. In the birds of prey the orbits have the shape of a "chalice," says Blumenbach, "or cup used in the communion service. The cornea, which is very convex, forms the bottom of the cup, and the posterior segment of the sclerotica resembles its cover. This peculiar form arises from the curvature and length of the bony plates, which, as in all other birds, occupy the front of the sclerotica, lying close together and overlapping each other. These bony plates form in general a flat or slightly convex ring; being long and curved in the *Accipitres* (Hawks) they form a concave ring, which gives the whole eyeball the above-mentioned form." By means of this ring the eye becomes a kind of self-adjusting telescope, so as to take in both near and very distant objects.

A representation of the sclerotic plates, forming the bony ring in the eye of the Penguin (*Aptenodytes*), is here given. They remind us forcibly of the eye-plates in some of the reptiles, particularly of those belonging to the eyes of the Enaliosaurians, or fossil marine lizards. The penguin has to adjust its eye for vision both on land and under water. This contrivance must greatly assist the adjustment necessary for seeing clearly in such different media.

Sclerotic Plates of Penguin (*Aptenodytes*).

The crystalline humour is flat in birds; and the vitreous humour is very small. The colour of the iris varies in different species, and in many cases is very brilliant. The marsupium, which arises in the back of the eye, and the use of which is not very clearly ascertained, is a peculiarity in the eye of birds. They have three eye-lids, two of which, the upper and lower, are closed in most of the race by the elevation of the lower one, as may be frequently seen in our domestic poultry. The owl, the goat-sucker, and a few others, have the power of depressing the upper eye-lid. Of these birds the upper only is furnished with eye-lashes generally; the ostrich, secretary vulture, some parrots, and a few other birds, have them in both lids. But the third eye-lid, or nictitating membrane, forms the most curious apparatus. When at rest, this, which is a thin semi-transparent fold of the tunica conjunctiva, lies in the inner corner of the eye, with its loose edge nearly vertical. By the combined action of two muscles which are attached towards the back of the sclerotica, it is capable of being drawn out so as to cover the whole front of the eye-ball like a curtain, and its own elasticity restores it to the corner in which it rested. This, it is said, enables the eagle to look at the sun. The peculiar movements of this organ may be seen amongst the fine collection of eagles at the gardens of the Zoological Society in the Regent's Park.

Hearing.—This sense appears to be sufficiently acute in birds, though (with the exception of the night-birds, the owls in particular) they have no external cartilaginous ear; and the peculiar valve, partly muscular, partly membranous, placed at the auditory opening even in those birds, has none of the development which generally marks the concha of mammifers. The peculiar arrangement of the comparatively loosely barbed feathers, however, round the aperture (meatus auditorius) compensates for it; and this arrangement may be well seen in the rapacious birds. The membrane of the drum (membrana tympani) is convex externally, and the drums of both ears are connected by the air-cells of the skull. There is neither malleus nor stapes, and their place is supplied by a single auditory bone (ossiculum auditus) which connects the membranes of the drum with the fenestra ovalis. The Eustachian tubes terminate in a sort of common aperture on the concavity of the palate. The labyrinth is without a cochlea; instead of which there is a short, blunt, hollow bony process obliquely directed backwards from the vestibule, and divided into two portions, one of which ends at the fenestra rotunda.

Smell.—This sense in the majority of birds seems to be highly developed. The olfactory nerve is given off from the foremost part of the front lobe of the brain, whence it passes along a canal to the nose, and is ramified on the pituitary membrane, which is spread over two or three pairs of bony or cartilaginous conchæ narium. The nostrils terminate in different parts of the upper mandible in different genera; and, according as these apertures are smaller or larger, or more or less covered by membranes, cartilages, feathers, or other integuments, the sense is probably more or less acute. But no bird is without nostrils, though Buffon asserts that several are unprovided with them: the puffin indeed and some others have them so small, and placed so closely on the margin of the mandible, that they are not easily detected.

This sense was supposed to have reached its highest point of perfection in the vultures and other carrion-birds. Poets and philosophers have dwelt on the 'delight' with which they—

> ". . . . . snuff'd the smell
> Of mortal change on earth . .
> Sagacious of the quarry from afar."

But, according to the experiments of Audubon (and they were made with a species which has obtained a reputation for great sagacity in this way), the nostrils do not seem to have been of the least assistance to the birds in directing them to their prey; while the eye, even when the birds were far above human sight, appears to have been infallible. This conclusion has been indeed disputed: but the facts stated by Audubon are very strong.

Taste.—Though all birds possess a tongue, it is probable that but few find enjoyment in the organ as ministering to their taste, and in those it is soft, thick, and covered with papillæ. Some of the birds of prey, some of the swimmers, and the parrots generally, have such a tongue, and there can be no doubt that these taste food of a soft or fluid nature, and select that which they like best. But in general the tongue is horny and stiff, and appears unsuited to convey such impressions, though as an organ for taking food it becomes of the highest importance. In the humming-birds and other honey-suckers it is a tubular pump, and in the woodpeckers it is an insect spear. In both cases it can be protruded and retracted at pleasure; and the simple but beautiful machinery by which this act of volition is performed is adapted with the most masterly fitness to the motion required. Upon examining the tongue of the common green woodpecker, we shall find that, instead of being very long, as it is erroneously supposed to be, it is really very short, sharp-pointed, and horny, with barbs at its sides. Behind this lies the singular tongue-bone (os hyoides), slender, and with two very long legs or appendages (crura). This is made up of five parts, consisting of a single portion and two pairs of cartilages. Let us suppose the tongue to be at rest, and then the single piece lies in a fleshy sheath, capable of great extension. To this piece the first pair of cartilages, which are situated at the sides of the neck, are joined, while the second pair, springing from these, run under the integuments completely over the skull, and, advancing forward, converge in a kind of groove, terminating generally in the right side of the upper jaw. This second pair, by their elasticity, become the springs which set the whole in motion. When the organ is to be protruded, the anterior pieces are drawn together, and enter the extended sheath of the single piece: the tongue is thus elongated as it were, and the bird can thrust it far forth.

Os Hyoides of Woodpecker.

Touch.—As applied to external objects this sense must be, generally speaking, very obtuse in birds. Feathers, horny beaks, and scaly skin, do not offer a satisfactory medium for conveying impressions by contact. But in those birds which search for their food in mud (ducks, for instance), where neither sight nor smell can be of much avail, the bill is covered with a skin abundantly supplied with sensation by nerves from all the three branches of the fifth pair, in order that they may successfully feel about for their hidden sustenance.

Reproduction and Migration.

The continuation of the species is carried on by eggs, which are laid in a nest more or less artificial according as the nestling is more or less capable of gathering its own food at the time of its exclusion from the egg. Of those birds whose young possess this capability in the highest degree, the male is for the most part polygamous, and does not pair; but among those whose young depend for some time on the parents for their sustenance, one male confines his attentions to one female, as long at least as the seasons of love, incubation, and parental anxiety endure. To the first and second of these seasons we, in great measure, owe that outpouring of melody which renders our groves and gardens so musical in spring.

"There is every reason," writes Montagu, "to believe it is necessary there should be native notes peculiar to each species, or the sexes might have some difficulty in discovering each other, the species be intermixed, and a variety of mules produced; for we cannot suppose birds discriminate colours by which they know their species, because some distinct species are so exactly alike that a mixture might take place. The males of song-birds, and many others, do not in general search for the female; but, on the contrary, their business in the spring is to perch on some conspicuous spot, breathing out their full and amorous notes, which by instinct the female knows, and repairs to the spot to choose her mate. This is particularly verified with respect to the summer birds of passage. The nightingale and most of its genus, although timid and shy to a great degree, mount aloft to pour forth their amorous strains incessantly, each seemingly vieing in their love-laboured song before the females arrive. No sooner do they make their appearance than dreadful battles ensue, and their notes are considerably changed; sometimes their song is hurried through without the usual grace and elegance, at other times modulated into a soothing melody. The first we conceive to be a provocation to battle on the sight of another male; the last an amorous cadence, a courting address. This variety of song lasts no longer than till the female is fixed in her choice, which is in general in a few days after her arrival; and if the season is favourable she soon begins the task allotted to her sex."

We entirely agree with the writer of this animated passage that "'Tis love creates their melody," and that the ear is a principal guide to the hen-bird in her choice of a mate; but we cannot entirely exclude the eye when we remember what pains have been taken in most instances to distinguish the sexes by the colour of their feathered garb, and even in many instances to prepare a nuptial dress ('plumage de nôces' of the French) for the male, which fades when the season of love has passed away.

We must not dwell here upon the wonders of birds'-nests, their admirable structure as places of comfort and concealment, and the exquisite workmanship of some of them—that of the goldfinch, for instance. In those snug receptacles the eggs are deposited and hatched. Then the old birds feel all the parent within them, and entirely forget their own safety and wants in protecting and providing for their helpless nestlings. This parental love changes the timid at once to the brave; for birds of prey, cats, dogs, and sometimes even man, when he approaches the sanctuary, are attacked and followed with angry cries. For some time after quitting the nest this care continues, till the nestling is able to provide for itself. Then the whole scene changes. The young bird still lingers about the old one, and approaches it when it finds a worm or insect, expectant of the morsel. At first the young bird is unheeded and treated coldly; but if it does not take this hint, and perseveres in its solicitations, the parent, which but a few days before would have braved a hawk or a cat in its defence, and would have been content to suffer hunger rather than have seen it without food, gives it a buffet, and thus compels it to rely on its own resources.

Few phenomena have attracted more attention than the migration of birds. That some of our delicate songsters, with no great power of wing, should cross the seas periodically, returning, as they undoubtedly do, to those spots which they have before haunted, and which are associated in their memories with the pleasing cares of former years, excites our admiration, if not our astonishment. As regularly as the seasons, of which many of them are the harbingers, do these little travellers visit us, and as regularly do they take their departure. The immediate cause of migration is no doubt to be found in temperature and food, particularly that which is adapted for the sustenance of the young; and the instinct of the bird accordingly leads it from one climate to another.

Systematic Arrangement and Natural History.

Birds appear to have been objects of interest from the earliest periods. In comparatively later times we find them mingling in the superstitions of Greece and Rome; and it is evident that their history and habits were familiar not only to the husbandman and the augur, but to the great mass of the people. Without such a familiarity on the part of the Athenians, Aristophanes would hardly have ventured on introducing his audience to Νεφελακοκκυγία (see his play entitled 'Ὄρνιθες,' 'The Birds'); nor would other poets, Grecian and Roman, so often have referred to these animals as well-known harbingers of certain times and seasons. But it remained for Aristotle, and after him Pliny, to take up the subject philosophically. The former, in his 'History of Animals,' has distinguished the species, and recorded the habits of birds with the accuracy and power which distinguished that great observer; the latter, in the tenth book of his 'Natural History' has displayed much learning but not a great deal of originality.

In modern literature the first writer of note on this subject is Pierre Belon, who in 1555 arranged these animals according to their habits and their haunts. In his system the rapacious birds form the first division, the waders the second, the swimmers the third, and the birds which nestle in trees or on the ground, the fourth. He was an able zoologist and accurate observer, and has pointed out the comparative anatomy of birds with reference to that of man especially.

The third part of Conrad Gesner's 'History of Animals,' published in 1555, consists of his treatise on birds, where he has with some labour collected their various national names, and referred to the writers who had noticed the subject.

In 1599 Aldrovandus of Bologna published his 'Ornithology.' Pursuing the plan of Belon, he arranged the birds according to their haunts and their food, adding many new descriptions.

These three works are all illustrated with woodcuts.

In 1657 Johnston published his 'Natural History,' a kind of 'Repertorium Zoologicum,' wherein all that had been done before his time was condensed, and where every monstrous zoological fable was perpetuated, even in the copper-plates, which ministered to the appetites of those who loved to see what mermen and mermaids were like, and delighted in the sight of "hydras and chimeras dire."

We now approach a period wherein the reign of System commenced; and we owe one of the first natural arrangements, if not the first, to Francis Willughby, an English gentleman, whose 'System of Ornithology' was edited by our celebrated countryman Ray in 1678, after the author's death. It is a work of very great merit. The general divisions are two, 'Land-Birds,' and 'Water-Birds.' The land-birds are further divided into those which have a crooked beak and crooked talons, and those which have those parts nearly straight.

The water-birds are arranged in three sections. The first consists of waders, and those which haunt watery places; the second of those that are of a "middle nature, between swimmers and waders, or rather that partake of both kinds, some whereof are cloven-footed and yet swim; others whole-footed, but yet very long-legged, like the waders;" the third is formed by the palmated birds, or swimmers.

The same friendly office that was performed for Willughby by Ray, Dr. Derham executed for the latter, whose 'Synopsis Methodica Avium,' a posthumous work, but entirely completed by the author before his death, was published by the Doctor in 1713. In this Synopsis Ray carried out and further improved Willughby's system. Upon the works of these English naturalists rested in great measure the zoological system of Linnæus.

The first sketch of the Swedish naturalist's 'Systema Naturæ' appeared in folio, at Leyden, in 1735. It consisted of twelve pages, and was, as Linnæus himself says, "Conspectus tantum operis et quasi mappa geographica." Eight subsequent editions, in various forms, with gradually increasing information, were published in various places, and in 1758 the ninth edition ("longè auctius factum a me ipso," says the author) was sent forth in 8vo. In this edition the birds are arranged under the same 'orders' as they are in the twelfth and last edition, which appeared in 1766. The thirteenth edition was not the author's, but Gmelin's.

The following are the orders of Linnæus's class *Aves* :—

1. *Accipitres.* Birds of Prey, properly so called.
2. *Picæ.* Woodpeckers, Crows, Humming-Birds, Kingfishers, &c. &c. &c.
3. *Anseres.* Swimmers.
4. *Grallæ.* Waders.
5. *Gallinæ.* Gallinaceous Birds (Partridge and Domestic Fowl, for instance).
6. *Passeres.* Sparrows, Finches, Thrushes, Doves, Swallows, &c. &c.

These orders, some of which are not very natural, include with their subdivisions 78 genera.

In 1760 appeared the system of Brisson, which divides birds into two great sections. The first, consisting of those whose toes are deprived of membranes; the second, of those whose toes are furnished with membranes through their whole length.

There are many subdivisions, under which are arranged 26 orders, including 115 genera. This able ornithologist owes much of his celebrity to the minute accuracy of his specific descriptions.

In 1770 Buffon published the first part of his work relating to birds. It is marked by the same eloquent animated style which adorns the rest of his 'Natural History;' but much cannot be said for its arrangement, nor for the justice of some of its conclusions.

Schæffer, in his 'Elementa Ornithologica,' which was given to the public in 1744, divides birds into two great families, *Nudipedes* and *Palmipedes.*

Scopoli (1777), in his 'Introduction to Natural History,' divides them also into two families; but he takes his distinction from the arrangement of the scaly skin on the legs; the first division or *Retipedes* consisting of those the skin of whose legs is marked by small polygonal scales; the second, *Scutipedes*, of those the front of whose legs is covered with segments or unequal rings with lateral longitudinal furrows.

In 1781 our countryman Latham published his general synopsis, and in 1787 and in 1801 his two supplements appeared. In 1790 his 'Index Ornithologicus,' in two volumes quarto, being an abridgment of his more extended work, was given to the public. Separating, like Willughby and Ray, the birds into two grand divisions, land-birds and water-birds, he arranges them under the following orders, which include 101 genera :—

Land-Birds.	Water-Birds.
1. *Accipitres.*	7. *Grallæ.*
2. *Picæ.*	8. *Pinnatipedes.*
3. *Passeres.*	9. *Palmipedes.*
4. *Columbæ.*	
5. *Gallinæ,*	
6. *Struthiones.*	

In 1799 M. de Lacépède published his method, arranging 130 genera under 39 orders.

In 1806 Duméril, in his 'Zoologie Analytique,' divided birds into six orders.

The following is Blumenbach's arrangement :—

Land-Birds.	Water-Birds.
1. *Accipitres.*	8. *Grallæ.*
2. *Levirostres.*	9. *Anseres.*
3. *Pici.*	
4. *Coraces.*	
5. *Passeres.*	
6. *Gallinæ.*	
7. *Struthiones.*	

In 1810 Meyer, in the 'Almanach des Oiseaux de l'Allemagne, par Messrs. Meyer et Wolff,' arranged them under 11 orders.

In 1811 Illiger divided them into seven orders, including 41 families.

Then came Cuvier, who in his 'Règne Animal' (1817) published the following method :—

1. *Accipitres.*	4. *Gallinæ.*
2. *Passeres.*	5. *Grallæ.*
3. *Scansores* (Climbers).	6. *Palmipedes.*

Vieillot, whose work is dated in 1816, though it did not appear till 1817, distributes birds into the following five orders :—

1. *Accipitres.*	4. *Grallatores.*
2. *Sylvicolæ.*	5. *Natatores.*
3. *Gallinacei.*	

Temminck's arrangement (1815-20) consists of the following 16 orders :—

1. *Rapaces.*	9. *Pigeons.*
2. *Omnivores.*	10. *Gallinacés.*
3. *Insectivores.*	11. *Alectorides*
4. *Granivores.*	12. *Coureurs.*
5. *Zygodactyles.*	13. *Grallés.*
6. *Anisodactyles.*	14. *Pinnatipèdes.*
7. *Alcyons.*	15. *Palmipèdes.*
8. *Chelidons.*	16. *Inertes.*

In 1825 Nicholas Aylward Vigors (following out the principle adopted by William Sharp M'Leay, in his 'Horæ Entomologicæ,' a work of great learning and deep reasoning) proposed his arrangement of birds according to their natural affinities. "I discovered," says the author in his paper in the 14th volume of the 'Transactions of the Linnæan Society,' "as I advanced, that the larger or primary groups were connected by an uninterrupted chain of affinities; that this series or chain returned into itself; and that the groups of which it was composed preserved in their regular succession an analogy to the corresponding groups or orders of the contiguous classes of zoology. I equally detected the existence of the same principle in most of the subordinate subdivisions, even down to the minutest, to a degree at least sufficiently extensive to afford grounds for asserting its general prevalence."

Thus, if his five orders

Insessores,
Raptores, AVES. *Rasores,*
Natatores, *Grallatores,*

be arranged round a common centre, the author conceives that they would be found to be mutually connected together, and that the plan which holds good in the general division will be found to be confirmed on examining the subdivisions.

The second order *Insessores,* for instance, he divides into five tribes :—

Conirostres,
Dentirostres, INSESSORES. *Scansores,*
Fissirostres, *Tenuirostres,*

in which he finds a similar connection, as he also does in the five families into which he further separates each tribe.

In the same year M. Latreille published his method as follows :—

Section 1, Les Terrestres.	Section 2, Les Aquatiques.
1. Rapaces.	6. Echassiers.
2. Passereaux.	7. Palmipèdes.
3. Grimpeurs.	
4. Passerigalles.	
5. Gallinacés.	

These orders include 252 genera.

The method proposed by M. de Blainville in 1815, 1821, and 1822, and developed by his pupil, M. Lherminier, in 1827, is founded entirely on anatomical details, and principally upon the comparative development of the sternum.

In 1828 M. Lesson published his 'Projet,' wherein he commences with the two great divisions 'Terrestrial' and 'Aquatic,' and distributes the birds into nine orders, founded on the form of the toes, wings, and beak. The ninth order consists of 'Paradoxaux,' to which he refers the Ornithorhynchus.

In 1831, Mr. Swainson, rejecting the quinarian theory above alluded to, which he had adopted in the year 1824, proposed (in the second part of the 'Fauna Boreali-Americana' containing the birds) a new arrangement, which he framed according to the dogma that "the primary divisions of every natural group, of whatever extent or value, are three, each of which forms its own circle."

No one can read over the preceding compendium, which only embraces the more prominent systems, without perceiving that the great aim of modern science has been to produce the best natural arrangement. No sooner has one method been advanced and considered, than doubts have arisen, and another and another still succeeds. Cuvier expressed his dissent from all the systems which he had seen; and it is no doubt as true now as when he expressed his conviction that the true arrangement is yet to be sought for.

To give a list of all the writers on the Natural History of Birds would be quite out of place in a work of this description; we must therefore conclude this article with the following enumeration of some of the most celebrated authors in this department.

The ornithology of America and the West Indies has been given by Hernandes, Marcgrave, De Azara, Sloane, Catesby, Vieillot, Wilson, Spix, C. L. Bonaparte (Prince of Canino), Audubon, Richardson, Swainson, and Nuttall.

That of Britain by Pennant, Lewin, White, Bewick, Montagu, Donovan, Selby, Mudie, Yarrell, Macgillivray, W. Thompson, Meyer, and others.

That of Europe by Temminck; that of Germany by Meyer and Wolff; and C. L. Bonaparte that of Italy. Gould's 'Birds of Europe' illustrate the ornithology of the Continent and British Islands. His other works on the Birds of Australia, the Humming-Birds, the Toucans, and various monographs, are amongst the most splendid contributions to the science of Natural History.

Le Vaillant has illustrated the birds of Africa and other countries.

The following names of some of those who have also distinguished themselves as general authors or particular illustrators will readily occur to the student who enters upon this branch of Natural History :— Albin, Audebert, Audubon, Barraband, Bechstein, Bennett, Blyth, Brisson, Brunnich, Buffon, Buhle, Cuvier, Daudin, Desmarest, Edwards, Fleming, Foster, Frisch, Gerardin, Gould, Gray, Gunther, Hardwicke, Herbert, Houttuyn, Hunter, Illiger, Jardine, Jenner, Leach, Lear, Lesson, Macartney, M'Leay, Markwick, Meyer, Naumann, Nilsson, Nozeman, Rennie, Rüppell, Sabine, Savigny, Selby, Sepp, Schæffer, Shaw, Sheppard, Slaney, Sonnini, Spix, Stephens, H. E. Strickland, Swainson, Sweet, Syme, Vieillot, Vigors, Wagler, Waterton, Whitear, N. Wood, Yarrell.

Fossil Birds.

Although the remains of birds in a fossilised condition are not numerous, yet recent discoveries have given an interest to them not less than to that of any other class of animals. Sir Charles Lyell, in his 'Principles of Geology,' says that "the imbedding of the remains of birds in new strata must be of very rare occurrence, for their powers of flight insure them against perishing by numerous casualties to which quadrupeds are exposed during floods; and if they chance to be drowned, or to die when swimming on the water, it will scarcely ever happen that they will be submerged so as to become preserved in sedimentary deposits. In consequence of the hollow tubular structure of their bones, and the quantity of their feathers, they are extremely light in proportion to their volume, so that when first killed they do not sink to the bottom like quadrupeds, but float on the surface until the carcass either rots away or is devoured by predaceous animals." Nevertheless remains of birds have been found.

The earliest indications of the existence of birds are certain foot-tracks discovered by Professor Hitchcock, of Amherst, in the Triassic or New Red Argillaceous Sandstones of the valley of the Connecticut River. These foot-prints occur in considerable numbers in the district mentioned, and have been described by geologists under the name of *Ornithichnites*. A slab on which these remarkable markings are to be seen is in the collection of the British Museum. They evidently belong to birds of a large size, but unfortunately none of the remains of the creatures to which they belong have yet been discovered. Sir Charles Lyell has recently examined the district in which these impressions occur, and agrees with Professor Hitchcock in regarding them as the production of the feet of birds.

Some remains found by Dr. Mantell in the Wealden Strata of Tilgate Forest, were supposed by Baron Cuvier and Professor Owen to belong to a species of wading bird, but subsequent investigations have shown that these specimens were portions of the skeleton of a species of Pterodactyl. A microscopic examination however by Mr. Bowerbank and Professor Quekett of specimens since discovered by Dr. Mantell, has led these gentlemen to conclude that they belong to birds, leading to the inference that these animals did exist at the period of the deposit of the Wealden Beds.

In the 'British Fossil Mammals and Birds' Professor Owen has described the remains of a gigantic bird obtained by the Earl of Enniskillen from the Chalk near Maidstone. The portion described is regarded by Professor Owen as the shaft of the humerus, and he concludes that it belonged to a bird closely allied to the Albatross of the present day. He has named it *Cimoliornis Diomedeus*.

As we approach nearer the historic period of the earth's surface, the remains of the bones of birds become more decisive and more numerous. In most of the ancient Tertiary Strata remains of several genera of birds occur. In the Sevalik hills of India they are associated with the remains of several species of proboscidiform animals. In the basin of Paris they have been found in conjunction with the bones of the *Palæotherium*, &c. In the Tertiary deposits of Auvergne they have also been found, and the ossiferous caverns of the continent of Europe and of Great Britain have presented the bones of numerous species of animals now living, with here and there an extinct species. These remains however have been sufficiently scarce to be greatly prized by the collectors of fossils.

In the year 1839 Professor Owen received from Mr. Rule a specimen of the femur of a gigantic bird, allied to the ostrich and other struthious birds now in existence. To the bird to which this bone belonged Professor Owen gave the name of *Dinornis*. [DINORNIS.] This specimen was obtained from New Zealand, and quickly followed by a large collection of the bones of other extinct birds, made by Mr. Walter Mantell of Wellington, son of the late Dr. Gideon Mantell. In this collection, not only were there the bones of *Dinornis*, confirming all the anticipations which had been formed by Professor Owen of this gigantic bird, but also the remains of several other species of *Dinornis*, and other genera. The character of some of these remains, and their having been found in fire-heaps in conjunction with human bones, and allusions in the traditions and songs of the natives, lead to the undoubted conclusion that within the historic period the *Dinornis*, under the name of 'Moa,' was known to the Maoris, the native inhabitants of New Zealand. Amongst the remains is that of a genus called *Notornis*; and during his excursions into the interior for the purpose of ascertaining if any of these birds still existed, Mr. W. Mantell had the good fortune to capture a living specimen. [NOTORNIS, *see* SUPP.] It has been described and figured by Mr. Gould in his 'Birds of Australia,' and an engraving is also given by the late Dr. Mantell in his popular work descriptive of the organic remains of the British Museum, entitled 'Petrifactions and their Teachings.'

From these facts we are led to conclude that long before New Zealand was inhabited by man it was densely peopled by colossal struthious birds, of which the *Apteryx* [APTERYX], *Brachypteryx* [BRACHYPTERYX], and *Notornis* are but the degenerate representatives. It is probable also that New Zealand, together with Chatham Island, Norfolk Island, and others, are but the mountain-tops of a continent, which was probably covered with these creatures, presenting a remarkable feature in the history of the earth's surface, and affording interesting matter for speculation with regard to the progression of organised life upon the globe.

The history of the New Zealand birds is also one of special interest in connection with a group of birds, some of which also, as the *Dodo* and *Solitaire* [DODO], have existed within the historic period, but are now no longer to be found, and which had their principal seat of existence in the Mauritius. [*See* SUPPLEMENT.]

(Ansted, *Geology*; Owen, *British Fossil Mammals and Birds*; Owen, *Transactions of the Zoological Society*, 1839, 1844, 1846, 1848, 1850; Colenso, *Annals of Natural History*; Mantell, *Petrifactions and their Teachings*; Strickland and Melville, *The Dodo and its Kindred*.)

BIRDS' NESTS, EDIBLE. [ALGÆ.]

BIRDS OF PARADISE. With no family of birds has fiction been more busy than with the Birds of Paradise. From one fabulist to another came the tradition (losing nothing, as is usual with traditions, in its descent), that these "gay creatures of the element" passed their whole existence in sailing in the air, where all the functions of life were carried on, even to the production of their eggs and young. The dew and the vapours were said to be their only food, nor were they ever supposed to touch the earth till the moment of their death, never taking rest except by suspending themselves from the branches of trees by the shafts of the two elongated feathers which form a characteristic of this beautiful race. The appellations of Lufft-Vogel, Paradyss-Vogel, Passaros de Sol, Birds of Paradise, and God's Birds (to say nothing of Phœnix, a name which was applied to one of them), kept up the delusion that originated in the craft of the inhabitants of the eastern countries where they are found; for the natives scarcely ever produced a skin in former times from which they had not carefully extirpated the feet. Nor was it only the extreme elegance and richness of their feathers that caused these birds to be sought as the plume for the turbans of oriental chiefs; for he who wore that plume, relying implicitly on the romantic accounts of the life and habits of the bird, and impressed with its sacred names, believed that he bore a charmed life, and that he should be invulnerable even where the fight raged most furiously.

In vain did honest Pigafetta, who is supposed to have been the first who introduced these birds to the notice of Europeans, represent them as being furnished with legs; in vain was the same truth attested by Marcgrave, John de Laet, Clusius, Wormius, and Bontius (the last of whom observes on their crooked claws, and even asserts that they devour little birds, such as greenfinches), and referred to by Hernandez. A fairy tale was not to be so put down. Aldrovandus himself was deceived by the birds brought over in the mutilated state above described, and joined in the cry against poor Pigafetta, charging him with falsehood. Johnston, in 1657, writes thus oracularly of the Birds of Paradise:—"It is peculiar to them all to be without feet (although Aristotle asserts that no bird is without feet, and Pigafetta assigns to them feet a hand breadth in length);" and this he declares after Clusius had refuted the absurdity, and had stated that they had been brought to Holland (where Johnston's book was printed) with their feet on; and after the publication of Tradescant's Catalogue, wherein are mentioned among the 'whole birds' of his museum "Birds of Paradise, or Manucodiata, whereof are divers sorts, some with, some without leggs." And yet this same Johnston has no mercy on that part of the fable which asserts that they live on dew, are perpetually flying, and that their eggs are hatched in a natural cavity on the back of the male. "Of a verity," says the sage, "they must necessarily require rest, and are with ease suspended to the branches of trees by those threads in their tails."

Willughby and Ray treat these nonsensical stories as they deserve, and as was to be expected from their reputation as observers.

The high value set upon these birds awakened the cupidity and the fraud of the Chinese, who made up from parrots, parakeets, and others, artificial Birds of Paradise, so clumsily however that it is difficult to suppose that Seba, who figures three of them in the 60th plate of his first volume, could have been taken in by the manifest imposition. But there is nothing in the text to show that his suspicion was even excited; and this is the more extraordinary, as he figures two of the real species (plate 38 and plate 63) with sufficient accuracy.

Linnæus, who has commemorated the fable of the want of feet in these birds by bestowing upon the species most extensively known the name of 'apoda,' because, as he observes, "the older naturalists called it footless," says that the food of this species consists of the largest butterflies.

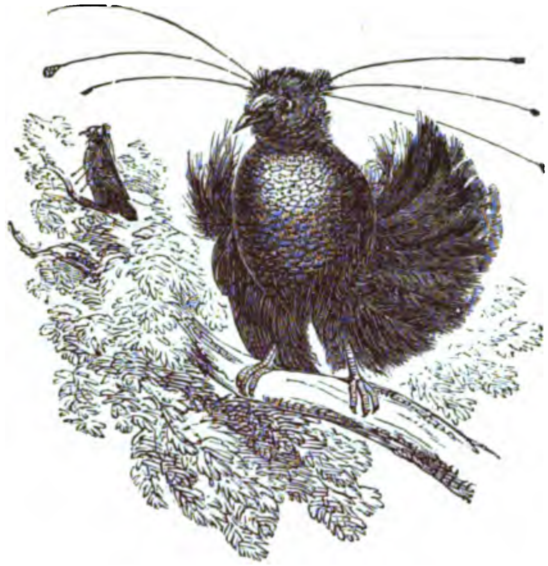
In the last edition of the 'Systema Naturæ' Linnæus gives but two species of the Birds of Paradise, to which he applies the generic name, *Paradisea*. These two species are *Paradisea apoda* and *Paradisea regia*. In Gmelin's edition the number of species is increased to eight, but one of them is the Paradise-Grakle.

Ornithologists seem to agree in placing these birds either among the Crows (*Corvidæ*) or in their immediate neighbourhood; and this, from the form of their beak and legs, and from their habits, to which we shall presently allude, appears to be their proper place.

Vieillot has divided the Linnæan genus *Paradisea* into the following genera:—

Parotia.—Beak furnished with short feathers to just beyond the middle, slender, compressed laterally, notched and curved at the tip; hypochondrial plumes long, broad, and loose.

Of this genus, *Parotia sexsetacea* (*Paradisea aurea* of Gmelin, *Paradisea sexsetacea* of Latham, the Sifilet of Buffon) is an example. The figure represents a male.



The Sifilet (*Parotia sexsetacea*).

Lophorina.—Beak furnished with elongated feathers to just beyond the middle, narrow above, slender, straight, notched, and bent at the tip; feathers of the neck long and disposed in a wing-form. Of this genus, *Lophorina superba* (*Paradisea superba* of Latham, Le Superbe of Buffon) is an example.

The Superb (*Lophorina superba*).

Cincinnurus.—Beak furnished at the base with small feathers directed forwards, slender, convex above, a little compressed at the sides, finely jagged and bent towards the tip; hypochondrial feathers broad, elongated, and truncated.

Of this genus, *Cincinnurus regius* (*Paradisea regia* of Linnæus, King-Bird of Paradise of Petiver, who has this note—"Brought from the Molucca Islands, and rarely to be seen here but in the cabinets of the most curious, as with Dr. Sloan, and in the repository of the Royal Society"—and Le Manucode of Buffon) is given as an example. The figure represents a male.

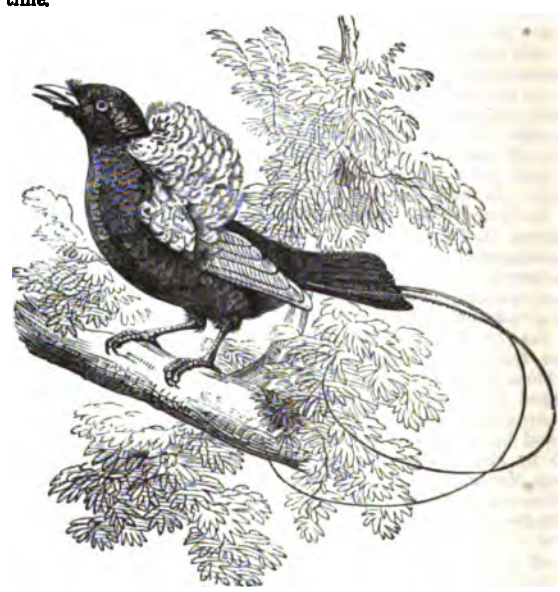
Samalia.—Beak robust, convex above, furnished at the base with velvet feathers, straight, compressed laterally, jagged towards the tip; hypochondrial feathers very long, flexible, decomposed, or cervical plumes moderate and stiff. Of this there are two sections, the type being *Paradisea magnifica* of Latham (Le Magnifique of Buffon).

But perhaps the most elegant of all these birds is that which is best known and most often seen, the Great Emerald, Le grand Émeraude of the French (*Paradisea apoda* of Linnæus).

The cuts, which are taken from Levaillant, may convey some very faint idea of the forms of these birds, whose beauty beggars all description. Even the magnificent works of Levaillant and Vieillot, splendid as they are, cannot represent the vivid and changing tints of the originals, though the former had the advantage of the pencil of Barraband, whose drawings have all the life and truth of portraits. To these works, and such as these, and to our museums, those who wish to have a distinct notion of what nature can produce in form and brilliancy of plumage must repair. They are all inhabitants of New Guinea.

King-Bird of Paradise (*Cincinnurus regius*).

One of the best accounts we have of the living habits of these birds is given by M. Lesson, who, though he deeply laments his short stay at New Guinea (only 13 days), appears to have made the best use of his time.



Paradisea magnifica.

"The Birds of Paradise," says M. Lesson, "or at least the Emerald (*Paradisea apoda*, Linn.), the only species concerning which we possess authentic intelligence, live in troops in the vast forests of the country of the Papuans, a group of islands situated under the equator, and which is composed of the islands Arou, Wagiou, and the great island called New Guinea. They are birds of passage, changing their quarters according to the monsoons. The females congregate in troops, assemble upon the tops of the highest trees in the forests, and all cry together to call the males. These last are always alone in the midst of some fifteen females, which compose their seraglio, after the manner of the gallinaceous birds."

M. Lesson then gives the following extract from his journal, written on the spot. After observing that the Birds of Paradise, with the exception of two species, were brought to the corvette, La Coquille, by the Papuans, and that the quantity afforded reason for supposing that these birds, so esteemed in Europe, were singularly multiplied in those countries, he thus continues:—

"The Manucode*, presented itself twice in our shooting excursions, and we killed the male and female. This species would seem to be monogamous, or perhaps it is only separated into pairs at the period

The Great Emerald (*Paradisea apoda*), mas.

Paradisea apoda, fem.

of laying. In the woods this bird has no brilliancy; its fine-coloured plumage is not discovered, and the tints of the female are dull. It loves to take its station on the teak-trees (Arbres de Teck), whose ample foliage shelters it, and whose small fruit forms its nourishment.

* *Cincinnurus regius*, Vieillot. *Manucodiata* or *Manucodewata* is an appellation common to all the Birds of Paradise, and is said to signify at the Moluccas 'The Bird of God.'

Its irides are brown, and the feet are of a delicate azure. The Papuans call it Saya.

"Soon after our arrival on this land of promise (New Guinea) for the naturalist, I was on a shooting excursion. Scarcely had I walked some hundred paces in those ancient forests, the daughters of time, whose sombre depth was perhaps the most magnificent and stately sight that I had ever seen, when a Bird of Paradise struck my view: it flew gracefully and in undulations; the feathers of its sides formed an elegant and aërial plume, which without exaggeration bore no remote resemblance to a brilliant meteor. Surprised, astounded, enjoying an inexpressible gratification, I devoured this splendid bird with my eyes; but my emotion was so great that I forgot to shoot at it, and did not recollect that I had a gun in my hand till it was far away.

"One can scarcely have a just idea of the Paradise-Birds from the skins which the Papuans sell to the Malays, and which come to us in Europe. These people formerly hunted the birds to decorate the turbans of their chiefs. They call them Mambéfore in their tongue, and kill them during the night by climbing the trees where they perch, and shooting them with arrows made for the purpose, and very short, which they make with the stem (rachis) of the leaves of a palm (latanier). The campongs or villages of Mappia and of Emberbakène are celebrated for the quantity of birds which they prepare, and all the art of their inhabitants is directed to taking off the feet, skinning, thrusting a little stick through the body, and drying it in the smoke. Some more adroit, at the solicitation of the Chinese merchants, dry them with their feet on. The price of a Bird of Paradise among the Papuans of the coast is a piastre at least. We killed, during our stay at New Guinea, a score of these birds, which I prepared for the most part. . . . . . .

"The Emerald when alive is of the size of a common jay, its beak and its feet are bluish; the irides are of a brilliant yellow; its motions are lively and agile; and in general it never perches except upon the summit of the most lofty trees. When it descends, it is for the purpose of eating the fruits of the lesser trees, or when the sun in full power compels it to seek the shade. It has a fancy for certain trees, and makes the neighbourhood re-echo with its piercing voice. The cry became fatal, because it indicated to us the movements of the bird. We were on the watch for it, and it was thus that we came to kill these birds; for when a male Bird of Paradise has perched, and hears a rustling in the silence of the forest, he is silent, and does not move. His call is 'voike, voike, voike, voiko,' strongly articulated. The cry of the female is the same, but she raises it much more feebly. The latter, deprived of the brilliant plumage of the male, is clad in sombre attire. We met with them, assembled in scores, on every tree, while the males, always solitary, appeared but rarely.

"It is at the rising and setting of the sun that the Bird of Paradise goes to seek its food. In the middle of the day it remains hidden under the ample foliage of the teak-tree, and comes not forth. He seems to dread the scorching rays of the sun, and to be unwilling to expose himself to the attacks of a rival. . . . .

"In order to shoot Birds of Paradise, travellers who visit New Guinea should remember that it is necessary to leave the ship early in the morning, to arrive at the foot of a teak-tree or fig-tree, which these birds frequent for the sake of their fruit—(our stay was from the 26th of July to the 9th of August)—before half-past four, and to remain motionless till some of the males, urged by hunger, light upon the branches within range. It is indispensably requisite to have a gun which will carry very far with effect, and that the grains of shot should be large; for it is very difficult to kill an Emerald outright, and if he be only wounded it is very seldom that he is not lost in thickets so dense that there is no finding the way without a compass.

"The little Emerald Paradise-Bird feeds, without doubt, on many substances, in a state of liberty. I can affirm that it lives on the seeds of the teak-tree, and on a fruit called Amihou, of a rosy white, insipid and mucilaginous, of the size of a small European fig, and which belongs to a tree of the genus *Ficus*."

M. Lesson then goes on to state that he saw two Birds of Paradise which had been kept in a cage for more than six months by the principal Chinese merchant at Amboyna. They were always in motion, and were fed with boiled rice, but they had a special fondness for Cockroaches (*Blattæ*).

Bennett, in his 'Wanderings,' gives the following account of a Bird of Paradise (*Paradisea apoda*) which he found in Mr. Beale's aviary at Macao, where it had been confined nine years, exhibiting no appearance of age:—

"This elegant creature has a light, playful, and graceful manner, with an arch and impudent look; dances about when a visitor approaches the cage, and seems delighted at being made an object of admiration; its notes are very peculiar, resembling the cawing of the raven, but its tones are by far more varied. During four months of the year, from May to August, it moults. It washes itself regularly twice daily, and after having performed its ablutions throws its delicate feathers up nearly over the head, the quills of which feathers have a peculiar structure, so as to enable the bird to effect this object. Its food during confinement is boiled rice, mixed up with soft egg, together with plantains, and living insects of the grasshopper tribe;

these insects when thrown to him the bird contrives to catch in its beak with great celerity. It will eat insects in a living state, but will not touch them when dead.

"I observed the bird previous to eating a grasshopper, given him in an entire or mutilated state, place the insect upon the perch, keep it firmly fixed with the claws, and divesting it of the legs, wings, &c., devour it, with the head always placed first. The servant who attends upon him to clean the cage, give him food, &c., strips off the legs, wings, &c. of the insects when alive, giving them to the bird as fast as he can devour them. It rarely alights upon the ground, and so proud is the creature of its elegant dress that it never permits a soil to remain upon it, and it may frequently be seen spreading out its wings and feathers, and regarding its splendid self in every direction, to observe whether the whole of its plumage is in an unsullied condition. It does not suffer from the cold weather during the winter season at Macao, though exposing the elegant bird to the bleak northerly wind is always very particularly avoided. Mr. Beale is very desirous of procuring a living female, to endeavour if possible to breed them in his aviary.

"The sounds uttered by this bird are very peculiar; that which appears to be a note of congratulation resembles somewhat the cawing of a raven, but changes to a varied scale of musical gradations, as 'he, hi, ho, haw,' repeated rapidly and frequently, as lively and playfully he hops round and along his perch, descending to the second perch to be admired, and to congratulate the stranger who has made a visit to inspect him; he frequently raises his voice, sending forth notes of such power as to be heard at a long distance, and as it could scarcely be supposed so delicate a bird could utter; these notes are 'whock, whock, whock, whock,' uttered in a barking tone, the last being given in a low tone as a conclusion.

"A drawing of the bird of the natural size was made by a Chinese artist. The bird advanced steadfastly towards the picture, uttering at the same time its cawing congratulatory notes; it did not appear excited by rage, but pecked gently at the representation, jumping about the perch, knocking its mandibles together with a clattering noise, and cleaning them against the perch, as if welcoming the arrival of a companion. After the trial of the picture a looking-glass was brought, to see what effect it would produce upon the bird, and the result was nearly the same; he regarded the reflection of himself most steadfastly in the mirror, never quitting it during the time it remained before him. When the glass was removed to the lower from the upper perch he instantly followed, but would not descend upon the floor of the cage when it was placed so low. . . . . .

"One of the best opportunities of seeing this splendid bird in all its beauty of action, as well as display of plumage, is early in the morning, when he makes his toilet; the beautiful sub-alar plumage is then thrown out, and cleaned from any spot that may sully its purity by being passed gently through the bill; the short chocolate-coloured wings are extended to the utmost, and he keeps them in a steady flapping motion, as if in imitation of their use in flight, at the same time raising up the delicate long feathers over the back, which are spread in a chaste and elegant manner, floating like films in the ambient air. . . . . . .

"I never yet beheld a soil on its feathers. After expanding the wings it would bring them together so as to conceal the head, then bending it gracefully it would inspect the state of its plumage underneath. This action it repeats in quick succession, uttering at the time its croaking notes; it then pecks and cleans its plumage in every part within reach, and throwing out the elegant and delicate tuft of feathers underneath the wings, seemingly with much care, and with not a little pride, they are cleaned in succession, if required, by throwing them abroad, elevating them, and passing them in succession through the bill. Then turning its back to the spectator, the actions above mentioned are repeated, but not in so careful a manner; elevating its tail and long shaft-feathers, it raises the delicate plumage of a similar character to the sub-alar, forming a beautiful dorsal crest, and, throwing its feathers up with much grace, appears as proud as a lady dressed in her full ball-dress. Having completed the toilet, he utters the usual cawing notes, at the same time looking archly at the spectators, as if ready to receive all the admiration that it considers its elegant form and display of plumage demands; it then takes exercise by hopping, in a rapid but graceful manner, from one end of the upper perch to the other, and descends suddenly upon the second perch, close to the bars of the cage, looking out for the grasshoppers which it is accustomed to receive at this time. . . . . .

"His prehensile power in the feet is very strong, and, still retaining his hold, the bird will turn himself round upon the perch. He delights to be sheltered from the glare of the sun, as that luminary is a great source of annoyance to him, if permitted to dart its fervent rays directly upon the cage. The iris frequently expanding and contracting adds to the arch look of this animated bird, as he throws the head on one side to glance at visitors, uttering the cawing notes or barking aloud. . . . . Having concluded, he jumps down to the lower perch in search of donations of living grasshoppers.

"The bird is not at all ravenous in its habits of feeding, but it eats rice leisurely, almost grain by grain. Should any of the insects thrown into his cage fall upon the floor, he will not descend to them, appearing to be fearful that in so doing he should soil his delicate plumage; he therefore seldom or ever descends, except to perform his ablutions in the pan of water placed at the bottom of the cage expressly for his use."

BIRGUS, a genus of Long-Tailed *Crustacea*, approaching the Hermit-Crabs (*Pagurus*) established by Leach. The following are the leading characters:—Middle antennæ having their second articulation crested or tufted; feet of the first pair of legs unequal, terminated by pincers or knob-claws; feet of the second and third pair terminated simply, in other words, by a single nail; fourth pair smaller and didactylous, or terminated by two fingers, one moveable; fifth pair rudimentary, very small, but didactylous; carapace somewhat in the form of a reversed heart, with the apex pointing forwards; post-abdomen or tail orbicular, crustaceous above, the plates being sub-annular, or rudiments of rings.

There are two species recorded, and of these *Birgus Latro*, Leach, *Pagurus Latro*, Fabr. and Lam., *Cancer Latro*, Linn., *Cancer crumenatus*, Börs-Krabbe (Purse-Crab) of Rumphius, is the largest. Its rostrum is terminated by a single point. The pincers are red, the left being much larger than the right, and both deeply toothed. The feet of the next three pairs are toothed on the edges, and marked with undulated streaks. It is a native of Amboyna and other neighbouring islands, where it is said to inhabit the fissures of rocks by day, and to come forth at night to seek its food on the beach. Mr. Cuming found it sufficiently abundant in Lord Hood's Island in the Pacific, but there the Purse-Crabs dwelt at the roots of trees, and not in holes in the rocks. When he met them in his road, they set themselves up in a threatening attitude and then retreated backwards, making both at first and afterwards a great snapping with their pincers. There appears to be a tradition among the natives that it climbs Cocoa-Nut Trees (*Cocos nucifera*) in the night to get the cocoa-nuts. Linnæus, Herbst, and Cuvier repeat this story, which, as Owen observes, is confirmed in a degree by Quoy and Gaimard, who relate that individuals of this species were fed by them for many months on cocoa-nuts alone; and still more amply by the observations communicated to him by Mr. Cuming, who states that these Purse-Crabs climb the *Pandanus odoratissimus*, a kind of palm, for the purpose of feeding on the small nut that grows thereon, and that he saw them in the tree.

Linnæus gives the Antilles as the locality of this Purse-Crab, as well as Amboyna, upon the authority of Rochefort, but this has arisen from a misunderstanding of the text of Rochefort.

In the following passage Rochefort refers to some of the Land-Crabs of the Antilles, and not to the genus *Birgus*:—

"What is the more worthy of note relating to these crabs is, that once a year, namely, after they are returned from their journey to the sea, they hide themselves entirely in the earth for some six weeks, so that not one appears. During this time they change their skin, or crust, and renew themselves altogether. They place the earth at this season so dexterously at the entrance of their holes, that one cannot perceive the opening. This they do that they may not be exposed to the air. For when they thus throw aside their old garb, the whole of their body is as it were naked, being only covered by a thin and delicate skin, which thickens and hardens by degrees into a crust as solid as that which they have left. Monsieur du Montel reports that he caused people to dig on purpose in those places where there was any appearance of their lying hid, and having met with some of them, that he found that they were enveloped as it were in the leaves of trees, which without doubt served them for nourishment and for a nest during this retreat; but they were so languid and so incapable of supporting the fresh air, that they seemed half dead, though in other respects they were fat and very delicate food. The inhabitants of the Isles call them at this period Purse-Crabs, and esteem them much. He saw quite close to them their old covering, that is to say, their shell, which appeared as entire as if the animal had been still within. What is wonderful is, that though he employed very good eyes, he could scarcely observe the opening or slit whence the body of the animal had come forth and had disengaged itself from this prison. Nevertheless, after having taken great care he remarked in the empty shells a small separation near the tail, by which the crabs had extricated themselves."

Then follows the most approved way of dressing these Land-Crabs for the table, a mode which is still in practice with little variation in the West Indies at the present day.

In a manuscript entitled 'Mémoires en Forme de Dictionnaire contenant l'Histoire Naturelle notamment de Cacao, l'Indigo, le Sucre, et le Tabac, Par M. ———, Inspecteur pour la Compagnie de Chandernagor,' there is a very full account of the Land-Crabs (Tourlouroux) of the Antilles, and the writer of the manuscript, speaking of their condition after they have thrown off their old crusts, says, "If they take the crabs then, they find them covered only with a slight red skin, tender and delicate as moistened parchment; the crabs are then much more delicious than they are at any other season; they call them at that period Purse-Crabs" (tom. ii. p. 526). The manuscript is without date, but was written after the publication of Labat's works, which the writer quotes.

Birgus Latro, which grows to a large size, is said to be excellent food when properly prepared. It was a favourite diet with the natives of Lord Hood's Island, but Mr. Cuming did not taste it.

There are specimens in the British Museum. There is only one species of this genus.

Purse-Crab (*Birgus Latro.*)

BIROSTRITES, a genus of Fossil *Mollusca* named by Lamarck. He has placed it under his family *Rudistes*, a family which, as Mr. G. Sowerby observes, might be struck out; for there can be hardly any doubt that Lamarck has misconceived or misplaced the genera of which it is composed. G. Sowerby, from an examination of the cast of the inside of the shell, expresses his conviction that *Birostrites* ought to be placed next to *Diceras*, or at least in the same family with *Chama* and *Diceras*, inasmuch as it accords very nearly with those shells in its internal characters. Rang has placed the genera *Batolites*, *Raphanistes*, and *Amplexus*, near to this genus.

The following is Lamarck's description of this singular fossil:—Shell composed of two pieces or valves, which do not unite by the edges of their base, one enveloping the other, and the dorsal disc of each being elevated into a nearly straight cone slightly arched within. These horn-shaped valves are unequal, and diverge obliquely under the form of a very open V. It seems as if one valve came out of the base of the other, and it is always the shortest that is enveloped. *Birostrites inæquilobus* is the only species which Lamarck records.

BIRTHWORTS. [ARISTOLOCHIACEÆ.]

BISH. [BIKH.]

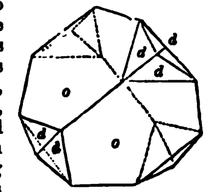
BISMORE, a name given in the Orkneys to the 15-spined Stickleback. [GASTEROSTEUS.]

BISMUTH, a metal that was unknown to the ancients. It was referred to by Agricola in his work on mining in 1529, and was subsequently described by Stahl and Dufay.

The minerals in which this metal constitutes the principal ingredient are comparatively few in number; and of these only two species are of any importance in a commercial point of view, namely, the native bismuth, and its sulphurets. The general characters of these minerals are the following. Before the blow-pipe they are readily fused and reduced to a metallic state, the regulus itself gradually subliming if the flame be continued, leaving on the charcoal an orange-yellow areola, which however may readily be made to disappear in the deoxidising flame. When the metallic regulus is fused in an open glass tube, a yellowish-white sublimate is obtained, and the regulus itself becomes covered by the fused oxide, which while hot is of a dark brown colour but assumes a yellow tint on cooling. These minerals are all of them soluble in strong nitric acid, the solution yielding a white precipitate on being dropped into water. They are known and described by mineralogists under the following names:—*Native* or *Octahedral Bismuth*, *Bismuth-Ochre*, *Prismatic Bismuth-Glance*, *Needle-Ore* or *Acicular Bismuth-Glance*, called by Phillips *Plumbo-Cupriferous Sulphuret of Bismuth*, *Tellurbismuth*, formerly known by the name of *Molybdan Silver*.

Native or *Octahedral Bismuth* is sometimes found crystallised: the observed forms are the octahedron, the tetrahedron, and combinations of the latter with the dodecahedron, which produce the shape seen in the accompanying figure.

The faces marked *o* belong to the tetrahedron and those marked with *d* to the rhombic dodecahedron. The edge between the faces *o* is therefore 70° 32′, between the faces *d* 120°, and in the edges of combination between *o* and *d* 144° 44′. These crystals are generally very imperfect, and the faces rough and uneven; they possess a perfect cleavage parallel to the faces of the octahedron. The hardness varies from 2 to 2·5, the specific gravity from 9·6 to 9·8. The crystals are opaque, possess the metallic lustre, and the fresh fracture presents a reddish silver white; but the surface is usually tarnished, owing to partial oxidation, and presents a variegated appearance of gray, red, and blue colours. They may be considered as presenting us with the metal Bismuth in a pure state, the only foreign matter being traces of arsenic. The occurrence of crystals is somewhat rare, this mineral being usually found in feathery and arborescent forms, and also in dentiform concretions in veins, traversing gneiss, mica, and clay-slates, where it is usually accompanied by ores of silver, cobalt, nickel, and iron. It is found at St. Colomb and Botallack mines in Cornwall, and at Castle-Carrock in Cumberland, but in much greater abundance in the mines of Saxony and Bohemia, at Johann-Georgenstadt, Annaberg, Altenberg, Schneeberg, and at Joachimsthal, from whence the greater portion of the Bismuth of commerce is obtained. It is also found at Beiber in Hainau, at Löling in Carinthia, and in the Sophia mine at Wittichen in Fürstenberg.



The *Bismuth-Ochre* is a rare mineral, which occurs massive and disseminated. It is of a straw-yellow, passing sometimes into a light yellowish gray. Its specific gravity is 4·36, and its chemical constitution—

Bismuth	89·87
Oxygen	10·13

It usually contains small quantities of arsenic and oxide of iron as impurities. Its known localities are St. Agnes, Cornwall; Schneeberg and Johann-Georgenstadt, in Saxony; and Joachimsthal, in Bohemia.

Bismuth-Glance, *Bismutite*, a Carbonate of Bismuth, occurs in four-sided prisms of unknown dimensions, but it is stated by Phillips to have angles about 91° and 89°. It is further characterised by its metallic lustre, and lead-gray approaching steel-gray colour, and from its possessing a perfect cleavage in the direction of the short diagonal, and one less perfect in the direction of the base. According to Mohs the hardness is between 2 and 2·5, and the specific gravity 6·549. It also occurs massive of a granular composition, or columnar, the individuals being long and straight, and aggregated in various directions. According to the analysis of H. Rose of a specimen from Reddarhyttan, it is thus composed:—

Sulphur	18·49	18·72
Bismuth	81·51	80·98

Before the blow-pipe sulphur is first driven off, which is followed by a sublimate having the odour of tellurium, and afterwards the characters are the same as those of the other minerals of Bismuth.

Bismuth-Blende is a Silicate of Bismuth.

Other minerals in which Bismuth occurs are *Needle-Ore* and *Tellurbismuth*. *Needle-Ore* is also called *Acicular Bismuth*. It is a sulphuret of bismuth, lead, and copper, containing a trace of gold. It comes from Siberia. *Tellurbismuth*, or *Tetradymite*, is composed of tellurium and bismuth. It has a foliated structure, and a pale steel-gray colour. It comes from Schemnitz, and also from Brazil.

(Dana, *Mineralogy*.)

BISON, the name of a genus of Ruminant Animals belonging to the family *Bovidæ*. The genus *Bison* comprehends two living species, one of them European, now become very scarce and verging towards extinction; the other American, and, notwithstanding the advances of man, still multitudinous.

European Bison.

As much difference of opinion has prevailed with regard to the historical records and true characters of the first or European species of Bison, we shall quote a few of the synonyms of this animal as given in the Catalogue of the Specimens of Mammalia, in the British Museum, by Dr. J. E. Gray.

The Bison Aurochs, or European Bison, is the *Bos Bison* of Linnæus; *Bison Bonassus*, Dr. J. E. Gray; *Bos Urus*, Boddaert; *Bos Bison Aurochs*, Lesson; *Bos Taurus Urus*, Gmelin; *Bos Bonassus*, Brisson; *Bison Europæus*, Owen; *Bos Bison seu Bonassus*, Wagner; *Bison jubatus*, Pliny; *Bison*, Gesner, Aldrovandus, and Gilibert; *Urus*, Cæsar; *Aurochs*, Cuvier, Buffon, and Desmoulins; *Bonasus*, Pliny, Gesner, Klein, Buffon, and Ray. It is also the Urochs, Auer-Ochse or Auer-Ochs, Wald-Ochse, Wilder Ochs, Berg-Ochs, Buckel-Ochs, Afrikanischer Wilder Ochs, Preussische und Lithanische Auer-Ochs, Zurb, and Manistier, of various German writers. To these various synonyms we may now add that of *Bison priscus* of Owen, as there is no doubt that the bones of the Great Fossil Aurochs belong to the same species as those now living in the forests of Lithuania.

The difficulty of identifying this animal has arisen from the fact, that besides the Bison there existed at one time in Europe and in Great Britain a wild ox (*Bos primigenius*), whose remains are numerous, but which has undoubtedly become quite extinct. Pennant, in his 'British Zoology,' after stating his belief that the ancient wild cattle of our island were the *Bisontes jubati* of Pliny, thus continues:—"The Urus of the Hercynian forest, described by Cæsar, book vi., was of this kind, the same which is called by the modern Germans Aurochs, that is, *Bos sylvestris*." Now let us look at Cæsar's description. "These Uri are little inferior to elephants in size, but are bulls in their nature, colour, and figure. Great is their strength and great their swiftness, nor do they spare man or beast when they have caught sight of them. These, when trapped in pitfalls, the hunters diligently kill. The youths exercising themselves by this sort of hunting are hardened by the toil; and those among them who have killed most, bringing with them the horns as testimonials, acquire great praise. But these Uri cannot be habituated to man or made tractable, not even when young. The great size of the horns, as well as the form and quality of them, differs much from the horns of our oxen. These, when carefully selected, they ring round the edge with silver and use them for drinking-cups at their ample feasts." Though there are parts of this description applicable to the European Bison, there is one striking character which forbids us to conclude that Cæsar's *Urus* was identical with it. A glance at the European Bison will convince us that it never could have afforded the horns whose amplitude Cæsar celebrates. In the 'Archæologia,' vol. iii. p. 15, it is stated that the Borstal horn is supposed to have belonged to the Bison or Buffalo. That it might have belonged to a Buffalo is not impossible, but that it did not belong to a Bison is sufficiently clear from the following description: "It is 2 feet 4 inches long on the convex bend, and 23 inches on the concave. The inside at the large end is 3 inches diameter, being perforated there so as to leave the thickness only of half an inch for about 3 inches deep; but farther in it is thicker, being not so much or so neatly perforated." This horn was no doubt supplied by the Great Fossil Ox, the *Bos primigenius*. Horns were anciently used amongst us in the conveyance of inheritances; of which we have examples in the Borstal horn, and the Pusey horn. These probably belonged to the Great Fossil Ox. That the common Ox could not be descended from the Bison as has been conjectured by some, is proved by the fact that the Aurochs or European Bison has 14 pairs of ribs, while the Ox has but 13, and that the legs of the Aurochs are more slender and longer than those of the Ox and true Buffalo. The European Bison, moreover, has but five lumbar vertebræ, while the other oxen, with the exception of the American Bison, which has only four according to Cuvier, possess six. [BOVIDÆ.]

"The front of the common Ox," says Cuvier, "is flattened, and even in a small degree concave; that of the Aurochs is rounded into convexity (bombé), though rather less than that of the Buffalo. It is square in the Ox, its height being nearly equal to its breadth, taking for its base an imaginary line between the orbits. In the Aurochs, with the same mode of measurement, it is much broader than it is high, in the proportion of three to one. The horns are attached in the Ox to the extremities of the most elevated salient line of the head, that, namely, which separates the occiput from the front; in the Aurochs this line is two inches farther back than the root of the horns. The plane of the occiput makes a sharp angle with the front in the Ox; this angle is obtuse in the Aurochs; and lastly, this quadrangular plane of the occiput, as it is in the Ox, represents a half circle in the Aurochs."

Skull of European Bison, front view.

Profile of the same.

The figures here given were taken from the skull of the European Bison or Aurochs in the museum at Paris. This must have been a young animal, as will be seen from comparing the representation of its skull with that of the following specimen.

There is now no doubt that the *Bison jubatus* of Pliny (book viii. c. 15, and xxviii. c. 10), which he seems to distinguish from the *Urus*, was the European Bison or Aurochs; and though in the 15th chapter of the 8th book he mentions the tradition of a wild beast in Pæonia called a *Bonasus*, after he has dismissed his *Bisontes jubati*, and with every appearance of a conclusion on his part that the *Bonasus* and *Bison* were not identical his own description, when compared with that of Aristotle, will leave little doubt that the *Bison jubatus* and *Bonasus* of Pliny and others, the Βόνασσος or Βόνασος of Aristotle (for the word is written both ways), and the Βίσων of Oppian, were no other than the European Bison.

Skull of old European Bison, front view.

Profile of the same.

European Bison (*Bison Europæus*).

Cuvier, in his 'Ossemens Fossiles,' states it to be his opinion that this animal, the largest or at least the most massive of all existing quadrupeds after the rhinoceros, is a distinct species which man has never subdued. Following out this subject with his usual industry and ability, that great naturalist goes on to state that if Europe possessed a *Urus*, a Thur of the Poles, different from the Bison or the Aurochs of the Germans, it is only in its remains that this species can be traced. Such remains are found in the skulls of a species of Ox different from the Aurochs, in the superficial beds of certain districts. This Cuvier was of opinion must have been the true *Urus* of the ancients, the original of our domestic Ox, the stock perhaps whence our wild cattle descended. Professor Owen, in his 'British Fossil Mammals,' has fully established the distinction between the Aurochs and the Great Fossil Ox, the *Urus* of the ancients, but he has shown that it is impossible that any of our forms of oxen or wild cattle should have been descended from this species which is now extinct. [BOVIDÆ.] The head given below is figured by Cuvier as of doubtful character, but if compared with the skull of the Aurochs there can be little doubt of its identity.

Skull of supposed Fossil Aurochs, front view. **Profile of the same.**

The remains of the Aurochs have been found abundantly on the continent of Europe, and been described by Faujas, Cuvier, and H. von Meyer. Some of these carry the antiquity of this animal as far back as the period of the extinct pachyderms of the newer Pliocene deposits. On comparing these with recent specimens of the Aurochs from the Lithuanian forests, they are found to be generally of larger size, to have longer and somewhat less bent horns, but they present no satisfactory specific distinction.

That the Aurochs existed formerly in Great Britain is attested from the discovery of remains of the cranium and horn-cores from various newer Tertiary Fresh-Water deposits, especially in the counties of Kent and Essex along the borders of the Thames. In the hall of the Geological Society of London is a cranium with horn-cores, obtained by Mr. Warburton from the Fresh-Water Tertiary deposits of Walton in Essex. A broken skull was also discovered by Mr. H. E. Strickland, in the Fresh-Water Drift at Cropthorne, Worcestershire. Professor Phillips, in his 'Geology of Yorkshire,' records the discovery of the skull with the cores of the horns and the teeth at Beilbecks, in Yorkshire. It was accompanied with the remains of fresh-water *Mollusca* and of the Mammoth, Rhinoceros, a species of *Felis*, a large Horse, a large Deer, Wolf, &c. It is to be regretted that the entire skeleton of the same individual has not hitherto been discovered, in order that a comparison of the number of ribs between this elder Bison, and the European and American Bisons of the present day might be made.

The European Bison, as found at the present day, has a very broad head and arched forehead. The eyes are large and dark; the hair on the forehead is long and wavy, and under the chin and breast it forms a kind of beard. In the winter the whole of the neck, hump, and shoulders are covered with a long dusky-brown hair, intermingled with a soft fur. The long hair is cast in the summer and renewed in the winter. The tail is of moderate length, covered with hair, and is terminated in a large tuft. The females are not so large as the males, and have not so much hair on their bodies.

The districts in which this animal is now found living are comparatively limited, as it appears to be confined to the forests of Lithuania, Moldavia, Wallachia, and some parts of the Caucasus. These animals have never been domesticated, but herds of them are protected in certain localities in the forest of Bialowieza in Lithuania, under the direction of the Emperor of Russia. There are twelve herds thus kept, each herd being under the superintendence of one herdsman. The estimated number of all the herds is 800. They feed on grass and brushwood, and the bark of young trees, especially the willow, poplar, ash, and birch. They do not attain their full stature till their sixth year. They are very shy, and can only be approached from the leeward, as their smell is exceedingly acute. When accidentally fallen in with they become furious, and passionately assail the intruder. When taken young they become accustomed to their keeper, but the approach of other persons excites their anger. Two young specimens were presented to the Zoological Society of London by the Emperor of Russia. Although it had been stated that the Aurochs had a natural enmity to domestic cattle, and that the young obstinately refused to be suckled by the domestic cow, the calves sent by the Emperor were suckled by a cow in the Regent's Park Gardens, and became very speedily attached to their foster-mother. These creatures unfortunately died a few months after they had been brought to this country. A very fine specimen was presented to the British Museum by the Emperor of Russia, which is now to be seen stuffed in the collection. The dimensions of this animal are as follows:—

	Ft.	In.
Length from the nose to the insertion of the tail	9	10
Height at the withers	5	6
Height at the rump	4	11
Length of head	1	8
Length of tail	3	0

American Bison.

We have seen that the European Bison has fourteen pairs of ribs, while the common Ox has but thirteen. The specific difference of the American Bison is marked by its having fifteen ribs on each side. Thus, in the Bisons, the supplementary ribs spring from the anterior lumbar vertebræ, or rather from vertebræ which are lumbar as far as regards their situation, but dorsal when considered in relation to their functions. The contour of the skull has much in common with that of the European species, but its development, and indeed that of the whole frame, is much inferior in the female. Beneath is represented the skull of a young female American Bison,—

Skull of young female American Bison, front view. **Profile of the same.**

and we shall at once see how tame and weak its chiselling is when compared with that of the old male.

Skull of old male American Bison, front view. **Profile of the same.**

The American Bison has many points of similarity with the Aurochs. In both we have the huge head and the lengthened spinal processes of the dorsal vertebræ for the attachment of the brawny muscles that support and wield it. In both we have the conical hump between the shoulders in consequence, and the shaggy mane in all seasons; and each presents a model of brute force, formed to push and throw down.

This is the *Taurus Mexicanus* of Hernandez, who gives a woodcut of the beast, but not a good one; the Taureau Sauvage of Hennepin, who also gives a figure of it, not better than that of Hernandez, and probably a copy from it; the Buffalo of Lawson, Catesby, &c., of the Hudson's Bay traders, and of the Anglo-Americans generally; the Bison of Ray and Pennant; *Bos Americanus* of Gmelin; American Wild Ox or Bison of Warden; Peecheek of the Algonquin Indians; Moostoosh of the Crees; and Adgiddah of the Chippewayans, according to Sir John Richardson.

Pennant says, "In America these animals are found in the countries

600 miles west of Hudson's Bay; this is their most northern residence. From thence they are met with in great droves as low as Cibole (on the authority of Purchas) in lat. 33°, a little north of California, and also in the province of Mivera in New Mexico. The species

American Bison (*Bison Americanus*), Females. A Bull in the distance.

American Bison (*Bison Americanus*), a Bull.

instantly ceases south of those countries. They inhabit Canada to the west of the lakes; and in greater abundance in the rich savannahs which border the river Mississippi and the great rivers which fall into it from the west, in Upper Louisiana. There they are seen in herds innumerable, promiscuously with multitudes of stags and deer during morning and evening, retiring in the sultry heats into the shade of tall reeds which border the rivers of America."

Joseph Sabine, in the Appendix to 'Franklin's Narrative,' says that they are abundant in all parts of North America, wherever the progress of cultivation has not interfered with their range, and that they are extremely numerous on the plains of the Saskatchewan River. They are also found, he observes, though less plentifully, in the woods as far north as Great Slave Lake. The most northern situation in which they were observed by Sir John Franklin's party was Slave Point, on the north side of the lake. In the same work it is stated that the natives say that the Wood Buffaloes, as they are called, are larger than those of the plains, but the difference is not material.

Sir John Richardson, in his 'Fauna Boreali-Americana,' gives the following compendious history of the geographical range of the American Bison:—"At the period when Europeans began to form settlements in North America, this animal was occasionally met with on the Atlantic coast; but even then it appears to have been rare to the eastward of the Appalachian Mountains, for Lawson has thought it to be a fact worth recording, that two were killed in one season on Cape Fear River. As early as the first discovery of Canada, it was unknown in that country, and no mention of it whatever occurs in the 'Voyages du Sieur de Champlain Xaintongeois,' nor in the 'Nova Francia' of De Monts, who obtained the first monopoly of the fur-trade. Theodat, whose 'History of Canada' was published in 1636, merely says that he was informed that bulls existed in the remote western countries. Warden mentions that at no very distant date herds of them existed in the western parts of Pennsylvania, and that as late as the year 1766 they were pretty numerous in Kentucky; but they have gradually retired before the white population, and are now, he says, rarely seen to the south of the Ohio, on the east side of the Mississippi. They still exist, however, in vast numbers in Louisiana, roaming in countless herds over the prairies that are watered by the Arkansas, Platte, Missouri, and upper branches of the Saskatchewan and Peace rivers. Great Slave Lake, in lat. 60°, was at one time the northern boundary of their range; but of late years, according to the testimony of the natives, they have taken possession of the flat limestone district of Slave Point, on the north side of that lake, and have wandered to the vicinity of Great Marten Lake, in lat. 63° or 64°. As far as I have been able to ascertain, the limestone and sandstone formations lying between the great Rocky Mountain ridge and the lower eastern chain of primitive rocks, are the only districts in the fur countries that are frequented by the bison. In these comparatively level tracts there is much prairie land, on which they find good grass in the summer, and also many marshes overgrown with bulrushes and carices,* which supply them with winter food. Salt-springs and lakes also abound on the confines of the limestone, and there are several well-known salt-licks where bisons are sure to be found at all seasons of the year. They do not frequent any of the districts formed of primitive rocks, and the limits of their range to the eastward, within the Hudson's Bay Company's territories, may be nearly correctly marked on the map by a line commencing in long. 97° on the Red River, which flows into the south end of Lake Winnipeg, crossing the Saskatchewan to the westward of Basquiau Hill, and running from thence by the Athapescow to the east end of Great Slave Lake. Their migrations to the westward were formerly limited by the Rocky Mountain range, and they are still unknown in New Caledonia and on the shores of the Pacific to the north of the Columbia River, but of late years they have found out a passage across the mountains, near the sources of the Saskatchewan, and their numbers to the westward are said to be annually increasing. In 1806, when Lewis and Clarke crossed the mountains at the head of the Missouri, bison-skins were an important article of traffic between the inhabitants on the east side and the natives to the westward. Farther to the southward, in New Mexico and California, the bison appears to be numerous on both sides of the Rocky Mountain chain."

The districts of America which these animals inhabit are described very graphically in Washington Irving's 'Tour on the Prairies.'

The American male Bison, when at its full size, is said to weigh 2000 lbs., though 12 or 14 cwt. is considered a good weight in the fur countries. Sir John Richardson gives 8½ feet as its length, exclusive of the tail, which is 20 inches, and upwards of 6 feet as its height at the fore quarters. The head is very large, and carried low; the eyes are small, black, and piercing; the horns are short, small, sharp, set far apart, for the forehead is very broad, and directed outwards and backwards, so as to be nearly erect, with a slight curve towards the outward-pointing tips. The hump is not a mere lump of fatty secretion, like that of the zebu, but consists, exclusive of a deposit of fat which varies much in quantity, of the strong muscles attached to the highly-developed spinous processes of the last cervical and first dorsal vertebræ, forming fit machinery for the support and movement of the enormous head. The chest is broad, and the legs are strong; the hind parts are narrow, and have a comparatively weak appearance. The tail is clothed with short fur-like hair, with a long, straight, coarse, blackish-brown tuft at the end. In winter the whole body is covered with long shagged hair, which in summer falls off, leaving the blackish wrinkled skin exposed, except on the forehead, hump, fore quarters, under-jaw, and throat, where the hair is very long and shaggy, and mixed with much wool. Catesby observes that on the forehead of a bull the hair is a foot long, thick, and frizzled, and of a dusky black colour; that the length of this hair hanging over their eyes impedes their flight, and is frequently the cause of their destruction; but that this obstruction of sight is in some measure supplied by their good noses, which are no small safeguard to them. A bull, says he, in summer, with his body bare and his head muffled with long hair, makes a very formidable appearance. In summer the general colour of the hair is between dark-umber and liver-brown, and lustrous. The tips of the hair as it lengthens in winter are paler, and before it is shed in summer much of it becomes of a pale dull yellowish-brown. In the female the head is smaller, and the hair on the fore parts is not so long as it is in the male.

Congregating in vast herds, these animals are said to cover the wide-extended savannahs of the more southern districts of the north for miles in extent. "Such was the multitude," say Lewis and Clarke, speaking of an assemblage of Bisons as they crossed the water, "that although the river, including an island over which they passed, was a mile in length, the herd stretched as thick as they could swim completely from one side to the other." The same travellers, speaking of

* *Carex* is the name of a genus of *Cyperaceæ*, a family of plants nearly allied to the Grasses.

another of these grand spectacles, say—"If it be not impossible to calculate the moving multitude which darkened the whole plains, we are convinced that 20,000 would be no exaggerated number." Catesby, after stating that they range in droves, feeding on the open savannahs morning and evening, says that in the sultry time of the day they retire to shady rivulets and streams of clear water gliding through thickets of tall canes. Dr. James had an opportunity of observing them on such occasions, and he thus describes their march:—"In the middle of the day countless thousands of them were seen coming in from every quarter to the stagnant pools;" and in another place he says that their paths are as frequent and almost as conspicuous as the roads in the most populous parts of the United States.

The Bisons, in truth, are a wandering race, the motives of their restlessness being either disturbance by hunters or change of pasture. After the fire has cleared the prairie of all the old herbage, the delicately tender grass which springs up in the room of the old wiry bents that fed the flame offers the most grateful food to the migratory Bisons: such spots are well known to the hunter as points of attraction to these animals. In the winter, when the snow lies deep over the vegetation, they scrape it away with their feet to get at the grass.

Fierce and terrible are the fights among the bulls in the rutting season, and perilous is the condition of the man who then approaches them. For the greatest part of the year the bulls and cows live in separate herds, but at all seasons, according to Sir John Richardson, one or two old bulls generally accompany a large herd of cows.

These powerful beasts are in general shy, and fly from the face of man till they are wounded; they then become furious, and pursue their enemy with the most vindictive spirit, as we shall presently see; but we must first say a word or two on some of the different modes of hunting them. Du Pratz and Charlevoix give several particulars of the chase of these animals by the Indians. If the rifle be used the hunter is careful to go against the wind, for the sense of smelling is so exquisite in the Bison that it will otherwise get scent of him, and precipitately retire. If he gets within rifle-distance he is careful so to take his aim that the beast may drop at once, and not be irritated by an ineffectual wound.

But the great hunting is, or rather was, somewhat after the manner of the Scottish 'tinchel.' A great number of men divide and form a vast square. Each band sets fire to the dry grass of the savannah where the herds are feeding. When the affrighted beasts perceive the fire approaching on all sides they retire in confusion to the centre of the square, where the bands close upon them and kill them, as they are huddled together in heaps, without hazard: 1500 or 2000 beeves have been given as the produce of such an expedition.

Sir John Franklin, in his account of his first voyage, gives us the following information. After stating that the Stone Indians are so expert with the bow and arrow that they can strike a very small object at a considerable distance, and shoot with sufficient force to pierce through the body of a buffalo when near, he thus describes a buffalo or bison pound:—

"The buffalo-pound was a fenced circular space of about 100 yards in diameter; the entrance was banked up with snow to a sufficient height to prevent the retreat of the animals that once have entered. For about a mile on each side of the road leading to the pound, stakes were driven into the ground at nearly equal distances of about 20 yards; these were intended to represent men, and to deter the animals from attempting to break out on either side. Within 50 or 60 yards from the pound branches of trees were placed between these stakes to screen the Indians, who lie down behind them to await the approach of the buffalo. The principal dexterity in this species of chase is shown by the horsemen, who have to manœuvre round the herd in the plains so as to urge them to enter the roadway, which is about a quarter of a mile broad. When this has been accomplished they raise loud shouts, and, pressing close upon the animals, so terrify them that they rush heedlessly forward towards the snare. When they have advanced as far as the men who are lying in ambush, they also rise, and increase the consternation by violent shouting and firing guns. The affrighted beasts having no alternative run directly to the pound, where they are quickly dispatched either with an arrow or gun. There was a tree in the centre of the pound on which the Indians had hung strips of buffalo flesh and pieces of cloth, as tributary or grateful offerings to the Great Master of life; and we were told that they occasionally place a man in the tree to sing to the presiding spirit as the buffaloes are advancing, who must keep his station until the whole that have entered are killed."

The same author further proceeds as follows:—"Other modes of killing the buffalo are practised by the Indians with success; of these, the hunting them on horseback requires most dexterity. An expert hunter, when well mounted, dashes at the herd, and chooses an individual which he endeavours to separate from the rest. If he succeeds he contrives to keep him apart by the proper management of his horse, though going at full speed. Whenever he can get sufficiently near for a ball to penetrate the beast's hide he fires, and seldom fails of bringing the animal down; though of course he cannot rest the piece against the shoulder nor take a deliberate aim. On this service the hunter is often exposed to considerable danger from the fall of his horse in the numerous holes which the badgers make in these plains, and also from the rage of the buffalo, which, when closely pressed, often turns suddenly, and, rushing furiously on the horse, frequently succeeds in wounding it or dismounting the rider. Whenever the animal shows this disposition, which the experienced hunter will readily perceive, he immediately pulls up his horse, and goes off in another direction." The reader will find some animated descriptions of such encounters in 'The Tour on the Prairies,' before alluded to. A great deal of interesting matter on the habits of these animals will also be found in Catlin's 'Letters and Notes on the North American Indians.'

"When the buffaloes are on their guard," as Sir John Franklin observes, "horses cannot be used in approaching them; but the hunter dismounts at some distance, and crawls in the snow towards the herd, pushing his gun before him. If the buffaloes happen to look towards him, he stops, and keeps quite motionless, until their eyes are turned in another direction; by this cautious proceeding a skilful person will get so near as to be able to kill two or three out of the herd. It will easily be imagined this service cannot be very agreeable when the thermometer stands 30° or 40° below zero, as sometimes happens in this country."

This chase of the bison is not unattended with danger, "for," says Catesby, "when wounded they are very furious, which cautions the Indians how they attack them in open savannahs, where no trees are to screen them from their fury. Their hoofs, more than their horns, are their offensive weapons, and whatever opposes them is in no small danger of being trampled into the earth."

Sir John Richardson, in his 'Fauna Boreali-Americana,' observes that "the bisons are less wary when they are assembled together in numbers, and that they will then often blindly follow their leaders, regardless of, or trampling down, the hunters posted in their way." He further states that, though the gait of these animals may appear heavy and awkward, they will have no great difficulty in overtaking the fleetest runner, and gives the following account of the determined violence with which a wounded Bison assails its enemy:—"While I resided at Carlton-House," writes Sir John Richardson, "an accident of this kind occurred. Mr. Finnan M'Donald, one of the Hudson's Bay Company's clerks, was descending the Saskatchewan in a boat, and one evening, having pitched his tent for the night, he went out in the dusk to look for game. It had become nearly dark when he fired at a bison bull, which was galloping over a small eminence, and as he was hastening forward to see if his shot had taken effect, the wounded beast made a rush at him. He had the presence of mind to seize the animal by the long hair on its forehead as it struck him on the side with its horn, and, being a remarkably tall and powerful man, a struggle ensued, which continued until his wrist was severely sprained, and his arm was rendered powerless; he then fell, and after receiving two or three blows became senseless. Shortly afterwards he was found by his companions lying bathed in blood, being gored in several places, and the bison was couched beside him, apparently waiting to renew the attack had he shown any signs of life. Mr. M'Donald recovered from the immediate effects of the injuries he received, but died a few months afterwards. Many other instances might be mentioned of the tenaciousness with which this animal pursues its revenge; and I have been told of a hunter having been detained for many hours in a tree by an old bull which had taken its post below to watch him. When it contends with a dog, it strikes violently with its fore feet, and in that way proves more than a match for an English bull-dog."

The same writer says that the favourite Indian method of killing the Bison is by riding up to the fattest of the herd on horseback, and shooting it with an arrow; and he speaks of the imposing spectacle which is afforded when a large party of hunters are engaged in this way on an extensive plain, and of the skill and agility displayed by the young men on such occasions. The horses, it appears, seem to enjoy the sport as much as their riders, and are very active in eluding the shock of the animal should it turn on its pursuer. It should be remembered, on such occasions, that when the Bison runs it leans very much first to one side for a short time, and then to the other, and so on alternately. This account is confirmed by Catlin in the work above quoted.

Sir John Richardson also confirms Sir John Franklyn in the assertion that the most generally practised plan of shooting the Bisons is by crawling towards them from the leeward, and that in favourable places great numbers are taken in pounds.

Though the risk of the chase be considerable the reward is great; for there are few animals that minister more largely to the wants and even to the comforts of man than the American Bison. The horns are converted into powder-flasks; the hide, which, according to Catesby, is too heavy for the strongest man to lift from the ground, is very valuable, and is used for a variety of purposes. Purchas relates that in old times the Indians made the best of targets of it; and Catesby says that they make their winter moccassins of it also, but that, being too heavy for clothing, it is not often put to that use. Sir John Richardson informs us that the wool has been manufactured in England into a remarkably fine and beautiful cloth; and that in the colony of Osnaboyna, on the Red River, a warm and durable coarse cloth is formed of it. Catlin says that "there are by a fair calculation more than 300,000 Indians who are now subsisting on the flesh of the buffaloes, and by these animals supplied with all the luxuries of life which they desire, as they know of none others."

"The flesh of a bison in good condition," says the author last quoted, "is very juicy and well-flavoured, much resembling that of well-fed beef." Others describe it as bearing the same relation to common beef that venison bears to mutton. The tongue, when well cured, is said to surpass that of the common ox as a relish. All concur in the praises of the delicious hump, rich, savoury, and tender. This is the fleshy part that covers the long spinous processes of the anterior dorsal vertebræ, and is called 'bos' by the Canadian voyagers, and 'wig' by the Orkney men in the service of the Hudson's Bay Company, according to Sir John Richardson, who says that much of the pemmican used by the voyagers attached to the fur companies is made of bison meat, procured at their posts on the Red River and Saskatchewan: he adds, that one bison cow in good condition furnishes dried meat and fat enough to make a bag of pemmican weighing 90 lbs.

The fat bulls yield a great quantity of tallow; and Du Pratz records that 150 lbs. have been procured from a single beast. Pennant says that these over-fed animals usually become the prey of wolves, for, by reason of their great unwieldiness, they cannot keep up with the herd; and, on the authority of Du Pratz, gives the following account of their sagacity in defending themselves against the attacks of their fierce persecutors:—"When they scent the approach of a drove of those ravenous creatures, the herd flings itself into the form of a circle: the weakest keep in the middle, the strongest are ranged on the outside, presenting to the enemy an impenetrable front of horns: should they be taken by surprise, and have recourse to flight, numbers of the fattest or the weakest are sure to perish." Sir John Richardson however, speaking of the numerous wolves on the sandy plains which, lying to the eastward of the Rocky Mountains, extend from the sources of the Peace and Saskatchewan rivers towards the Missouri, says that there bands of them hang on the skirts of the buffalo herds, and prey upon the sick and straggling calves, but that they do not, under ordinary circumstances, venture to attack the full-grown animal. As a proof of this, he adds, that the hunters informed him that they often saw wolves walking through a herd of bulls without exciting the least alarm, and that the marksmen, when they crawl towards a bison for the purpose of shooting it, occasionally wear a cap with two ears in imitation of the head of a wolf, knowing from experience that they will be suffered to approach nearer in that guise.

The Grisly Bear is one of the most formidable enemies of the American Bison; and the strongest bull goes down before him. [BEAR.]

The Indian is too wild in his habits to submit to the fetters which an attempt to domesticate animals would impose upon his liberty; a child of the wilderness, he depends on his bow or his rifle for his subsistence, and wanders free. It is not therefore surprising that no attempt should have been made by the aboriginal inhabitants to reduce the Bison to obedience. Catesby however says that these animals have been known to breed with tame cattle that were become wild, but that the calves being so too were neglected, "and though," he continues, "it is the general opinion that if reclaiming these animals were not impracticable (of which no trial has been made), to mix the breed with tame cattle would much improve the breed, yet nobody has had the curiosity nor have given themselves any trouble about it." Pennant states that the experiment has been made, and that it has failed, for he thus writes in his 'Arctic Zoology:'—"Attempts have been made to tame and domesticate the wild bison, by catching the calves and bringing them up with the common kind, in hopes of improving the breed. It has not yet been found to answer: notwithstanding they had the appearance for a time of having lost their savage nature, yet they always grew impatient of restraint, and, by reason of their great strength, would break down the strongest inclosure, and entice the tame cattle into the corn-fields. They have been known to engender together and to breed; but I cannot learn whether the species was meliorated by the intercourse."

A very fine American Bison bull was shown some years ago in this country as the 'Bonassus,' and under that name found its way into the epilogue of the Westminster Play as one of the wonders of the day. It was afterwards purchased by the Zoological Society of London; but it had been enfeebled by confinement and disease, and died soon after the Society became possessed of it. The Hudson's Bay Company supplied its place by presenting a young cow in 1829, which is still alive in the Gardens, Regent's Park (July, 1853.)

(Owen, *British Fossil Mammals and Birds*; Vasey, *Delineations of the Ox-Tribe*; Cuvier, *Ossemens Fossiles*; A. White, *Popular History of Mammalia*; *Proceedings of Zoological Society*.) [*See* SUPPLEMENT.]

BI'STON, a genus of Moths, belonging to the family *Geometridæ*. The principal distinguishing characters of this genus are as follows:—Palpi short and three-jointed; antennæ rather long, and distinctly pectinated in the males, each joint being furnished with a ciliated branch, and these branches longest on the central joints (in the females these branches are wanting, or nearly so); body thick; wings present in both sexes, not very thickly covered with scales, and hence slightly transparent, especially in the females. The larva has ten legs, and is elongate, cylindrical, and tuberculated, and has the head more or less notched in front; it assumes the pupa state underground at the roots of trees.

There appears to be an analogical resemblance between these moths and the *Notodontidæ*, their larvæ showing that they are not otherwise allied. The imago state of the species however may be distinguished by the different texture of the wings, and structure of the antennæ.

Three species of this genus have been discovered in this country:—*Biston prodromaria*, the Oak-Beauty; *B. betularius*, the Pepper-Moth; and *B. hirtarius*, the Brindled Beauty. The first of these has the antennæ bipectinated to the apex, and the last two have the antennæ simple at the apex in the males.

B. prodromaria has the wings of an ash-colour, or approaching to white, finely sprinkled with black: each of the upper wings has two transverse bent fasciæ of a brown colour, more or less margined with black, and the under wings have one fascia of the same description. When the wings are expanded it measures from an inch and a half to two inches in width.

The caterpillar feeds upon the oak, poplar, &c. The moth is rare, but is found in the month of March in the trunks of oak trees in the neighbourhood of London, and elsewhere.

B. betularius has received the name of Pepper-Moth from its being of a white colour, and, as it were, peppered with black almost uniformly over the wings.

This moth is about the same size as the last, and is not uncommon in the month of June in woods near London, and in other parts. Its caterpillar feeds upon the oak, willow, poplar, elm, &c.

B. hirtarius is of a brown colour, dotted with gray, with three or four transverse black bent lines on each wing, and a whitish fascia near the hinder margin. It is common among poplar and lime-trees, and is about an inch and three-quarters in expanse. In the females the wings have a greenish hue.

BISTORT. [POLYGONUM.]

BITTER-BLAIN. [VANDELLIA.]

BITTER-CRESS. [CARDAMINE.]

BITTER-SPAR, a name given to Magnesian Limestone. [DOLOMITE.]

BITTER-SWEET. [SOLANUM.]

BITTER-WOOD. [XYLOPIA.]

BITTERN, *Botaurus* (Brisson), a genus of Birds belonging to the family of Herons, or *Ardeidæ*. The following are the characters which principally distinguish the Bitterns from the rest of the family:—Bill strong, about as long as the head, compressed, and higher than it is broad; mandibles equal in length, the upper being rather the deepest, and slightly curved from the base to the point; edges of both mandibles somewhat incurved, very sharp, and finely serrated toward the point. Legs, as compared with those of others of the family, rather short. Neck also comparatively short, covered on its sides and front with long loose feathers which can be erected at pleasure, and on the back (of the neck) with down, the long loose feathers of the side meeting behind, and covering the downy part in certain attitudes, as, for example, when the bird passes through the reeds and rushes.

The Bitterns comprehended under the Prince of Canino's subgenus *Botaurus* are widely diffused, but being solitary birds, haunting wooded swamps or reedy marshes, where they generally lie hid all day, and coming forth to feed at night, they are seldom seen. There are several species of this subgenus, and of these the Night Heron or Qua-Bird (*Ardea Nycticorax*, Linnæus, *Nycticorax Europæus*, Stephens) is found both in the Old and New World. [NYCTICORAX.]

As an example of the subgenus, the Common Bittern or Bittour (*Botaurus Stellaris*, Steph., *Ardea Stellaris*, Linn., Uccello Lepre and Trombutto of the Italians, Rohrtrommel of the Germans, and Butor of the French) may be taken. The provincial English names of Mire-Drum, Bull of the Bog, &c., will occur to many of our readers as being indicative, in common with some of the foreign ones, of the bellowing or drumming noise for which the bird is so famous. This deep note of the 'hollow-sounding bittern' is exerted on the ground at the breeding season, about February or March. As the day declines he leaves his haunt, and rising spirally soars to a great height in the twilight. Willughby says that it performs this last-mentioned feat in the autumn, "making a singular kind of noise nothing like to lowing." Bewick says that it soars as above described when it changes its haunts. Ordinarily it flies heavily, like the heron, uttering from time to time a resounding cry, not bellowing; and then Willughby, who well describes the bellowing noise of the breeding-season, supposes it to be the night-raven, at whose 'deadly voice' the superstitious wayfarer of the night turned pale and trembled. "This, without doubt," writes Willughby, "is that bird our common people call the night-raven, and have such a dread of, imagining its cry portends no less than their death or the death of some of their near relations; for it flies in the night, answers their description of being like a flagging collar, and hath such a kind of hooping cry as they talk of." Others, with much reason, consider the Qua-Bird above mentioned (which utters a loud and most disagreeable noise while on the wing, conveying the idea of the agonies of a person attempting to vomit), to be the true night-raven.

The food of the Bittern consists for the most part, as might be suspected from its haunts, of aquatic animals. Pennant says that frogs are its principal food, adding, "not that it rejects fish, for small trouts have been taken out of its stomach."

The rude nest of the Bittern is generally formed of reeds, sticks, &c., on some 'tump,' to use Montagu's expression, in a reedy marsh or well-clothed rushy moor, and contains four or five pale green eggs. The time of incubation is about twenty-six days.

In the palmy days of falconry the Bittern afforded the best of sport. We find it mentioned in the 'flights to the field, called great flights.' "There is yet," says Turbervile, "another kinde of flight to the fielde, which is called the great flight, as to the cranes, wild geese, bustard, birde of Paradise, bittors, shovelars, hearons, and many other such like." Accordingly we find it protected by the severe penalties of the stat. 25 Hen. VIII. c. 11, confirmed by stat. 3 and 4 Edw. VI. c. 7. One year's imprisonment, and a forfeiture of eightpence for each egg, was the punishment awarded to those who destroyed or took away the eggs of the 'bittour.' When the hawk had 'bound with' the bittern and brought it down, it was the duty of the falconer to make in apace to rescue her, by plunging the bill of the bittern into the ground, to prevent injury to the hawk; for when wounded the bittern is not daunted, but lies watching his opportunity to dart his spear-like bill at his enemy as soon as he comes within his reach, and as he generally aims at the eye, he should be approached with the greatest caution. The modern sportsman should beat for these birds with pointers or very close-hunting spaniels; for they are moved with as much difficulty as a jack-snipe, and, like that bird, will often lie till they are almost trodden on, rather than take wing.

The Bittern was well known to the ancients, and there can be little doubt that it is the 'Ἀστερίας ('Ερωδιός), of Aristotle. ('Hist. Anim.' book ix. c. xviii.) In the same chapter its sluggishness and the fable of its origin from slaves metamorphosed into birds are mentioned. Aristotle observes further that the Φώϋξ especially strikes at the eyes; and in the edition of Belon (1557), 'enrichy de quatrains,' we find the following verse below the figure of the 'butor:'—

> "En un Butor Phoix, pour sa paresse
> Fut par les dieux changé divinement.
> Un paresseux aussi communement
> Est dit Butor, pour son peu d'alegresse."

The flesh of the Bittern was formerly in high esteem (in the reign of Henry VIII. it was valued at a shilling), nor is it despised in the present day; when well fed, its flavour somewhat resembles that of the hare, nor is it rank and fishy, like that of some of its congeners. The long claw of the hind toe is much prized as a tooth-pick, and in the olden time it was thought to have the property of preserving the teeth.

A paragraph in the last edition of Pennant, signed J. L., written probably by Latham, states that this bird "is said to inhabit the greater part of Africa; and is certainly found on the coast of Barbary,

Common Bittern (*Botaurus stellaris*).

at the Cape of Good Hope, and also in India and China." Selby observes that its geographical distribution "seems confined to Europe, extending nearly to the confines of Asia;" but it was in the collection formed in the neighbourhood of Trebizond by Keith E. Abbott, Esq., and presented to the Zoological Society by that gentleman. Colonel Sykes notes it as rare in Dukkun (Deccan), and Mr. Gould as inhabiting the three continents of the Old World. In England inclosure and drainage have made the Bittern a very scarce bird, and its capture is no longer an ordinary event.

In size the Common Bittern is less than the Common Heron, being about 2½ feet in length. The bill is about 4 inches long, brown above, greenish below; irides yellow; feathers on the crown black, shot with green, those of the hinder part of the head, neck, and breast long and loose; general colour of the plumage dull pale yellow, variegated with spots and bars of black; tail short; legs moderate, pale-green; toes and claws long and slender, middle claw serrated on the inner edge, most probably to aid it in securing its slippery prey.

B. minutus, the Little Bittern, is also a summer inhabitant of Great Britain, and is the smallest British example of the family to which it belongs. It is a native of the southern parts of Europe, the south-western parts of Asia, and probably of Africa generally. It has been killed as far north as Sweden. It is found occasionally in Germany, and is not uncommon in Holland, and occurs in France, Provence, and Italy.

B. lentiginosus, the American Bittern, is not quite so large as the Common Bittern. It is a common bird in America from Hudson's Bay to Carolina. It has different names in the various states, such as Indian Billet, Indian Hen, and Dunkadoo. In its habits and voice it is very like the Common Bittern. It has been shot several times in Great Britain; first at Piddleton, in Dorsetshire, in 1804, and since then in several other parts of the country.

(Yarrell, *British Birds*; Thompson, *Birds of Ireland*.)

BITU'MEN, a Latin word used by Tacitus, Pliny, and other Roman writers. A considerable number of combustible mineral substances are sometimes arranged under the head of Bitumens; but their properties vary greatly in some respects, as, for example, with regard to solidity, fluidity, and colour. The term Bitumen is however usually applied to two varieties, namely, *Asphaltum* [ASPHALTUM], and a softer kind called *Elastic Bitumen*, which we shall now describe.

Elastic Bitumen, sometimes called Fossil Caoutchouc, is a rare mineral product, which has hitherto been found in three places only: 1st, in the Odin mine, near Castleton in Derbyshire, in a Secondary Limestone, accompanied by asphaltum, calcareous spar, fluor, blende, galena, and pyrites; 2nd, in a coal-mine of Montrelais, a few leagues from Angers in France, it occurs among quartz and calcareous crystals, in the veins of grit of the Coal Formation; 3rd, in a coal-mine near South Bury in Massachussets, United States.

Elastic Bitumen possesses the following characters:—It is brown, or blackish brown, and translucent in small portions; it is soft and elastic like caoutchouc, but sometimes it is as hard as leather: it has the property, like caoutchouc, of effacing pencil-marks. Its density varies from 0·9053 to 1·233. It fuses readily, and at a higher temperature it takes fire and burns with a sooty flame: it sometimes leaves one-fifth of its weight of ashes, composed chiefly of silica and peroxide of iron. If the Derbyshire Elastic Bitumen be subjected to distillation, it yields acidulous water and volatile oil, resembling that of naphtha in smell: the oil is neither acid nor alkaline, slightly soluble in alcohol, but readily so in ether; after the distillation of the water and oil, a brown viscid mass remains in the retort, which is insoluble in water or alcohol, but is dissolved by ether and by potash. If the distillation be longer continued, an empyreumatic oil resembling that of amber is obtained, and a black shining coal remains.

When the Elastic Bitumen of Montrelais is similarly treated, there is obtained a yellow bitter fetid oil, which is lighter than water and insoluble in alcohol, but it dissolves in the alkalies.

Elastic Bitumen swells when put into oil of turpentine or of petroleum; ether and oil of turpentine when boiling extract a kind of soft resin from the English and French bitumen, and this remains after the evaporation of the solvent: this resin is of a brownish-yellow colour, is bitter and inelastic; its weight is nearly half that of the bitumen employed.

It is but slightly soluble in alcohol, but readily in potash; it is inflammable, and burns with a smell of petroleum; that portion of the bitumen which is insoluble in the ether and oil of turpentine, is a grayish dry mass, resembling paper; it burns with difficulty, and carbonises; potash dissolves only a part of it. If after separating these two principles they are mixed together, the bitumen does not regain its elasticity.

Concentrated sulphuric acid does not act upon Elastic Bitumen; but when long boiled with nitric acid it yields resin, tannin, and a little nitroperic acid. According to the analysis of M. Henry, jun., the Elastic Bitumen consists of

	English.	French.
Carbon	52·250	58·260
Hydrogen	7·496	4·890
Nitrogen	0·154	0·104
Oxygen	40·100	36·746
	100·000	100·000

Berzelius remarks that the difference in the quantity of hydrogen in these specimens is so considerable, that it is surprising their properties are not more dissimilar. [NAPHTHA.]

BIVALVE, a name applied to those forms of Shell-Fish which have two shells or valves in contradistinction to those which have one shell, and which are called *Univalve*. [MOLLUSCA.] Before the structure of the Invertebrate Animals was as well known as it is at the present day, the Barnacles and Sea Acorns, which have several external valves or shells, were referred to the *Mollusca*, under the name of *Multivalves*.

BIXA, a West Indian genus of plants belonging to the natural order *Flacourtiaceæ*. It produces the substance called Arnotto. The only species of any general interest in the genus is the *Bixa Orellana*, a native of the Malayan Archipelago, but now extremely common in the West Indies, where it is cultivated in rich moist soil by the sides of rivers.

Bixa Orellana.

1, A flower seen from beneath; 2, a petal; 3, an ovary with style and stigma; 4, a seed cut vertically, showing the embryo; 5, a ripe fruit.

This plant forms a small tree with deep-green shining heart-shaped leaves, and clusters of purplish flowers, which are succeeded by capsules of a heart-shaped form, covered with stiffish bristles, and opening into two valves which contain, attached to their middle, a number of seeds covered with a soft, sticky, vermilion-coloured rind. It is the latter which furnishes the arnotto of commerce. According to Fée, this substance is obtained by heaping up the seeds in water for several weeks or months, and afterwards pressing them, when the colouring matter separates and is afterwards precipitated in the water. Or the pulp is separated by washing and maceration, and the colouring matter precipitated by the aid of an acid, and caught upon fine sieves. Independently of the use of arnotto for staining cheese and butter, the Indians paint their persons with it, and thus, it is said, destroy the subcutaneous vermin with which they are infested. It acts as a purgative taken internally; but its reputed powers as an antidote to the poison of the cassava are imaginary.

BIXINEÆ, a natural order of plants named after the genus *Bixa*. The genus *Bixa* and its allies are now placed in the natural order *Flacourtiaceæ*. [FLACOURTIACEÆ.]

BLACKBERRY. [RUBUS.]

BLACKBIRD, the English name for the well-known native songster, *Merula vulgaris* of Ray, *Turdus Merula* of Linnæus, the Schwarz-Drossel and Schwarze-Amsel of the Germans, Merle of the French, Merla and Merlo of the Italians, and Κόττυφος or Κόσσυφος of the ancient Greeks.

The Blackbird is too well known to require a description, but a word or two on the subject of its habits may not be misplaced. There are not wanting those who praise the song-thrush at the expense of the blackbird, alleging that, though the former commits depredation in our fruit-gardens in summer, it makes amends by its destruction of the shell-snails (*Helix aspersa* and *H. nemoralis*); whereas the blackbird is a most notorious fruit-eater, without any such redeeming quality. That the thrush does this service is most true, but it is not less true that the blackbird is particularly fond of the shell-snails, which it devours in the same way as the thrush. In truth, small slugs and shell-snails, to use the expression of a garden labourer, form "the chief of its living," while the thrush is equally fond of fruit in the season; but the plumage of the thrush is in its favour, and it is often pecking away at the fruit without being seen. When disturbed it glides away without noise; but the blackbird's sharp cry of alarm as it escapes generally strikes the ear, if its black coat and yellow bill have not arrested the eye. Thus much in justice to the blackbirds, for we know of instances where a war of extermination has been waged against them while the thrushes have been held sacred.

Early in the spring the Blackbird begins to build its nest. A thick-set hedge-row, an insulated close bush, a low ivied tree, are all favourite places. Moss, small sticks, root-fibres, are the materials, with an internal coat of mud-plaster, over which is a lining of fine dry grass. Four or five eggs of a bluish-green, variegated with darker markings, are here deposited. Aristotle (book v. c. 13) observes that it lays twice, and Buffon says that the first deposit ranges from five to six eggs, but the second only from four to five. The early season at which it begins to lay is often so cold as to destroy the first brood; moreover, the leafless state of the hedge or bush at that period makes the nest an easy prey to the school-boy.

The Blackbird is in general shy, but there are exceptions to the remark, as is proved by the following statement. In the spring of 1834 a pair of blackbirds built their nest in a faggot-pile close to the door of a kitchen-garden in the parish of Sunbury, Middlesex, where the garden-labourers were passing all day long wheeling manure into the garden, &c. The nest was built among some dead thorns, there piled up, so low that the passer-by could look into it, and was very much exposed; but the parents, notwithstanding the curiosity of spectators, brought up their nestlings. This was a late brood; and as many early nests had been taken in the neighbouring hedge-rows, it is not impossible that the birds, disappointed of their first brood, might have been driven to choose a spot nearer the house for security.

Albinos sometimes occur among these birds. Several instances are recorded: the following is from 'Loudon's Magazine' (No. 43, p. 596):—"In 1829 a blackbird's nest, containing four or five young ones, was found at Rougham, near Bury St. Edmunds, Suffolk. One of the young ones differed in colour materially from the rest. Its eyes were red, its bill was yellow (which is not usual in very young blackbirds). The nest was not taken till the young were fully fledged. On attempting to capture them, two or three made their escape; the white one was safely caught. The red-eyed bird afterwards became nearly or wholly white, and it still retains this colour." In the British Museum there is a female of a dusky white or cream-colour with Yorkshire for its locality. Other instances are recorded.

Bechstein, in his work on Cage-Birds, says, "The white variety is very well known; there is besides the streaked, the black with a white head, and the pearl-gray." The same author gives the following account of the musical properties of the Blackbird in confinement:—"Its voice is so strong and clear that in a city it may be heard from one end of a long street to the other. Its memory is so good that it retains without mixing them several airs at once, and it will even repeat little sentences. It is a great favourite with the lovers of a plaintive, clear, and musical song, and may in these respects be preferred to the bullfinch, whose voice is softer, more flute-like, but also more melancholy. The price of these two birds, if well taught, is about the same."

Turdus torquatus is called the Ring-Blackbird. [TURDUS.]

BLACK-BONNET, one of the names of the Reed Bunting. [EMBERIZA.]

BLACK-CAP, the common English name for the Black-Cap Warbler, Der Mönch of the Germans, Fauvette à Tête Noire of the French, Caponera Gentile of the Italians, *Atricapilla* of Aldrovandus, *Curruca atricapilla* of Brisson, *Motacilla atricapilla* and *Motacilla moschita* of Gmelin (the latter being the female), *Sylvia atricapilla* of Latham and of Bechstein, and *Curruca atricapilla* of Gould ('Birds of Europe').

"Of all the birds," says Sweet, "that reside in or visit the British Islands there is none that can come up to the present for song except the nightingale, and by some persons it is more admired than even that bird. Its arrival in this country is generally about the first week in April, and the earliest that I ever saw was on the 25th of March. They leave us again about the end of September, sometimes a straggling one may be seen at the beginning of October; the latest I ever saw in a wild state was on the 15th of that month. When it first arrives in this country its chief food is the early ripened berries of the ivy, and where those are there the black-caps are first to be heard singing their melodious and varied song. By the time the ivy-berries are over the little green larvæ of the small moths will be getting plentiful, rolled up in the young shoots and leaves; this then is their chief food until the strawberries and cherries become ripe; after that there is no want of fruit or berries till their return, and there is no sort of fruit or berry that is eatable or wholesome that they will refuse. After they have cleared the elder-berries in autumn they immediately leave us."

Nor is Sweet singular in his eulogy. All agree in praising its melody. In Norfolk and in other places in Great Britain it is called

Black-Cap (*Curruca atricapilla*), male.

the Mock Nightingale, and indeed, like the nightingale, it continues its song far into the night. Bechstein, who has paid so much attention to the song of birds, says that it rivals the nightingale, and that many persons even give it the preference. "If," adds that author, "it has less volume, strength, and expression, it is more pure, easy, and flute-like in its tones, and its song is perhaps more varied, smooth, and delicate."

This fruit-eating warbler is one of the *Ficedulæ* so much prized under the name of Beccafico, though, as Bechstein well observes, every taste but that of the palate must be destroyed if this charming bird is caught for the table. [BECCAFICO.] Its fondness for ivy-berries seems to have been noticed in Italy, where it is permanent, and thence probably is derived one of its Italian names, Caponera d'Edera. The difference of plumage in the males and females, and in the young birds, which resemble the females, may possibly throw some light on the opinion which Willughby thus mentions:—"The ancients report," writes Willughby, "that the black-caps (*Atricapillæ*) in the beginning of autumn are changed into Ficedulæ and Beccaficos by the mutation of their voice and colour; from whom, till I be assured by experience, I must crave leave to dissent."

There can be little doubt that Willughby had in his mind that passage in the 49th chapter of the 9th book of Aristotle where the latter, speaking of the changes of birds, states that the Beccaficos (Συκαλίδες) and the Black-Caps (Μελαγκόρυφοι) are changed into each other. Indeed Willughby thus heads his chapter on the Black-Cap:—"The Black-Cap: *Atricapilla seu Ficedula*, Aldrov.; called by the Greeks Συκαλὶς et Μελαγκόρυφος; by the Italians Capo Negro." The passage in Aristotle may be thus freely translated:—

"And in like manner beccaficos and black-caps, for these too are changed into each other. The bird is a beccafico at the commencement of autumn and a black-cap at the decline of that season, and the only difference is in their plumage and their voice. That they are the same birds may be seen by observing them before the change is complete, and when they are neither one nor the other."

Pliny too appears to have had this passage in his view, though he does not acknowledge it, when he wrote (lib. x. cap. 29):—"Alia ratio ficedulis. Nam formam simul coloremque mutant. Hoc nomen non nisi autumno habent, postea melancoryphi vocantur."

Belon (ed. 1555, folio) makes the Bullfinch the Συκαλὶς and Μελαγκόρυφος of the Greeks, and Beccafighi of the Italians, naming it also *Atricapilla*; but in a subsequent edition, 'enrichy de Quatrains' (small 4to. 1557), the Greek, Latin, and Italian names, identifying it as a *Ficedula*, as well as the name *Atricapilla*, are omitted; and the bird appears with the provincial synonyms of the Bullfinch. In other instances, in that of the very next bird for example, the Greek and Latin names given in the folio edition are retained.

Upon the whole, there is reason for coming to the conclusion that our Black-Cap is the bird alluded to by Aristotle. Ray seems to have been of this opinion, for he thus records it in his 'Synopsis':—"*Atricapilla sive Ficedula*, Aldrov.; Συκαλὶς et Μελαγκόρυφος, Græcis; the Black-Cap."

It occurs frequently in the greater portion of Europe, through the northern and eastern parts of which it is widely diffused. Temminck says that it is rare beyond the Apennines and Pyrenees. C. Bonaparte notes it as permanent and common near Rome. It visits the southern coasts of England, from Sussex to the Land's End. It visits Wales, and has been taken in the north of Ireland. It visits also Suffolk and Norfolk, and the northern counties of England. It is a summer visitor in Denmark, Norway, Sweden, and Lapland.

The male Black-Cap is nearly 6 inches in length, and about 4½ drachms in weight. Upper part of the head black; back of the neck ashy brown; upper parts of the body gray, with a greenish tinge; quills and tail dusky, edged with dull green; breast and belly light ash-colour; legs and feet bluish-gray, or lead-colour; bill brown; irides dark hazel.

The female is of larger size; the crown of the head is of an umber-brown or rust-colour; and the plumage generally is darker, and more inclining to greenish than it is in the male.

The plumage of the young when they leave the nest resembles that of the female.

Gardens, orchards, and thick hedges are the favourite haunts of the Black-Cap; and there, among brambles and nettles, or in some low bush, its nest is built. Dry stalks of goose-grass and a little wool, lined with fibrous roots, and frequently with a few long hairs, with now and then a little moss on the outside, form the structure. Four or five, sometimes six eggs of a reddish-brown, weighing about 35 grains, mottled with a darker colour, and sometimes dotted with a few ashy specks, are then deposited. Pennant speaks of a nest which he discovered in a spruce fir. Temminck mentions the hawthorn-bush as the most frequent place.

The Black-Cap in a state of nature is with difficulty seen when singing, at which time it seems to take pains to secrete itself. White however, who saw it in this act, says that while warbling the throat is wonderfully distended.

In captivity it seems to be a great favourite not only from its song but from its attractive qualities. Even in a state of nature it is a mocking bird, and when caged it soon learns the notes of the nightingale and canary. The female is also, but in a limited degree, a songster.

Bechstein speaks of the striking affection which it shows for its mistress:—"It utters a particular sound, a more tender note to welcome her; at her approach he darts against the wires of his cage, and by a continued fluttering, accompanied with little cries, he seems to express his eagerness and gratitude. A young male, which I had put in the hot-house for the winter, was accustomed to receive from my hand every time I entered a meal-worm; this took place so regularly, that immediately on my arrival he placed himself near the little jar where I kept the meal-worms. If I pretended not to notice this signal, he would take flight, and, passing close under my nose, immediately resume his post; and this he repeated, sometimes even striking me with his wing, till I satisfied his wishes and impatience."

BLACK-COCK, one of the English names for the Heath-Cock, the male of the Black Game or Black Grouse; the Birk-Hahn of the Germans; Coq de Bruyère à Queue Fourchue, Coq de Bois, and Faisan Bruyant (Belon), of the French; Gallo di Monte, Gallo Cedrone, Gallo Selvatico, Gallo Alpestre, Fasan Negro, and Fasiano Alpestre of the Italians; Orrfugl of the Norwegians; *Tetrao seu Urogallus minor* of Willughby and Ray; *Tetrao tetrix* of Linnæus; and *Lyrurus tetrix* of Swainson. The female is called a Gray Hen, and the young are named Poults,* a term which is applied to the Black Game generally on the borders of Hampshire and Dorsetshire.

This noble bird, whose plumage when in full beauty has defied all pencils save that of Edwin Landseer, the only painter who has given a true idea of it, is now the largest of its race in the British Islands, of whose fauna it is one of the principal ornaments. It is, says Temminck, more widely diffused over the central parts of Europe than the Capercailzie (*Tetrao Urogallus*, Pennant); or the Rakkelhan (*Tetrao medius*, Meyer). In Germany, France, and Holland it is tolerably plentiful: in the northern countries, such as Denmark, Sweden, Norway, and Russia it abounds.

Of the southern counties of England, Hampshire, Dorsetshire, Somersetshire, and Devonshire possess it, and now and then it is seen in the heathy parts of Sussex and Surrey. In the New Forest, and the wild heaths on the borders of Hampshire and Dorsetshire, in the neighbourhood of Wimborne, it is perhaps more common than it is anywhere else in the south. The Quantocks, and some other uncultivated tracts in Somersetshire, and Dartmoor and Sedgemoor in Devonshire are its head-quarters in those counties; but it is comparatively rare.

Staffordshire has it sparingly, and Northumberland plentifully.

In the Highlands of Scotland the Black-Cock is abundant, and it is found in some of the Hebrides. In North Wales it occurs sparingly, where it is strictly preserved.

The following account of the haunts and habits of the Black-Cock is from the pen of Mr. Selby:—

"The bases of the hills in heathy and mountainous districts, which are covered with a natural growth of birch, alder, and willow, and intersected by morasses clothed with long and coarse herbage, as well as the deep and wooded glens so frequently occurring in extensive wastes, are the situations best suited to the habits of those birds, and

* This is an old name for the Black Game. Thus Turbevile (1611) writes, "If your goshawke be once a good partridger, beware that you let her not flee the pout or the feasant."

most favourable to their increase. During the months of autumn and winter the males associate, and live in flocks, but separate in March or April; and, being polygamous, each individual chooses some particular station, from whence he drives all intruders, and for the possession of which, when they are numerous, desperate contests often take place. At this station he continues every morning during the pairing season (beginning at day-break) to repeat his call of invitation to the other

Black-Cock (*Tetrao tetrix*).

sex, displaying a variety of attitudes, not unlike those of a turkey-cock, accompanied by a crowing note, and one similar to the noise made by the whetting of a scythe. At this season his plumage exhibits the richest glosses, and the red skin of his eyebrows assumes a superior intensity of colour. With the cause that urged their temporary separation their animosity ceases, and the male birds again associate and live harmoniously together. The female deposits her eggs in May; they are from six to ten in number, of a yellowish-gray colour, blotched with reddish-brown. The nest is of most artless construction, being composed of a few dried stems of grass placed on the ground, under the shelter of a tall tuft or low bush, and generally in marshy spots where long and coarse grasses abound. The young of both sexes at first resemble each other, and their plumage is that of the hen, with whom they continue till the autumnal moult takes place; at this time the males acquire the garb of the adult bird, and quitting their female parent join the societies of their own sex. The food of the black grouse, during the summer, chiefly consists of the seeds of some species of *Juncus*, the tender shoots of heath and insects. In autumn the Crowberry or Crawcrook (*Empetrum nigrum*), the Cranberry (*Vaccinium oxycoccos*), the Whortleberry (*Vaccinium Vitis Idæa*), and the Trailing Arbutus (*Arctostaphylos Uva Ursi*), afford it a plentiful subsistence. In winter, and during severe and snowy weather, it eats the tops and buds of the birch and alder, as well as the embryo shoots of the fir tribe, which it is well enabled to obtain, as it is capable of perching upon trees without difficulty. At this season of the year, in situations where arable land is interspersed with the wild tracts it inhabits, descending into the stubble grounds, it feeds on grain."

Linnæus says that the young are brought up upon gnats.

That the Black-Cock was known to the ancients there is little doubt. Aristotle, in the first chapter of his 6th book, where he is speaking of the nidification of birds, says that "Those which are not strong of flight, such as partridges and quails, do not lay in nests (properly so called) but on the ground, merely collecting together materials (ὕλην): so also do the larks (κόρυδες) and the tetrix." At the end of the chapter he says, "But the Tetrix, which the Athenians call Ourax, neither makes its nest upon the bare ground nor yet upon trees, but upon low plants (ἐπὶ τοῖς χαμαιζήλοις φυτοῖς):" answering to Temminck's description—"niche dans les bruyères ou dans les buissons:" to Selby's—"under the shelter of a tall tuft or low bush, generally where long and coarse grasses abound:" and to Graves's—"on any dry grass or heath, without any appearance of a nest, but most generally in the midst of a high tuft of heath." This Tetrix, then, which the Athenians called Ourax, was not improbably our Black-Cock.

Pliny's description (cap. xxii. lib. x.)—"Decet tetraonas suus nitor absolutaque nigritia, in superciliis cocci rubor"—looks very like our bird, though the passage occurs in his chapter on Geese, and so it struck Belon. The tetraones mentioned in company with the peacocks, guinea-fowls, and pheasants, in chap. xii. of Suetonius (in 'Calig.') were probably the same.

Gray Hen (*Tetrao tetrix*), female.

The flesh of the Black Grouse is much esteemed. The different colour of the flesh of the pectoral muscles must have struck every one. The internal layer, which is remarkably white, is esteemed the most delicate portion. Belon goes so far as to say that the three pectoral muscles have three different flavours: the first that of beef, the next that of partridge, and the third that of pheasant.

Male.—Weight of a fine specimen about 4 pounds; bill dusky black; irides hazel; head, neck, breast, back, and rump glossy black, shot with steel-blue and purple; eye-brows naked, granulated, and of a bright vermilion red; belly, wing-coverts, and tail pitch black; secondaries tipped with pure white, and forming with the neighbouring coverts a band across each wing; under tail-coverts pure white; legs furnished with hair-like feathers of a dark-brown, speckled with gray; toes pectinated; tail black—the exterior feathers bend outwards, and are much longer than those in the middle: this arrangement gives the singular curvature and forked shape to the tail which distinguishes the bird.

Female.—Weight about 2 pounds; general colour ferruginous, barred and mottled with black above, paler below, with dusky and brown bars; under tail-coverts white, streaked with black; tail orange-brown, speckled with black, showing a slight disposition to be forked, tipped with grayish white.

No person is permitted to kill, destroy, carry, sell, buy, or have in his possession, any Heath-Fowl, commonly called Black Game, between the 10th of December and 20th of August. The limitation in the New Forest, Somerset, and Devon is greater, being from the 10th of December to the 1st of September.

Hybrids.

Several well-authenticated instances have occurred of hybrids bred between the Common Pheasant and the Gray Hen. White, in his 'History of Selborne,' gives an account of a bird, of which the Hon. and Rev. W. Herbert says, in a note to White's 'Selborne,' 1833, "I saw this curious bird stuffed in the collection of the Earl of Egremont at Petworth, and I have not the slightest hesitation in pronouncing that it was a mule, between the black cock and the common pheasant. I did not entertain the slightest doubt on the subject: Mr. Markwick's suggestion that the bird may be an old pea-hen is very weak. He might as well have said an ostrich. Neither in size, shape, nor colour had the bird the least affinity to a pea-fowl. I can also most positively assert that this bird was not, as suggested in a note (p. 343), a hen pheasant with the feathers of a cock. Such birds are well known to me, and it noways resembled them. To Mr. White's description of the bird above, where he says that the back, wing-feathers, and tail were somewhat like the upper parts of a hen partridge, I scratched out at the time the words 'somewhat like,' and wrote in the margin 'much browner than,' and with that correction I believe Mr. White's description to be quite correct."

Notwithstanding Mr. Herbert's opinion, Mr. Yarrell has stated his conviction that the hybrid grouse of White's 'Natural History of Selborne' to be a young Black-Cock having nearly completed his first moult.

Of undoubted cases of hybrids arising from a mixture with the Gray Hen, the following are related.

At a meeting of the Zoological Society on the 24th of June, 1834, Mr. Sabine called the attention of the meeting to a specimen of a hybrid bird between the Common Pheasant (*Phasianus Colchicus*, Linn.) and the Gray Hen (*Tetrao tetrix*, Linn.), which was exhibited. Its legs were partially feathered; it bore on the shoulder a white spot; and its middle tail-feathers were lengthened. Mr. Sabine stated his intention of entering at some length into the history of hybrid and cross animals in connection with his description of this bird, which was bred in Cornwall. This bird was a male.

On the 12th of May, 1835, at a meeting of the same society was read 'Some Account of a Hybrid Bird between the Cock Pheasant (*Phasianus Colchicus*, Linn.) and Gray Hen (*Tetrao tetrix*, Linn.), by Thomas C. Eyton, Esq.' This paper was illustrated by the exhibition of the preserved skin of the bird, and also of a drawing made from it.

The subjoined table shows some comparative measurements between the hybrid bird in question (the Cock Pheasant) and the Gray Hen:—

	Gray Hen		Hybrid Bird, female.		Male Pheasant.	
	Ft.	In.	Ft.	In.	Ft.	In.
Length of the tarsus	0	2 3/10	0	2¾	0	3 1/10
Length of the middle toe	0	2 1/10	0	2½	0	2 3/10
Expansion of the wings	2	0	2	2	2	4½
Length of the middle tail-feathers	0	4	0	7½	1	7
Length of the intestinal canal from vent to gizzard	4	2	3	5½	4	0
Length from the vent to the cœca	0	6	0	5½	0	4½
Length of the cæca	2	0	2	0	0	8½

The late Mr. W. Thompson, of Belfast, has also described a hybrid of this kind that was shot in Wigtonshire ('Mag. Zool. and Bot.' vol. i.). Mr. Yarrell, in the second volume of his 'British Birds,' has also recorded other instances.

BLACK FISH. [CENTROLOPHUS.]

BLACK JACK, the name given by miners to the Sulphuret of Zinc. [ZINC.]

BLACK-THORN. [PRUNUS.]

BLADDER, or *Vesica Urinaria*, so called to distinguish it from the Gall-Bladder, is a musculo-membranous bag or pouch, which serves as a temporary reservoir for the urine; it communicates with the kidneys by means of the ureters, and opens externally by means of the urethra.

The urinary apparatus is confined to the red-blooded classes of animals, all of which have kidneys, whilst some orders and genera have no urinary bladder. In quadrupeds the bladder is of a pyriform shape, and is completely surrounded by the peritonæum or serous lining of the abdomen; and it may be taken as a general rule that it is smaller, stronger, and more muscular in carnivorous than in graminivorous animals; in the latter it is almost membranous, and in some of them is particularly large.

In the whole class of birds there is no urinary bladder, and the ureters open into the cloaca, a musculo-membranous bag, which takes the place of the rectum, bladder, and uterus, and serves as a reservoir for the solid excrements, the urine, and eggs. The urine in these animals dilutes the fæces, and deposits the carbonate of lime which constitutes the basis of the shell. The urinary bladder exists in several genera and species of fishes.

In the human subject the urinary bladder is placed in the pelvis or basin immediately behind the symphysis pubis, and before the rectum, or terminal portion of the intestines, in the male; but it is separated from it in the female by the uterus and vagina. Its form and relations vary according to the age of the individual. In infancy it is of a pyriform shape, and is contained almost entirely in the abdomen, thus resembling its permanent condition in quadrupeds. At this period it may be considered as consisting of three portions; the narrow tapering part, or neck, the upper rounded portion, or fundus (sometimes called summit), and the intermediate portion, or body; but as the pelvis expands the bladder gradually subsides into it, and undergoes a remarkable change of form. Thus, in the adult its figure is that of a short oval, compressed at the fore and back part; its lower surface subsides on the rectum, and expanding forms what is termed by anatomists the bas fond of the bladder. This change of form is dependent not only upon the enlargement of the cavity in which the bladder is contained, but also upon the weight of the fluid which it habitually sustains, and thus in advanced age it is more deeply sunk in the pelvis than in the middle periods of life. In the female its transverse diameter is greater than in the male, in consequence of the antero-posterior diameter of the pelvis being encroached upon by the uterus. Its capacity varies in the different periods of life; and as a general rule it may be said to increase in proportion as the individual advances in years, and to be greater in females than in males. Its capacity is modified in different individuals by their habits and the natural exercise of its functions. It is more particularly changed by disease; thus, from the effects of long-continued irritation it may be reduced to such a state that it will not contain more than a few drops of urine; and, on the contrary, when from any cause its contents cannot be duly evacuated, it may be distended so as to contain many quarts of urine, and occupy a large proportion of the abdomen. Its ordinary capacity may be estimated at a pint and a half.

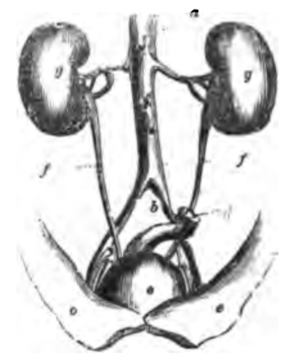


Fig. 1.—The Ureters, running from the kidneys to the bladder.

a, Aorta; *b*, bifurcation; *c*, abdominal muscles turned down; *d*, the rectum cut and tied; *e*, bladder; *f f*, ureters; *g g*, kidneys.

The neck or constricted portion of the bladder is compared to a truncated cone, longer at the sides and below than above. In infancy, owing to the position of the bladder, its direction is oblique; for a similar reason it is horizontal in the adult; it differs in structure from the rest of the organ. The neck, which is formed of a somewhat fibrous whitish substance, is the connecting medium between the bladder and the urethra. Its posterior part rests on the rectum; its anterior is surrounded, at least below and at the sides, by the prostate gland, which is peculiar to the male, and is composed of an aggregation of mucous follicles, disposed so as to form three lobes, one on each side of the neck of the bladder, and one below called the middle lobe, which forms a slight projection into the opening of the urethra.

The bladder, like the other hollow viscera, is composed of three layers, or coats, united to each other by cellular tissue; these coats are the peritonæal or serous, the muscular, and the mucous. The peritonæal coat has been already described as investing only a portion of the organ; it is united to the muscular coat by cellular tissue, which is extended over the whole of the latter, being however thinner under the peritonæal coat than elsewhere. The muscular coat has been described by some anatomists as a distinct muscle under the name of detrusor urinæ; it is composed of pale fibres interlacing in all directions. Three distinct layers have been described, but it is sufficient for all useful purposes to say, that the superficial fibres are directed in the course of the axis of the bladder; that at the sides they are more and more oblique; and that the more internal fibres assume a circular direction as they approach the neck of the bladder, so that some anatomists have described them in this part as a distinct muscle, under the name of sphincter vesicæ. This reticulated structure of the muscular coat enables the bladder to contract so perfectly as to expel every drop of its contents.

When the bladder is much distended, the muscular coat becomes attenuated to such a degree, that it is difficult to distinguish it from cellular tissue. Sometimes its fibres become so much enlarged from the effects of long-continued irritation and overaction of the organ, that they form projecting lines or columns under the mucous coat; this appearance of the bladder is dessignated by the French Vessie à Colonnes. The mucous membrane is occasionally protruded between these columns, forming sacs, or pouches, in which urinary calculi are sometimes lodged; these calculi are then said to be encysted or sacculated. The muscular coat is united to the third, last, or mucous coat by a distinct layer of cellular tissue, to which the term nervous or vascular coat is sometimes improperly applied. The mucous coat, or lining of the bladder, belongs to that division of the mucous membranes denominated genito-urinary; it not only lines the bladder, but is prolonged upwards along the ureters into the kidneys, and downwards along the urethra; it is of a pale rose-colour, is smooth when the bladder is distended, and corrugated when it is empty; it secretes a viscid fluid termed mucus, which protects it from the acrimony of the fluid with which it is constantly in contact. Three openings are seen in it; two situated posteriorly, about an inch and a half from each other, which are the openings of the ureters, and one anteriorly, which is the opening of the urethra. Extending from the openings of the ureters to that of the urethra are observed two prominent lines, which are formed by muscular fibres elevating the mucous coat; these lines form the sides of a triangle, the base of which is an imaginary line drawn between the openings of the ureters;

the apex is at the urethra. The space thus marked out is denominated the trigone vesicale; it is paler than the rest of the internal surface of the bladder, is possessed of peculiar sensibility, and is smooth in the contracted as well as in the distended condition of the bladder.

The two prominent lines which form the sides of the trigone vesicale, according to Sir C. Bell, are distinct muscles, the muscles of the ureters. They have their fixed point or origin at that prominence or tubercle existing at the inferior surface of the urethra, which has been already described as formed by the middle lobe of the prostate, their insertion or moveable point being at the opening of the ureters. Their use is to assist in the contractions of the bladder, to support and close the mouths of the ureters, and to preserve the obliquity of these canals by drawing them down during the contractions of the bladder. The tubercle whence these muscles are supposed to take their origin is termed the luette or uvula vesicæ; but these terms are more particularly applicable to it when enlarged and diseased. It then forms a prominent tumour at the orifice of the urethra, acts the part of a valve, and becomes a troublesome cause of retention of urine.

The arteries of the bladder are derived from the internal iliac and its branches; its veins empty themselves into the internal iliac vein; these vessels are most abundant about its neck and bas fond. The lymphatics follow the course of these vessels. The nerves are of two kinds, the one derived from the sacral plexus of the cerebro-spinal system, the nerves of animal life; the other derived from the hypogastric plexus of the sympathetic, the nerves of organic life.

Fig. 2.—Side view of the Bladder of an adult male.

a, Pubes; *b*, sacrum; *c*, recti muscles; *d d*, rectum; *e*, bladder; *f*, vas deferens; *g*, ureter; *h*, vesicula seminalis; *i*, prostate gland; *j*, urethra; *k k k*, peritonæum, reflected from rectum upon bladder, thence upon the recti muscles.

The direction of the bladder is oblique, being inclined somewhat forwards and upwards. In proportion to the degree of distension the obliquity is increased, in consequence of the neck being fixed. It is retained in its position by two lateral ligaments, one on each side, and an anterior ligament; the lateral ligaments are prolongations of the fascia iliaca, which passing down into the pelvis assumes the name of fascia pelvica, and becomes identified with the prostate gland and side of the bladder. The anterior ligament is double, and it is formed by the fascia transversalis, which passing down behind the symphysis pubis is reflected upon the upper surface of the prostate gland; from the point of reflection two strong fasciculi of fibres pass to the anterior surface of the bladder. These ligaments are sometimes called the proper ligaments of the bladder to distinguish them from certain folds of the peritonæum, sometimes called false ligaments. As the bladder is peculiarly interesting in a surgical point of view, anatomists have endeavoured to describe it precisely, and with this view they have divided it into six regions or surfaces—an anterior, a posterior, two lateral, a superior, and an inferior.

The anterior surface, in the collapsed state of the organ, lies behind the symphysis pubis, with which it is connected by loose cellular tissue; when distended, the bladder rises, and its anterior surface comes in relation, or in contact, with the recti muscles of the abdomen. The posterior surface is covered by the peritonæum, which in the male is reflected upon it from the rectum, in the female from the uterus and vagina; it is then reflected from the sides of the bladder to the iliac fossæ; at the points of reflection it forms folds, one on each side and two posteriorly; these have been improperly described as ligaments, for instead of confining the bladder they serve rather as provisions to facilitate its expansion.

The lateral regions are partially covered by the peritonæum; running along them we find the umbilical arteries, or their remains, in both sexes, and the vasa deferentia in the male. The superior region, or fundus, is partially covered by the peritonæum, which is reflected thence on to the inner surface of the recti muscles; it has a fibrous cord attached to it termed the urachus, which lies between the peritonæum and the recti muscles, and being accompanied by the remains of the umbilical arteries extends to the umbilicus, where it becomes identified with the abdominal aponeuroses. This fibrous cord appears to be useful in retaining the bladder in its situation, for never in the human subject, except in certain cases of malformation, which are very rare, does it present the form of a canal, such as it is found to be in the young of certain quadrupeds, in which it is the medium of communication between the bladder and a bag, or sac termed the allantoid.

The secretion of the urine is performed by the kidneys [KIDNEY]; it is constantly going on, and does not exhibit those alternations of action and repose observable in the other secretions.

The urine, being secreted, dribbles along the ureters, and its descent is probably aided by the contractility of these tubes and the impulse of the neighbouring arteries. It drops into the bladder and gradually distends it, but it is prevented from regurgitating into the ureters in consequence of these tubes taking an oblique course between the muscular and mucous coats before they perforate the latter. As the urine accumulates, these tubes are more and more compressed, and the obstacle to regurgitation is increased; but the column of urine descending along the ureters, being higher than that contained in the bladder, is not prevented from entering into it.

When a sufficient quantity of urine is accumulated in the bladder, varying according to the degree of irritability of the organ, a general uneasy sensation is produced, and a more particular one referred to the trigone vesicale: the diaphragm and abdominal muscles are called into action, the resistance of the neck of the bladder is overcome (the sphincter, if we admit its existence, relaxes), the muscular fibres of the bladder contract, and are able without further assistance to evacuate every drop of its contents.

BLADDER-CATCHFLY. [SILENE.]

BLADDER-GREEN. [RHAMNUS.]

BLADDER-NUT. [STAPHYLEA.]

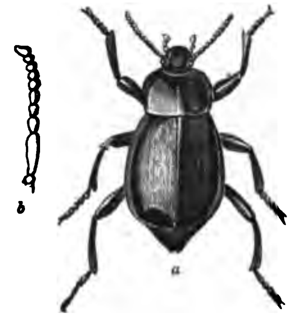
BLADDER-SENNA. [COLUTEA.]

BLADDERWORT. [UTRICULARIA.]

BLAKEA, a genus of plants belonging to the natural order *Melastomaceæ*, named by Dr. Patrick Browne in honour of Martin Blake. The species are trees or shrubs with large showy red flowers. The calyx is girded with from four to six broad scales; the corolla with six petals; the fruit a 6-celled berry, crowned with the calyx. The leaves have from three to five nerves. *B. quinquenervis*, Aublet, *B. triplinervis*, Linnæus, is a native of Brazil, Guyana, and Trinidad. It produces a large yellow berry, which is eaten in the countries where it grows. *B. parasitica* is a native of Guyana and Maranham, having red flowers. It is a climbing shrubby plant, rooting itself in other trees. It yields a colouring matter employed for dyeing red.

BLAPS (Fabricius), a genus of Insects belonging to the order *Coleoptera*, of the section *Heteromera*, and family *Melasoma* (Latreille). The principal generic characters are:—Antennæ with the two basal joints short, their breadth equalling their length; the third joint long, exceeding that of the two following together; the three following joints are longer than broad; the remaining joints nearly round, excepting the terminal one, which is round at the base and acuminated towards its extremity; maxillary palpi with the terminal joint flattened, and when viewed from above or below somewhat hatchet-shaped; thorax broad, sides rounded, posterior margin straight: abdomen oblong-ovate, exceeding the thorax in width: elytra generally soldered together, incurved so as to embrace the sides of the abdomen, more or less acuminated towards the apex, and prolonged to a point at the apex.

The species of this genus are tolerably abundant, and frequent dark damp situations, such as the caverns in rocks, &c. In this country there are only two well-authenticated species, *Blaps obtusa* and *B. mortisaga*: the latter is very common in our kitchens and cellars (in company with the cockroach); the former is much less abundant. It is occasionally found with *B. mortisaga*.



a, *Blaps obtusa*, rather above the natural size; *b*, an antenna of the same magnified.

Both species are of an obscure black colour, and about three-quarters of an inch in length. As *B. mortisaga* is a well-known common species, we will merely mention the characters, distinguishing the rarer one from it. The first striking difference is the superior breadth in *B. obtusa*; the antennæ are shorter, the fourth, fifth, and sixth joints are scarcely longer than broad (while in *B. mortisaga* their length is nearly double the breadth): the thorax has its hinder angles rounded (in *mortisaga* they are acute): the legs are much shorter in proportion, and the elytra are distinctly punctured.

Baker relates that he kept a Darkling Beetle (*B. mortisaga*) three years without food.

(Kirby and Spence, *Introduction to Entomology*.)

BLA'TTIDÆ, a family of Insects of the order *Orthoptera*.—Distinguishing characters: tarsi 5-jointed, the under wings folded longitudinally only, head hidden by the thorax; body oval or rounded, and depressed; antennæ long and thread-like, and composed of a great number of very minute joints; palpi long; thorax large, slightly convex, generally broader than long, and as it were a shield, covering the head and base of the wing-cases, which latter are of a parchment-like nature, and ramified with nerves; one elytron laps over the other; the posterior extremity of the abdomen is furnished with two conical articulated appendages; legs furnished with spines.

The *Blattidæ* are extremely active voracious insects, some species apparently eating almost anything that comes in their way. Mr. Stephens enumerates seven species indigenous to this country, and four that are not strictly so; among the last mentioned, the well-known and troublesome Cockroach (*Blatta orientalis*) may be enumerated. It is said to have come originally from Asia, but on this point there is some little doubt; the nocturnal habits and ravages of this species are too well known to need description. The male in its mature state has wings extending only half the length of the body; the female has only rudimentary wings; her eggs, which are about 16 in number, are deposited inclosed in an oblong, nearly cylindrical, but slightly compressed case, with an elevated serrated edge on one side: this at first is of a whitish colour, but after a little time becomes brown and of a firm nature; the female carries this case about with her at first, fixed to the abdomen by a gum-like substance. From this asylum the young make their escape by emitting a fluid which softens a part of the case.

The species of this family have been divided into two genera by Latreille; *Blatta* and *Kakerlac* (a named used for the *Blattæ* by the American colonists), the latter division including those species in which the females are apterous (of which the *B. orientalis* forms a type), and the former those in which both sexes possess wings.

The number of exotic species of this tribe is very great; the indigenous species of this country are—*B. Germanica, pallens, perspicillaris, Panzeri, nigripes, livida, pallida,* and *Lapponica.* Most of these are comparatively small, and are found in woods; the last-mentioned species is said to swarm in the huts of the Laplanders, where it commits great havoc, and in conjunction with *Silpha Lapponica* has been known to devour their whole supply of dried fish in a single day.

(Kirby and Spence, *Introduction to British Entomology;* Stephenson, *Illustrations of British Entomology.*)

BLAUW-BOC, or BLUE BUCK. [ANTILOPEÆ.]

BLAZING-STAR. [HELONIAS.]

BLECHNUM, a genus of plants belonging to the natural order of Ferns and the tribe *Adiantariæ.* It has its thecæ in a continuous line parallel to the midrib upon the transverse anastomosing veins, and covered by a continuous scarious indusium. There is but one British species of this genus, the *B. boreale,* Hard Fern. It has barren pectinate-pinnatifid fronds, with broadly linear rather obtuse pinnæ, fertile frond pinnate, pinnæ linear acute. This plant is exceedingly common in Great Britain, and is found almost everywhere in woods, on commons, heaths, and all uncultivated ground. It occurs in every European list of plants, and has been found in Northern Africa and North America. It is the *Lomaria Spicant* of Desveux, who is followed by Mr. Newman, in his 'History of British Ferns.' Linnæus described it as an *Osmunda.* The roots of this fern are black, tough, and wiry; the rhizoma tufted and hairy. The other species of *Blechnum* are inhabitants of South America, Australia, and the Cape of Good Hope. They are frequently cultivated in collections of Ferns. (Babington, *Manual;* Newman, *History of British Ferns.*)

BLE'DIUS, a genus of Insects of the order *Coleoptera* and family *Stenidæ.* Antennæ with the basal joint very long, the remaining joints bent at an angle with the first; maxillary palpi with the second and third joints large, terminal one slender; mandibles armed with a tooth internally towards the apex; body elongate and cylindrical; head furnished with two tubercles or spines; thorax armed with a horn in the males; legs short, the four anterior tibiæ broad and flat, having numerous spines on the external part; tarsi four-jointed.

The *Bledii* appear to be peculiar to the sea-coast, where they burrow in the wet clay or sand near pools of water, by means of the spined anterior tibiæ above described. They are gregarious in their habits. Three species have been discovered in this country, all of which are of a black colour, with the wing-cases more or less red.

Bledius tricornis, in the male sex, has two short horns on the head, and one long smooth horn proceeding horizontally from the front of the thorax. Length about 3-12ths of an inch.

B. Taurus, in the male, has two long and slender horns on the head; the thoracic horn is pubescent at the apex; about the same size as the last.

B. Ruddii has short acute horns on the head, and the thoracic horn pubescent at the apex; it is rather less than the two foregoing species.

BLE'MUS, a genus of Insects of the order *Coleoptera* and family *Harpalidæ.* Head almost as large as the thorax, the portion joining the anterior part of the eyes distinctly elevated; antennæ very long; palpi with the terminal joint somewhat conical and rather acute; labium slightly notched in front; thorax considerably narrowed posteriorly; body elongate and rather depressed; wings ample; the joints of the anterior tarsi of the male dilated.

About six British species of this genus have been discovered, the largest of which does not exceed 3-12ths of an inch. All the species are of a pale-yellow or ochre colour, having more or less of a bluish shade on the disc of the elytra, excepting *B. conspurtus,* which although generally placed in this genus we do not consider as strictly belonging to it. *B. fasciatus,* which may be considered the type of the genus, is rather more than 2-12ths of an inch in length, and of a pale ochre-colour, with a blue-black fascia crossing the elytra. This beautiful little species has been found near London, and in various other parts; but, like all the species of this genus, is rather scarce.

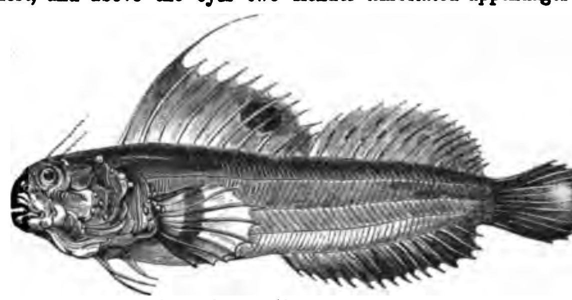
BLENDE, a name particularly given to Zinc-Blende, but most commonly used by mineralogists as denoting an order which in the system of Professor Jameson of Edinburgh contains the following genera:—Manganese-Blende, Zinc-Blende or Garnet-Blende, Antimony-Blende, Ruby-Blende. The word is probably derived from a German verb (used only in combinations) signifying to mix: the term 'blende' signifies a mineral which contains no ore—in fact a pseudo-galena. [ZINC.]

BLE'NNIUS, Blennies (French, Baveuses), a genus of Fishes of the section *Acanthopterygii* and family *Gobioidæ* (Gobies). Both the Greek and the French names have been applied to this genus from the mucous matter with which the bodies of these fishes are covered. They may be easily distinguished by their having the ventral fin placed before the pectoral, and containing generally but two rays. The head is short and rounded; teeth long and slender, and placed in a single row; body long, compressed, smooth, and possessing only one dorsal fin, which extends nearly the whole length of the back; they have no air-bladder.

The species of this genus are small, live in shoals, but not in great numbers. They are very active and tenacious of life, and frequent rocky coasts, where they may often be found in the pools of water left by the tide, hiding themselves among the weeds and in the crevices of the rocks.

The genus *Blennius* of Linnæus, in Cuvier's 'Règne Animal,' is divided into the following subgenera: *Myxodes, Salarias, Clinus, Cirrhibarba, Marænoides, Opistognathus,* and *Zoarcus.* At present we confine ourselves to the Blennies, properly so called, of which, according to Mr. Yarrell, we have five species frequenting our coasts. The first, *B. Montagui,* Montagu's, or Diminutive, Blenny, is generally of an olive-green above, spotted with pale-blue shaded to white; belly white, pectoral fins spotted with orange. The head, viewed laterally, forms an obtuse angle in front, and is furnished with a transverse conic or angular fimbriated crest. The dorsal fin has 30 rays, pectoral 12, ventral 2, anal (which extends from the vent to the tail) 18, and the caudal (which is rounded) 14. It is found on the south coast of Devon.

B. ocellaris, the Ocellated Blenny, or Butterfly-Fish, is scarcely three inches long, the head is rounded, the part anterior to the eyes very short, and above the eyes two slender fimbriated appendages are



Butterfly-Fish (*Blennius ocellaris*).

situated; body elongate; dorsal fin extending from the back part of the head to the tail, and consists of 26 rays, of which the first is considerably longer than the rest, the nine following diminish in length to the eleventh, which is shortest, the twelfth nearly double the length of the last, from this the remaining rays gradually increase in length to about half-way, and then decrease towards the tail; a large dark-brown spot extends from the sixth to the ninth ray. The pectoral fins have each 12 rays, ventral 2, anal 17, and caudal 11. The body is of a pale-brown colour, varied with patches of a deeper hue; the pectoral and ventral fins are darker than the others. This species frequents the coast of Devonshire and elsewhere, but is not common.

B. gattorugine, the Gattoruginous Blenny, is about five or six inches in length; it is elongate, rather robust anteriorly, the forehead slopes considerably from the posterior part to the anterior; the head is grooved between the eyes, and furnished with two branched membranes situated just above the eyelids; the dorsal fin extends from the back part of the head to the tail, the central part is very slightly narrower than the rest. The fins and body are of a dark reddish-brown colour, the belly and hinder portion of the former is of a paler brown. The dorsal fin has 33 rays, the pectoral fins are broad and rounded, and have each 14, the ventral fin 2, and the anal 23 rays; the tali is slightly rounded, and has 11 rays. It has been found in Poole Harbour and other parts. Not common.

B. pholis, the Shanny. In this species all the rays of the dorsal fin are nearly of equal length, except the eleventh and twelfth (which are short); the number of these rays is 31, pectoral 13, ventral 2, anal 19, caudal 11; the colour is very variable, but consists of shades of brown.

B. pholis may however be readily distinguished from any of the known British species by the absence of the appendages on the head.

B. Yarrellii, the Crested or Yarrell's Blenny. This species may be known by its elongated even shape, the uniform length of the rays of the dorsal fin, the form of the tail (which has the external rays shortest, the others increasing in length to the middle, thus being somewhat lanceolate in shape), and the four appendages of the head which are all fimbriated. Two of these appendages are placed one over each eye, and connected by a transverse fold of skin; behind these are placed the other pair, which are of a larger size. The fin rays are, dorsal 51, pectoral 14, ventral 3, anal 36, and caudal 16.

This species was formerly confounded with *B. palmiconius* and *B. galerita*, but Valenciennes has pointed out its distinctive characters and named it after the distinguished British icthyologist whose name it now bears. A specimen of this very rare British fish was exhibited amongst the earliest specimens in the Aquavivarium in the Regent's Park, and is still alive (July, 1853). Many other species of Blenny have been exhibited in the tanks of the establishment. All the species are remarkable for the facility with which they use the ventral fins for enabling them to cling to and move about upon the rocks and stones by which they are surrounded.

BLE'PHARIS, a genus of Acanthopterygious Fishes, which according to Cuvier belongs to the seventh family of that tribe, called *Scomberoides*. They may be distinguished by their having long filaments to their second dorsal, and to their anal fin rays; ventrals much prolonged, the spines of the first hardly piercing the skin; body elevated, the profile with the ordinary degree of curvature.

BLE'PSIAS, a genus of Acanthopterygious Fishes, belonging to the section having hard cheeks. Of this genus but one species, *Billosus*, is known, which belongs to the Aleutian Islands. Generic characters: head compressed, cheeks mailed, fleshy barbels under the lower jaw, gills with five rays; one dorsal fin divided into three unequal lobes; ventral fin very small.

BLESS-BOC. [ANTILOPEÆ.]

BLETHI'SA (Bonelli), a genus of Insects belonging to the order *Coleopteræ*, by some authors associated with the family *Harpalidæ*, and by others with the *Elaphridæ*. The former is probably more correct, as doubts may be entertained that the latter family is a natural one. Head large, eyes slightly prominent, mandibles obscurely toothed; palpi with the two terminal joints of equal length, the terminal rather ovate, truncated at the apex; mentum emarginate anteriorly, the emargination with an obscure bifid lobe; antennæ short, the three basal and base of the fourth joints naked; thorax rather short, rounded at the sides; elytra elongated, very convex and impressed with numerous small excavations; anterior tarsi of the male with four slightly-dilated joints.

Of this beautiful genus but one species has been found in this country, *Blethisa multipunctata;* and apparently only two others are yet known on the continent. The species just named frequents marshy situations, and is often found crawling upon willow-trees; it is about half an inch long, and of a rich bronze or brassy hue, by which characters, combined with the numerous indented points on the elytra, it may easily be distinguished.

BLETIA, a genus of plants belonging to the natural order *Orchidaceæ*. The corms of *Bletia verecunda* are said by Dr. P. Browne to have a bitterish flavour, and when dry to be used with advantage as a stomachic.

BLETTING. All ripe fruits after they have been kept for some time begin to decompose, and the spots formed on the fruit during this process have been called by Professor Lindley 'Blets.' During the whole time of the growth of the fruits of plants various important chemical changes go on in their tissues, especially whilst ripening. These changes have been examined with great care by Berard. At first the flesh of most fruits consists of fibrous or cellular tissue, which is mostly composed of lignine. The liquid of fruits is sap, which exists between the cells in the intercellular passages. This liquid, besides a great quantity of water, contains sugar, gum, malic acid, malate of lime, colouring matter, a peculiar vegeto-animal substance (protein), and an aromatic secretion proper to each fruit. In such fruits as the grape there is tartrate of potash and lime; in the lemon and the gooseberry, citric acid. As the process of ripening goes on, the quantity of water diminishes, and the sugar increases. This sugar is formed at the expense of the lignine, and is either in a concrete state, as in the grape, fig, and peach, or fluid, as in most fruits. It is after this period that Bletting comes on, and changes take place in the fruit which render it unfit for the ordinary uses of man. Bletting is attended with the formation of carbonic acid, the nitrogenised substance enters into a state of putrefaction, and the sugar undergoes fermentation. These processes are undergone most rapidly when the fruit is exposed to the action of the oxygen of the atmosphere. The fruits in which these changes have been most accurately observed are the pear and the apple. A jargonelle pear was found to have sustained a loss of its constituents in the following proportion:—

	Ripe.	Bletted.
Lignine	2·19	1·85
Sugar	11·52	8·77
Water	83·88	62·73

It acquired rather more malic acid, gum, and nitrogenised matter.

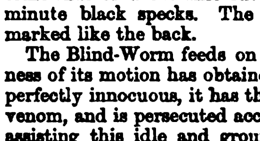
The fact has been observed by Dr. Hassall that in all bletted fruits there exists a low form of *Fungus*, which he considers the cause of the decay. He found, on inoculating sound fruits, even while growing on the tree, that he could produce immediately the process of decay, and wherever this was indicated by bletting, there he discovered the fibres of the fungus with the microscope. This appearance of the fungus however is only in accordance with what we know of the habits of fungi, whose sporules, being everywhere diffused through the air, immediately spring up where a fitting nidus is found for their growth. We find that as soon as a fruit becomes ripe its constituents commence union with the oxygen of the air, forming carbonic acid gas, and it is during this state of their elements that the fungus finds a soil ready for its development.

Whichever view be taken of the rotting of fruits, their preservation must be conducted on the same principle, for what will exclude oxygen will exclude the sporules of fungi. As a simple process it has been recommended to place at the bottom of a bottle a paste formed of lime, sulphate of iron, and water, and then to introduce the fruit, which has been pulled a few days before ripening. The fruits should be kept from the bottom of the bottle and as much as possible from each other, and the bottle should be closed by a cork and cement. In this way peaches, prunes, and apricots may be kept from 20 days to a month; pears and apples for three months. Dr. Hassall recommends that fruits should be washed over with a composition consisting of water one pound, shell-lac and borax two ounces.

(Lindley, *Introduction to Botany;* Hassall, *Transactions of Microscopical Society*, vol. i.)

BLI'GHIA, a genus of plants named after Captain William Bligh, R.N., master of the Bounty in the celebrated mutiny, belongs to the natural order *Sapindaceæ*. It has a 5-parted calyx, 5 petals, a very short style, 3 stigmas, and a solitary seed with a very large arillus. Only one species of this genus has been described, the *B. sapida*, Akee-Tree. It is a native of Guinea, from whence it has been introduced into the West Indies and South America. It is a tree attaining a height of 30 or 40 feet. It has pubescent leaves, with three or four pairs of ovate-lanceolate veined leaflets. The fruit of this tree is a berry of a reddish or yellowish colour, about the size of a hen's egg. The aril of the seed is pulpy, and of a grateful subacid flavour, and is eaten in Africa and the West Indies. This tree does not produce flowers in this country. It may however be easily cultivated. It grows well in a mixture of loam and peat. Cuttings will strike in sand under a hand-glass. They should not be deprived of any of their leaves. (Loudon, *Encyclopædia of Plants.*)

BLIND-WORM, the English name for a species of Reptile belonging to the family of *Anguidæ*, Les Orvets of the French, and the genus *Anguis* of Linnæus. It is also called in England Slow-Worm. The Blind-Worm (*Anguis fragilis*), is common throughout Europe. Its length varies from about 11 inches to somewhat more than a foot, and instances have been given of its attaining more than double that length. The eyes are small (whence one of its names), and the irides are red. The head is small, the teeth are minute and numerous, the neck is slender, and thence the body enlarges, continuing of equal bulk to the tip of the tail, which ends bluntly, and is as long as the trunk, or body part. The scales are very smooth, shining, of a silvered yellow on the upper parts, and dusky beneath; the sides are of a somewhat reddish cast. Down the back extend three black lines, which change with age into different series of black specks, and at length disappear. The general colour of the back may be described as cinereous, with somewhat of a metallic lustre, and marked with very fine lines of minute black specks. The dusky belly and the reddish sides are marked like the back.



Head of Blind-Worm.

The Blind-Worm feeds on earth-worms, insects, &c.; and the slowness of its motion has obtained for it another of its names. Though perfectly innocuous, it has the character of possessing the most deadly venom, and is persecuted accordingly. Pennant quotes Dr. Borlase as assisting this idle and groundless notion, by mentioning a variety of this serpent with a pointed tail, and adding that he had been informed that a man lost his life by the bite of one in Oxfordshire. Now, if the serpent that bit the man in Oxfordshire had a pointed tail, it could not have been a blind-worm; and if the story of the death be true, he most probably lost his life by the bite of a black or dusky viper, as Pennant suggests. [VIPER.] The country people still hold this harmless reptile in utter abhorrence, and wage an exterminating war against it: but the reader may be assured that the 'blind-worm's sting' exists only in imagination. The animal is very brittle. Laurenti and others assert that when captured it throws itself into such rigidity that it sometimes breaks in two. A smart blow with a switch divides it; and from this fragility Linnæus gave it the specific name which it still retains. Cuvier is of opinion that the *Anguis eryx* of Linnæus is only a young blind-worm, which has the dorsal lines well marked, and that the *Anguis clivicus*, which Daudin makes an *Eryx*, is nothing more than an old blind-worm with a truncated tail. The Blind-Worm, or Slow-Worm, of the old English authors is the Long Cripple of the Cornish, according to Borlase, Ormsla and Koppar-Orm of the 'Fauna

Suecica,' L'Orvet of Lacépède, Blind Schleiche of the Germans, *Anguis fragilis* of Linnæus. It brings forth its young alive, and it is said twice a year, in the seasons of spring and autumn.

The general opinion is (and we think it well founded) that the Blind-Worm is the *Cæcilia* of the Latins, and the Τύφλωψ and Τυφλῖνος of the ancient Greeks, names given in allusion to its supposed blindness, and that it was sometimes called Κωφίας on account of its assumed deafness. Belon considers it to be the serpent called Tephloti, Tephliti, and Tephlini by the modern Greeks. Columella ('De Re Rusticâ,' 6. c. 17), following the opinion of its deleterious nature, says that its poison is fatal to oxen, and that the cure is the flesh of storks, because they devour this serpent. Upon the principle, we suppose, of counteracting one poison by the application of another, a Theriaca, or poison-antidote, made from the harmless Blind-Worms (*Cæciliis*) and the theriacal water was used as a sudorific against the pestilence. Mr. Bell says this creature is kept alive with difficulty in confinement. It feeds on worms, insects, slugs, &c. Its habits are exceedingly gentle and inoffensive, and even should it attempt to bite when irritated it is incapable of producing injury. (Bell, *British Reptiles.*)

BLINDS, a name given in Devonshire and Cornwall to the Whiting Pout. [MORRHUA.]

BLITUM (from βλίτον), a genus of plants belonging to the natural order *Chenopodiaceæ*. It has no corolla, a trifid calyx, a pistil with 2 styles, a single seed immersed in its berried calyx. Two species of this genus are known by the name of Strawberry Blite—*B. capitatum* and *B. virgatum*. The former has its flowers in terminal spikes; the latter has its heads lateral and scattered. Some writers have made the *B. virgatum* only a variety of the first, but its axillary flowers are constant. After flowering, the calyx of these two species swells out, and presents the size, colour, and appearance of the common wood-strawberry. It is succulent, stains the hands, and was formerly used for colouring puddings. The taste is insipid. These plants are not natives of Great Britain, but are common on way-sides and in cultivated grounds in the south of Europe. The species of *Chenopodium* are closely allied to those of *Blitum*; and Meyer, Reichenbach, and Koch have referred the European species of *Chenopodium* with vertical seeds to the genus *Blitum*. These are the *C. rubrum*, *C. Bonus Henricus*, and *C. glaucum* of Babington's 'Manual of British Botany,'—all three of which are Linnæan species.

(Koch, *Flora Germanica;* Loudon, *Encyclopædia of Plants;* Babington, *Manual.*)

BLOOD, the animal fluid by which the tissues of the body are nourished, and which is contained in the tubes called from their office Blood-Vessels.

On first flowing from the vessel in which it is contained the blood is a thick, viscid, and tenacious fluid. In all the more highly-organised animals it is of a red colour: but redness is not one of its essential properties. In several tribes of animals which possess true and proper blood, this fluid is not of a red colour, and there is no animal whose blood is visibly red in all the parts of the body. The blood of the insect is colourless and transparent; that of the reptile is of a yellowish colour; in the main part of the body of the fish, that is, in the whole of its muscular system, the blood is without colour; hence the whiteness of the general substance of the body of the fish: but in the more important organs, and especially in those which constitute the circle of nutrition, called the organs of organic life, the blood is of a red colour, as in the heart, the branchiæ or gills, and so on. In the bird the blood is of a deep red; but it is the deepest of all in the mammalia. In some species of mammalia it is deeper than in others; in the hare, for example, it is much deeper than in the rabbit. It is deeper in some varieties of the same species than in others, and more especially in different varieties of the human family.

In man and all the higher animals the body contains two kinds of blood, each of which is distinguished by a striking difference of colour. Each kind of blood is contained in its own peculiar set of vessels: the one in the vessel called a vein, hence called venous blood; the other in the vessel called an artery, arterial blood. Venous blood is of a dark or Modena-red colour; arterial blood is of a bright scarlet colour. Venous differs from arterial blood in its most essential properties no less than in its colour: venous blood is incapable of nourishing the body and of stimulating the organs; arterial blood is the proper nutrient and stimulant of the system.

The specific gravity of human blood (water being 1000) may be stated to be about 1055 or 1056, from which standard it is capable of increasing to 1120, and of sinking to 1026, this being the extreme range of variation hitherto observed. Venous is heavier than arterial blood, the former being commonly estimated at 1052, and the latter at 1049. The higher the organisation of the blood the greater is its specific gravity: hence the specific gravity of the blood of the higher is greater than that of the lower animals.

There is a remarkable difference in different classes of animals in the temperature of the blood. In some it is only a degree or two above that of the surrounding medium. Creatures with blood of this low temperature are called cold-blooded, in contradistinction to warm-blooded animals, whose temperature is maintained under whatever variety of circumstances they may be placed considerably above that of the surrounding air.

The following table of the temperature of the blood of different animals, is compiled from the researches of Tiedemann and Rudolphi on this subject.

Animal.	Degrees of Fahrenheit.
Great Titmouse	111·25
Swallow	111·25
Ducks and Geese	106 to 111
Common Hen	102 to 109
Species of Eagles, Hawks, &c.	104 to 109
Pigeon	106 to 109
Gull	100
Bat	106
Squirrel	105
Ox	104
Ape	103
Dog	101
Cat	98 to 103
Elephant	99
Horse	98·24
Man	98

Arterial is warmer by one degree than venous blood.

Disease is capable of effecting a considerable change in the temperature of the blood. In almost every case of fever the temperature of the blood differs from the natural standard. In the cold fit of intermittent fever (ague) it sometimes sinks as low as 94°; in some types of continued fever it rises as high as 102°. In cholera it sinks to 90°. In inflammation of moderate severity it exceeds the natural standard by 4 degrees; in intense inflammation it is capable of rising above it as high as 7 degrees.

The blood, whilst circulating in the body is composed of two parts, a liquid and a solid. The liquid is called liquor sanguinis, and the solid, on account of its cellular character, blood-globules or corpuscles. When blood is allowed to stand, after it is taken from the body, it separates into two distinct parts, a solid mass, and a fluid matter in which the solid mass swims. The solid portion of the blood, which includes the blood-corpuscles and a portion of the liquor sanguinis called the fibrin, is termed the Clot, or the Crassamentum; the fluid portion is called the Serum; and the process by which the separation takes place is denominated Coagulation.

The change in the constitution of the blood by which this separation into a solid and fluid portion is effected commences directly the blood leaves the blood-vessel. In about eight or nine minutes after blood is drawn from a living animal it begins to thicken, and in the course of a quarter of an hour the clot begins to form, and the serum exudes. This process arises from the fact that the fibrin is not dissolved, only suspended in the blood, and when allowed to stand it separates, sinking in the liquid blood, and carrying with it the blood-corpuscles. When the latter separate from the fibrin, which they do under various circumstances, forming a layer at the lower part of the clot, the upper part of the clot, which is of a yellow or buff colour, is called the buffy coat.

The Coagulation of the Blood is not simply a separation of the fibrin from the serum of the blood, dependent on physical causes, as is evident from the manner in which it is hastened or delayed by external causes. This may be stated without the necessity of making any inferences from the phenomena presented. Temperature exerts an influence, as cold delays coagulation, whilst moderate heat hastens its occurrence. Exposure to the atmosphere facilitates this process, as also contact with foreign bodies; but the exclusion of air delays it. The cessation of active motion whilst the blood is in the body hastens coagulation, but movement also gives a tendency to it out of the body. A mixture of half the bulk of the blood with water increases the coagulative tendency, but increased dilution diminishes it. States of the system affect it. Faintness is favourable to coagulation, but excitement and suffocation retard it. Coagulation is quicker in arterial than in venous blood. Foreign substances generally hasten it, but alkalies delay it.

The Clot or Crassamentum separates into two portions—a substance of a yellowish-white colour forming the top of the clot, and a red mass always found at the bottom of the clot. When the yellowish substance forming the top of the clot is completely separated from the red mass it is found to be a solid of considerable consistence, soft, firm, elastic, and tenacious, or gluey. Its distinctive character is derived from the disposition manifested by its component particles to arrange themselves into minute threads or fibres; these threads or fibres are often so disposed as to form a complete net-work. In its general aspect as well as in its chemical relations this substance bears a striking resemblance to pure muscular fibre; that is, to muscular fibre deprived of its enveloping membrane and of its colouring matter. Several names have been given to this substance—gluten, coagulable lymph, fibre of the blood, and fibrin; the latter is the name commonly appropriated to it. Of all the constituents of the blood Fibrin is by far the most important. Whatever other constituent may be absent, this in all animals which possess blood is invariably present. The main part of all the solid structures of the body is composed of it; it forms the basis of muscle, and in the lower animals, in which distinct muscular fibres cannot be traced, it probably performs the function of muscle. This substance or some modification of it is also found in plants, and seems to be the chemical compound with which the active functions of life are connected.

The second constituent of the Clot, the red matter, being heavier than the fibrin, gradually subsides to the lower surface, where it is always found forming the bottom of the clot. The proportion of this red matter to the fibrin differs in different classes of animals, and even in the same animal at different times. The greater the energy and activity of the animal the larger is the proportion of the red matter, and it is also generally large in proportion to the elevation of the animal temperature.

When a drop of blood is placed under the microscope it is found to consist of the liquor sanguinis and a number of globules or cells. It is these latter which constitute the red matter of the blood. When carefully examined these cells are found to be of two kinds—the one white or colourless, the other red. The former except in states of disease are far less in number than the latter, and are found to be identical with cells which are found in the lymph and chyle. Hence they are sometimes called lymph- or chyle-corpuscles. These white corpuscles have only of late years attracted much attention, though they had been described as far back as the time of Hewson. In man and the mammalia they are often larger than the red corpuscles; they may be recognised by their granular appearance, their peculiar contour, and the irregular shading of their figure. (*Figs.* 4 and 5.)

Blood-Corpuscles.

1, Red corpuscles of human blood, exhibiting their flattened surfaces; 2, the same, adherent by their flattened surfaces so as to form rolls; 3, red corpuscles of frog's blood; 4, colourless corpuscles of human blood; 5, the same, enlarged by the imbibition of water.

They are also to be distinguished from the red corpuscles by their different actions towards chemical re-agents; they are not attacked by water, but remain in it for a long time without apparent change; they are not rendered transparent and dissolved by acetic acid; they only become more decidedly granular under its action, and a kind of nucleus is developed in their centre. As they are in all respects similar to those of lymph and chyle, and as they have the same chemical relations, they have been regarded by many as the corpuscles of the lymph mingled with the blood (Hewson, Müller); others have viewed them as globules of coagulated fibrin (Mandl, Weber); and others again with more propriety as blood-corpuscles in progress of solution or disintegration (Wharton Jones, Hughes Bennett). They may be seen in the capillary system of living animals (in transparent structures, as for instance in the frog's foot) swimming with the ordinary blood corpuscles, but not so much moving rapidly in the great current of the blood as progressing in close contact with the walls of the vessels in a slower stream. They are not elastic like the ordinary corpuscles, and seem to stick to each other. The exact functions of these corpuscles are still unknown, but there are many facts which seem to indicate that there is a decided relation between them and between the nutritive or organic life of the tissues.

In addition to these cells, which as we have said are comparatively rare, an immense number of what are termed 'red corpuscles,' but which usually present a yellow appearance, are present in the red matter. The blood of numerous animals has been submitted to microscopic examination by Nasse, Wagner, Gulliver, and other observers, and in general it is found that these red particles have a circular form in all animals constituting the class Mammalia. A remarkable exception to this rule has been shown by Mandl to occur in the corpuscles of the camel tribe. The mean long diameter of the blood-corpuscles of the Dromedary he found to be the 3254th of an inch, while the mean short diameter was only the 5921st of the same standard. In the Paco (*Auchenia paco*) and Guanaco (*Auchenia glama*) the blood-corpuscles scarcely differed in form and size from those of the dromedary, whilst in the Vicuña they were slightly smaller. In structure and magnitude however these oval corpuscles of the *Camelidæ* belong entirely to the mammiferous type; they have no perceptible nucleus like those of birds, and they are not much more than half the size of even the smallest that have been observed in birds or reptiles.

The difference of size in the corpuscles of different mammalia is worthy of notice. The average diameter of those of man, according to Mr. Gulliver, is the 3300th of an inch; but the average diameter of those of the elephant, according to the same observer, is as much as the 2745th of an inch (which were the largest he observed amongst the mammalia), whilst those of the Napu musk-deer were no more than the 12,325th, and some were as small as the 16,000th of an inch in diameter. There is also an exception to the general statement that the corpuscles of fishes are oval; in one class, namely the *Cyclostomi*, or Lamprey Tribe, they are circular. The largest red corpuscles hitherto observed are amongst the reptiles known as the Siren and the Proteus, which are so large as even to be visible to the naked eye as very minute specks.

There can be no doubt that the red corpuscles go through the same course as other cells. We have undoubted evidence of their rapid regeneration in cases where much blood has been lost, and of the peculiar power which chalybeate medicines have in forwarding their production. The precise method in which they are developed is however not exactly known.

With respect to the chemical composition of the blood-corpuscles, the walls are formed of a substance which has been called globulin, and which is undoubtedly a protein compound. The red colour is due to a pigment which has received the name of Hæmatin, and is inclosed in the vesicles of globulin. It has been generally assumed that this substance exists in two distinct states in arterial and venous blood, having in the former an excess of oxygen and in the latter an excess of carbon or carbonic acid. Mulder has however shown that its elementary composition is the same whether obtained from arterial or venous blood, and that it may be represented by the formula $C_{44}H_{22}N_3O_6Fe$; the following being the analyses from which he deduced it:—

	1	2	3	4	5	According to the formula.
Carbon .	66·49	65·91	66·20	65·73	65·90	65·84
Hydrogen	5·30	5·27	5·44	5·28	5·27	5·37
Nitrogen	10·54	..	10·46	10·57	10·61	10·40
Oxygen .	11·01	..	11·15	11·97	..	11·75
Iron .	6·66	6·58	6·75	6·45	..	6·64

1, 2, and 3 were arterial, and 4 venous ox-blood; 5 was the mixed blood of a sheep.

It may be shown by conclusive experiments that the red colour is not dependent on the iron, for that constituent may be removed from the hæmatin without materially altering its tint, although it is very firmly combined with the four organic elements. The condition in which the iron exists in hæmatin—whether as an oxide, a carbonate, a carburet, or in the metallic state—has long been disputed. According to Liebig the iron of the hæmatin is the most essential constituent of the blood in relation to the respiratory process. The following is his view of the theory of respiration:—"During the passage of the venous blood through the lungs, the globules change colour, and oxygen is absorbed from the atmosphere. Further, for every volume of oxygen absorbed, an equal volume of carbonic acid is in most cases given out. The red globules contain a compound of iron, and no other constituent of the body contains iron. Whatever changes the other constituents of the blood undergo in the lungs, this much is certain, that the globules of venous blood experience a change of colour, and that this change depends on the action of oxygen. Now we observe that the globules of arterial blood retain their colour in the larger vessels, and lose it only during their passage through the capillaries. All those constituents of venous blood which are capable of combining with oxygen take up a corresponding quantity of it in the lungs. Experiments made with arterial serum have shown that when in contact with oxygen it does not diminish the volume of that gas. Venous blood in contact with oxygen is reddened, while oxygen is absorbed, and a corresponding quantity of carbonic acid is formed. It is evident that the change of colour in the venous globules depends on the combination of some one of these elements with oxygen; and that this absorption of oxygen is attended with the separation of a certain quantity of carbonic acid gas. This carbonic acid is not separated from the serum; for the serum does not possess the property when in contact with oxygen of giving off carbonic acid. On the contrary, when separated from the globules it absorbs from half its volume to an equal volume of carbonic acid, and at ordinary temperatures is not saturated with that gas. Arterial blood, when drawn from the body, is soon altered; its florid colour becomes dark red. The florid blood, which owes its colour to the globules, becomes dark by the action of carbonic acid, and this change of colour affects the globules, for florid blood absorbs a number of gases which do not dissolve in the fluid part of the blood when separated from the globules. It is evident therefore that the globules have the power of combining with gases. The globules of the blood change their colour in different gases; and this change may be owing either to a combination or to a decomposition. Sulphuretted hydrogen turns them blackish-green, and finally black; and the original red colour cannot in this case be restored by contact with oxygen. Here a decomposition has obviously taken place. The globules darkened by carbonic acid become again florid in oxygen, with disengagement of carbonic acid. The same thing takes place in nitrous oxide. It is clear that they have here undergone no decomposition, and consequently they possess the power of combining with gases, while the compound they form with carbonic acid is destroyed by oxygen. When left to themselves out of the body, the compound formed with oxygen again becomes dark, but does not recover its florid colour a second time by the action of oxygen. The globules of the blood contain a compound of iron. From the never-failing presence of iron in red blood, we must conclude that it is unquestionably necessary to animal life; and since physiology has proved that the globules take no share in the process of nutrition, it cannot be doubted that they play a part in the process of respiration. The compound of iron in the globules has the characters of an oxidised compound, for it is decomposed by sulphuretted hydrogen, exactly in the same way as the oxides or other analogous compounds of iron. By means of diluted mineral acids, peroxide (sesqui-oxide) of iron may be extracted at the ordinary temperature from the fresh or dried red colouring matter of the blood. The characters of the compounds of iron may perhaps assist us to explain the share which that metal takes in the respiratory process. No other metal can be compared with iron for the remarkable properties of its compounds. The compounds of protoxide of iron possess the property of depriving other oxidised compounds of oxygen; while the compounds of peroxide of iron under other circumstances give us oxygen with the utmost facility. Hydrated peroxide of iron, in contact with organic matters destitute of sulphur, is converted into carbonate of the protoxide. Carbonate of protoxide of iron, in contact with water and oxygen, is decomposed; all the carbonic acid is given off, and by absorption of oxygen it passes into the hydrated peroxide, which may again be converted into a compound of the protoxide. Not only the oxides of iron but also the cyanides of that metal exhibit similar properties. Prussian blue contains iron in combination with all the organic elements of the body; hydrogen and oxygen (water), carbon and nitrogen (cyanogen). When it is exposed to light, cyanogen is given off, and it becomes white; in the dark it attracts oxygen, and recovers its blue colour. All these observations taken together lead to the opinion that the globules of arterial blood contain a compound of iron saturated with oxygen, which in the living blood loses its oxygen during its passage through the capillaries. The same thing occurs when it is separated from the body and begins to undergo decomposition. The compound, rich in oxygen, passes therefore, by the loss of oxygen, into one far less charged with that element. One of the products of oxidation formed in this process is carbonic acid. The compound of iron in the venous blood possesses the property of combining with carbonic acid; and it is obvious that the globules of the arterial blood, after losing a part of their oxygen, will, if they meet with carbonic acid, combine with that substance. When they reach the lungs they will again take up the oxygen they have lost; for every volume of oxygen absorbed, a corresponding volume of carbonic acid will be separated; they will return to their former state, that is, they will again acquire the power of giving off oxygen. For every volume of oxygen which the globules can give off, there will be formed (as carbonic acid contains its own volume of oxygen without condensation) neither more nor less than an equal volume of carbonic acid. For every volume of oxygen which the globules are capable of absorbing, no more carbonic acid can possibly be separated than that volume of oxygen can produce. When carbonate of protoxide of iron by the absorption of oxygen passes into the hydrated peroxide, there are given off, for every volume of oxygen necessary to the change from protoxide to peroxide of iron, four volumes of carbonic acid gas. But from the one volume of oxygen only one volume of carbonic acid gas can be produced. And the absorption of one volume of oxygen can only cause directly the separation of an equal volume of carbonic acid; consequently the substance or compound which has lost its oxygen during the passage of arterial into venous blood, must have been capable of absorbing or combining with carbonic acid; and we find, in point of fact, that the living blood is never in any state saturated with carbonic acid; that it is capable of taking up an additional quantity without any apparent disturbance of the functions of the globules. Thus, for instance, after drinking effervescing wines, beer, or mineral waters, more carbonic acid must necessarily be expired than at other times. In all cases where the oxygen of the arterial globules has been partly expended otherwise than in the formation of carbonic acid, the amount of this latter gas expired will correspond exactly with that which has been formed; less however will be given out after the use of fat and of still wines than after champagne. According to the views now developed, the globules of arterial blood in their passage through the capillaries yield oxygen to certain constituents of the body. A small portion of this oxygen serves to produce the change of matter, and determines the separation of living parts, and their conversion into lifeless compounds, as well as the formation of the secretions and excretions. The greater part, however, of the oxygen is employed in converting into oxidised compounds the newly-formed substances which no longer form part of the living tissues. In their return towards the heart, the globules which have lost their oxygen combine with carbonic acid, producing venous blood; and when they reach the lungs an exchange takes place between this carbonic acid and the oxygen of the atmosphere. The organic compound of iron, which exists in venous blood, recovers in the lungs the oxygen it has lost, and in consequence of this absorption of oxygen the carbonic acid in combination with it is separated."

Mulder is strongly opposed to this theory; he denies that the iron takes any essential part in the respiratory process; and he refers the process entirely to the oxidation of the protein-compounds. He alleges the following grounds against the probability of the correctness of Liebig's views:—

1. The iron is so intimately connected with the other elements of hæmatin, that it cannot be removed even by long digestion of this constituent in dilute hydrochloric or sulphuric acid. If these re-agents cannot effect its oxidation, it is highly improbable that it should be oxidised in the lungs. Respecting Liebig's assertion that dilute acids remove iron from dried blood, Mulder proves that this fact is valueless in relation to his theory, because other constituents of the blood besides the hæmatin contain this metal, apparently in an oxidised state.

2. If, as Liebig asserts, peroxide of iron exists in arterial blood, and carbonate of protoxide of iron in venous blood, almost any dilute acid would be capable of removing it. But this is not the case. Hæmatin properly prepared may be digested with dilute hydrochloric or sulphuric acid for many days without the least diminution in the quantity of the iron. From hæmatin treated in this manner Mulder obtained by combustion 9·49 per cent. of peroxide of iron, which is the constant quantity always left after the combustion of well-prepared hæmatin.

3. The probability that the iron exists in a metallic state is strongly supported by the observation that hydrogen is evolved when a clot of blood is digested in sulphuric acid, and water is added. Mulder suggests that it occurs as an integral constituent of hæmatin in just the same manner that iodine occurs in sponge, sulphur in cystin, or arsenic in the cacodyl series.

4. The amount of hæmatin in the whole mass of the blood is far too inconsiderable to carry a due supply of oxygen to the whole system.

Having thus shown the principal objections to which Liebig's celebrated theory is open, we shall endeavour briefly to explain the rival theory of Mulder. It is a well-known fact, that the protein-compounds are capable of undergoing oxidation when in contact with the oxygen of the air. When a protein-compound becomes oxidised, it assumes a plastic character, that is to say, it has a tendency to become solid and to adhere to solid substances. It has been already stated that the blood-corpuscles are cells, of which the wall consists of a protein-compound named globulin. When a respiration is performed, the exterior layer of such of the corpuscles as are exposed in the lungs to the action of the air, becomes converted into oxidised protein, it becomes whitish and less transparent. This is the state in which the corpuscles exist in arterial blood. As they reach the capillary system, this white exterior layer is employed in the change of material of the body, and is in that way consumed. Having lost this white layer, they again become transparent. The dark colouring substance in the corpuscles of arterial blood, shining through a white layer, must necessarily appear of a bright red tint, as may be shown by pouring dark red blood into a vessel of milky glass.

The fluid part of the blood called the Serum is a transparent fluid, of a light straw-colour tinged with green. The proportion of it to the solid part of the blood, or Clot, differs in different species of animals. There is a strict relation between its relative proportion and the strength and ferocity, or weakness and gentleness of the animal. It is small in proportion to the power and fierceness of the animal, and large in proportion to its weakness and timidity: thus it is small in the carnivorous animals, and large in the hare, sheep, and so on.

Serum has an adhesive consistence and a saline taste. Its characteristic property is that of coagulating by heat and by the application of certain chemical agents. At the temperature of 160° it is converted into a white opaque solid substance, exactly resembling the white of egg when hardened by boiling, being in fact perfectly pure albumen. Serum contains a quantity of uncombined alkali, for it converts the vegetable colours to green, and it holds in solution various earthy and neutral salts. According to M. Le Canu, who has made the most recent chemical analysis of serum, 1000 parts contain—

Water	906·00
Albumen	78·00
Animal Matter soluble in water and alcohol	1·69
Albumen combined with Soda	2·10
Crystallisable Fatty Matter	1·20
Oily Matter	1·00
Hydrochlorate of Soda and Potash	6·00
Subcarbonate and Phosphate of Soda and Sulphate of Potash	2·10
Phosphate of Lime, Magnesia, and Iron, with Subcarbonate of Lime and Magnesia	·91
Loss	1·00
	1000·00

If a mass of coagulated Serum be cut into small pieces and placed in the mouth of a funnel, a thin fluid drains from it, which is called Serosity, and which constitutes the gravy of meat dressed for the table.

According to M. Le Canu the relative proportions of the constituents of Human Blood to each other, as they exist in most individuals, is as follows, this table being the mean of two analyses:—

1000 parts of Human Blood contain—

Water	783·37
Fibrin	2·83
Albumen	67·25
Colouring Matters	126·31
Fatty Matters in various states	5·16
Various undefined Animal Matters and Salts	15·08
	1000·00

The relative proportion of the different constituents of the blood is constantly varying. Thus the quantity of water, according to M. Le Canu, is capable of varying in 1000 parts from 853·135, the maximum, to 778·625, the minimum. In the male the medium quantity is 791·944, in the female 821·764: the watery proportion also varies with the temperament. In the lymphatic temperament, in the male it is 830·566, in the female 803·716; while in the sanguineous it is, in the male 786·584, and in the female it is 793·007.

The proportion of albumen contained in 1000 parts of blood is capable of varying from 78·270, the maximum, to 57·890, the minimum. The quantity of fibrin varies from 1·360 to 7·236, the medium of twenty-two experiments being 4·298. It appeared to be the greatest in the young or middle aged of the sanguineous temperament and in the inflammatory state; and least in the lymphatic constitution, the aged, and those suffering under congestion and hæmorrhage.

The proportion of the red particles varies more remarkably than that of any other constituent of the blood. In sound health the maximum was found to be in 1000 parts of blood 148·450, and the minimum 68·349; the medium 108·399. In the male, the medium quantity is 132·150, in the female 99·169. It varies considerably with the temperament. In the lymphatic temperament, the medium quantity was found to be, in the male 117·667, in the female 116·300; in the sanguineous temperament, in the male 136·497, in the female 126·174. According to this statement there are contained in 1000 parts of blood, in a sanguineous temperament, 19·830 more red particles than in the lymphatic temperament. Both spontaneous hæmorrhage and the artificial abstraction of blood from the body diminish the relative proportion of the red particles far beyond that of any of the other constituents of the blood. This is found on examination of the blood in the female after an excessive loss of blood; and on examining portions of blood taken from the same body after certain intervals, it was found that a first bleeding furnished in 1000 parts of blood, 792·897 of water, 70·210 of albumen, 9·163 of soluble salts and extraneous matter, and 127·73 of red particles; but a third bleeding a few days afterwards in the same patient, a female, gave 834·053 of water, 71·111 of albumen, 7·329 of soluble salts and extraneous matter, and 87·510 of red particles.

According to analyses more recent than those of Le Canu, the following are the ingredients which are found to be present in healthy blood:—

1.		Water.
2.	Protein-Compounds	Fibrin. Albumen. Globulin. Binoxide and Tritoxide of Protein.
3.	Colouring Matters	Hæmatin. Hæmaphæin.
4.	Fats.	Cholesterin. Serolin. Red and white Solid Fats containing Phosphorus. Margaric Acid. Oleic Acid.
5.		Iron.
6.	Salts.	Albuminate of Soda (?). Phosphates of Lime, Magnesia, and Soda. Sulphate of Potash. Carbonates of Lime, Magnesia, and Soda (?). Chlorides of Sodium and Potassium. Lactate of Soda (?). Oleate and Margarate of Soda (?).
7.	Gases.	Oxygen. Nitrogen. Carbonic Acid.
8.		Urea—a trace.
9.		Sugar—a trace (?).

It will be observed that there are notes of interrogation to several of the salts: the presence of these constituents is denied by Enderlin and Liebig's school generally. Their objection is founded on the circumstance, that if these salts were exposed to a red heat, they would become converted into carbonates; and that the ash obtained from the incineration of blood, if examined directly after the operation, does not contain those salts. As these experiments have been performed under Liebig's personal observation, and have been published in his 'Journal,' and as further they apply equally to almost all the other fluids of the animal body, we shall give the leading grounds on which the presence of alkaline carbonates in the ash is disproved, and its alkalinity is otherwise accounted for:—

1. The ash does not effervesce on the addition of an acid.

2. Hot water poured over the ash becomes alkaline; it holds in solution alkaline phosphates and sulphates, chloride of sodium, and sometimes chloride of potassium, but no other salts.

a. On the addition of a neutral solution of nitrate of silver to this fluid, there is a yellow precipitate which is partly soluble in nitric acid; a portion however consisting of chloride of silver remains undissolved. The addition of nitric acid causes no effervescence. On neutralising the acid filtrate with ammonia, a yellow precipitate of tribasic phosphate of silver ($3\,Ag\,O,\,P_2\,O_5$) is thrown down.

b. On treating the aqueous solution of the ash with a solution of chloride of calcium, there is a copious gelatinous precipitate of phosphate of lime ($3\,Ca\,O,\,P_2\,O_5$) which dissolves in nitric acid without effervescence. On treating this acid solution with nitrate of silver, and neutralising with ammonia, the tribasic phosphate of silver is precipitated as before. The addition of the chloride of calcium neutralises the previously alkaline fluid. From 1, we see that the alkaline reaction is not due to the presence of alkaline carbonates; and 2 shows it is not dependent on the presence of free potash or soda, for otherwise the fluid would not be neutralised by the chloride of calcium. Hence the albumen in the blood cannot exist as a soda compound (albuminate of soda); neither can there be alkaline lactates, acetates, nor fatty-acid salts in that fluid. On the above grounds Enderlin conceives that we are justified in assuming that the alkaline reaction of the ash is dependent on the presence of tribasic phosphate of soda ($3\,Na\,O,\,P_2\,O_5$); and as this is the only salt that remains tribasic at a red heat, he concludes that the alkalinity of the blood, as well as of the ash, is dependent on it. The manner in which he accounts for the occurrence of carbonates in the analyses of other chemists is very plausible. On exposing the tribasic phosphate of soda to the atmosphere, it becomes converted into $2\,Na\,O,\,H\,O,\,P_2\,O_5$, and $Na\,O,\,C\,O_2$, or phosphate of soda, in which one atom of the base is replaced by an atom of water and carbonate of soda.

This question regarding the salts actually occurring in the blood is however far from settled, Ludwig having positively denied Enderlin's statements. (Day's 'Report on the Progress of Chemistry,' in Ranking's 'Half-Yearly Abstract of the Medical Sciences,' vol. iii., 1846.)

Generally speaking it is only requisite in the analysis of the blood, to determine a few of the most important constituents; as, for instance, the water, fibrin, blood-corpuscles (globulin and hæmatin), and the solid residue of the serum (the organic portion and the salts). For this purpose we may adopt the following simple plan lately published by Figuier. It is based on the fact made known many years ago by Berzelius, that after the addition of a solution of a neutral salt to defibrinated blood, the globules do not (as before) pass through filtering paper. On the addition of two parts of a solution of sulphate of soda of specific gravity 1.130 to one of blood, Figuier found that the whole of the corpuscles remained on the surface of the filter. The following are the steps of his analysis:—The fibrin is removed by stirring, dried, and weighed; the weight of the corpuscles is ascertained by the method indicated, and that of the albumen by coagulating by means of heat the filtered solution. The proportion of water is known by evaporating a small known weight of the blood. The filter containing the corpuscles should be dipped in boiling water, which removes any sulphate of soda that may be present, and at the same time renders the corpuscles insoluble. Separate and frequently difficult processes are requisite to detect those ingredients which occur in small quantity or only in morbid conditions.

With regard to the distinctions between Arterial and Venous Blood, we have already noticed the circumstance that the external envelope of the blood-corpuscles becomes converted during the act of respiration into oxidised protein, and that the bright-red colour of arterial blood is owing in part to the modifying influence of the white investing membrane. But there is yet another mode in which it acts. The buffy coat, which is the name given to the superimposed layer of fibrin in the clot, is frequently observed on the upper part of the clot in inflammatory diseases as being very apt to curl up and become concave. Now this buffy coat consists, for the most part, of the oxides of protein—of the very same matter with which the blood-corpuscles become invested. For this reason the form assumed by the two laminæ on both sides of the little flat body—the corpuscle—must resemble that of the buffy coat. The tendency to contract and become bi-concave is so strong, that the central portion of the crust becomes entirely depressed. In this form the corpuscles reflect a great deal more light than when, in consequence of the removal of the buffy coat in the capillaries, they have a less bi-concave form.

From four analyses of the blood of horses, Simon deduces the following rule regarding the chemical differences of arterial and venous blood:—"Arterial contains less solid residue generally than venous blood; it contains less fat, less albumen, less hæmatin, less extractive matter and salts, than venous blood. The blood-corpuscles of arterial blood contain less colouring matter than those of venous blood."

The arterial blood was taken from the carotids, and the venous from the jugulars.

In a medical point of view the composition of venous blood is the most interesting, because it is from the veins that blood is almost always taken in disease, and because venous blood can naturally only be compared with venous blood for the purpose of ascertaining any deviations that may occur. The following table represents the mean composition of human venous blood without reference to sex:—

Water	795·278
Solid Constituents	204·022
Fibrin	2·104
Fat	2·346
Albumen	76·660
Globulin	103·022
Hæmatin	6·209
Extractive Matters and Salts	12·012

100 parts of blood-corpuscles contain 5·7 of hæmatin.

Hence the blood contains about 20 per cent. of solid constituents, much more than 0·2 per cent. of fibrin, and about an equal quantity of fat; the blood-corpuscles considerably exceed the albumen in quantity, and contain about 5 or 6 per cent. of colouring matter.

The blood undergoes various modifications in different forms of disease. The extent of these variations is obvious from the following table, drawn up from Simon's 'Animal Chemistry,' vol. i., p. 246.

The Water may vary from	915·0	to	725·0
The Solid Residue "	275·0	to	85·0
The Fibrin "	10·3	to	a trace.
The Fat "	4·3	to	0·7
The Albumen "	131·0	to	55·1
The Globulin "	106·6	to	30·8
The Hæmatin "	8·7	to	1·4
The Extractive Matters and Salts	16·5	to	7·6

The following synopsis will give an idea of the distribution of the constituents of the blood.

Water		790·37	Serum	869·15
Albumen		67·80		
Oxygen, Nitrogen, Carbonic Acid, Extractive Matter, Fatty Matter, Salts, Colouring Matter		10·98		
Fibrin		2·95	Clot	130·85
Hæmatin 2·27; Globulin 125·63	Blood corpuscles	127·90		
		1000·00		1000·00

It will be seen from the previous account that the blood is one of the most important constituents of the body. It is in fact the prime source of life, and is the great medium through which the constituents of the body pass in their way from the vegetable and mineral kingdoms to become part and parcel of the tissues of the body. The food is taken up from the intestines [FOOD] by the lacteals, and is converted into blood before it is appropriated in the tissues of the body. The correspondence between the flesh or tissues of the body and the blood may be seen in the following statement of the ultimate composition of the two.

	Flesh.	Blood.
Carbon	51·86	51·96
Hydrogen	7·58	7·25
Nitrogen	15·03	15·07
Oxygen	21·30	21·30
Ash	4·23	4·42

The blood is not only the source whence the tissues are supplied with the fresh materials for their growth, but it is the means by which effete matters are thrown off from the system. The constituents of the bile, the urine, the perspiration, the expired air from the lungs, are all found in the blood, and separated from it by the liver, kidneys, skin, and lungs. The changes involved in the formation of these excretions are some of them important to life, as that of carbonic acid gas during respiration [RESPIRATION], which is attended with the development of animal heat.

Any interruption or impediment to the performance of the functions of the blood is attended with disease. This has long been suspected, but it is only since the employment of the microscope and chemical analysis that any advance has been made in studying the relation of abnormal conditions of the blood to particular diseases of the body.

(Hunter, *On the Blood*; Sharpey, *Quain's Anatomy*, vol. i.; Simon, *Animal Chemistry*, translated by Day; Milne-Edwards, article '*Blood*,' in *Cyclopædia of Anatomy and Physiology*; Lehmann, *Physiological Chemistry*, translated by Day; Liebig, *Animal Chemistry*; Carpenter, *Human Physiology*). [*See* SUPPLEMENT.]

BLOOD-HOUND, the name of a hound celebrated for its exquisite scent and unwearied perseverance, qualities which were taken advantage of, by training it not only to the pursuit of game, but to the chase of man. A true Blood-Hound (and the pure blood is rare) stands about 28 inches in height, muscular, compact, and strong; the forehead is broad, and the face narrow towards the muzzle; the nostrils are wide and well developed; the ears are large, pendulous, and broad at the base; the aspect is serene and sagacious; the tail is long, with an upward curve when in pursuit, at which time the hound opens with a voice deep and sonorous, that may be heard down the wind for a very long distance.

The colour of the true breed is stated to be almost invariably a reddish-tan, darkening gradually towards the upper parts till it becomes mixed with black on the back; the lower parts, limbs, and tail being of a lighter shade, and the muzzle tawny. Pennant adds, "a black spot over each eye," but the blood-hounds in the possession of Thomas Astle, Esq. (and they were said to have been of the original blood) had not these marks. Some, but such instances were not common, had a little white about them, such as a star in the face, &c. The better opinion is, that the original stock was a mixture of the deep-mouthed southern hound, and the powerful old English stag-hound.

Gervase Markham, in his 'Maison Rustique,' speaking of hounds, says:—"The baie-coloured ones have the second place for goodnesse, and are of great courage, ventring far, and of a quicke scent, finding out very well the turnes and windings . . . . . they runne surely, and with great boldnesse, commonly loving the stagge more than any other beast, but they make no account of hares. It is true, that they be more head-strong and harde to reclaime than the white, and put men to more paine and travaill about the same. The best of the fallow sort of dogges are those which are of a brighter haire, drawing more unto the colour of red, and having therewithall a white spot in the forehead, or in the necke, in like manner those which are all fallow: but such as incline to a light yellow colour, being graie or blacke spotted, are nothing worth: such as are trussed up and have dewclawes, are good to make bloud-hounds."

Our ancestors soon discovered the infallibility of the Blood-Hound in tracing any animal, living or dead, to its resting place. To train it the young dog acccompanied by a staunch old hound was led to the spot whence a deer or other animal had been taken on for a mile or two; the hounds were then laid on and encouraged, and after hunting this 'drag' successfully, were rewarded with a portion of the venison which composed it. The next step was to take the young dog, with his seasoned tutor, to a spot whence a man whose shoes had been rubbed with the blood of a deer had started on a circuit of two or three miles: during his progress the man was instructed to renew the blood from time to time, to keep the scent well alive. His circuit was gradually enlarged at each succeeding lesson, and the young hound, thus entered and trained, became at last fully equal to hunt by itself, either for the purposes of wood-craft, war, or 'following gear,' as the pursuit after the property plundered in a border foray was termed. Indeed, the name of this variety of *Canis domesticus*, to which Linnæus applied the name of *sagax*, cannot be mentioned without calling up visions of feudal castles with their train of knights and warders, and all the stirring events of those old times when the best tenure was that of the strong hand.

Sir Walter Scott gives a striking reality to the scene, when he makes the moss-trooper, William of Deloraine, who had "baffled Percy's best blood-hounds," allude to the pleasure of the chace, though he himself was the object of pursuit, in pronouncing his eulogy over Richard Musgrave.

In the same 'Lay of the Last Minstrel' there is one of the best poetical descriptions of the blood-hound in action, if not the best; for though Somerville's lines may enter more into detail, they want the vivid animation of the images brought absolutely under the eye by the power of Scott, where the "noble child," the heir of Branksome, is left alone in his terror.

Indeed this feudal dog is frequently introduced by our poet, from his ballads, where Smaylho'me's Lady gay, wooing the Phantom Knight to come to her bower, in the 'Eve of St. John,' tells the spectre that she will "chain the blood-hound," down to that grand moonlight scene in the 'Legend of Montrose,' where Dalgetty and Ranald of the Mist are traced to their wood-girt retreat after their escape from Argyle's dungeons.

The pursuit of border forayers was called the 'hot-trod.' The 'harried' party and his friends followed the marauders with blood-hound and bugle-horn, and if his dog could trace the scent into the opposite kingdom he was entitled to pursue them thither.

Sir Walter Scott states that the breed was kept up by the Buccleuch family on their border estates till within the 18th century, and records the following narrative:—"A person was alive in the memory of man who remembered a blood-hound being kept at Eldinhope, in Ettricke Forest, for whose maintenance the tenant had an allowance of meal. At that time the sheep were always watched at night. Upon one occasion, when the duty had fallen upon the narrator, then a lad, he became exhausted with fatigue, and fell asleep upon a bank, near sun-rising. Suddenly he was awakened by the tread of horses, and saw five men well mounted and armed ride briskly over the edge of the hill. They stopped and looked at the flock; but the day was too far broken to admit the chance of their carrying any of them off. One of them, in spite, leaped from his horse, and coming to the shepherd seized him by the belt he wore round his waist; and setting his foot upon his body pulled it till it broke, and carried it away with him. They rode off at the gallop; and the shepherd giving the alarm, the blood-hound was turned loose, and the people in the neighbourhood alarmed. The marauders, however, escaped, notwithstanding a sharp pursuit. This circumstance serves to show how very long the license of the Borderers continued in some degree to manifest itself."

This, perhaps, is the last instance of an attempted 'Border foray' on record. The times were changed. The nobles had ceased to pride themselves on their ignorance of all the arts save the art of war, and to make it matter of thanksgiving that they knew not how to use the pen. Civilisation advanced as learning was diffused, till the law of the strongest no longer prevailed against the law of the land. The Blood-Hound, from the nobler pursuit of heroes and knights, 'minions of the moon,' who swept away the cattle and goods of whole districts, marking the extent of their 'raid' by all the horrors of fire and sword, sank to the tracker of the deer-stealer and petty felon. About a century and a quarter ago, when deer-stealing was a common crime, the park-keepers relied upon their blood-hounds principally for detecting the thief; and so adroit were these dogs, that when one of them was fairly laid on, the escape of the criminal was with good reason considered to be all but impossible. Even now the breed still lingers about some of the great deer-parks; and many of our readers will remember the noble specimen at Richmond Park, bearing the name of Procter, and the admirable study of his head engraved by T. Landseer from a painting by his brother Edwin. Another of this race has been perpetuated by Sir Edwin Landseer. It belonged to Jacob Bell, Esq., and was killed by jumping out of a window, and its accidental death is perpetuated by the artist having drawn it after death as though sleeping.

This noble variety is now only kept as an object of curiosity and ornament; for its services have long since been superseded by the justice's warrant and the police-officer. We find it, indeed, recorded about 50 years ago, that "the Thrapston association for the prevention of felons in Northamptonshire have provided and trained a blood-hound for the detection of sheep-stealers. To demonstrate the unerring infallibility of this animal a day was appointed for public trial; the person he was intended to hunt started, in the presence of a great concourse of people, about 10 o'clock in the forenoon, and at 11 o'clock the hound was laid on. After a chase of an hour and a half, notwithstanding a very indifferent scent, the hound ran up to a tree in which he was secreted, at the distance of 15 miles from the place of starting, to the admiration and perfect satisfaction of the very great number assembled upon the occasion." But this may be considered more in the light of a proceeding 'in terrorem' than anything else.

Strong and hardy as the Blood-Hound seems to be, it is unable, apparently, to encounter a low temperature. Mr. Lloyd, in his 'Field Sports,' relates that one presented to him by Mr. Otway Cave was entirely paralysed by the piercing cold of the northern regions which were the scene of his exploits.

English Blood-Hound.

Cuban Blood-Hound.—The reputation which this variety has obtained for sagacity and fierceness, and the share that the terror of its name had in extinguishing the last Maroon war in Jamaica, render it an object of some interest. In 1733 these Maroons had become very troublesome, and the Assembly, among other plans for suppressing them, appointed garrisons, from whose barracks excursions were from time to time made against the insurgents. "Every barrack," says Bryan Edwards, "was also furnished with a pack of dogs, provided by the churchwardens of the respective parishes, it being foreseen that these animals would prove extremely serviceable, not only in guarding against surprises in the night but in tracking the enemy." The tiresome war went on however, till at last articles of pacification with the Maroons of Trelawney town were concluded on the 1st of March, 1738. This alliance continued, not without frequent complaints of the conduct of the Maroons, till July, 1795, when two of these people from Trelawney town, having been found guilty by a jury of stealing some pigs, were sentenced to receive thirty-nine lashes each, and the sentence was executed. On their return to Trelawney town their account drove the Maroons into open revolt, and a bloody and successful war was waged by these savages against the whole force that the government could direct against them.

At last the Assembly, in the month of September, remembering the expedient of employing dogs previous to the treaty of 1738, resolved to send to the island of Cuba for 100 blood-hounds, and to engage a sufficient number of Spanish huntsmen to direct their operations. The employment, according to Edwards, to which these dogs are generally put by the Spaniards is the pursuit of wild bullocks, which they slaughter for the hides; and the great use of the dogs is to drive the cattle from such heights and recesses in the mountainous parts of the country as are least accessible to the hunters. This determination of the Assembly was not made without some opposition. After much discussion it was determined to send for the dogs, and at last after several delays the commissioner, who had been dispatched to the Havanna, arrived at Montego Bay on the 14th of December with forty chasseurs, or Spanish hunters, chiefly people of colour, and about 100 Spanish dogs.

Dallas, in his 'History of the Maroons,' gives the following account of the first appearance of these dogs before the commander-in-chief:—"Anxious to review the chasseurs, General Walpole left head-quarters the morning after they were landed before day-break, and arrived in a post-chaise at Seven Rivers, accompanied by Colonel Skinner, whom he appointed to conduct the intended attack. Notice of his coming having preceded him, a parade of the chasseurs was ordered; and they were taken to a distance from the house, in order to be advanced when the general alighted. On his arrival the commissioner having paid his respects was desired to parade them. The Spaniards soon appeared at the end of a gentle acclivity, drawn out in a line containing upwards of forty men, with their dogs in front unmuzzled, and held by cotton ropes. On receiving the command 'fire,' they discharged their fusils and advanced as upon a real attack. This was intended to ascertain what effect would be produced on the dogs if engaged under a fire of the Maroons. The volley was no sooner discharged than the dogs rushed forward with the greatest fury, amid the shouts of the Spaniards, who were dragged on by them with irresistible force. Some of the dogs maddened by the shout of attack, while held back by the ropes, seized on the stocks of the guns in the hands of their keepers and tore pieces out of them. Their impetuosity was so great that they were with difficulty stopped before they reached the general, who found it necessary to get expeditiously into the chaise from which he had alighted; and if the most strenuous exertions had not been made to stop them, they would most certainly have seized upon his horses."

This scene was well got up, and it had its effect. General Walpole was ordered to advance on the 14th of January following, with his Spanish dogs in the rear. Their fame however had reached the Maroons, and the general had penetrated but a short way into the woods when a supplication for mercy was brought from the enemy, and 260 of them soon afterwards surrendered on no other condition than a promise of their lives.

It is stated that these dogs when properly trained will not kill or harm the pursued unless they are resisted. "On reaching a fugitive they bark at him till he stops, and then couch near him, terrifying him with a ferocious growling if he stirs. They then bark at intervals to give notice to the chasseurs, till they come up and secure their prisoner."

Dallas however, who had his information from the commissioner himself, William Dawes Quarrell, to whom his work is dedicated, gives a description and representation of one of these Spanish chasseurs with his dogs; and he relates the following instances of the strength and determined ferocity of the latter:—

"The party had scarcely erected their huts when the barking of a dog was heard near them. They got immediately under arms, and proceeding in the direction of the sound discovered a negro endeavouring to make his escape. One of the Spanish dogs was sent after him On coming up the negro cut him twice with his muschet,* on which the dog seized him by the nape of the neck and secured him. He proved to be a runaway—said that he and two other negroes had deserted the Maroons a few days before, and that the party was at a great distance from the town, but that he would conduct them to it by noon next day."

In the next anecdote recorded by Dallas the attack was fatal both

* A long straight muschet, or couteau, longer than a dragoon's sword, and twice as thick, something like a flat iron bar sharpened at the lower end, of which about eighteen inches are as sharp as a razor. The point is not unlike the old Roman sword. Such is Dallas's description of the chasseur's muschet.

to the unhappy object of it and to the dog:—"One of the dogs that had been unmuzzled to drink when there was not the least apprehension of any mischief, went up to an old woman who was sitting attending to a pot in which she was preparing a mess. The dog smelled at it and was troublesome; this provoked her; she took up a stick and

Chasseur with Cuban Blood-Hounds.

began to beat him, on which he seized on her throat, which he would not let go till his head was severed from his body by his master. The windpipe of the woman being much torn, she could not be saved."

A dog and a bitch, said to be of the true Cuban Blood-Hound breed, were some years ago brought to this country, where soon after their arrival the bitch littered ten pups, one of them deformed. The figure here given is from one of these pups, which had not attained its full growth. They are shorter on their legs than the English variety; the muzzle is shorter, and the animal is altogether smaller, with less of the hound about it than the English Blood-Hound has; the height is about

Cuban Blood-Hound.

two feet; the colour generally tawny, with black about the muzzle, or brindled like some of the Ban-Dogs. They show great attachment, and are very gentle till seriously provoked, and then their ferocity is alarming.

In Cuba the common employment of these dogs was to traverse the country in pursuit of murderers and other felons, and an extraordinary proof of their activity is recorded by Dallas, who states that the event occurred about a month before the arrival of the commissioner at the Havanna. A fleet from Jamaica, under convoy to Great Britain, passing through the Gulf of Mexico, beat up on the north side of Cuba. One of the ships, manned with foreigners, chiefly renegado Spaniards, being a dull sailer, and consequently lagging astern, standing in with the land at night, was run on shore, the captain, officers, and the few British hands on board murdered, and the vessel plundered by the Spanish renegadoes. The part of the coast on which the ship was stranded being wild and unfrequented, the assassins retired with their booty to the mountains, intending to penetrate through the woods to some remote settlements on the south side, where they hoped to secure themselves and elude all pursuit. Early intelligence of the crime however had been conveyed to the Havanna, and the assassins were pursued by a detachment of twelve of the Chasseurs del Rey with their dogs. In a few days the criminals were all brought in and executed, not one of them being in the least hurt by the dogs when captured.

African Blood-Hound.—On his return from Africa the late Colonel Denham, then major, presented two dogs and a bitch of this variety to the royal menagerie in the Tower, which, under the care of the keeper, Mr. Cops, then contained a very choice collection of animals,

African Blood-Hound.

recorded in that interesting publication 'The Tower Menagerie, London, 8vo, 1829. The Major informed Mr. Cops that with them he hunted the gazelle, and that they displayed great cunning, frequently quitting the circuitous line of scent for the purpose of cutting off a double, and recovering the scent again with ease. They would hit off and follow a scent after a lapse of two hours from the time when the animal had been on the spot, and this delicacy of nose had not escaped observation, for they were applied to nearly the same purposes as the other varieties here mentioned, and were commonly employed in Africa to trace a flying enemy to his retreat. It is well remarked in the work last above mentioned that for symmetry and action they were perfect models, and a regret is expressed that in consequence of their not having shown any disposition to perpetuate their race, though they had at the time of making the observation been three years in England, there appeared to be no chance of crossing our pointers with this breed. We agree with the writer in thinking that this blood so introduced would be a very valuable acquisition. It was remarked that of the three in the Tower the males were very mild, but the female was of a very savage disposition.

BLOODSTONE, also called *Heliotrope*, is a deep green stone—a jaspery variety of Quartz. It has obtained its name from being spotted with red so as to resemble drops of blood. In addition to silica it contains oxide of iron and clay, which are mechanically introduced, and in this way the red spots are produced. In the royal collection at Paris there is a bust of Christ in this stone, so managed that the red spots represent drops of blood. (Dana, *Mineralogy*.)

BLOOD-VESSELS. The blood from which the tissues of the body obtain the material of their nourishment is conveyed from one part of the body to another by means of branched tubes which are named Blood-Vessels. It is carried along these vessels by the impulse given by the action of the Heart. [HEART.] The vessels which carry the blood from the heart are called Arteries. [ARTERY.] Those which return the blood to the heart are named Veins. [VEIN.] Whilst a very generally diffused network of Blood-Vessels exist, connecting the arteries and veins, which are called Capillaries. [CAPILLARY VESSELS.]

The Blood-Vessels, whatever may be their ultimate destination, seem to originate in the same manner. Observations on this subject have been made by Schwann and Kölliker in Germany, and by Professor Paget in this country. The observations of the two former were made on the development of the vessels in the germinal membrane of the egg, and on the capillary blood-vessels of the tail of the larva of a frog. Mr. Paget's observations were made on the tissues of the fœtal sheep. According to these observers it appears that these vessels originate from nucleated cells similar to those which at first constitute the different parts of the embryo. The cell-wall or external envelope of these cells shoots out into slender pointed processes, such as is seen in the forms of stellate vegetable tissue. The projections from neighbouring cells encounter each other, and becoming organically united, the intervening walls between the two projections are absorbed, and thus a continuous tube is produced. In cases where new vessels are produced in the neighbourhood of old ones, the stellate cells are formed in the new part, and projections are formed in the old capillary vessels which unite with the new ones, and thus the circulation is re-established. The projections when first united are solid and very slender, but eventually the intervening substance disappears and the vessels attain a uniform calibre. In growing parts where the web of vessels is kept up, new ones are constantly being added by the development of stellate cells in the interstices of the previous web. Whilst the capillaries early attain the development at which they remain, those vessels which are to become arteries or veins on either side of the capillary vessels go on increasing in size till they acquire the special membranes or coats which distinguish these parts of the circulating system. This explanation seems however only applicable to the smaller veins and arteries, as the observations of Kölliker would seem to show that the larger Blood-Vessels may take their origin in the same manner as the heart, in which organ there is first an agglomeration of cells, the interior ones of which become soft, and at last disappear, whilst the outside ones become firmer and constitute the outer walls. On this subject further observations are wanting.

(Sharpey, *Quain's Elements of Anatomy;* Schwann, *Microscopical Researches into the Accordance in the Structure and Growth of Animals and Plants,* translated by H. Smith; Kölliker, *Handbuch der Gewebelehre der Menschen;* Paget, *Supplement to Müller's Physiology,* by Baley and Kirkes.)

BLUE-BIRD, the American name for the *Motacilla sialis* of Linnæus, *Sylvia sialis* of Wilson, *Saxicola sialis* of Bonaparte, *Ampelis sialis* of Nuttall, and *Erythaca* (*Sialia*) *Wilsonii* of Swainson.

Blue-Bird (*Motacilla sialis*).

Like our red-breast this harbinger of spring to the Americans "is known to almost every child, and shows," says Wilson, "as much confidence in man by associating with him in summer, as the other by his familiarity in winter.

"So early as the middle of February, if the weather be open, he usually makes his appearance about his old haunts, the barn, orchard, and fence-posts. Storms and deep snows sometimes succeeding, he disappears for a time; but about the middle of March is again seen accompanied by his mate visiting the box in the garden or the hole in the old apple-tree, the cradle of some generations of his ancestors." . . . . "When he first begins his amours," says a curious and correct observer, "it is pleasing to behold his courtship, his solicitude to please and to secure the favour of his beloved female. He uses the tenderest expressions, sits close by her, caresses and sings to her his most endearing warblings. When seated together if he espies an insect delicious to her taste he takes it up, flies with it to her, spreads his wing over her, and puts it in her mouth."

The food of the Blue-Bird consists principally of insects, particularly large beetles and other *Coleoptera*, frequently of spiders, and sometimes of fruits and seeds.

The nest is built in holes in trees and similar situations. The bird is very prolific, for though the eggs, which are of a pale-blue colour, seldom exceed six, and are more frequently five in number, two and sometimes three broods are produced in a season.

Its song is cheerful, continuing with little interruption from March to October, but is most frequently heard in the serene days of the spring.

With regard to its geographical distribution, Catesby says:—"These birds are common in most parts of North America, for I have seen them in Carolina, Virginia, Maryland, and the Bermuda Islands." Wilson gives the United States, the Bahamas, Mexico, Brazil, and Guyana, as its localities. About November it takes its departure from the United States.

The whole upper part of the bird, which is about 7½ inches long, is of a rich sky-blue shot with purple; the bill and legs are black; shafts of the wing and tail feathers black; throat, neck, breast, and sides, partially under the wings, reddish chestnut; wings dusky-black at the tips; belly and vent white. The female is duller in its colours. It is said to be much infested with tape-worms.

BLUE-BOTTLE. [CENTAUREA.]

BLUE-BREAST, one of the English names for this pretty bird, which, as Bechstein observes, may be considered as the link between the Redstart and Common Wagtail, having strong points of resemblance to both. It is also called Blue-Throated Robin and Blue-Throated Redstart. It is the Gorge-Bleue of the French, the Blaukehlein of the Germans, Petto Turchino of the Italians, the *Cyanecula* of Brisson, *Motacilla Suecica* of Linnæus, *Sylvia cyanecula* of Meyer, the Blue-Throated Warbler and *Sylvia Suecica* of Latham, *Phœnicena Suecica* of Gould, *Ficedula Suecica* of Eyton.

Blue-Breast (*Motacilla Suecica*).

According to Temminck the Blue-Breast is found in the same countries which are inhabited by the Red-Breast, and particularly on the borders of forests, but is more rare in France and Holland than the latter bird. Bonaparte notes it as accidental and very rare in the neighbourhood of Rome, and as only appearing in severe winters. In England it is very rarely seen. Yarrell in his 'British Birds' records four instances of its having been shot in England.

The food of the Blue-Breast, according to Temminck, consists of flies, the larvæ of insects, and worms. Bechstein says that it also eats elder-berries. It is one of those unfortunate birds which is called by some a Beccafico. The nest is said to be built in bushes and in the holes of trees. The eggs, of a greenish-blue, are six in number.

The following is Bechstein's accurate description of the male:—"Its length is 5½ inches, of which the tail occupies 2¼ inches. The beak is sharp and blackish, yellow at the angles; the iris is brown; the shanks are 14 lines high, of a reddish-brown, and the toes blackish; the head, the back, and the wing-coverts are ashy-brown, mottled with a darker tint; a reddish-white line passes above the eyes; the cheeks are dark-brown, spotted with rust-red and edged at the side with deep ash-gray; a brilliant sky-blue covers the throat and half-way down the breast; this is set off by a spot of the most dazzling white, the size of a pea, placed precisely over the larynx, which enlarging and diminishing successively by the movement of this part when the bird sings produces the most beautiful effect. The blue passes into a black band, and the latter into a fine orange; the belly is dusky-white, yellowish towards the vent; the thighs and sides are reddish; the quill-feathers dark-brown; the tail-feathers red at the base, and half the summit black; the two intermediate ones are entirely dark-brown. Some males have two little white spots on the throat, some even have three while others have none; these latter are probably very old, for I have observed that as the bird grows older the blue deepens and the orange band becomes almost maroon."

The female resembles the male in the upper parts. On each side of the neck is a blackish longitudinal streak passing on the upper parts of the breast into a large blackish space tinged with ash-colour. On the middle of the neck is a great spot of pure white. Flanks clouded with olive, the rest of the lower parts white. The very old females have the throat sometimes of a very bright blue. This is probably a sign that they have done laying, and are putting on the plumage of the male. Bechstein says that the females when young are of a celestial blue tint on the sides of the throat, which deepens with age and forms the two longitudinal lines.

The young, according to Temminck, are brown spotted with white, and have all a large white space upon the throat. "Its song," says Bechstein, "is very agreeable; it sounds like two voices at once; one deep, resembling the gentle humming of a violin string, the other the soft sound of a flute."

BLUMENBA'CHIUM, a genus of Fossil Alcyonoid *Polypiaria*, proposed by Dr. König.

BLYSMUS, a genus of plants belonging to the natural order *Cyperaceæ*. The glumes are fertile, the outermost the largest and empty; bristles three to six; style not thickened at the base, persistent, but plano-convex, tipped with the undilated base of the style; the spikelets bracteated, alternate, forming a close distichous compound terminal spike. Two species of this inconspicuous genus are found in Great Britain. *B. compressus* is found in boggy pastures in England and Scotland. *B. rufus* inhabits marshes near the sea on the northern and western coasts. (Babington, *Manual.*)

BOA, a name applied to various forms of large Snakes. The species to which this name has been given are mostly included in the family *Boidæ*. [BOIDÆ.]

BOAR-FISH. [CAPROS.]

BOA'RMIA, a genus of Moths of the family *Geometridæ*. All the species of this genus are of an ashy colour, or white minutely dotted with brown, and adorned with several fasciæ of a deeper colour; the antennæ of the males, instead of being pectinated, a character common in the *Geometridæ*, are pilose; palpi short, clothed with short scales, three-jointed, the two basal joints of equal length, the terminal joint concealed; antennæ simple in the females; thorax small, velvety; wings, when at rest, placed horizontally; body slender in the males, in the females shorter and more robust.

Mr. Stephens, in his 'Illustrations of British Entomology,' enumerates seven species of this genus, most of which are found in woods in the neighbourhood of London.

BOAT-BILL, the English name for the genus *Cochlearius* of Brisson, *Cancroma* of Linnæus, Les Savacous of the French.

This genus of the family *Ardeidæ* (Heron-like Birds) would approach quite closely, as Cuvier observes, to the herons [ARDEA] in regard to their bill and the kind of food which it indicates, were it not for the extraordinary form of that organ, which is nevertheless, when closely observed, the bill of a heron or a bittern very much flattened out. This bill is of an oval form, longer than the head, very much depressed, and not unlike the bowls of two spoons placed one upon the other, with the rims in contact. The mandibles are strong, with sharp edges, and dilated towards the middle. The upper mandible is carinated, and hooked at its point, which has a small tooth or notch on each side of it. The lower mandible is flatter than the upper, straight, membranous in the centre, and terminated by a sharp point. The nostrils are oblique, longitudinal, and closed.

The first quill is short; the five next are the longest. The feet are furnished with four toes, all long, and almost without membranes.

Though zoologists have described more than one species, it appears that they may be referred to the only species yet known, *Cochlearius fuscus* of Brisson, *Cancroma cochlearia* of Linnæus, Le Savacou of Buffon, the differences on which *Cancroma cancrophaga* (Linnæus, &c.) is founded not being allowed to be specific. Leach, in his 'Zoological Miscellany,' figures and describes the common Boat-Bill under the title of *Cancroma vulgaris*, but assigns no reason for altering the specific name given by Linnæus.

The common Boat-Bill is about the size of a domestic hen. In the male, the forehead and upper parts of the neck and breast are dirty white; the back and lower part of the belly rusty-reddish; the bill is black, and the legs and feet are brown. From the head depends a long crest of black feathers, falling backwards. The female has the top of the head black, without the elongated crest; the back and the belly rusty-reddish; the wings gray; the forehead and rest of the plumage white; and the bill, legs, and feet, brown.

"This species," says Latham, in his 'Synopsis,' "for I refer all that has been treated of above to one only, inhabits Cayenne, Guyana, and Brazil, and chiefly frequents such parts as are near the water. In such places it perches on the trees which hang over the streams, and, like the kingfisher, drops down on the fish which swim beneath. It has been thought to live on crabs likewise, whence the Linnæan name; but this is not clear, though it cannot be denied; yet we are certain that fish is the most common, if not the only food."

Lesson ('Manuel') says, "The Boat-Bill perches on trees by the side of rivers, where it lives on fish, and not on crabs, as its name indicates;" and speaks of it as inhabiting the inundated savannahs of South America, and as being especially common in Guyana.

Boat-Bill (*Cancroma cochlearia*), male.

Leach ('Zoological Miscellany') says that it inhabits Southern America, and feeds on fishes, *vermes*, and *crustacea*, in quest of which it is continually traversing the borders of the sea.

Cuvier ('Règne Animal') says that it inhabits the warm and moist parts of South America, and perches on trees by the side of rivers, whence it precipitates itself on the fish which afford its ordinary nourishment.

BOB-O-LINK, or BOB-LINK, the usual name by which the Rice-Bird, or Reed-Bird—the Skunk-Bird, Seecawk-Petheesew of the Cree

Bob-o-Link (*Dolichonyx orizyvorus*).

Indians, the Rice-Bunting of Pennant and of Wilson, Rice-Troopial of authors, *Hortulanus Carolinensis* of Catesby, *Emberiza orizyvora* of Linnæus, *Icteria agripennis* of Bonaparte, *Dolichonyx orizyvorus* of Swainson—is known in the United States.

Catesby, Wilson, Audubon, and Nuttall give the most complete accounts of this well-known bird:—"The whole continent of America," says the latter, "from Labrador to Mexico and the great Antilles, are the occasional residence of this truly migratory species. About the middle of March, or beginning of April, the cheerful Bob-o-Link makes his appearance in the southern extremity of the United States, becoming gradually arrayed in his nuptial livery, and accompanied by troops of his companions, who often precede the arrival of their more tardy mates." (Bartram's 'Travels,' p. 295, edit. Lond.) "Their wintering resort appears to be rather the West Indies than the tropical continent, as their migrations are observed to take place generally to the east of Louisiana, where their visits are rare and irregular." (Audubon's 'Ornithological Biography,' vol. i. p. 283.) At this season also they make their approaches chiefly by night, obeying as it were more distinctly the mandates of an overruling instinct, which prompts them to seek out their natal regions; while in autumn their progress, by day only, is alone instigated by the natural quest of food. About the 1st of May the meadows of Massachusetts begin to re-echo their lively ditty. At this season in wet places, and by newly-ploughed fields, they destroy many insects and their larvæ; but while on their way through the southern states they cannot resist the temptation of feeding on the early wheat and tender barley. According to their success in this way parties often delay their final northern movement as late as the middle of May, so that they appear to be in no haste to arrive at their destination at any exact period. The principal business of their lives however, the rearing of their young, does not take place until they have left the parallel of the 40th degree. In the savannahs of Ohio and Michigan, and the cool grassy meadows of New York, Canada, and New England, they fix their abode, and obtain a sufficiency of food throughout the summer without molesting the harvest of the farmer until the ripening of the latest crops of oats and barley, when in their autumnal and changed dress, hardly known now as the same species, they sometimes show their taste for plunder, and flock together like the greedy and predatory blackbirds.

The song of the male generally ceases about the first week in July, and about the same time his variegated dress, which from a resemblance in its colours to that of the quadruped obtained for it the name of 'Skunk-Bird' among the Cree Indians, is exchanged for the sombre hues of the plumage of the female. The author above quoted thus describes the autumnal migration:—

"About the middle of August, in congregating numbers, divested already of all selective attachment, vast foraging parties enter New York and Pennsylvania on their way to the south. Here along the shores of the large rivers, lined with floating fields of the Wild Rice (*Zizania*), they find an abundant means of subsistence during their short stay; and as their flesh, now fat, is little inferior to that of the European ortolan, the reed- or rice-birds, as they are then called in their sparrow dress, form a favourite sport for gunners of all descriptions, who turn out on the occasion and commit prodigious havoc among the almost silent and greedy roosting throng. The markets are then filled with this delicious game, and the pursuit, both for success and amusement along the picturesque and reedy shores of the Delaware and other rivers, is second to none but that of rail-shooting. As soon as the cool nights of October commence, and as the wild rice-crops begin to fail, the reed-birds take their departure from Pennsylvania and New Jersey, and in their further progress through the southern states they swarm in the rice-fields; and before the crop is gathered they have already made their appearance in the islands of Cuba and Jamaica, where they also feed on the seeds of the Guinea Grass (*Sorghum*), becoming so fat as to deserve the name of 'Butter-Birds,' and are in high esteem for the table."

Catesby, under the name of Caroline Ortolan, gives the following interesting account of the Rice-Bird, from which it appears that the damage done to the farmer by this comparatively weak agent is very great:—

"In the beginning of September, while the grain of rice is yet soft and milky, innumerable flights of these birds arrive from some remote parts to the great detriment of the inhabitants. In 1724 an inhabitant near Ashley River had forty acres of rice so devoured by them that he was in doubt whether what they had left was worth the expense of gathering in. They are esteemed in Carolina the greatest delicacy of all other birds. When they first arrive they are lean, but in a few days become so excessively fat that they fly sluggishly and with difficulty, and when shot frequently burst with the fall. They continue about three weeks, and retire by the time the rice first begins to harden. There is something so singular and extraordinary in this bird that I cannot pass it over without notice. In September, when they arrive in infinite swarms to devour the rice, they are all hens, not being accompanied with any cock. Observing them to be all feathered alike, I imagined they were young of both sexes not perfected in their colours; but by opening some scores prepared for the spit I found them to be all females, and that I might leave no room for doubt repeated the search often on many of them, but could never find a cock at that time of the year. Early in the spring both cocks and hens make a transient visit together, at which time I made the like search as before, and both sexes were plainly distinguishable. . . . . In September, 1725, lying upon the deck of a sloop in a bay at Andros Island, I and the company with me heard three nights successively flights of these birds (their note being plainly distinguishable from others) passing over our heads northerly, which is their direct way from Cuba to Carolina; from which I conceive, after partaking of the earlier crop of rice at Cuba, they travel over sea to Carolina for the same intent, the rice there being at that time fit for them."

Sir John Richardson says that the 54th parallel, which it reaches in June, appears to be the most northern limit of the Bob-o-Link, and gives a description of a male in its nuptial dress, which was killed on the Saskatchewan in that month in the year 1827.

Swainson places it as a genus of his third sub-family, *Agelainæ*, in the third or aberrant group of his *Sturnidæ*.

Grassy meadows are the spots usually selected by the bird for its nest, which is made on the ground, generally in some slightly depressed spot, of withered grass, so carelessly bedded together as scarcely to be distinguishable from the neighbouring parts of the field. Here five or six eggs of purplish-white, blotched all over with purplish, and spotted with brown round the larger end, are laid.

The length of the Bob-o-Link is about 7½ inches. The male in his nuptial dress has the head, fore part of the back, shoulders, wings, tail, and the whole of the under plumage black, going off in the middle of the back to grayish; scapulars, rump, and upper tail-coverts white; there is a large patch of ochreous yellow on the nape and back of the neck; bill bluish-black, which in the female, young male, and adult male in his autumnal dress, is pale flesh-colour; the feathers of the tail are sharp at the end like a woodpecker's; legs brown.

The female, whose plumage the adult male assumes after the breeding season, has the back streaked with brownish-black, not unlike that of a lark, according to Catesby, and the whole under parts of a dirty yellow. The young males resemble the females.

BODENITE, an ore of Cerium resembling *Orthite*. It is found at Boden in Saxony.

BŒHMERIA, a genus of plants belonging to the natural order *Urticaceæ*. The species were formerly comprehended under the genus *Urtica*. One of the species *B. nivea*, formerly *Urtica nivea*, is the Rheea of Asam, and yields fibres of remarkable fineness and tenacity. It appears from the investigations of Dr. Falconer, that the plant which yields the celebrated grass-cloth of China is identical with the Asam plant. Several specimens of these fibres manufactured into light articles of dress were exhibited in the Indian collection at the Great Exhibition of 1851. The *B. nivea* is a herbaceous plant, with broad ovate leaves which are downy and white beneath, hence its specific name. It bears no sting.

BOERHAAVIA, a genus of plants named after the celebrated Boerhaave, belonging to the natural order *Nyctaginaceæ*. The species of *Boerhaavia* have generally emetic and purgative properties, and have been employed medicinally both by the natives of Peru and the East Indies, where the species grow. *B. tuberosa* is stated by Lindley to be the Yerba de la Purgacion of Peru, and that it is employed as a culinary vegetable. The root of *B. decumbens* is called Hog-Meat in Jamaica, and on account of its emetic properties it is sometimes called Ipecacuanha in Guyana. Sir Robert Schomburgk states that it is astringent, and is useful in dysentery. *B. decumbens* and *B. hirsuta* are also said to possess medicinal properties. (Lindley, *Vegetable Kingdom*.)

BOG. The name of Bog has been given indiscriminately to very different kinds of substances. In all cases the expression signifies an earthy substance wanting in firmness or consistency, which state seems to arise generally (perhaps not always) from the presence of a superabundant supply of moisture having no natural outlet or drain.

In some cases, where springs of water, or the drainage from an extensive area, are pent up near the surface of the soil, they simply render it soft or boggy, and in this state the land is perhaps more properly called a Quagmire. A second state of bog is where, in addition to the condition just described, a formation of vegetable matter is induced, which dying and being reproduced on the surface assumes the state of a spongy mass of sufficient consistence to bear a considerable weight. Bogs of this description are numerous and extensive in Ireland, where they are valuable from the use made of the solid vegetable matter, both as fuel and as a principal ingredient in composts for manures. Where the turf has been cut away for these purposes, several bogs have been reclaimed by draining; and the subsoil is then readily brought into cultivation. Bogs also occur in all parts of Great Britain where the form of the surface and the nature of the earth favour the general condition under which bog is formed. Thus there are bogs on the high granitic plateau of Cornwall, on the road from Launceston to Bodmin; and in the large granitic mass, of which Brown Willy is the centre, the bottoms of the valleys are covered with bogs, the lower part of which is consolidated into peat. Although peat-moss always springs from some moist spot, it will grow and spread over sound ground, and if not stopped by some natural or artificial impediment, such as a wall, would overrun whole districts. In this case it absorbs any moisture which reaches it, and retains it like a sponge.

The depth of a bog depends on the level of the surrounding grounds. It cannot rise much higher than the lowest outlet for the water. Where there is no immediate outlet the bog increases, until the evaporation is equal to the supply of the springs and rains, or till it rises to a level with its lowest boundary, where it becomes the source of a stream or river, and forms a lake. The mud being deposited at the bottom, gradually becomes a true peat, or is quite reduced to its elementary earths. In this case it may become a stratum of rich alluvial soil, which some convulsion of nature may lay dry for the benefit of future ages. From this circumstance has arisen the great advantage of draining bogs, to which the attention of agriculturists and men of science has often been profitably directed.

The bogs of Ireland are estimated in the whole to exceed in extent 2,800,000 English acres. The greater part of these bogs may be considered as forming one connected mass. If a line were drawn from Wicklow-Head on the east coast to Galway, and another line from Howth-Head, also on the east coast, to Sligo, the space included between those lines, which would occupy about one-fourth part of the entire superficial extent of Ireland, would contain about six-sevenths of the bogs in the island, exclusive of mere mountain-bogs, and bogs of no greater extent than 800 English acres. This district resembles in form a broad belt drawn from east to west across the centre of Ireland, having its narrowest end nearest to Dublin, and gradually extending its breadth as it approaches the western ocean. This great division is traversed by the river Shannon from north to south, which thus divides the great system of bogs into two parts. Of these, the division to the west of the river contains more than double the extent of bogs in the eastern division, so that if we suppose the whole of the bogs of Ireland (exclcusive of mere mountain-bogs, and of bogs of less extent than 800 acres) to be divided into twenty parts, twelve of these parts will be found in the western division, and five parts in the eastern division of the district already described, while of the remaining three parts, two are to the south and one to the north of that district.

The smaller bogs, excluded from the foregoing computation, are very numerous in some parts. In the single county of Cavan there are above 90 bogs, not one of which exceeds 800 English acres, but which collectively contain about 17,600 English acres, without taking into the account many bogs the extent of which is from five to twenty acres each.

Most of the bogs which lie to the eastward of the Shannon and which occupy a considerable portion of the King's County and the county of Kildare, are generally known by the name of the Bog of Allen. It must not however be supposed that this name is applied to any one great morass; on the contrary, the bogs to which it is applied are perfectly distinct from each other, often separated by high ridges of dry country, and inclining towards different rivers as their natural directions for drainage.

The surface of the land rises very quickly from the Bog of Allen on all sides, particularly to the north-west, where it is composed to a considerable depth of limestone gravel, forming very abrupt hills. In places where the face of the hills has been opened the mass is found to be composed of rounded limestone, varying in size from two feet in diameter to less than one inch; the largest pieces are not so much rounded as the small, and frequently their sharp angles are merely rubbed off. They are usually penetrated by contemporaneous veins of Lydian stone, varying in colour from black to light gray. The colour of the limestone is usually light smoke-gray, rarely bluish-black; when it is bluish-black the fracture is large conchoidal; that of the gray is uneven, approaching to earthy. The Lydian stone when unattached to the limestone has usually a tendency to a rhomboidal form, sometimes cubical; the edges are more or less rounded; the longitudinal fracture is even, the cross fracture is conchoidal.

The Grand Canal from Dublin to Shannon Harbour passes through a considerable part of the great bog-district of Ireland. In forming this canal it was necessary to make considerable embankments, the surface-water of the canal being generally on a higher level than the surface of the immediately adjoining bogs. Where this was not the case advantage was taken of the circumstance to conduct the drainage of the bogs into trenches for the supply of the canal.

The bogs situated to the south of the great belt in the centre of Ireland occur in Tipperary, Kilkenny, Clare, and Queen's County; those to the north of that belt occur in Antrim, Down, Armagh, Tyrone, and Londonderry.

It appeared from the examination of the surveyors appointed by parliament in 1810 to investigate the nature and extent of the bogs in Ireland, that they consist of "a mass of the peculiar substance called peat, of the average thickness of twenty-five feet, nowhere less than twelve nor found to exceed forty-two—this substance varying materially in its appearances and properties in proportion to the depth at which it lies. The upper surface is covered with moss of various species, and to the depth of about ten feet is composed of a mass of the fibres of similar vegetables in different stages of decomposition, proportioned to their depth from the surface, generally however too open in their texture to be applied to the purposes of fuel; below this generally lies a light blackish-brown turf, containing the fibres of moss, still visible though not perfect, and extending to a further depth of perhaps ten feet under this. At a greater depth the fibres of vegetable matter cease to be visible, the colour of the turf becomes blacker and the substance much more compact, its properties as fuel more valuable, and gradually increasing in the degree of blackness and compactness proportionate to its depth; near the bottom of the bog it forms a black mass, which when dry has a strong resemblance to pitch or bituminous coal, having a conchoidal fracture in every direction, with a black shining lustre, and susceptible of receiving a considerable polish."

The surface of Irish bogs is not in general level; indeed it is most commonly uneven, sometimes swelling into hills and divided by valleys, thus affording great facilities for drainage. None of the bogs of Ireland which have been described occur on low ground, a fact which seemed to strengthen the opinion of their having always originated from the decay of forests. This theory of the original formation of bogs was at one time very generally adopted, but the result of more recent investigations shows that it cannot be supported. That some bogs may have been formed in this manner is not denied. It is stated in the 'Philosophical Transactions,' No. 275, that "the Romans under Ostorius, having slain many Britons, drove the rest into the forest of Hatfield (in Yorkshire), which at that time overspread all the low country; and the conqueror taking advantage of a strong south-west wind, set fire to the pitch-trees of which the forest was chiefly composed, and when the greater part of the trees were thus destroyed, the Roman soldiers and captive Britons cut down the remainder, except a few large ones, which were left growing as remembrancers of the destruction of the rest. These single trees did not long withstand the action of the winds, but falling into the rivers intercepted their currents, and caused the waters to rise and flood the whole flat country; hence the origin of the mosses and moory bogs which were afterwards formed there." This moorland near Hatfield, seven miles north-east from Doncaster, and about Thorne, is now a boggy peat covered with heath, several feet higher than the adjoining land, and very wet; whence it has been aptly compared to a sponge full of water. The Thorne waste with some adjacent tracts and the Hatfield Moor contain about 12,000 acres.

Underneath the peat in many places the layers of trees are found which serve to confirm this theory of the origin of these bogs. Some of them give indications of having been felled by human agency.

In the 'Ordnance Survey of the County of Londonderry,' presented by Lord Mulgrave to the British Association during its meeting (Aug. 1835) in Dublin, are some remarks on the subject which are deserving of attention:—

"In the production of bog, *Sphagnum* [*Sphagnum palustre*] is allowed on all hands to have been a principal agent, and superabundant moisture the inducing cause. To account for such moisture various opinions have been advanced, more especially that of the destruction of large forests, which by obstructing in their fall the usual channels of drainage, were supposed to have caused an accumulation of water. That opinion however cannot be supported; for as Mr. Aher remarks in the 'Bog Reports,' such trees as are found have generally six or seven feet of compact peat under their roots, which are found standing as they grew, evidently proving the formation of peat to have been previous to the growth of the trees, a fact which in relation to firs may be verified in probably every bog in this parish, turf from three to five feet thick underlying the lowest layer of such trees. This fact is indeed so strongly marked in the bog which on the Donegal side bounds the road to Muff, that the turf-cutters having arrived at the last depth of turf, find timber no longer, though formerly it was abundant, as is proved by their own testimony, from experience, and by the few scattered stumps which still remain resting on the present surface. Not so however with oaks, as their stumps are commonly found resting on the gravel at the base, or on the sides of the small hillocks of gravel and sand which so often stud the surfaces of bogs, and have by Mr. Aher been aptly called islands. He further adds that in the counties of Tipperary, Kilkenny, &c. they are popularly called Derries (signifying 'a place of oaks'), a name deserving attention whether viewed as expressive of the existing fact or as resulting from a lingering traditionary remembrance of their former condition, when, crowned with oaks, they were distinguishable from the dense forest of firs skirting the marshy plains around them. The strong resemblance to ancient water-courses of the valleys and basins which now contain bogs, and the occurrence of marl and shells at the bottoms of many, naturally suggest the idea of shallow lakes, a view of the subject adopted in the 'Bog Reports' by Messrs. Nimmo and Griffiths. Such lakes may have originated in the natural inequalities of the ground, or been formed by the choking up of channels of drainage by heaps of clay and gravel, or they may have been reduced to the necessary state of shallowness by the gradual wearing away of obstacles which had dammed up and retained their waters at a higher level."

The probable process of the formation of bog in such cases is thus explained in the 'Ordnance Survey:'—"A shallow pool induced and favoured the vegetation of aquatic plants, which gradually crept in from the borders towards the deeper centre. Mud accumulated round their root and stalks, and a spongy semi-fluid mass was thus formed, well fitted for the growth of moss, which now, especially *Sphagnum*, began to luxuriate. This, absorbing a large quantity of water and continuing to shoot out new plants above while the old were decaying, rotting, and compressing into a solid substance below, gradually replaced the water by a mass of vegetable matter. In this manner the marsh might be filled up, while the central or moister portion continuing to excite a more rapid growth of the moss, it would be gradually raised above the edges until the whole surface had attained an elevation sufficient to discharge the surface-water by existing channels of drainage, and calculated by its slope to facilitate their passage, when a limit would be in some degree set to its further increase."

According to the personal observations of Mr. Griffiths, made during many years, the growth of turf in these bogs is very rapid, amounting sometimes to two inches in depth in one year : this however is stated to be an excessive growth under peculiarly favourable circumstances.

The roots which were attached to the ground decay, and the whole of the surface becomes a floating mass of long interlaced fibres which when taken out has been significantly called in Ireland 'Old Wives' Tow.' The black mass of the bog is a mud almost entirely formed of decomposed vegetable fibres, but not of sufficient specific gravity to sink to the bottom; thus producing that semi-liquid state which distinguishes a quaking bog from a peat-moss. The vegetation which continues on the surface and at some depth below has the appearance of a fine green turf. In many cases the roots are so matted together and so strong as to form a web capable of bearing the gentle and light tread of a man accustomed to walk over bogs, bending and waving under him without breaking; and while a person unskilfully attempting to walk upon it would infallibly break through and be plunged in the bog like a venturous skater on unsound ice, the practised 'bog-trotter' with proper precautions passes over them in safety. This has often been of considerable advantage in war or in the pursuit of illegal employments. The fugitive escapes over his native bogs where the pursuer cannot venture to follow, or if he does he generally pays the penalty of his ignorance or rashness by sinking in them. Many examples of this were witnessed in Ireland during the last rebellion, and many bodies have been found in bogs years after, preserved from decay and tanned in a manner by the astringent principle which is always found where vegetable fibre has been decomposed under water.

When bogs become consolidated or compressed they are called Peat-Mosses. The consolidation here mentioned must be carried to a considerable extent before the soil is capable of sustaining such a growth of timber as it is seen to have frequently borne.

An extensive tract of peat-moss (Chat-Moss) in the county of Lancaster attracted public attention some years ago, from the circumstance of the Liverpool and Manchester railway having been carried through it. The length of Chat-Moss is about 6 miles, its greatest breadth about 3 miles, and its depth varies from 10 to upwards of 30 feet, the whole of which is pure vegetable matter throughout, without the slightest mixture of sand, gravel, or other material. On the surface it is light and fibrous, but it becomes more dense below. At a considerable depth it is found to be black, compact, and heavy, and in some respects resembles coal: it is in fact exactly similar to the composition of the bogs of Ireland, as already described.

The Moss is bounded on all sides by ridges of rolled stones mixed with clay, which prevent the immediate discharge of its waters. It is probable that this bar, by interrupting the course of the waters, originally caused the growth of Chat-Moss. This moss presents at its edges nearly an upright face; the spongy surface of the moss being elevated at a very short distance from the edge from 10 to 20 feet above the level of the immediately adjoining land. The immediate substratum to the bog is a bed of silicious sand, which varies from one to five feet in thickness, below which is a bed of bluish and sometimes reddish clay marl of excellent quality. This marl varies in thickness very considerably; in some parts it is not more than three feet, in others its depth has not been ascertained; below the marl is a bed of sandstone-gravel of unknown thickness. It is this bed of gravel which extends beyond the edge of the bog, and prevents the direct discharge of the waters from the flat country to the north into the river Irwell. (See Camden's remarks on this Moss, in his 'Britannia,' vol. ii. p. 966, Gibson's edition.)

About 1797 the late Mr. Roscoe of Liverpool began to improve Trafford-Moss, a tract of 300 acres, lying 2 miles east of Chat-Moss, which operation was so successful as to encourage him to proceed with the improvement of Chat-Moss, the most extensive lowland bog in England, including 7000 acres. After making a great variety of experiments Mr. Roscoe gave it as his decided opinion "that the best method of improving moss-land is that of the application of a calcareous substance, in sufficient quantity to convert the moss into a soil, and by the occasional use of animal or other extraneous manures, such as the course of cultivation and the nature of the crops may be found to require."

In June 1833 an ancient wooden house was discovered in Drumkelin Bog, in the county of Donegal in Ireland. The framework of the house was very firmly put together, without any iron; the roof was flat and made of thick oak planks. The house was 12 feet square and 9 feet high: it consisted of two floors one above the other, each about 4 feet high; one side of the house was entirely open. The whole stood on a thick layer of sand spread on the bog, which continues to the depth of 15 feet below the foundation of the house. On the same level as the foundation of the house stumps of oak trees were found standing, just such as had supplied the timber of the house; and beneath all this there are still 15 feet of peat.

Bogs not unfrequently burst out and suddenly cover large tracts. This phenomenon happened in 1835 in Ireland, on a part of Lord O'Neill's estate, on the Ballymena road, in the neighbourhood of Randalstown. On the 19th September an individual near the ground was surprised by hearing a rumbling noise as if under the earth, and immediately after a portion of the bog moved forward a few perches, when it exhibited a broken rugged appearance, with a soft peaty substance boiling up through the chinks. It remained in this state until the 22nd, when it again moved suddenly forward, covering corn-fields, potato-fields, turf-stacks, hay-ricks, &c. The noise made by its burst was so loud as to alarm the inhabitants adjoining, who on perceiving the flow of the bog immediately fled. It directed its course towards the river Maine which lay below it; and so great was its force that the moving mass was carried a considerable way across the river. Owing to the heavy rain which had fallen for some time previously, the river forced its channel through the matter deposited in its bed, and considerable damage was thus obviated which would otherwise have occurred from the forcing back of the waters.

The Irish Amelioration Society, the British and Irish Peat Company, and other associations, have of late years been engaged in converting turf and peat into charcoal and other products. Charcoal from turf and peat to a considerable amount has already been made in Ireland. There are two methods of carbonising the turf or peat, either to subject it to heat in close vessels, by which the other products are saved as well as the carbon, or to pile it in heaps and apply heat, in the same manner as for wood-charcoal. The heating in close vessels is expensive, and there is not sufficient compensation in the distilled products. The acetic acid and the tar are generally small in quantity and the gases are deficient in illuminating power: hence the charcoal is the only product of much value. The charcoal obtained is from 30 to 40 per cent. of the weight of the dry turf. The more economical mode of piling up the turf in heaps has hitherto been found preferable. The sods are regularly arranged, and laid as close as possible; they are better for being large, say 15 inches long, 6 inches broad, and 5 inches deep. The heaps are built hemispherically, and are smaller than those of wood. The mass is allowed to heat more than is necessary for wood, and the process is very carefully attended to, on account of the great combustibility of the material. The quantity of charcoal obtained by this method is from 25 to 30 per cent. of the weight of dry turf. The charcoal so obtained is very light and very inflammable, and possesses nearly the volume of the turf. It usually burns with a slight flame, as the volatile matters are not entirely expelled.

A specimen subjected to analysis gave the following result:—

Carbon	89·90
Hydrogen	1·70
Oxygen and Nitrogen	4·20
Ashes	4·20
	100·00

For many industrial purposes charcoal so prepared is too light, but compressed turf converted into charcoal may attain a density far superior to wood-charcoal, and even equal to that of the best coke obtained from coal.

It is of peculiar importance in the preparation of charcoal from turf that the material selected should be as free as possible from impurities. Surface-turf generally contains less than 10 per cent. of ash, whilst that of the dense turf of the lower strata sometimes contains from 20 to 30 per cent., a quantity which renders it unfit for most practical purposes.

BOG-IRON-ORE, a loose earthy ore of iron, consisting of Peroxide of Iron and water. It is of a brownish-black colour, and occurs in low boggy grounds.

BOG-MANGANESE, a native hydrated Peroxide of Manganese; also called *Wad*.

BOGMARUS, a genus of Fishes, to which the Vaagmaer, or Deal-Fish is referred by Schneider under the specific title of *B. Islandicus*. [TRACHYPTERUS.]

BOG-MYRTLE. [MYRICA.]

BOHEMIAN CHATTERER. [BOMBYCILLA.]

BOHEMIAN WAX-WING. [BOMBYCILLA.]

BOIDÆ, the fourth family of the second order (*Ophidia*) of Reptiles. This family is known by the following technical characters:—The ventral shields narrow (except in *Bolyeria*), transverse, band-like, often six-sided; the hinder limbs developed under the skin, formed of several bones and ending in an exserted horny spine, placed one on each side of the vent; the tail short, generally prehensile; the pupil oblong, erect (except in *Tortrix*).

The species live in marshy places. Fixing themselves by the tail to some aquatic tree, they allow themselves to float, and thus entrap their prey. They are without venom, the absence of which is amply compensated by immense muscular power, enabling some of the species to kill large animals by constriction, preparatory to swallowing them whole.

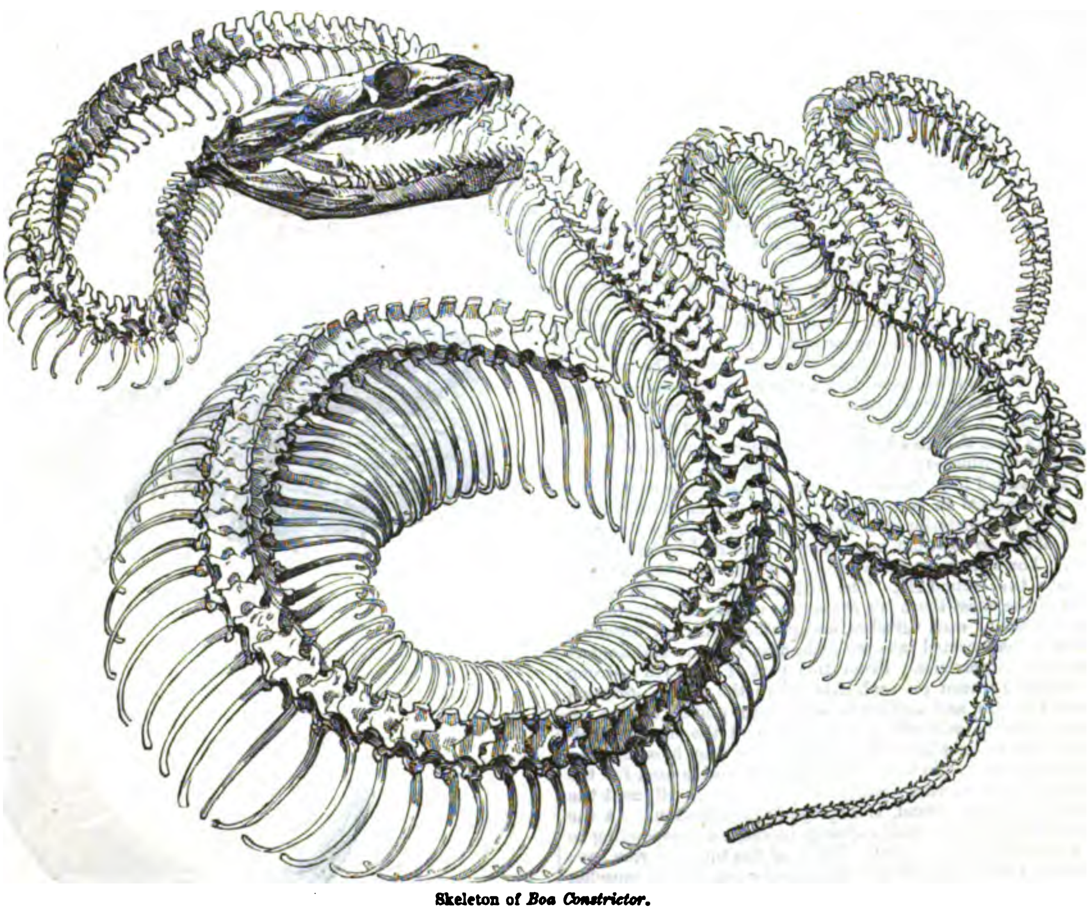
There are few fables which have not some truth for their origin. The voyages of Sinbad have become proverbial; but the stories of the monstrous serpents in the valley of diamonds, and of the "serpent of surprising length and thickness, whose scales made a rustling as he wound himself along," that swallowed up two of his companions, probably had their foundation in traditions of the size and strength of a family of serpents belonging to the Old World, but nearly allied in their organisation and habits to those which we are about to consider.

Of the same race probably were the monsters to which the following allusions are made by ancient writers:—

Aristotle (book viii. c. 28) writes of Libyan serpents of enormous size, and relates that certain voyagers to that coast were pursued by some of them so large that they overset one of the triremes. The two monstrous snakes sent by Juno to strangle the infant Hercules in his cradle, described by Theocritus in his 24th Idyll, exhibit some of the peculiarities of these reptiles. The way in which Theocritus represents them to have rolled their folds around the boy, and relaxed them when dying in his grasp, indicates the habit of a constricting serpent. Virgil's Laocoon, and the unrivalled marble group, which the poet's description most probably called into existence, owe their origin undoubtedly to the stories current of constricting serpents. Valerius Maximus (book i. c. 8, s. 19), quoting Livy, gives a relation of the alarm into which the Romans under Regulus were thrown by an enormous snake, which had its lair on the banks of the Bagradas or Magradas (Mejerda), near Utica. It is said to have swallowed many of the soldiers, to have killed others in its folds, and to have kept the army from the river; till at length, being invulnerable by ordinary weapons, it was destroyed by heavy stones slung from the military engines used in sieges. But according to the historian its persecution of the army did not cease with its death; for the waters were polluted with its gore, and the air with the steams from its corrupted carcass, to such a degree that the Romans were obliged to move their camp, taking with them however the skin, 120 feet in length, which was sent to Rome. Gellius, Orosius, Florus, Silius Italicus, and Zonaras, make mention of the same serpent nearly to the same effect. Pliny (viii. 14, 'De Serpentibus Maximis et Bois') says that Megasthenes writes that serpents grow to such a size in India that they swallowed entire stags and bulls. (See also Nearchus, quoted by Arrian, 'Indic.' 15.) He speaks too of the Bagradian serpent above mentioned as matter of notoriety, observing that it was 120 feet long, and that its skin and jaws were preserved in a temple at Rome till the time of the Numantine war: and he adds, that the serpents called *Boæ* in Italy confirm this, for that they grow to such a size that in the belly of one killed on the Vatican Hill in the reign of Claudius an entire infant was found. Suetonius (in 'Octav.' 43) mentions the exhibition of a serpent 50 cubits in length in front of the comitium. But without multiplying instances from Ælian and others, we will now come to more modern accounts. Bontius (v. 23) says, "The Indian serpents are so multitudinous that my paper would fail me before I enumerated them all; nevertheless I must say something about the great ones, which sometimes exceed 36 feet in length, and are of such capacity of throat and stomach that they swallow entire boars." He then speaks of the great power of distention in the jaws, adding, "To confirm this there are those alive who partook with General Peter Both of a recently swallowed hog, cut out of the belly of a serpent of this kind. They are not venomous, but they strangle by powerfully applying their folds around the body of a man or other animal." Mr. M'Leod, in his interesting 'Voyage of H. M. S. Alceste,' p. 312, gives the following account:—

"It may here be mentioned that during a captivity of some months at Whidah, in the kingdom of Dahomey, on the coast of Africa, the author of this narrative had opportunities of observing snakes more than double the size of this one just described; but he cannot venture to say whether or not they were of the same species, though he has no doubt of their being of the genus *Boa*. They killed their prey however precisely in a similar manner, and from their superior bulk were capable of swallowing animals much larger than goats or sheep. Governor Abson, who had for 37 years resided at Fort William (one of the African Company's settlements there), described some desperate struggles which he had either seen, or had come to his knowledge, between the snakes and wild beasts as well as the smaller cattle, in which the former were always victorious. A negro herdsman belonging to Mr. Abson (who afterwards limped for many years about the fort) had been seized by one of these monsters by the thigh, but from his situation in a wood the serpent, in attempting to throw himself around him, got entangled with a tree; and the man being thus preserved from a state of compression which would instantly have rendered him quite powerless, had presence of mind enough to cut with a large knife which he carried about with him deep gashes in the neck and throat of his antagonist, thereby killing him, and disengaging himself from his frightful situation. He never afterwards however recovered the use of that limb, which had sustained considerable injury from his fangs and the mere force of his jaws." All these gigantic serpents were most probably the Pythons of modern nomenclature.

According to Pliny the name *Boa* was given to these serpents because they were said to be at first nourished by the milk of cows, and Johnston and others observe that they derived the name not so much from their power of swallowing oxen as from a story current in old times of their following the herds and sucking their udders. Boa is also stated by some to be the Brazilian name for a serpent.



Skeleton of *Boa Constrictor*.

Before entering upon the subdivisions of this family we will examine some of the most remarkable points in the structure and organisation of the *Boidæ*.

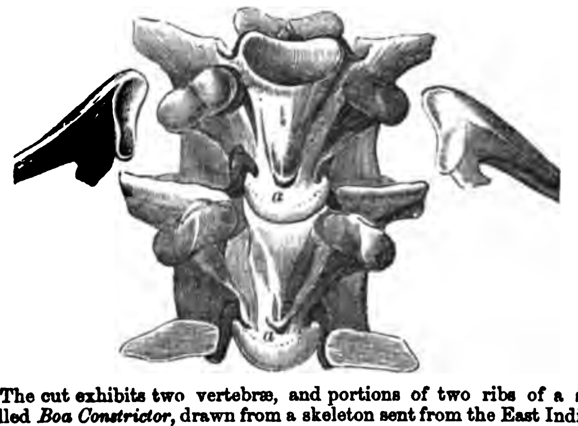
On looking at the accompanying representation of the skeleton of a *Boa Constrictor*, drawn from the beautiful preparation in the British Museum, we first observe the strong close-set teeth, of which there is a double row on each side of the upper jaw, all pointing backwards, and giving the serpent the firmest hold of its struggling victim, which is thus deprived of the power of withdrawing itself when once locked within the deadly jaws. Serpents do not masticate. The prey is swallowed whole, and to assist deglutition their under jaw consists of two bones easily separable at the symphysis, or point of junction, while the bone similar to the os quadratum in birds, by the intervention of which it is fitted to the cranium, further facilitates the act. The upper jaw moreover is so constructed as to admit of considerable motion.

We next observe the spine, formed for the most extensive mobility, and the multitude of ribs constructed as organs of rapid progression, when joined to the belly-scales, or scuta, with which the whole inferior surface of the body may be said to be shod. "When the snake," writes Sir Everard Home, "begins to put itself in motion, the ribs of the opposite sides are drawn apart from each other, and the small cartilages at the end of them are bent upon the upper surfaces of the abdominal scuta on which the ends of the ribs rest, and as the ribs move in pairs the scutum under each pair is carried along with it. This scutum by its posterior edge lays hold of the ground, and becomes a fixed point from whence to set out anew. This motion is beautifully seen when a snake is climbing over an angle to get upon a flat surface. When the animal is moving it alters its shape from a circular or oval form to something approaching to a triangle, of which the surface on the ground forms the base. The coluber and boa having large abdominal scuta, which may be considered as hoofs or shoes, are the best fitted for this kind of progressive motion." ('Lectures on Comparative Anatomy,' vol. i.)

Sir Everard, in the same lecture, speaking of the ribs as organs of locomotion, says :—"An observation of Sir Joseph Banks during the exhibition of a coluber of unusual size first led to this discovery. While it was moving briskly along the carpet he said he thought he saw the ribs come forward in succession like the feet of a caterpillar. This remark led me to examine the animal's motion with more accuracy, and on putting the hand under its belly while the snake was in the act of passing over the palm the ends of the ribs were distinctly felt pressing upon the surface in regular succession, so as to leave no doubt of the ribs forming so many pairs of levers by which the animal moves its body from place to place." The merit however of this discovery is due to the sharp-sighted Tyson, who was the first to observe the locomotive power of the ribs of the *Boa*.

Sir Everard Home informs us by what additional mechanism this faculty is effected. The ribs, he observes, are not articulated in snakes between the vertebræ, but each vertebra has a rib attached to it by two slightly concave surfaces that move upon a convex protuberance on the side of the vertebra, by which means the extent of motion is unusually great; and the lower end of each vertebra having a globular form fitted to a concavity in the upper end of the vertebra below it, they move readily on one another in all directions. The muscles which bring the ribs forward, according to Sir Everard, consist of five sets—one from the transverse process of each vertebra to the rib immediately behind it, which rib is attached to the next vertebra. The next set goes from the rib a little way from the spine, just beyond where the former terminates; it passes over two ribs, sending a slip to each, and is inserted into the third : there is a slip also connecting it with the next muscle in succession. Under this is the third set, which arises from the posterior side of each rib, passes over two ribs, sending a lateral slip to the next muscle, and is inserted into the third rib behind it. The fourth set passes from one rib over the next, and is inserted into the second rib. The fifth set goes from rib to rib. On the inside of the chest there is a strong set of muscles attached to the anterior surface of each vertebra, and passing obliquely forwards over four ribs to be inserted into the fifth, nearly at the middle part between the two extremities. From this part of each rib a strong flat muscle comes forward on each side before the viscera, forming the abdominal muscles, and uniting in a beautiful middle tendon, so that the lower half of each rib which is beyond the origin of this muscle, and which is only laterally connected to it by loose cellular membrane, is external to the belly of the animal, and is used for the purpose of progressive motion; while that half of each rib next the spine, as far as the lungs extend, is employed in respiration. At the termination of each rib is a small cartilage in shape corresponding to the rib, only tapering to the point. Those of the opposite ribs have no connection, and when the ribs are drawn outwards by the muscles, they are separated to some distance, and rest through their whole length on the inner surface of the abdominal scuta, to which they are connected by a set of short muscles; they have also a connection with the cartilages of the neighbouring ribs by a set of short straight muscles. These observations apply to snakes in general, but the muscles have been examined in a *Boa Constrictor* 3 feet 9 inches long preserved in the Hunterian Museum. In all snakes, adds the author, the ribs are continued to the anus, but the lungs seldom occupy more than one half of the extent of the cavity covered by the ribs. Consequently these lower ribs can only be employed for the purpose of progressive motion, and therefore correspond in that respect with the ribs in the *Draco volans* superadded to form the wings.

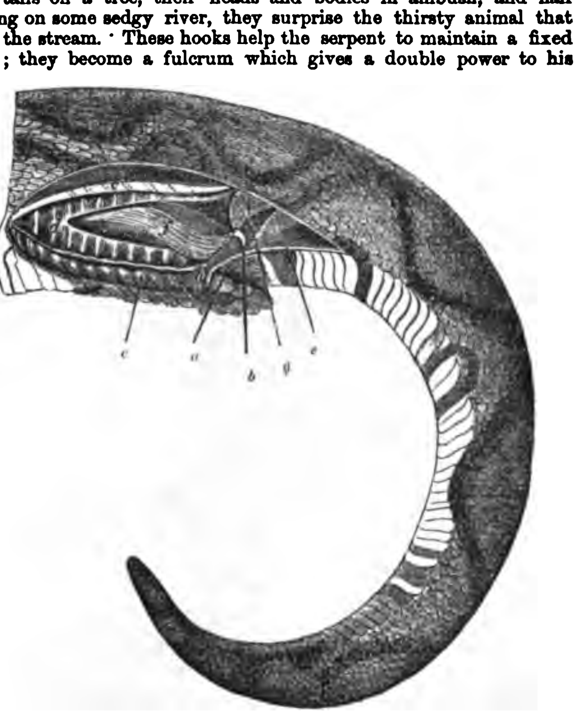
The subjoined cut, copied from that given as an illustration by Sir Everard Home, will explain the articulating surfaces of the vertebræ and ribs; and on the under surface of the former will be seen the protuberance for the attachment of the muscles which are employed in crushing the animals round which the snake entwines itself.



The cut exhibits two vertebræ, and portions of two ribs of a so-called *Boa Constrictor*, drawn from a skeleton sent from the East Indies by the late Sir William Jones, and deposited in the Hunterian Museum. The letters, *a*, *a*, point to the protuberance on the under surface for the attachment of the constricting muscles, according to Sir Everard Home.

Though the term *Boa Constrictor* is used throughout by Sir Everard Home in his lecture, there can be little doubt that the serpent sent from India by Sir William Jones was a Python. The small specimen from which the description of the organs employed in progressive motion was taken may have been a boa. But whether boa or python, it would have had the hooks or spurs near the vent, and the bones and muscles belonging to these spurs, which are of no small consequence in the organisation of a boa or a python, rudiments of limbs though they be; these appear to have escaped Sir Everard Home's observation, occupied as he was in following out the mechanism of progressive motion.

No one can read of the habits of these reptiles in a state of nature without perceiving the advantage which they gain when holding on by their tails on a tree, their heads and bodies in ambush, and half floating on some sedgy river, they surprise the thirsty animal that seeks the stream. These hooks help the serpent to maintain a fixed point; they become a fulcrum which gives a double power to his



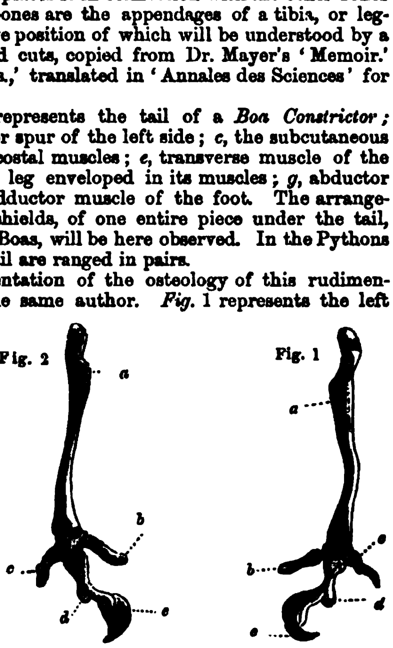
energies. Dr. Mayer detected these rudiments of limbs, and has well explained their anatomy. He says that the spur or nail on each side of the vent in the *Boa Constrictor* and other species of the genus is a true nail, in the cavity of which is a little demi-cartilaginous bone, or ungual phalanx, articulated with another bone much stronger which is concealed under the skin. This second bone of the rudiment of a foot in the *Boa* has an external thick condyle, with which the ungual phalanx is articulated, as above stated; it presents, besides a smaller internal apophysis, which places it in connection with the other bones of the skeleton. These bones are the appendages of a tibia, or leg-bone, the form and relative position of which will be understood by a reference to the subjoined cuts, copied from Dr. Mayer's 'Memoir.' ('Trans. Soc. Nat. Curios.,' translated in 'Annales des Sciences' for 1826.)

The previous figure represents the tail of a *Boa Constrictor;* *a*, the vent; *b*, the hook or spur of the left side; *c*, the subcutaneous muscle; *d*, ribs and intercostal muscles; *e*, transverse muscle of the abdomen; *f*, bone of the leg enveloped in its muscles; *g*, abductor muscle of the foot; *h*, adductor muscle of the foot. The arrangement of the scuta, or shields, of one entire piece under the tail, characteristic of the true Boas, will be here observed. In the Pythons the shields beneath the tail are ranged in pairs.

We here have a representation of the osteology of this rudimentary limb, taken from the same author. *Fig.* 1 represents the left posterior limb of the *Boa Scytale*, seen anteriorly: *a*, tibia, or leg-bone; *b*, external bone of the tarsus; *c*, internal bone of the tarsus; *d*, bone of the metatarsus with its apophysis; *e*, nail or hook.

Fig. 2 represents the same limb, seen posteriorly.

Fig. 2 Fig. 1



Doctors Hopkinson and Pancoast have given in the 'Transactions of the American Philosophical Society,' held at Philadelphia, for promoting useful knowledge (vol. v. new series, part i.), an interesting account of the visceral anatomy of the Python (Cuvier), described by Daudin as the *Boa reticulata*. And here it may be as well to remark that the differences between the Boas and the Pythons are so small, that the accounts given of the constricting powers and even of the principal anatomical details of the one, may be taken as illustrative of the same points in the history of the other.

Perhaps the best way of illustrating the habits of these creatures in seizing and killing their prey is to relate some of the incidents with which books of travels abound.

Mr. M'Leod, in his 'Voyage of H.M.S. Alceste,' gives the following painfully vivid account of a serpent, a native of Borneo, 16 feet long, and of about 18 inches in circumference, which was on board. There were originally two; but one, to use Mr. M'Leod's expression, "sprawled overboard and was drowned."

"During his stay at Ryswick," says Mr. M'Leod, speaking of the survivor, "he is said to have been usually entertained with a goat for dinner, once in every three or four weeks, with occasionally a duck or a fowl by way of a dessert. The live-stock for his use during the passage, consisting of six goats of the ordinary size, were sent with him on board, five being considered as a fair allowance for as many months.

"At an early period of the voyage we had an exhibition of his talent in the way of eating, which was publicly performed on the quarter-deck, upon which his crib stood. The sliding part being opened, one of the goats was thrust in, and the door of the cage was shut. The poor goat, as if instantly aware of all the horrors of its perilous situation, immediately began to utter the most piercing and distressing cries, butting instinctively at the same time, with its head towards the serpent, in self-defence.

"The snake, which at first appeared scarcely to notice the poor animal, soon began to stir a little, and turning his head in the direction of the goat, he at length fixed a deadly and malignant eye on the trembling victim, whose agony and terror seemed to increase; for previous to the snake seizing his prey, it shook in every limb, but still continuing its unavailing show of attack, by butting at the serpent, which now became sufficiently animated to prepare for the banquet. The first operation was that of darting out his forked tongue, and at the same time rearing a little his head; then suddenly seizing the goat by the fore-leg with his fangs, and throwing it down, it was encircled in an instant in his horrid folds. So quick indeed and so instantaneous was the act, that it was impossible for the eye to follow the rapid convolution of his elongated body. It was not a regular screw-like turn that was formed, but resembling rather a knot, one part of the body overlaying the other, as if to add weight to the muscular pressure, the more effectually to crush the object. During this time he continued to grasp with his fangs, though it appeared an unnecessary precaution, that part of the animal which he had first seized. He then slowly and cautiously unfolded himself, till the goat fell dead from his monstrous embrace, when he began to prepare himself for swallowing it. Placing his mouth in front of the dead animal, he commenced by lubricating with his saliva that part of the goat, and then taking its muzzle into his mouth, which had, and indeed always has, the appearance of a raw lacerated wound, he sucked it in, as far as the horns would allow. These protuberances opposed some little difficulty, not so much from their extent as from their points; however they also in a very short time disappeared, that is to say, externally; but their progress was still to be traced very distinctly on the outside, threatening every moment to protrude through the skin. The victim had now descended as far as the shoulders; and it was an astonishing sight to observe the extraordinary action of the snake's muscles when stretched to such an unnatural extent—an extent which must have utterly destroyed all muscular power in any animal that was not like himself endowed with very peculiar faculties of expansion and action at the same time. When his head and neck had no other appearance than that of a serpent's skin stuffed almost to bursting, still the workings of the muscles were evident; and his power of suction, as it is erroneously called, unabated; it was in fact the effect of a contractile muscular power, assisted by two rows of strong hooked teeth. With all this he must be so formed as to be able to suspend for a time his respiration; for it is impossible to conceive that the process of breathing could be carried on while the mouth and throat were so completely stuffed and expanded by the body of the goat, and the lungs themselves (admitting the trachea to be ever so hard) compressed as they must have been by its passage downwards.

"The whole operation of completely gorging the goat occupied about two hours and twenty minutes, at the end of which time the tumefaction was confined to the middle part of the body, or stomach, the superior parts, which had been so much distended, having resumed their natural dimensions. He now coiled himself up again, and lay quietly in his usual torpid state for about three weeks or a month, when his last meal appearing to be completely digested and dissolved, he was presented with another goat, which he killed and devoured with equal facility. It would appear that almost all he swallows is converted into nutrition, for a small quantity of calcareous matter (and that perhaps not a tenth part of the bones of the animal), with occasionally some of the hairs, seemed to compose his general fæces. . . . .

"It was remarked, especially by the officers of the watch, who had better opportunities of noticing this circumstance, that the goats had always a great horror of the serpent, and evidently avoided that side of the deck on which his cage stood." (P. 305.)

Mr. Broderip, in the second volume of the 'Zoological Journal,' after referring to Mr. M'Leod's interesting narrative, of the correctness of which, as far as it goes, he says he has not a single doubt, and observing that two points in that description struck him forcibly, the one as being contrary to the probable structure of the animal, and the other as being contrary to Mr. Broderip's observations, proceeds to give the following account of the manner in which the serpent takes its prey in this country.

Mr. Broderip had an opportunity of seeing one of these creatures when kept in the Tower. The keeper says Mr. Broderip "sent to inform me that one of these reptiles had just cast his skin, at which period they, in common with other serpents, are most active and eager for prey. Accordingly I repaired with some friends to the Tower, where we found a spacious cage, the floor of which consisted of a tin case covered with red baize and filled with warm water, so as to produce a proper temperature. There was the snake, 'positis novus exuviis,' gracefully examining the height and extent of his prison as he raised, without any apparent effort, his towering head to the roof and upper parts of it, full of life, and brandishing his tongue.

"A large buck rabbit was introduced into the cage. The snake was down and motionless in a moment. There he lay like a log without one symptom of life, save that which glared in the small bright eye twinkling in his depressed head. The rabbit appeared to take no notice of him, but presently began to walk about the cage. The snake suddenly, but almost imperceptibly, turned his head according to the rabbit's movements, as if to keep the object within the range of his eye. At length the rabbit, totally unconscious of his situation, approached the ambushed head. The snake dashed at him like lightning. There was a blow—a scream—and instantly the victim was locked in the coils of the serpent. This was done almost too rapidly for the eye to follow: at one instant the snake was motionless; in the next he was one congeries of coils round his prey. He had seized the rabbit by the neck just under the ear, and was evidently exerting the strongest pressure round the thorax of the quadruped; thereby preventing the expansion of the chest, and at the same time depriving the anterior extremities of motion. The rabbit never cried after the first seizure; he lay with his hind legs stretched out, still breathing with difficulty, as could be seen by the motion of his flanks. Presently he made one desperate struggle with his hind legs; but the snake cautiously applied another coil with such dexterity as completely to manacle the lower extremities, and, in about eight minutes, the rabbit was quite dead. The snake then gradually and carefully uncoiled himself, and, finding that his victim moved not, opened his mouth, let go his hold, and placed his head opposite to the fore part of the rabbit. The boa generally, I have observed, begins with the head; but in this instance the serpent, having begun with the fore legs, was longer in gorging his prey than usual, and in consequence of the difficulty presented by the awkward position of the rabbit, the dilatation and secretion of lubricating mucus were excessive. The serpent first got the fore legs into his mouth; he then coiled himself round the rabbit, and appeared to draw out the dead body through his folds; he then began to dilate his jaws, and holding the rabbit firmly in a coil as a point of resistance, appeared to exercise at intervals the whole of his anterior muscles in protruding his stretched jaws and lubricated mouth and throat at first against and soon after gradually upon and over his prey. The curious mechanism in the jaws of serpents which enables them to swallow bodies so dipropor-tioned to their apparent bulk is too well known to need description; but it may be as well to state that the symphysis of the under jaw was separated in this case, and in others which I have had an opportunity of observing. When the prey was completely ingulphed, the serpent lay for a few moments with his dislocated jaws still dropping with the mucus which had lubricated the parts, and at this time he looked quite sufficiently disgusting. He then stretched out his neck, and at the same moment the muscles seemed to push the prey further downwards. After a few efforts to replace the parts, the jaws appeared much the same as they did previous to the monstrous repast.

"I now proceed to the first of the two points above alluded to, and have to state my opinion that the *Boa Constrictor* does respire 'when his head and neck have no other appearance than that of a serpent's skin stuffed almost to bursting;' and I think that, upon a more close examination, the same phenomenon would have been observable in the serpent shipped at Batavia. It is to be regretted that the dissection of that serpent appears to have been confined to the stomach; at least nothing is said of any other part of the animal. I have never had an opportunity of dissecting the pulmonary system of a boa, or of satisfying myself as to the structure of the extremely long trachea, which must be very firm to resist such an immense pressure; but I believe, from a near and accurate inspection, in company with others, that respiration goes on during the period of the greatest dilatation. While these serpents are in the act of constringing or swallowing their prey, they appear to be so entirely pervaded by the ὄρεξις [appetite] which then governs them, that I am convinced they would suffer themselves to be cut in pieces before they would relinquish their victim. I have assisted in taking them up, and removing them with their prey in their coils, without their appearing to be in the least disturbed by the motion, excepting that, if after the victim is no more and the constriction is somewhat relaxed, an artificial motion be given to the dead body, they instantly renew the constriction. When thus employed they may be approached closely and with perfect security for the reason above stated, and I have uniformly found that the larynx is, during the operation of swallowing, protruded sometimes as much as a quarter of an inch beyond the edge of the dilated lower jaw. I have seen, in company with others, the valves of the glottis open and shut, and the dead rabbit's fur immediately before the aperture stirred, apparently by the serpent's breath, when his jaws and throat were stuffed and stretched to excess. In the case above mentioned, where the prey was taken very awkwardly, and the dilatation was consequently much greater than usual, I saw this wonderful adaptation of means to the exigencies of the animal much more clearly than I had ever seen it before.

"With regard to the next point, it is more difficult to account for the variance between the agony of antipathy shown by the goat as described by Mr. M'Leod, and the indifference which I have uniformly observed in the full grown fowls and rabbits presented to these serpents for prey. Immediately after our boa had swallowed his first rabbit, a second was introduced; but the serpent now exhibited a very different appearance. The left side of his lower jaw was hardly in its place, and he moved about the cage instead of lying in wait as on the former occasion. As for the rabbit, after he had been incarcerated a little while, he treated the snake with the utmost contempt, biting it when in his way, and moving it aside with his head. The snake, not having his tackle in order, for his jaw was not yet quite right, appeared anxious to avoid the rabbit, which at last stumbled upon the snake's head in his walks, and began to treat it so roughly, that the rabbit was withdrawn for fear of his injuring the snake. This treatment of the snake by the rabbit did not appear to be the effect of anger or hatred, but to be adopted merely as a mode of removing something, which he did not appear to understand, out of his way. I have seen many rabbits and fowls presented to different specimens of boa for prey, and I never saw the least symptom of uneasiness either in the birds or quadrupeds. They appear at first to take no notice of the serpent, large as it is, and when they do discover it they do not start, but seem to treat it with the greatest indifference. I remember one evening going up into the room where one of these snakes was kept at Exeter 'Change, and seeing the hen which was destined for the prey of the boa, very comfortably at roost upon the serpent. The keeper took the hen in his hands and held it opposite to the head of the snake, without succeeding in inducing him to take the bird, which, when let out of the keeper's hands again, settled herself down upon the serpent for the night.

"The only solution which I can offer of the difference between Mr. M'Leod's description and my experience, is one which I do not propose as absolutely satisfactory, but which may nevertheless be found to approach the truth. The goats put on board at Batavia for the serpent, which it appears was brought from Borneo, were in all probability natives of Java, and if so, they would, according to the wonderful instinct which nature has implanted in animals for their preservation, be likely to have a violent antipathy to large serpents, such as those which there lurk for their prey. The great Python is a native of Java, and if these goats were wild, or originally from the wild stock of the island, their instinctive horror at the sight of the destroyer may be thus accounted for. But our domestic fowls and rabbits (the stock of the latter most probably indigenous, and that of the former of such remote importation, and so much changed by descent, as to be almost on the same footing), having no such natural enemy as a large serpent, against which it is necessary for them to be on their guard, are entirely without this instinct, although it is strong enough in the case of their ordinary enemies, such as hawks, dogs, and cats; and they consequently view the boa which is about to dash at them with the same indifference as if he were a log of wood."

We now proceed to give an account of the genera and species of the family *Boidæ*, and in doing this we shall follow the arrangement of Dr. J. E. Gray in the Catalogue of the specimens of Snakes in the British Museum.

I. *Tail prehensile, strong; Head distinct; Muzzle truncated.*

a. Subcaudal plate two-rowed; intermaxillary or incisive teeth distinct; superciliary bone distinct.

* Crown of head with small shield-like plates.

1. *Morelia.* Upper and lower labial shields deeply pitted; muzzle with symmetrical shields. There are two species of this genus, one with the vertical plate indistinct, the other with the same plate distinct:—

M. spilotes (*Coluber argus*, Linnæus, *Coluber spilotes*, Lacépède), the Diamond-Snake. This species has the vertical plates indistinct. It is of a bluish-black colour, very irregularly yellow, spotted, a spot on the centre of each scale, forming a group of five or six together or a kind of tied blotch; occiput with an angular band. It is a native of Australia.

M. variegata, the Carpet-Snake. Vertical plates distinct. It is whitish, with numerous irregular black-edged olive cross-bands, with irregular serrated and torn edges; head olive, varied with two or three white spots in the centre of the crown, and a broad short band behind each eye. Several specimens of this species are in the British Museum, brought from Port Essington, Swan River, and other parts of Australia.

** Crown of head shielded to behind the eyes.

2. *Python.* Upper and lower labial shields deeply pitted; muzzle and forehead with symmetrical shields; nostrils vertical.

There are two species of this genus which have been referred to by many writers as varieties of *Boa Constrictor*. They are distinguished by placing their eggs in a group and covering them with their body. This statement, which was made by Mr. Bennett, and afterwards confirmed by M. Lamare Picquot, has been doubted, but its truthfulness has been confirmed by the proceedings of a python in the Garden of Plants at Paris.

P. reticulatus, the Ular Sawad, is distinguished from the next species by the four front upper labial plates being pitted; the frontal plate simple; the head has a narrow longitudinal brown stripe. It is one of the most brilliant species of the whole family, its whole body being covered with a gay lacing of gold and black. It is a native of Hindustan, Ceylon, and Borneo. Several specimens are in the British Museum, and a living specimen in the gardens of the Zoological Society, Regent's Park. It is said to increase till it is more than thirty feet in length and stout in proportion. The powers of such a gigantic reptile must be enormous, and it is stated that this serpent is able to manage a buffalo. Nor are there wanting horrible instances of man himself having fallen a prey to these monsters in modern times. The story goes that a Malay prow was anchored for the night under the island of Celebes. One of the crew had gone on shore to search for betel-nut, and is supposed to have fallen asleep upon the beach from weariness on his return. In the dead of the night his companions on board were roused by dreadful screams: they immediately went ashore, but they came too late; the cries had ceased, and the wretched man had breathed his last in the folds of an enormous serpent, which they killed. They cut off the head of the snake and carried it, together with the lifeless body of their comrade, to the vessel. The right wrist of the corpse bore the marks of the serpent's teeth, and the disfigured body showed that the man had been crushed by the constriction of the reptile round the head, neck, breast, and thigh. The picture by Daniell, representing a man seized by one of these monsters, will be familiar to many of our readers.

P. molurus (*Coluber molurus*, Linnæus, *P. Javanicus*, Kuhl, *P. Tigris*, Daudin), the Rock-Snake, is one of the species of this family often called by the name *Boa Constrictor*. It is characterised by having the two pairs of front upper and three hinder lower labial shields pitted, with the frontal plate double. The structure of the head and jaws of this species is seen in the annexed cuts, which will illustrate generally these points in the anatomy of the family. In the Museum of the College of Surgeons are several beautiful preparations of the structure of this gigantic snake. Four living examples are now in the Gardens of the Zoological Society, Regent's Park. This species is a native of Hindustan, Java, and other parts of Asia.

Head of Python molurus, seen from above.

Head of the same.
a, upper part of the head, seen from below; *b*, the skull, seen in profile.

3. *Hortulia.* Upper and lower labial shields deeply pitted; muzzle and forehead with symmetrical shields; nostrils lateral. There are three species natives of Africa:—

H. Natalensis (*Python Natalensis*, Andrew Smith), the Natal Rock-Snake. It has two pairs of front upper labial shields pitted, with two or three supra-ocular shields.

Dr. Andrew Smith, in his 'Illustrations of South Africa' gives a very beautiful figure of *Python Natalensis;* and he states that this snake, or at least one resembling it in size, was formerly an inhabitant of the districts now within the Cape Colony, and that the traditions of the older Hottentots abound with instances of its miraculous powers. "At present," he says, "it is not to be found within hundreds of miles of the boundaries of the colony, and few specimens have been obtained nearer than Port Natal." He informs us that it occasionally attains a very large size, and according to the natives, individuals have been seen whose circumference was equal to that of the body of a stout man. Dr. Smith himself saw a skin which measured twenty-five feet, though a portion of the tail part was deficient. "It feeds," he says, "upon quadrupeds, and for some days after swallowing food it remains in a torpid state, and may then be easily destroyed. The South Africans however seldom avail themselves of ridding themselves of a reptile they view with horror, as they believe that it has a certain influence over their destinies; and affirm that no person has ever been known to maltreat it without sooner or later paying for his audacity."

Rock-Snake (*Python molurus*).

H. Sebæ (*Coluber Sebæ*, Gmelin, *Python bivittatus*, Kuhl), the Guinea Rock-Snake and Fetish Snake, closely resembles the last in many points of structure. It is a native of western Africa, and specimens in the British Museum have been obtained from Ashantee, Gambia, and the Gold Coast. There is a living specimen in the Zoological Gardens, Regent's Park, estimated to weigh one hundred-weight.

H. regia (*Boa regia*, Shaw, *Python regius*, Dumeril), the Royal Rock-Snake, distinguished from the last two by the four pairs of front upper labials being pitted, the supra-ocular plate single, the lower labial shields broad, four. It is an inhabitant of Gambia, in western Africa. It is of a black colour, marked on the middle of the back with a series of oblong longitudinal white spots; the sides with a series of very large white spots, with one or two oblong black spots on their upper part; the head black, with a streak over the nostrils and the top of the eyes, another from the lower edge of the eye; the lips, chin, and beneath white.

4. *Liasis.* Upper and lower labial shields pitted; muzzle and space between the eyes shielded. This genus includes various species of *Python* of other authors. Dr. Gray describes four:—

L. amethystinus, the Liasis; an inhabitant of New Ireland.

L. Macklotii, Macklot's Liasis, an inhabitant of Timor and Samao. Neither of these is in the British Museum.

L. Childrenii, Children's Liasis, an inhabitant of North-Western Australia. One specimen in the British Museum is from Port Essington.

L. olivacea, the Lisalia, also a native of Australia. Specimens have been brought from Port Essington and Sir Charles Hardy's Island.

5. *Nardoa.* Lower labial shields pitted; crown with eleven symmetrical shields. Of this genus there are two species, *N. Schlegelii*, the Nardoa of New Ireland, and *N. Gilbertii*, Gilbert's Nardoa, a native of North Australia.

b. Subcaudal plates entire, one-rowed; intermaxillary or incisive teeth none; supra-orbital bone none.

* Scales smooth; labial shields pitted.

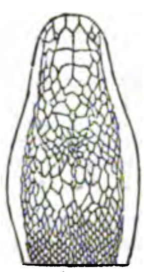
6. *Epicrates.* Forehead with symmetrical shields; crown scaly. The species are natives of America and the West Indies.

E. angulifer, the Pale-Headed Epicrates, is a native of Hayti.

E. Cenchria (*Boa Cenchria*, Linnæus, *Eunectes Aboma*, Cuvier), the

Aboma. It is one of the largest of the family, and sometimes attains a gigantic size. It is of a yellowish colour, with a row of large brown rings running the whole length of the back, and variable spots

Natal Rock-Snake (*Hortulia Natalensis*)

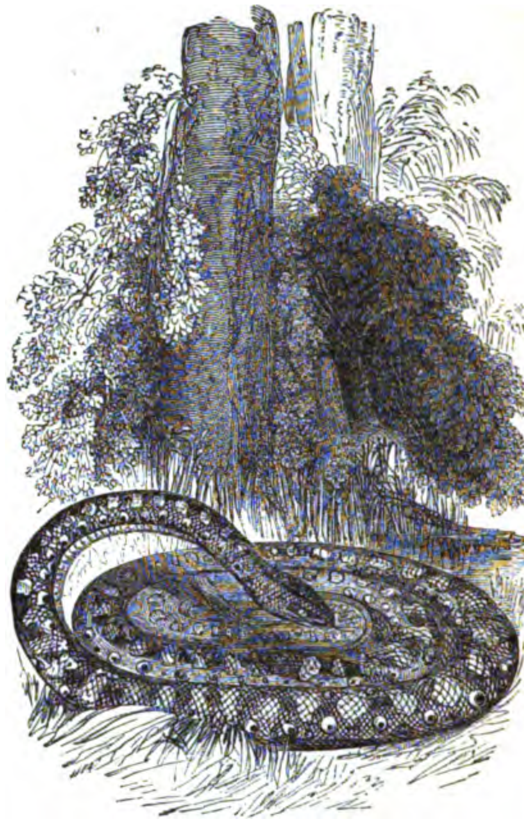


Head of *Hortulia Natalensis*.

on the sides. These are generally dark, often containing a whitish semi-lunar mark. This species, according to Seba, who describes it as Mexican, is the Temacuilcahuillia (or Tamacuilla Huilia, as Seba writes the word) described by Hernandez. This species haunts the marshy places of the warm parts of South America; there, adhering by the tail to some aquatic tree, they suffer the anterior part of the body to float upon the water, and patiently wait to seize upon the quadrupeds which come to drink.

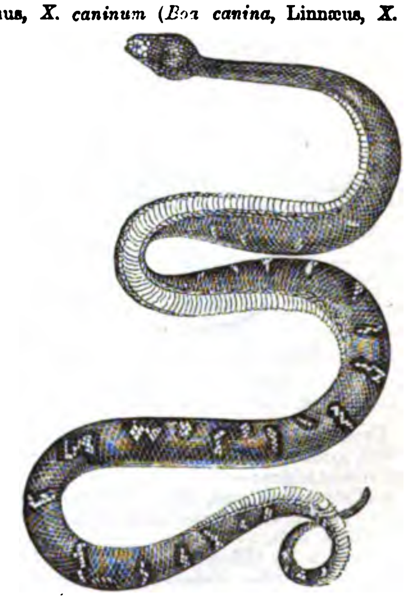
E. maurus, the Brown Aboma of Gray, is of a brown colour, and is a native of Venezuela

7. *Xiphosoma*. Forehead and crown scaly; muzzle with regular shields; labial plates short and all pitted. There is but one species

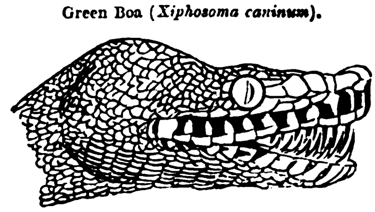


Aboma (*Epicrates Cenchria*).

of this genus, *X. caninum* (*Boa canina*, Linnæus, *X. Araramboya*

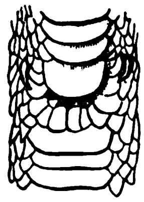


Green Boa (*Xiphosoma caninum*).



Head of *Xiphosoma caninum*.

Spix), the Bojobi, or Green Boa. It is a native of America. It is greenish, with white irregular longish spots somewhat annularly disposed. This is the *Boa viridis* of Boddaert, the *Boa thalassina* of Laurenti, the Bojobi of the Brazilians, the Tetrauchoatl Tlcoa (a Mexican name) according to Seba, and the Cobra Verde of the Portuguese, who relate that these serpents sometimes remain in the houses, doing no harm till irritated, when they at last bite and inflict a wound full of danger, not from injected poison, for the serpent has none, but on account of the injury sustained by the nerves from the very sharp, slender, and long teeth. Great inflammation follows, and the symptoms are aggravated by terror, so that a gangrene is the consequence unless the proper remedies are applied. In the absence of these, certain death is said to be the consequence of a severe bite from this serpent. The immediate cause of death is not stated by Seba, but from the long and penetrating teeth of the Bojobi it may be presumed to be often tetanus or locked jaw. Seba says that this species varies in size, adding that the specimen from which his figure was taken was more than two cubits in length. Cuvier is of opinion that the *Boa hipnale* is only a young Bojobi or *Boa canina*.



A portion of the under part of the tail of *Xiphosoma caninum*, showing the hooks near the vent, and the arrangement of the scuta.

Living specimens of this snake are in the Gardens of the Zoological Society, Regent's Park.

8. *Corallus*. Forehead and crown scaly; muzzle with regular shields; labial shields short, hinder ones pitted. There is but one species:—

C. hortulanus, the Cencoatl. It is most extensively distributed in South America, and amongst the specimens in the British Museum several varieties can be distinctly observed. This snake, which is the *Coluber hortulanus* and *Boa hortulana* of Linnæus, has been extensively observed, and has numerous synonyms.

9. *Sanzinia*. Forehead and crown scaly; muzzle with regular shields; labial shields elongate prismatic.

S. Madagascariensis, the Sanzin of Madagascar, is the only species, and of this a specimen exists in the Museum at Paris; there is none in the British Museum.

10. *Cliftia*. Forehead and crown scaly; muzzle with regular shields; labial shields broad, low. Dr. Gray remarks of this genus that it may be the same as *Casarea*, "but the scales in the dry specimens are not keeled; and the front upper labial shields appear to be pitted, and the tail is short."

C. fusca, a native of India, is the only species.

** Scales smooth; labial shields smooth, not pitted.

11. *Boa*. Crown covered with scales; nostrils lateral, between two plates. There are four species of *Boa*, all of which have been described as the *Boa Constrictor*, and it is always difficult to identify the particular species of snake referred to by travellers, on account of the loose manner in which the name is generally employed.

B. Constrictor of Linnæus (the *Boa Constrictrix* of Schneider, *Constrictor formosissimus* of Laurenti), the Boiguacu, is characterised by the scaly circle of the orbit being separated from the upper labial plates by one or two series of scales. It is also distinguished by a large chain extending the whole length of the back, composed alternately of great blackish stains or spots irregularly hexagonal, and of pale oval stains or spots notched or jagged at either end, the whole forming a very elegant pattern. Shaw, in his lectures, mentions a skin of this species measuring 35 feet, preserved in the British Museum, and adds, that it is probable that many ages ago much larger specimens might have occurred than any at present to be found, the increased population and cultivation of most countries having tended more and more to lessen the number of such animals. The locality of this species, according to the best authorities, is confined to the New World. Daudin, indeed, believed that it was found in the ancient continent, but without sufficient grounds for his opinion. Le Vaillant and Humboldt brought it from Guyana, and the Prince de Wied found it in Brazil. Cuvier gives it as his opinion that there are no true boas of large size in the Old World. All the specimens in the British Museum are from tropical America.

Linnæus, quoting Dahlberg, says that the *Boa Constrictor* was worshipped by the Americans.

"Snake-worship," says Dr. Southey, in his notes to Madoc, "was common in America." (Berna Dios, p. 3, 7, 125.) The idol described, vii. p. 25, somewhat resembles what the Spaniards found at Campeche, which is thus described by the oldest historian of the discoveries:—"Our men were conducted to a broade crosse-way, standing on the side of the towne. Here they show them a square stage or pulpit foure steppes high, partly of clammy bitumen, and partly of small stones, whereto the image of a man cut in marble was joyned, two foure-footed unknown beastes fastening upon him, which, like madde dogges, seemed they would tear the marble man's guts out of his belly. And by the image stood a serpent, besmeared all with goare bloud, devouring a marble lion, which serpent, compacted of bitumen and small stones incorporated together, was seven and fortie feete in length, and as thicke as a great oxe. Next unto it were three rafters or stakes fastened to the grounde, which three others crossed under-propped with stones; in which place they punish malefactors condemned, for proof whereof they saw innumerable broken arrowes, all bloudie, scattered on the grounde, and the bones of the dead cast into an inclosed courte neere unto it."—Pietro Martire.

This serpent appears to have been the Tlicoatl and Temacuilcahuilia of the Mexicans. "It derives its name," says Hernandez, "from its strength, for Temacuilcahuilia is, 'fighting with five men;' it attacks those it meets, and overpowers them with such force that if it once coils itself round their necks it strangles and kills them, unless it bursts itself by the violence of its own efforts;" and he goes on to state how its attack is avoided by the man opposing a tree or other object to its constriction, so that while the serpent fancies that it is compressing the man it may be torn asunder by its own act, and so die. The same author states that he had seen serpents as thick as a man's thigh, which had been taken when young by the Indians, and tamed, and how they were provided with a cask strewn with litter, in the place of a cavern, where they lived, and were for the most part quiescent except at meal times, when they came forth, and amicably climbed about the couch or shoulders of their master, who placidly bore the serpent-embrace (amplexus) of the terrific animal; or how, lying coiled up in folds, and equalling a large wheel in size, they harmlessly received the food offered to them. In the description of the Temacuilcahuilia we have, allowing for some exaggerations, the predatory habits of an enormous Boa; and in the relation of the manners of the tamed constricting serpents which follows it, we find an engine which might be and no doubt was turned to account by the ancient Mexican priests.

Boa Constrictor.

Specimens of this and the following species are living in the Gardens of the Zoological Society, Regent's Park.

B. diviniloqua (*Constrictor diviniloquus*, Laurenti), the Lamanda, is an inhabitant of Santa Lucia, and the specimen in the possession of the Zoological Society appears to be the only one in Europe.

B. Imperator, the Emperor Boa, is a native of Mexico and Honduras.

B. Eques, the Chevalier Boa, is an inhabitant of Peru.

12. *Pelophilus*. Crown covered with irregular plates; nostrils lateral, between two scales.

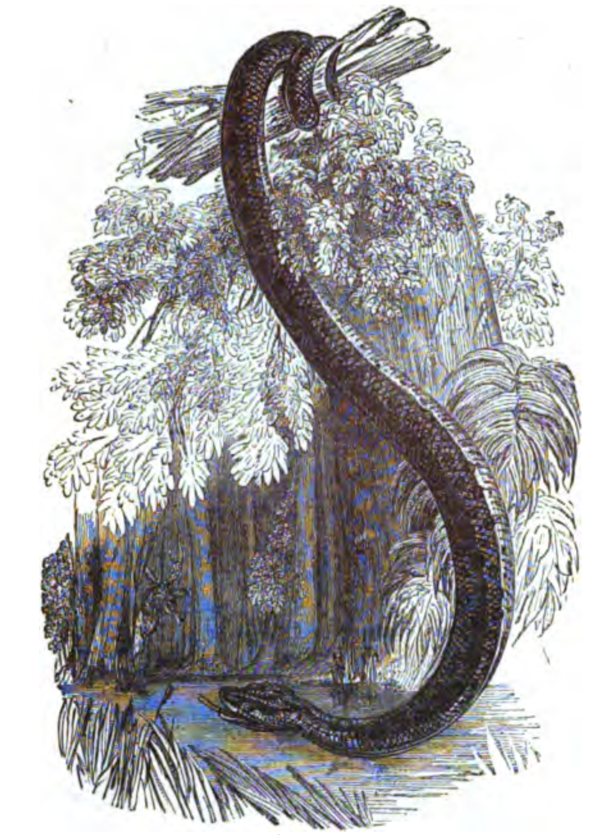
P. Madagascarensis, the Pelophile, a native of Madagascar, is the only species.

13. *Eunectes*. Crown covered with irregular shields; nostrils vertical, between three plates.

E. murinus (*Boa Scytale* and *Boa murina*, Linnæus, *Boa aquatica*, Prince Maximilian, *Boa gigas*, Latreille, *Boa Anaconda* and *Boa Aboma*, Daudin), the Anaconda. It is a native of tropical America.

Mr. Bennett observes in the 'Tower Menagerie' that the name of Anaconda, like that of *Boa Constrictor*, has been popularly applied to all the larger and more powerful snakes. He adds that the word appears to be of Ceylonese origin, and applies it to the *Python Tigris*.

This species is brownish, with a double series of roundish black blotches all down the back; the lateral spots annular and ocellated, the disks being white, surrounded by blackish rings. The trivial name *murinus* was given to it from its being said to lie in wait for



Anaconda (*Eunectes murinus*).

mice; and Seba has given a representation of it about to dart upon an American mouse, which he says is its usual food. Such 'small deer' may be the prey of this species when very young, but it grows to a size equalling that of *Boa Constrictor* and *Epicrates Cenchria*. We think it very probable that this is the Culebra de Agua of the Venezuelans. The other provincial name, El Traga Venado, or 'Deer-Swallower,' indicates the prey of the serpent when of mature age. Linnæus says of his *Boa Scytale*, "Constringit et deglutit capras, oves," &c. (It constricts and swallows goats, sheep, &c.)

The following description of a species, of which a specimen was forwarded to the United Service Museum, was given by Sir Robert Ker Porter:—"It is not venomous, nor known to injure man (at least not in this part of the New World); however the natives of the plains stand in great fear of it, never bathing in waters where it is known to exist. Its common haunt, or rather domicile, is invariably near lakes, swamps, and rivers; likewise close to wet ravines produced by inundations of the periodical rains; hence, from its aquatic habits, its first appellation. Fish and those animals which repair there to drink are the objects of its prey. The creature lurks watchfully under cover of the water, and whilst the unsuspecting animal is drinking suddenly makes a dash at its nose, and with a grip of its back-reclining double range of teeth never fails to secure the terrified beast beyond the power of escape. In an instant the sluggish waters are in turbulence and foam, the whole form of the Culebra is in motion, its huge and rapid coilings soon encircle the struggling victim, and but a short moment elapses ere every bone is broken in the body of the expiring prey. On its ceasing to exist the fleshy tongue of the reptile is protruded (taking a long and thinnish form), passing over the whole of the lifeless beast, leaving on it a sort of glutinous saliva that greatly facilitates the act of deglutition, which it performs gradually by gulping it down through its extended jaws—a power of extension of them it possesses to so frightful and extraordinary a degree as not to be believed when looking at the comparative smallness of the mouth and throat in their tranquil state. After having completely devoured or rather hidden its prey in the way described it becomes powerless as to motion, and remains in an almost torpid state for some days, or until nature silently digests the swallowed animal. The snake now sent was killed with lances when just regarding its powers of action.

"The flesh of this serpent is white, and abundant in fat. The people of the plains never eat it, but make use of the fat as a remedy for rheumatic pains, ruptures, strains, &c. When these creatures are young the colours on the skin are very bright, and gradually lose their brilliancy with age."

There is generally in these descriptions an account of the fleshy tongue of the reptile, and of its application to the dead animal for the purpose of covering it with saliva, previous to the operation of swallowing it. A glance at the tongue of a Boa or a Python will convince the observer that few worse instruments for such a purpose could have been contrived. The delusion is kept up by the mode in which these serpents are sometimes preserved in museums, where they may be occasionally seen with fine artificial, thick, fleshy, vermilion tongues in the place of the small dark-coloured extensile organs with which nature has furnished them. We have frequently watched constricting serpents while taking their prey, and it is almost superfluous to add that they never covered the victim with saliva from the tongue before deglutition. When the prey is dead and the serpent is about to swallow it, the tongue of the destroyer is frequently thrust forth and vibrated, as if indicatory of the desire for food; but the mucus is not poured out till it is required to lubricate the dilated jaws and throat for the disproportioned feast.

14. *Chilabothrus.* Crown covered with regular shields; nostrils lateral, between three scales.

C. inornatus, the Yellow Snake, is a native of Jamaica. The head and front part of the body olive; temple with a narrow black streak; back with small scattered black oblique cross lines; hinder part of the body black, with olive spots. A living specimen is in the Gardens of the Zoological Society.

*** Scales keeled; lateral shields not pitted; nostrils between two plates.

15. *Ungalia.* Head covered with symmetrical shields. The species are natives of tropical America.

U. melanura, Black-Tailed Ungalia, has been found in Cuba.

U. maculata, the Pardaline Ungalia, is found in Cuba and Jamaica.

**** Scales keeled; lateral shields not pitted; nostrils a single plate.

16. *Enygrus.* Head covered with small irregular shields; nostrils in a single plate. There are two species, inhabitants of the Asiatic islands.

E. carinatus, the Candoia. It has been found in New Guinea.

E. Bibroni. Bibron's Enygrus. A specimen exists in the Museum at Paris.

17. *Casarea.* Head scaly; muzzle covered with symmetrical shields; nostrils in a single plate (?). One species,

C. Dussumieri, the Casarea, is found in the Isle Ronde near Mauritius.

18. *Bolyeria.* Head covered with symmetrical shields; nostrils in a single plate.

B. multicarinata, the Bolyeria, is the only species. It is a native of Port Jackson, Australia.

II. *Tail very short, slightly or not prehensile; Head indistinct, short.*

a. Head covered with scales; pupil oblong; scales convex; subcaudal shield one-rowed; intermaxillary teeth none; supra-orbital bone none.

19. *Cusoria.* Muzzle rounded; ventral and subcaudal plates narrow; scales ovate, of body and tail smooth.

C. elegans, the Cusoria, is the only species. Inhabits Affghanistan.

20. *Gongylophis.* Muzzle wedge-shaped; jaws equal; head with small keeled scales; scales of back keeled; body fusiform.

G. conica (*Boa conica*, Schneider; *B. ornata*, Daudin; *Eryx Bengalensis* and *Scytale coronata*, Guerin), the Padain Cootoo. It is a native of Hindustan.

21. *Eryx.* Muzzle wedge-shaped; upper jaw largest; head with small scales; scales of back smooth, of hinder part of body keeled.

E. Jaculus (*Tortrix Eryx*, *Anguis Jaculus*, *A. colubrina*, Linnæus; *A. cerastes*, Hasselquist, *Eryx Delta*, Geoffroy), the Eryx. This species, known by its distinct gular groove and two pairs of frontals, has been found in Egypt, Corfu, Xanthus, Naxos, Greece, and on the shores of the Mediterranean.

E. Thebaicus, the Shielded Eryx, has no gular groove, and one pair of frontals. It is a native of Egypt and the North of Africa.

22. *Clothonia.* Muzzle wedge-shaped; upper jaw largest; scales smooth.

C. Johnii (*Boa Johnii*, Rüppell, *Eryx Johnii*, Dumeril, *Tortrix Eryx*, Schlegel, *Amphisbæna*, 'Penny Cyclopædia,' *fig.*), the Clothonia, is the only species belonging to this genus.

This species is of a reddish brown colour, and is a native of Hindustan.

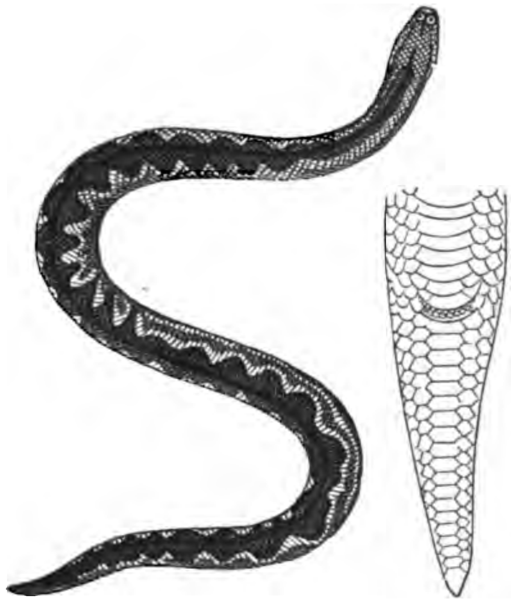
b. Head shielded; pupil round.

23. *Cylindrophis.* Nostrils in a single shield; eyes surrounded by shields; intermaxillary teeth none. This genus has three species.

C. melanota, the Black-Backed Pamboo. It has a triangular truncated tail. The muzzle is black, the end of tail white; the belly black and white banded; the tail longer than the head. It is a native of Celebes.

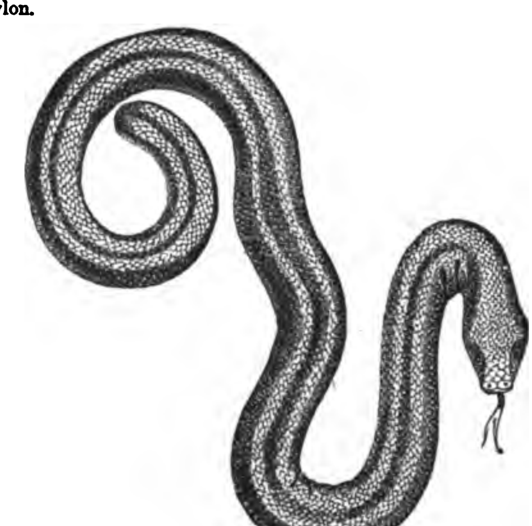
C. rufa, the Schilaj Pamboo, with a conical tail and broad muzzle. It is black or reddish, often white-ringed; head and tip of tail black;

a white spot on each fronto-nasal plate. It is a native of Penang. Dr. Gray describes two varieties, one from Borneo, another from Celebes.



Padain Cootoo (*Gongylophis conica*).

C. maculata (*Tortrix maculata*, Schlegel; *Anguis tesselata*, *A. derupata*, Laurenti), the Miguel, has a conical tail and narrow muzzle. It is red or brown, netted with black; beneath whitish. It inhabits Ceylon.



Clothonia (*Clothonia Johnii*).

24. *Charina*. Nostrils between two shields; eyes surrounded by small scales.

C. Bottæ (*Tortrix Bottæ*, Blainville), the Charina, is the only species. It is of a pale yellow colour, with back and tail darker. It is found in California.

25. *Tortrix*. Nostrils between two shields; eyes in a single shield; intermaxillary teeth distinct.

T. Scytale (*Anguis Scytale*, Linnæus, *A. ater*, Shaw, *Tortrix corallinus*, Oppell), the Coral Snake. It is a native of tropical America.

BOIS DE COLOPHANE. [BURSERA.]

BOLBO'CERUS, a genus of Coleopterous Insects of the family *Geotrupidæ* (*Scarabæus* of Linnæus). The species of this genus are remarkable for their short compact form, above appearing almost spherical. The male is armed with an erect horn springing from the head, the female has merely a tubercle in the same part; the thorax has frequently four small horns, or tooth-like processes, arranged in a transverse line on the anterior part; the antennæ are eleven-jointed, the three terminal joints form a compact round knob, the middle joint being almost inclosed by the other two; one mandible is armed internally with two teeth, the other is simple; the anterior portion of the mentum is entire; the elytra are striated.

These insects live upon dung, and excavate cylindrical holes in the ground under the mass, in which they deposit their eggs enveloped in a ball of the excrement.

There are about sixteen species known: their most common colour is brown or yellowish, and sometimes black. In this country but two species have occurred, *B. mobilicornis* and *B. testaceus*. *B. mobilicornis* is of a pitchy black colour, and about one-third of an inch long; the head in the male sex has a recurved horn; antennæ with the club red; thorax punctured, and furnished with four tooth-like projections on the fore part; elytra striated; legs and body inclining to a red colour.

B. testaceus is entirely of an ochre colour; head with two tubercles; thorax sparingly punctured; elytra with punctured striæ. About the same size as the last, of which by some it is supposed to be a variety. Both of these species are very rare.

BOLDOA, a genus of plants belonging to the natural order *Monimiaceæ*. *B. fragrans* is the Boldu of Chili. It produces an aromatic succulent fruit which is eaten by the natives. The wood is very fragrant, and makes a charcoal which is preferred by the smiths of Chili to that from any other wood. The leaves are also very fragrant. The bark is employed in tanning. (Lindley, *Vegetable Kingdom*.)

BOLE, a hydrous silicate of Alumina, which occurs as an earthy mineral in amorphous masses in various countries, as in Armenia, Saxony, in Tuscany, at Sienna, in Ireland, and in Scotland in the Isle of Skye.

The colour of Bole is various, either yellow, brown, red brownish, or pitch-black. It is dull, has a greasy feel, and adheres to the tongue. Its fracture is conchoidal, yields to the nail, and the streak is shining. When put into water it readily absorbs it, emits bubbles of air, and falls to pieces. The Armenian Bole, according to Wiegleb, consists of

Silica	63·13
Alumina	22·67
Iron	11·00
Loss	3·20
	100·00

The Lemnian Bole, called also Lemnian Earth, was anciently an article of Materia Medica, and kept by apothecaries in small pieces under the name of Terræ Sigillatæ: these were impressed on one side with the figure of a goat, &c. According to Pliny it was also used as red pigment.

Klaproth found the composition of this Bole to be

Silica	66
Alumina	14·5
Oxide of Iron	6
Soda	3·5
Water	8·5
A trace of Lime and Magnesia	
	98·5

The only Bole at present used is as a coarse red pigment, for which purpose it is calcined and levigated, and vended in Germany under the name of Berlin and English Red.

These earths were formerly employed as astringent, absorbent, and tonic medicines. They might be slightly serviceable as absorbents, in the same way as putty powder is used in the present day, when sprinkled over excoriations of the skin. Any tonic power which they possessed was due to the oxide of iron, which is now administered in a purer state. These once celebrated articles have fallen into merited disuse: they are still however employed in the East, and occasionally as veterinary medicines in Europe, where earths of a similar kind are found abundantly among volcanic, basaltic, and the older calcareous rocks, and are called after the different countries in which they are found. Those which have less colour are called *Bolus alba*, are procured in Bohemia, Salzburg, &c., and consist of lithomarge, which is formed of silica and alumina with water, and a little oxide of iron. These substances are extensively employed to adulterate articles of food, as anchovies, cocoa, and other things having naturally a red colour. The Bole Armenian must not be confounded with the Lapis Armenius, which is a native carbonate of copper. The Terra Lemnia is sometimes employed to signify the pulp of the fruit of the *Adansonia digitata*, the Baobab, or Monkey-Bread, which is used as an astringent for the cure of dysentery by the inhabitants of Senegal.

BOLETO'BIUS, a genus of Coleopterous Insects of the section *Brachelytra* (M'Leay), and family *Tachyporidæ* (*Staphylinus* of older authors.) Generic Characters:—Head long and pointed anteriorly; antennæ with the basal joint rather long and slender; the three next joints slender, and nearly of equal length, the remaining joints gradually increasing in width to the last, inclusive; palpi rather long and slender; thorax narrower before than behind, the hinder angles rounded; elytra smooth, or indistinctly striated; body long, widest at the base, and tapering to a point at the apex; legs moderate, tibiæ spinose, the four posterior with long spines at their apices.

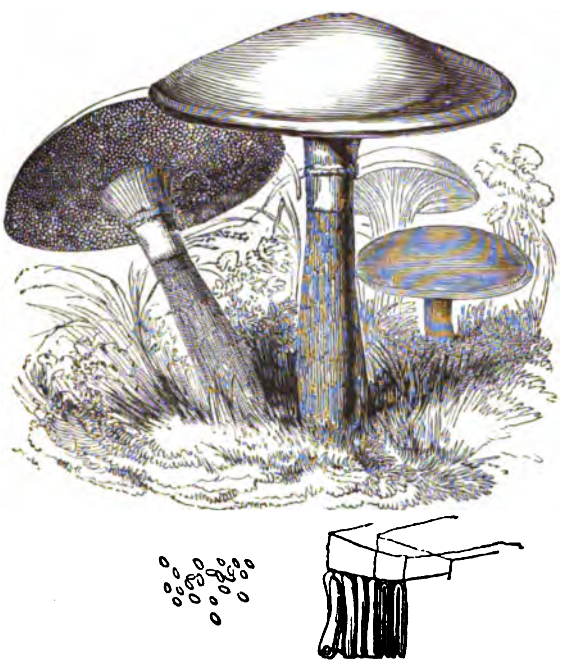
The species of this genus reside in *Boleti* and other species of *Fungi*, in which they occur in the greatest abundance, particularly when in a state of decay. They are all exceedingly active, and their smooth slender bodies and pointed heads render it an easy task for them to thread their way with rapidity through the putrescent *Fungi*.

B. lunatus (Linnæus) is one of the most beautiful and largest species of the genus, and is not uncommon. It is about a quarter of an inch long. The head is black; the antennæ have the three basal joints yellow, the remaining black, with the exception of the terminal joint, which is yellow; the thorax and legs are yellow; the wing-cases are of a blue-black colour, with an oblique yellow spot on the shoulders; the body is yellow, with the apex black.

About eighteen species of this genus have been found in this country, almost all of which are varied with yellow and black. Many have the wing-cases yellow, with two black spots, one on each side of the apex; some have also the region of the scutellum black.

(Stephens, *Illustrations of British Entomology.*)

BOLE'TUS, an extensive genus of *Fungi*, consisting, according to the old botanists, of leathery masses, which are sometimes of considerable thickness, and having the spores lodged in tubes which occupy the same situation as the plates in the gills (or hymenium) of the common mushroom. Fries, the great modern describer of *Fungi*, defines the genus thus :—Hymenium formed of a peculiar substance, altogether distinct from the cap, entirely composed of tubes united into a porous layer; these tubes are undivided, separable from each other, long, cylindrical, or angular, open from end to end, and bear asci (spore-cases) on their inside; asci cylindrical, with small roundish spores; the stalk is central, and often netted; the cap is fleshy, soft, spread out into a hemispherical form; veil present in many of them. He includes within his definition but a small number of the old *Boleti*, referring the principal part to *Polyporus*, which is especially characterised by having the tubes of its hymenium inseparable from the cap, which is more leathery, and usually without a stalk.



Boletus luteus.

The true *Boleti* are generally found growing on the ground in woods and meadows, especially in pine woods: the *Polypori* are commonly met with on trees, especially pollards. Of the former, several species are eatable, as *B. edulis*, *B. scaber*, *B. subtomentosus*, and *B. granulatus*; others are acrid and dangerous. Of these Dr. Badham, who has written on the Esculent Funguses of England, recommends only *B. edulis* and *B. scaber*.

B. edulis, the Edible Boletus, has the following characters :—Pileus or cap from six to seven inches across, smooth, with a thick margin varying in colour from light brown or bronze to bay, dark brown, or black, or a mixture of all these colours; the epidermis firmly adherent to the flesh, which is fine, and except the part in immediate contact with the skin, white; the under surface of the cap nearly flat, often presenting a circular pit or depression round the stalk; the tubes at first white, then yellow, lastly of an olive or yellow green tint, in the earlier stage of their growth closed; afterwards as the cap expands stopped up with a waxy-looking material of a dirty pearl-colour; stem varying much in shape at different periods of the growth of the Boletus, always thick and solid, at first white but soon changing to fawn-colour, beautifully netted with reticulations. As the period of the ripening of the spores advances the under part of the cap swells, the waxy matter is absorbed, the tubes present deep and rounded orifices to the eye, and emit an ochreous green dust, which consists of sporules. After this the whole fungus becomes flaccid, the tubes turn to a dirty green, and decomposition rapidly proceeds. This Boletus grows in woods consisting of pines, oaks, or chestnuts; it is most abundant in autumn, but occurs in spring and summer. Dr. Badham says of other *Fungi* likely to be comfounded with it :—"The *B. castaneus*, which bears some little resemblance to it, is at once distinguished by having a cottony fibrillose stem without reticulations, a downy cap, and dirty yellow dust: neither can it be confounded with the *B. subtomentosus* or *B. luridus*, because in addition to many other points of difference, both these change colour on being cut or bruised." As an article of diet, Dr. Badham says "It imparts a relish alike to the homely hash and the dainty ragout, and may be truly said to improve every dish of which it is a constituent."

B. scaber has a cap from three to seven inches across the surface, which becomes viscid when moist and is invariably downy. There are two varieties, in one of which the pileus is of a beautiful deep orange hue and the stem black. In the other the pileus is gray and the stem covered with orange scales. The flesh is thick and flabby, of a dingy white, not greatly changeable in young specimens, but deepening in colour when old. It is not so agreeable as the last species.

B. officinalis, supposed to have been the 'Αγαρικὸν of Dioscorides, is an old-fashioned medicine remarkable for the extreme acridity of its powder; it acts as a powerful purgative, but is never employed at the present day.

B. igniarius, when dried and sliced, furnishes the German Tinder, or Amadou, a leathery substance sold in the tobacconists' shops. [AMADOU.]

B. destructor is one of the many species of *Fungi* the ravages of which are too well known under the name of Dry Rot. Their destructive qualities are not however caused by the fructification, or the part which we commonly consider the fungus itself, but by the ramifications through the substance of the wood of what botanists call the Thallus and gardeners the Spawn of such plants, which is in effect their stem and root in a mixed state. Other species of *Fungi* produce dry rot. [MERULIUS.]

BOLITO'PHAGUS (Fabricius), *Eledona* of Latreille, Leach, and Millard, and *Opatrum* of some other authors, a genus of Coleopterous Insects of the section *Heteromeia* and family *Tenebrionidæ*. The principal generic characters are as follows :—Head short, partially hidden by the thorax, in the males sometimes armed with a horn or tubercle; antennæ very short and thick, the three or four apical joints much broader than the rest; maxillary palpi rather large and distinct, the terminal joint truncated, its length equalling that of the two preceding joints; labial palpi small; thorax coarsely punctured or rugose, the lateral margins more or less toothed; elytra deeply striated; legs short and thick, the anterior tibiæ compressed.

There are about six species of this genus known: they live in *Boleti*, and are of a small size, a short ovate form, and their prevailing colours are brown-black. In this country but one species has as yet been discovered, *B. Agaricola* or *Agaricicola*. It is of a brown colour, and about one-twelfth of an inch long. It is rather local, but where it does occur it is found in tolerable abundance.

BOLOGNA SPAR, a variety of Sulphate of Barytes. [BARYTES.]

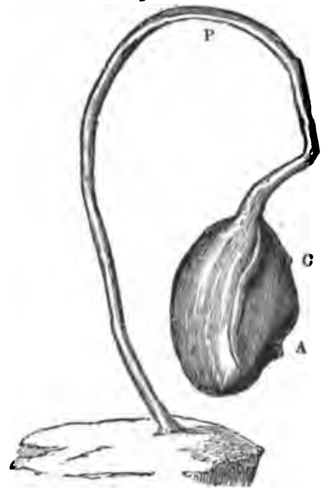
BOLSOVER STONE. The yellow limestone of Bolsover in Derbyshire is used in the construction of the new Houses of Parliament. It was selected for its durability, strength, fitness for ornamental work, and colour. It is a combination of carbonate of magnesia with carbonate of lime [DOLOMITE] in small granular crystals, without the slightest trace of organisation, flinty nodules, or other blemishes. It has been subjected to various and severe mechanical pressures, chemical re-agents, &c., and has sustained them with credit; but it is yet to be seen whether it can withstand the atmosphere of London, which has destroyed the Bath and Portland Oolites. Many other public buildings in England have been built with stone from the same formation, which is called Magnesian Limestone.

BOLTE'NIA, a subgenus of *Ascididæ*, a family of the group *Tunicata*, which, according to W. S. M'Leay, are the animals that connect the *Acrita*, or lowest primary division of the animal kingdom, with the *Mollusca*, from which he observes they differ in the following points: first, in having an external covering consisting of an envelope distinctly organised and provided with two apertures, of which one is branchial, the other anal; secondly, in their mantle forming an internal tunic corresponding to the outer covering or test, and provided like it with two openings; and thirdly, in having branchiæ which occupy all or at least part of the membranous cavity formed by the internal sides of the mantle. From the *Acrita* the *Tunicata* (or *Heterobranchiata*, as De Blainville calls them) differ in having distinct nervous and generative systems, while their intestinal canal is provided with two openings, both internal. [TUNICATA.]

The following is the generic character of *Boltenia* (Savigny) as reformed by M'Leay :—Body with a coriaceous test, supported from the summit by a long pedicle, and having both orifices lateral and cleft into four rays. Branchial pouch divided into longitudinal folds, surmounted by a circle of compound tentacula, and having the reticulation of its respiratory tissue simple; abdomen lateral; ovary multiple.

There are three species recorded, namely, *B. ovifera*, *B. fusiformis*, and *B. reniformis*.

The following is M'Leay's character and description of *B. reniformis* (*Ascidia globifera*, Sabine, *A. clavata*, Fabricius) :—Obscure, roughish; body sub-reniform, the orifices being somewhat prominent; peduncle terminal; envelope sub-pellucid, whitish; mantle or tunic very thin, provided with transverse circular narrow muscles, which cut each other very obliquely; tentacula about ten or twelve in number, very unequal, clavate, with the clava plumiform, or beautifully divided into a number of regular laciniæ; branchial pouch marked with about fifteen or sixteen large folds, and having the net-work simple and regular; dorsal sulcus having the two lateral filaments winged and the intermediate simple; œsophagus descending vertically to the lower end of the body, as suspended, and there meeting an ascending ovoidal stomach without any apparent internal folioli; intestine with an oblong, longitudinal, open loop, which is prolonged to the pedicle; rectum narrow, subconical, and ascending nearly parallel to the œsophagus, only higher; anus having a scolloped margin; liver coating the stomach behind the right ovary, and running from the lower end of the body, as suspended, about half way up; it is divided into several granulated globes, some of which are separated from the others, particularly towards the pharynx; ovaries two, elongate, lobate, situated on each side of the body, and directed towards the anal orifice; right ovary straight, claviform, lying close within the loop of the intestine; left ovary larger and less lobate, but undulated and extending downwards behind the branchial vein.



Boltenia reniformis, from a preserved specimen.

P, pedicle; C, branchial orifice of envelope; A, anal orifice of envelope.

M'Leay gives the northern seas of America as the locality of the animal. Captain J. C. Ross says that a single specimen was dredged up from a depth of seventy fathoms near Elizabeth Harbour. He observes that he can add nothing to M'Leay's admirable description except that the colour of the body is a very light brown; that of the pedicle darker.

The sphere wherein this Ascidian moves must necessarily be very contracted. Anchored by its pedicle, the length of its moorings fixes the limit of its motions, which are most probably confined to the oscillations arising from the agitation of the waves. Both the body and pedicle, as M'Leay observes, are scabrose, or covered with a rough surface, which is formed by exceedingly short coarse hairs. The original colour he could not ascertain; but in spirits it was cinereous, or dirty white, which, he adds, may possibly be the true colour of the animal, as it is not unfrequently that of the other *Ascididæ*. M'Leay's specimen was brought home from Winter Island by W. N. Griffiths, Esq., while under the command of Captain (now Sir Edward) Parry.

BOLTONITE, a native anhydrous Silicate of Magnesia. It occurs massive with a granular structure, or in yellowish or bluish-gray grains. The cleavage is in one direction; the lustre vitreous; transparent to translucent. It is found disseminated through limestone in the United States of America, at Bolton, Roxborough, and Nittleton, Massachusetts; and Ridgefield and Reading, Connecticut.

BOMBA'CEÆ, a group of plants considered by some a distinct natural order, by others as a mere section of *Sterculiaceæ*. They are usually large trees, with broad deep-green leaves, and flowers of considerable size. Technically they differ from *Malvaceæ* in having two cells to their anthers which are often doubled down upon themselves, in their calyx opening in an irregular rather than a valvate manner, and in their stamens being usually collected into five parcels. Their anthers are often described as having only one cell; but this is an inaccurate mode of speaking of them, inasmuch as they are formed upon the common two-celled type, and merely have the cells united at the point of the connective.

This group contains some of the most majestic and beautiful trees that are known, but nothing of much medical or economical importance is furnished by them. Their wood is light and spongy; the long cottony substance found within their fruit, and which has gained for some of them the name of Cotton-Trees, is too short in the staple to be manufactured into linen; and the slightly acid or mucilaginous qualities that occur in the group are altogether inferior to those of many *Malvaceæ*. The Baobab Tree is one of them. [ADANSONIA.] It is remarkable for the excessive thickness of its trunk as compared with its height, and this is a character of common occurrence. Several American species spread enormously near the ground, forming huge buttresses with the angles of their trunks. This is especially the case with the genus *Eriodendron*, which is moreover often defended by very large conical prickles, which do not fall off till they are exfoliated by the gradual distension of the trunk. Among these plants is a singular instance of a flower resembling the paw of some animal. [CHEIROSTEMON.] No bombaceous plants are found far beyond the tropics.

BOMBAX (from βόμβυξ), a genus of plants, the type of the natural order *Bombaceæ*. It has a naked, campanulate, unequally 2-5-lobed or truncately 5-toothed calyx; five petals joined together, and somewhat connected at the base with the column of the stamens; numerous stamens, monadelphous at the base, but free at the apex; the anthers inserted at the middle, kidney-shaped or oblong, opening above by a transverse chink; the capsules large, 5-celled, 5-valved, woody; cells many-seeded; albuminous seeds surrounded by silky cotton. The species of this genus are large trees with a soft spongy wood, which is frequently used for making canoes. They are natives of South America and the East Indies.

B. Ceiba, Common Silk-Cotton Tree, has a prickly trunk, palmate leaves with five leaflets, turbinate fruit concave at the apex. This plant is a very large tree, and is a native of the West Indies and South America. Some of the older travellers gave extravagant accounts of its height; it is however frequently seen reaching above 100 feet. The down, which is contained in the seed-vessel, is very soft, but is too short to be used in the manufacture of cloth. It is made into hats and bonnets, and used for stuffing chairs and pillows by the poor people in the districts in which it grows. It is not made into beds, as it is reputed unwholesome to lie upon. The trunks of the largest are made into canoes, and some of these will carry from fifteen to twenty hogsheads of sugar. Columbus in his first voyage to America speaks of having seen a canoe made of this tree in Cuba, which contained 150 men. When the stem decays it becomes the prey of the larva of the Macaca Beetle, which when gutted and fried is esteemed as a great delicacy in the districts where it occurs.

B. pubescens has an unarmed trunk, the lower leaves quinate, the upper ones ternate; the leaflets obovate, elliptical, emarginate, coriaceous, smooth, or covered with black dots of stellate pili beneath; the pedicles inflated and hollow under the flower, and as well as the calyxes covered with black dots of stellate tomentum; the petals tomentose, three times longer than the calyx, with a smooth ovary. This plant reaches from 20 to 30 feet in height. It is a native of Brazil, in the province of Minas Geraes, where the tree is called Embirussu. The bark is very tough, and is used for making ropes. The other species of *Bombax*, of which from fourteen to twenty have been described, possess the same general qualities as the two species described. The wool of the pods of the *B. Malabaricum* is used in India to stuff pillows and beds. *B. insigne* is a native of the Birman Empire, and is remarkable for its large red very showy flowers. All the species grow best in a rich loamy soil. Cuttings not too ripe, when taken off at a joint, will root freely in sand under a hand-glass in a moist heat. The best mode of propagating them is from seeds brought from the places of their natural growth. None of the species seem to have flowered in stoves, but this arises probably from the want of height.

(Burnett, *Outlines*; Loudon, *Encyclopædia of Plants*; G. Don, *Gardener's Dictionary*.)

BO'MBUS, the generic name of those Insects commonly called Humble-Bees: this latter name was derived (Messrs. Kirby and Spence conjecture) from the German Hummer- or Hummel-Biene, a name probably given to these insects from the humming sound which they emit. The *Bombi* belong to the order *Hymenoptera* and family *Apidæ*, and as regards the English species are by far the largest of the tribe. They may be distinguished by the following characters:—Body thickly covered with hair; head with a longitudinal groove and an indentation extending across from the upper part of the eyes; in this indentation the three stemmata are placed, being arranged nearly in a straight line; and it is from the central stemmatum that the longitudinal groove has its origin, whence it extends downwards; antennæ with twelve joints; labrum with its surface uneven; mandibles with several longitudinal grooves on the upper side; posterior tibiæ compressed, smooth, margined with strong recurved hairs, and armed with spines at the apex.

The above are the peculiarities of the females. In the males the antennæ are thirteen-jointed and considerably longer than those of the other sex; the hinder tibiæ want the corbicula; the mandibles are bidentate at the apex and each furnished with a tuft of curved hairs; they differ likewise in possessing no sting and in the structure of their claws, but these two last characters are common to the whole tribe of *Apidæ*.

The neuter bees resemble the females in every respect excepting size; in this they are inferior to the males, which latter are rather less than the females.

Kirby, in his monograph on the bees of this country, enumerates 37 species as belonging to his section '* * c. 2:' this section, with the exception of a few species [PSYTHIRUS], now constitutes the genus of which this article treats.

The prevailing colours of the species are yellow, red, and black: and as these colours are disposed with a certain degree of uniformity, we have arranged the following, which form the principal part of the British species, under three heads, namely, those which have the apex of the body more or less red, those which have that part white, and those in which the ground-colour of the body is yellow or buff: by this arrangement much repetition in the descriptions is avoided.

Section I. *Apex of the Body red.*

B. lapidarius (female), black. The male is rather long and narrow; head and anterior and posterior portions of the thorax yellow.

This species, well known by the name Red-Tailed Bee, is one of the largest and commonest of the genus; the females are to be seen in the spring and summer months; in the autumn, when the males make their appearance, they are less common.

B. Raiellus (female). Smaller and shorter in proportion than the last, from which it may moreover be distinguished by having red hair on the hinder tibiæ.

B. Derhamellus, colour ashy-brown. Thorax and abdomen each with a black fascia. Most probably the male of the last described.

B. subinterruptus (female), black. Anterior portion of the thorax yellow; abdomen with a subinterrupted fascia of the same colour towards the base.

B. Pratorum, black. Anterior portion of the thorax yellow.

B. Burrellanus (male), yellow. Thorax with the central portion black; abdomen with a black fascia near the middle.

B. Cullumanus (male). Like the last, but the fascia of the abdomen is very narrow, occupying only one segment.

B. Donovanellus (female), black. Thorax with the anterior portion yellow; abdomen with the basal portion yellow. In the male the anterior portion of the thorax is obscurely coloured.

Section II. *Apex of the Abdomen white.*

B. terrestris.—This is the largest and most common of the yellow and black Humble-Bees. It has the anterior margin of the thorax and the segment next the basal one of the abdomen of a yellow or buff colour; the rest of the body is black, with the exception of the apex, which is sometimes of a dirty yellow colour and at others white.

The neuters of all the species are very variable in size, but in this there appears to be the greatest extreme; we have specimens which are scarcely as large as the common hive-bee.

B. Hortorum, black. Thorax with the anterior and posterior portions yellow; abdomen with the base yellow; rather less than the preceding species.

B. Tunstallanus (female), black. Thorax with the anterior and posterior margins narrowly edged with yellow.

The insect described by Kirby under the name of *Latreillella* has lately been discovered by Mr. Pickering to be the male of this species. It is of a pale yellow colour, with the central portion of the thorax and two indistinct fasciæ towards the base of the abdomen black.

B. Jonellus (male), yellow. Thorax and abdomen each with a black fascia.

B. lucorum (male), yellow. Thorax with the central portion black; abdomen with the two basal segments yellow, and the two following black, the remainder white.

Section III. *Ground-Colour of the Body yellow or buff.*

B. Muscorum, yellow. Thorax orange.

B. floralis, yellow. Abdomen with a black spot on each side of the second segment, the three following segments with their bases black.

B. Beckwithellus, pale buff colour. Thorax and apex of the abdomen reddish yellow, the latter with a black fascia in the middle.

B. Curtisellus. Like the last, but the abdomen is black, with the base of reddish-yellow.

B. Fosterellus. Thorax buff coloured, with the anterior part blackish; abdomen with three obscure black fasciæ.

(Observation.—We have reason to believe the last four to be varieties of the same species.)

B. Sylvarum, yellowish-white. Thorax with a black fascia; abdomen with two black fasciæ; the apex red interspersed with white.

B. fragrans, bright yellow. Thorax with a black fascia.

Of the above species, *B. terrestris* and *Lapidarius* are the largest. *B. fragrans*, *Tunstallanus*, and *Hortorum*, are the next in size. All the rest of the species are nearly of a size, with the exception of *B. Pratorum.*

The habits and economy of these insects are not less interesting than other members of the order *Hymenoptera.*

In the autumnal months, when the cold weather begins to be felt, and the various honey-yielding flowers disappear, the male and neuter Humble-Bees die, having performed their allotted task, which as far as we can discover, appears to be that of fecundating certain plants, by conveying the pollen from the male to the female flowers: a task which is unavoidably accomplished by their visiting different flowers for the purpose of collecting honey and pollen to rear their young. Some female Humble-Bees also die, whereas others (probably those only which had been reared in the previous summer) seek a convenient spot in which they may pass the winter as little exposed to the cold as possible; sometimes in rotten wood of old pollard trees, and sometimes in moss, or among dead leaves, or in fact in almost any situation which will afford the desired protection. Here they remain in a torpid state and without food. The warmth of the spring causes these females again to make their appearance, and having been impregnated the previous autumn, they seek a convenient spot wherein they may construct their nests. Grassy banks are the localities most frequently chosen for this purpose, but various situations, and even a difference of soil apparently, are selected by the different species of Humble-Bees; for we observe certain species abounding more in one situation than another, and that in places distant from each other but similar in character. The nests are sometimes built upon the ground, but most generally they are in a hole excavated by the bee. These excavations vary in depth and form, even though made by the same species of bee. In their construction the animal uses its jaws to dislodge the particles of earth, which are then, by means of the anterior pair of legs, passed backwards to the hinder pair, which perform the same office: but as the burrow becomes deeper, the whole body of the bee is used to eject the grains of soil. In saying that the Humble-Bees form the burrows in the ground in which we find them, we speak upon the authority of Réaumur, for although we have frequently observed the female bee commence removing particles of earth, apparently with intent to make such an excavation, upon returning to the same spots after a sufficient interval of time, the work was always abandoned. Huber, who paid much attention to these insects, says, "I have not discovered in what manner they excavate the holes which lead to their nests, nor do I know how they form the vaults in which they are placed, neither am I aware whether they always construct these vaults themselves, or whether they do not sometimes avail themselves of the holes made by moles or other animals." Upon consulting some other authors, these points appear to be treated of in too vague a manner. When a small cylindrical but generally tortuous gallery is formed, it is terminated by an arched chamber of considerable extent, and it is in this chamber that the nest is constructed. Those species which do not burrow in the ground choose a situation in which the herbage is sufficiently thick to afford shelter, and there form on the surface of the ground an arched chamber of moss thickly matted together. In what manner the female first commences the interior arrangement of her nest, and how she brings up her young whilst in her solitary state, Huber and some of the earlier authors did not ascertain. We are indebted to M. le Comte Saint-Fargeau for this portion of the present history. This author informs us that having collected a quantity of pollen and honey, these substances are formed by the female humble-bee into a ball, in which the eggs are deposited, so that when the eggs are hatched the larvæ are surrounded by the substance, which serves them both for food and protection. The balls generally contain numerous eggs, and consequently when these are hatched numerous larvæ. Réaumur found them to vary from three to thirty. Each larva feeding upon the food nearest to it, the original crust of their enclosure becomes thin, and the parent insect then takes care to add fresh alimentary paste to the weakest parts. When the larvæ are full grown each one incloses itself in a silken cocoon of an oval form and placed always in a perpendicular position. A certain number of neuters, or workers, having undergone their final transformation, the nest is enlarged, and an inner coating of wax is attached to it, and in those nests which are constructed with moss the particles of wax are so amalgamated with it that a portion of the moss cannot be removed without injuring the interior more or less. Wax is also used by the workers in the construction of little cells for the reception of honey. Each species of Humble-Bee makes these cells, as Huber informs us, in a different manner; some construct them on the top of the cocoons, and of a half oval form; others build them of an egg-shape, with the apex truncated. In some again they resemble the first, but have a ring of wax within the top. The next variety is almost a perfect oval, having but a small opening at the apex. Lastly, these Humble-Bees show, says Huber, "that they are not inferior to the hive-bee in the art of economy. Between four honey-pots there would necessarily be a vacant space; but this is occupied by a fifth reservoir, which is not of the same form as those by which it is surrounded, but sometimes approaches to a square," &c. As an instance of the intelligence of these bees, Huber relates that when a bee is prevented from obtaining the honey at the bottom of the flower by the tube of the corolla being too narrow and deep, they drill a hole with their proboscis through the calyx and corolla right into the tube, and in this manner tap the vessel containing the liquid of which they are so fond.

The male Humble-Bees are not reared till late in the season, and do not appear in any abundance till the autumn. As in the case of the hive-bee therefore, they take no part in the duties of rearing the young, which it appears are almost entirely under the protection of the neuters as soon as they are hatched.

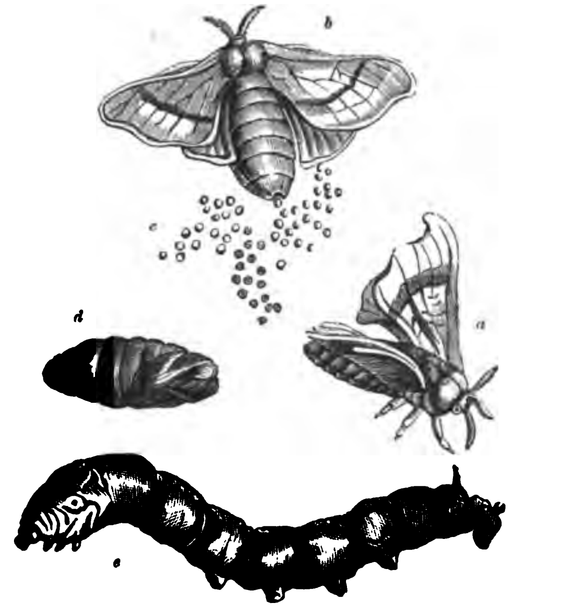
When the nest is tolerably well peopled, it presents a mass of oval cocoons spun by the larvæ as before described; interspersed with which there are numerous masses of an irregular but generally somewhat rounded form, and of a brown colour: some of the largest are about the size of a small walnut. Each of these masses incloses either eggs or larvæ, and is composed of pollen mixed with honey. To these must be added the little honey-pots which are irregularly interspersed with the cocoons.

BOMBY'CIDÆ, a family of Insects of the order *Lepidoptera*, belonging to the section *Lepidoptera nocturna* of Latreille, or Moths.

The principal characteristics of this family are—their possessing only rudimentary maxillæ, remarkably small palpi, and bipectinated antennæ.

Some of the species fly very rapidly, and make their appearance in the day-time as well as in the evening. The caterpillars of most of the species are hairy (some produce great irritation to the hand when touched), and assume the pupa state in a cocoon spun for its protection. The pupa is simple.

One of the most interesting of the family is the *Bombyx Mori*, well known as the moth to which the Silkworm turns. This species which was originally from China is of a white or cream colour, with a brown fascia and two or more waved lines of a deeper colour crossing the upper wings. In this country the eggs of this moth hatch early in May; the caterpillar or silkworm is at first of a dark colour, but soon becomes light, and in its tints much resembles the perfect insect, a circumstance common in caterpillars. Its proper food is the mulberry, though it will likewise eat the lettuce and some few other plants; on the latter however it does not thrive equally well, and the silk yielded is of a poor quality.



a and *b*, *Bombyx Mori*; *c*, the eggs; *d*, the pupa; *e*, silkworm or caterpillar.

The Silkworm is about eight weeks in arriving at maturity, during which period it changes its skin four or five times. When about to cast its skin it ceases to eat, raises the fore part of the body slightly, and remains in perfect repose. In this state it is necessary that it should continue for some little time, in order that the new skin, which is at this time forming, may become sufficiently mature to enable the caterpillar to burst through the old one. This operation, which is apparently one of considerable difficulty, is performed thus:—the fōre part of the old skin is burst; the silkworm then by continually writhing its body (but not moving from the spot) contrives to thrust the skin back to the tail, and ultimately to disengage itself altogether; this last part of the operation however is the most difficult, since it is no uncommon occurence for them to die from not being able to disengage the last segment of the body from the old skin.

Those who have reared silkworms must have observed how large the head is in proportion to the body in those which have just changed their skins; this circumstance is worthy of observation, for in it will be found a most beautiful contrivance.

When the larva of an insect has just changed its skin, every part is soft, and in many cases (such as caterpillars) the greater portion of the body still remains in this flexible state; but the skin of the head and some few other parts in all instances soon become hardened, after which it never grows. The same happens with those larvæ which have the body in a great measure covered with hard plates, which circumstance leaves no parts to enlarge but such as are flexible. In the instance of a caterpillar the body increases in size rapidly after change of skin, but the head it will be observed does not enlarge, and although the body may have increased very much it does not appear that the skin has grown; it seems only to be stretched with the increase of size of the inner parts. In the case of those larvæ which have the body covered with hard plates, it is the skin between the plates that stretches to allow of growth in the inner parts, so that just before changing skin a llthe plates are considerably separated.

From the above we conclude that the external covering of insects does not grow at all, except at the time of repose previous to the casting off the old skin, after which operation the head and those parts which soon become hard are sufficiently grown to last until the next change; and also that the soft parts of the external covering will bear stretching to a certain extent and no further when it becomes necessary that they should change that covering for a larger one. With respect to the silkworm and other caterpillars, an unobserving person would not readily understand how the head, which is much larger than the one the case of which has just been cast off, can have come out of it; but if the silkworm be examined just before it is about to change its skin, it will be seen that such is not exactly the case, for part of the new head may be seen thrust out behind the old one, so that the fore part only is inclosed by the latter.

When full grown the silkworm commences spinning its web in some convenient spot, and as it does not change the position of the hinder portion of its body much, but continues drawing its thread from various points and attaching it to others, it follows that after a time its body becomes in a great measure inclosed by the thread. The work is then continued from one thread to another, the silkworm moving its head and spinning in a zigzag way, bending the fore part of the body back to spin in all directions within reach, and shifting the body only to cover with silk the part which was beneath it. As the silkworm spins its web by thus bending the fore part of the body back, and moves the hinder part of the body in such a way only as to enable it to reach the farther back with the fore part, it follows that it incloses itself in a cocoon much shorter than its own body, for soon after the beginning the whole is continued with the body in a bent position. From the foregoing account it appears that with the most simple instinctive principles all the ends necessary are gained. If the silkworm were gifted with a desire for shifting its position much at the beginning of the work it could never inclose itself in a cocoon; but by its mode of proceeding, as above explained, it incloses itself in a cocoon which only consumes as much silk as is necessary to hold the chrysalis.

During the time of spinning the cocoon the silkworm decreases in length very considerably, and after it is completed, it is not half its original length; at this time it becomes quite torpid, soon changes its skin, and appears in the form of a chrysalis. The time required to complete the cocoon is about five days. In the chrysalis state the animal remains from a fortnight to three weeks; it then bursts its case and comes forth in the imago state, the moth having previously dissolved a portion of the cocoon by means of a fluid which it ejects.

The moth is short-lived; the female, in many instances, dies almost immediately after she has laid her eggs; the male survives her but a short time.

The silkworms, which are most extensively reared for the purpose of producing silk [Silk, in Arts and Sc. Div.], are liable to many diseases, and none have been more destructive than that called muscardine. This disease attacks the caterpillar when about to enter the chrysalis state. It is always attended with the development within the body of a minute fungus closely resembling our common mould. It is probable the fungus only attacks those worms which are predisposed to disease, but in certain seasons this fungus has been so extensively developed as to lead to the supposition that it produces the disease itself. It is very certain that, when this fungus is prevailing and its spores are introduced into the body of the silkworm, it becomes rapidly diseased and dies. The fungus spreads internally before the death of the worm and afterwards it shoots forth from the surface of the skin. The chrysalis and moth will have the disease if inoculated with the fungus, but it only occurs spontaneously on the caterpillar. [*See* Supplement.]

BOMBYCILLA, a genus of Tooth-Billed Birds (*Dentirostres*). Cuvier places the genus among the Dentirostral genera of his second order *Passereaux;* Latreille also arranges it under that order, but does not allow it to belong to the *Dentirostres*, and classes it among his first family, that of the Broad-Billed Birds (*Latirostres*). Temminck, considering it to be an omnivorous bird, finds a place for it under the name of *Bombycivora*, in his second order *Omnivores*. Vieillot's second order (*Sylvicolæ*) contains two tribes; and in the sixteenth family (*Baccivori*) of the second tribe (*Anisodactyli*), the genus in question will be found. Vigors places it in the second tribe *Dentirostres* of his second order, *Insessores*, or Perching Birds; and after some hesitation, and expressing his doubt whether its natural situation is not in the family *Merulidæ*, is inclined to arrange it provisionally among the *Pipridæ*, his last family of *Dentirostres*. Bonaparte makes it a genus of his family *Sericati*. Swainson, in the 'Fauna Boreali-Americana,' arranges it under his *Bombycillinæ*, a subfamily belonging to the aberrant group of his *Ampelidæ*, or Fruit-Eaters; but in giving his table of *Ampelidæ*, he expresses considerable doubts on the true nature of the aberrant divisions. Linnæus at one time made it a Butcher-Bird (*Lanius*), and afterwards an *Ampelis*. Brisson classed it among the Thrushes (*Turdus*), and Illiger among the Crows (*Corvus*).

The birds of this genus are known by the English names of Wax-Wings or Waxen-Chatterers; and the following are the principal generic characters according to Temminck:—Bill short, straight, elevated; upper mandible curved towards its extremity, with a strongly marked tooth; nostrils basal, ovoid, open, hidden by strong hairs directed forwards; feet, with three toes before and one behind, the exterior toe connected (soudé) with the middle one; wings moderate, the first and second quills longest.

Only three species have been recorded. The first has a wide geographical range; the second is confined to North America; and the third is Oriental.

B. garrula, European Wax-Wing or Chatterer. This elegant species, which is also known by the English names of the Bohemian Chatterer, Bohemian Wax-Wing and Silk-Tail, is Le Jaseur de Bohême (Buffon, &c.), Grand Jaseur (Temminck), and Geay de Bohême of the French; Garrulo di Boemia of the Italians; Rothlichgrauer Seidenschwantz (Meyer), Europäischer Seidenschwanz, and Gemeine Seidenschwanz (Bechstein) of the Germans; *Garrulus Bohemicus* of Gesner; *Bombycilla* of Schwenck.; *Ampelis* of Aldrovand.; *Bombycilla Bohemica* of Brisson; *Ampelis garrulus* of Linnæus; *Bombyciphora garrula* of Brehm; *Bombyciphora poliocœlia* of Meyer; *Bombycivora garrula* of Temminck; and *Bombycilla garrula* of Vieillot.

In addition to the nomenclature above given, the bird is said to be named by the Italians in some localities Becco-Frisone, in others, Galletto del Bosco; and by the bird-catchers of Bologna, Uccello del Mondo Novo; by the Germans, Zinzerelle, Wipstertz, Schnee-Vogel and Schnee-Leschke, and by those in the neighbourhood of Nürnberg, Beemerle and Behemle; by the Swedes, Siden-Swants; and by the Bohemians, Brkoslaw.

That the Bohemian Chatterer was known to the ancients there can be little doubt; but a great deal of obscurity prevails as to the names by which it was distinguished. Some have taken it to be the *Incendiaria Avis* of Pliny (book x. c. 13), the inauspicious bird, on account of whose appearance Rome more than once underwent lustration, but more especially in the consulship of L. Cassius and C. Marius, when the apparition of a great owl (*Bubo*) was added to the horrors of the year. Others have supposed that it was the bird of the Hercynian forest (book x. c. 47), whose feathers shone in the night like fire. Aldrovandus, who collected the opinions on this point, has taken some pains to show that it could be neither the one nor the other. The worthy Italian gravely assures his readers that its feathers do not shine in the night; for he says he kept one alive for three months, and observed it at all hours ("quâvis noctis horâ contemplatus sum").

It is by no means improbable that this bird was the Γνάφαλος of Aristotle ('Hist. Anim.,' book ix. c. 16).

The geographical range of the Bohemian Chatterer is extensive, comprehending a great portion of the arctic world. It appears generally in flocks, and a fatality was at one time believed to accompany their movements. Thus Aldrovandus observes that large flights of them appeared in February, 1530, when Charles V. was crowned at Bologna; and again in 1551, when they spread through the duchies of Modena, Piacenza, and other Italian districts, carefully avoiding that of Ferrara, which was afterwards convulsed by an earthquake. In 1552, according to Gesner, they visited the banks of the Rhine, near Mentz, in such myriads that they darkened the air. In 1571 troops of them were seen flying about the north of Italy, in the month of December, when the Ferrarese earthquake, according to Aldrovandus, took place, and the rivers overflowed their banks.

Necker, in his Memoir on the Birds of Geneva, observes that from the beginning of this century only two considerable flights have been observed in that canton, one in January, 1807, and the other in 1814, when they were very numerous, and having spent the winter there, took their departure in March. In the first of those years they were scattered over a considerable part of Europe, and early in January were seen near Edinburgh. Savi observes that they are not seen in Tuscany except in very severe winters, and that the years 1806 and 1807 were remarkable for the number of them which entered Piedmont, especially the valleys of Lanzo and Suza.

It has been said that it is always rare in France, and that of late years it has become scarce in Italy and Germany; but Bechstein observes that in moderate seasons it is found in great flights in the skirts of the forests throughout the greater part of Germany and Bohemia, and that it is to be seen in Thuringia only in the winter: if the season be mild in very small numbers, the greater portion remaining in the north; if the weather be severe, it advances farther south.

The Bohemian Chatterer must be considered only as an occasional visitant to the British Islands, though Pennant says that they appear only by accident in South Britain, but that about Edinburgh they come annually in February, and feed on the berries of the mountain-ash; adding that they also appear as far south as Northumberland, and like the fieldfare make the berries of the white thorn their food: he records the death of one which was killed at Garthmeilio in Denbighshire in a fir-tree during the severe frost of December, 1788. Latham, in a note to this statement, says that the late Mr. Tunstall informed him that in the winter of 1787 many flocks were seen all over the county of York, and that towards the spring a flock of between twenty and thirty were observed within two miles of Wycliffe, his place of residence. Bewick states that in the years 1790, 1791, and 1803 several of them were taken in Northumberland and Durham as early as the month of November. Selby says that in the winter of 1810 large flocks were dispersed through various parts of the kingdom, and that from that period it does not seem to have visited our island till the month of February, 1822, when a few came under his inspection, and several were again observed during the severe storm in the winter of 1823. Montagu says that he received it out of Staffordshire, and that he has known others killed in the more southern counties in the autumn and winter. In Mr. Rennie's edition of the 'Ornithological Dictionary' (1833) it appears that one had been shot in the park of Lord Boringdon at Saltram in Devonshire, and that not less than twenty had been killed in the counties of Suffolk and Norfolk during the three preceding winters. Graves says that about Christmas, 1803, a number were shot in the neighbourhood of Camberwell, from one of which, being but slightly wounded, his figure was taken. In 'Loudon's Magazine' it is stated that a fine specimen was shot near Coventry in December, 1830, where it appeared to associate with starlings, and that during the same month of the same year six were killed in the vicinity of Ipswich. The late Mr. W. Thompson records various instances of the occurrence of this bird in Ireland. In the British Islands it more frequently occurs in the north than the south, and Mr. Yarrell states that "the winters of 1787, 1788, 1789, 1790, 1791, 1803, 1810, 1820, 1822, 1828, 1830, 1831, 1834, and 1835, are particularly recorded as having afforded opportunities of obtaining specimens in some one or other of various northern localities."

Although called the Bohemian Wax-Wing, it is not more common in Bohemia than England. In the central and southern parts of the European continent it is only an occasional visitor.

In northern Russia and the extreme north of Norway, according to C. L. Bonaparte, they are seen in great numbers every winter, being observed there earlier than in temperate countries. In northern Asia and eastern Europe their migrations are tolerably regular. Very numerous flocks pass through Scania in November, and are again seen on their return in the spring.

But the species is not confined to Europe and Asia. "By a singular coincidence," says the Prince of Canino, "whilst we were proclaiming this species as American, it was received by Temminck from Japan, together with a new species, the third known of the genus." He says that his best specimen was shot on the 20th of March, 1825, on the Athabasca River, near the Rocky Mountains; and observes that the species appears to be spread widely, as he had been credibly informed by hunters that "cedar-birds of a large kind" had been shot a little beyond the Mississippi; adding that he is at a loss to conceive why it should never have been observed on this side of the last-mentioned river. Mr. Drummond in the spring of 1826 saw it near the sources of the Athabasca, and Sir John Richardson observed it in the same season at Great Bear Lake in lat. 65°, where a male, of which he gives a description, was shot on the 24th of May of that year. He also says that he observed a large flock of at least three or four hundred on the banks of the Saskatchewan, at Carlton House, early in May, 1827. They alighted in a grove of poplars, settling all on one or two trees, and making a loud twittering noise. They stayed only about an hour in the morning, and were too shy to allow him to approach within gunshot.

The district where these birds breed is unknown. Bechstein says that it does not build in Germany when wild, but within the Arctic Circle.

Bonaparte gives a very amiable character of the European Wax-Wing in a state of nature, attributing to them a particular sentiment of benevolence, even independent of reciprocal sexual attraction. "Not only," says the Prince, "do the male and female caress and feed each other, but the same proofs of mutual kindness have been observed between individuals of the same sex." Speaking of their habits he says, "They always alight on trees, hopping awkwardly on the ground. Their flight is very rapid: when taking wing they utter a note resembling the syllables zi, zi, ri, but are generally silent notwithstanding the name that has been given them." Bechstein says, "When wild we see it in the spring eating, like thrushes, all sorts of flies and other insects; in autumn and winter, different kinds of berries; and in time of need, the buds and sprouts of the beech, maple, and various fruit-trees." Willughby states that it feeds upon fruit, especially grapes, of which it is very greedy. "Wherefore it seems to me," he adds, "not without reason, to be called by that name *Ampelis*." Bonaparte makes their food to consist of different kinds of juicy berries, or of insects, observing that they are fond of the berries of the mountain-ash and *Phytolacca*, and that they are extremely greedy of grapes, and also, though in a less degree, of juniper- and laurel-berries, apples, currants, figs, and other fruits. He adds that they drink often, dipping their bills repeatedly.

In captivity its qualities do not appear to be very attractive, according to Bechstein, who says that nothing but its beauty and scarcity can render the possession of it desirable, for that it is a stupid and lazy bird. Indeed he draws such a picture of its greediness and dirty habits, that, if it be not overcharged, few we should think would wish to have it as an inmate. Leaving out the more unpleasant parts of his description, we take the following extract from his 'Cage Birds': —"During the ten or twelve years that it can exist in confinement, and on very meagre food, it does nothing but eat and repose for digestion. If hunger induces it to move, its step is awkward, and its jumps so clumsy as to be disagreeable to the eye. Its song consists only of weak and uncertain whistling, a little resembling the thrush, but not so loud. While singing it moves the crest, but hardly moves the throat. If this warbling is somewhat unmusical it has the merit of continuing throughout every season of the year. When angry, which happens sometimes near the common feeding-trough, it knocks very violently with its beak. It is easily tamed." The same author says, that in confinement the two universal pastes appear delicacies to it; and it is even satisfied with bran steeped in water. It swallows everything voraciously, and refuses nothing eatable, such as potatoes, cabbage, salad, fruit of all sorts, and especially white bread. It likes to bathe, or rather to sprinkle itself with water, for it does not wet itself so much as other birds.

It is taken in nooses, to which berries are fixed, which for this purpose, says the author last quoted, "should always be kept in store till February. It appears to be frightened at nothing, for it flies into nets and traps, though it sees its companions caught, and hanging and uttering cries of distress and fear."

Length about eight inches; the size altogether approaching that of a starling.

Male. Bill strong, black, except at the base, where the colour inclines to a yellowish-white; nostrils hidden under small black feathers. Irides purplish-red. Chin and throat velvety black, as is also the streak (in the midst of which is the eye) passing from the bill to the hinder part of the head. Forehead reddish-brown. Head feathers long, silky, forming a reclining crest approaching to reddish-chestnut, which the bird can erect or depress at pleasure. Upper parts purplish-red, or vinaceous-brown dashed with ash-colour, the rump lightest. Breast and belly pale purplish-ash, tinged with pale brownish-red. Vent and under tail-coverts orange-brown inclining to reddish-orange. Greater wing-coverts black, tipped with white. Lesser wing-coverts of a shade darker than the general tint of the upper plumage. Primaries black, with a bright yellow spot near the white tips of their outer webs. Montagu says that the three first are tipped with white, and the others with yellow on their outer margins. Secondaries gray, tipped with white on the outer web, and seven or eight of them terminated with small flattish, oval, horny appendages, of the colour of red sealing-wax. Sometimes there are not more than 5 or 6 of these wax-like tips, and in Montagu's specimen there were 5 on one side and 6 on the other. Graves gives the number at from 6 to 9 (Bechstein at from 5 to 9), and mentions the specimen in Mr. Haworth's collection, which had some on the tail, which is black tipped with yellow, and dashed with ash-colour at the base. Shanks, toes, and claws, black.

European Wax-Wing (*Bombycilla garrula*), male.

Female. Generally similar to the male; but the yellow on the wings and tail is not so bright, nor are the wax-like appendages so large or so numerous.

The flesh of this species is said to be delicate food.

B. Carolinensis, the American Wax-Wing, or Cedar-Bird, was considered by some of the older naturalists to be identical with the European species, from which it had degenerated.

This species is the *Ampelis garrulus*, var. *β.* of the 'Systema Naturæ'; *Garrulus Carolinensis*, le Jaseur de Caroline, the Chatterer of Catesby; *Turdus garrulus Carolinensis* of Klein; Coquantotot of Hernandez; *Avis Americana cristata, Xomotl dicta* of Seba; Chatterer of Carolina of Edwards; Cedar-Bird, *Ampelis Americana*, of Wilson; Recollet of the Canadian Voyageurs; *Bombycilla Carolinensis* of Brisson, Bonaparte, Audubon, and others. It is said to be found in the whole extent between Mexico and Canada, and parties are said occasionally to roam as far south as the forests of Guyana. In the United States it is a resident during the whole year, the northern and middle states being its more usual quarters in the summer, and the southern in the winter season. It is stated that the bird has been found on the north-west coast of America, but its northern boundary appears to fall short of that of *Bombycilla Bohemica*. Say saw it near the Winnipeg River, in lat. 50°, and Sir John Richardson states his belief that it has not been hitherto observed to the northward of the 54th parallel. He says that Mr. Drummond saw several small flocks on the south branch of the Saskatchewan on the 27th June, and gives a description of a male killed there in lat. 52½° on that day, 1827. He adds that it frequents the northern shores of Lake Huron and of Lake Superior in summer.

The Cedar-Birds utter a feeble lisping sound, and fly, says Wilson, "in compact bodies of from twenty to fifty; and usually alight so close together on the same tree, that one half are frequently shot down at a time. In the months of July and August they collect together in flocks, and retire to the hilly parts of the state, the Blue Mountains, and other collateral ridges of the Alleghany, to enjoy the fruit of the *Vaccinium uliginosum*, Whortleberries, which grow there in great abundance, whole mountains for many miles being almost entirely covered with them; and where in the month of August I have myself found the cedar-birds numerous. In October they descend to the lower cultivated parts of the country, to feed on the berries of the sour gum and red cedar, of which last they are immoderately fond; and thirty or forty may sometimes be seen fluttering among the branches of one small cedar-tree, plucking off the berries. . . . . In the fall and beginning of summer, when they become very fat, they are in considerable esteem for the table; and great numbers are brought to the market of Philadelphia, where they are sold at from twelve to twenty-five cents per dozen. During the whole winter and spring they are occasionally seen; and about the 25th of May appear in numerous parties, making great havoc among the early cherries, selecting the best and ripest of the fruit." Audubon says that they reach Louisiana about the beginning of November, and retire towards the middle districts in the beginning of March. "The holly," writes the author last quoted, "the vines, the persimon, the pride of China, and various other trees, supply them with plenty of berries and fruits, on which they fatten, and become so tender and juicy as to be sought by every epicure for the table. I have known an instance of a basketful of these little birds having been forwarded to New Orleans as a Christmas present." And delicious these fruit-eating birds (for such is their general diet, albeit they are said to be excellent fly-catchers) undoubtedly are; though Hernandez, who met with them near Tetzcuco (apud Tetzcoquenses), says that neither in their song nor in the flavour of their flesh are they better than other small birds ("neque est cantu aut nutrimento cæteris aviculis commendatior"). Their appetite is extraordinary: "They gorge themselves," observes Audubon, "to such excess, as sometimes to be unable to fly, and suffer themselves to be taken by the hand. Indeed I have seen some which, although wounded and confined in a cage, have eaten of apples until suffocation deprived them of life in the course of a few days. When opened afterwards they were found to be gorged to the mouth."

Notwithstanding this greediness they are, according to some writers, remarkable for their social and kindly disposition in a state of nature. Nuttall, on the authority of an eye-witness, states that one among a row of these birds seated upon a branch, darted after an insect, and offered it to his associate when caught, who very disinterestedly passed it to the next, and each delicately declining the offer, the morsel went backwards and forwards before it was appropriated.

After fattening on the fruits of May and early June they begin to turn their attention to the continuation of their species, and commence about the 10th or 12th of the latter month building a nest large in proportion to the bird, sometimes in their favourite cedar-tree (*Juniperus Virginiana*, Willd.), but more frequently in the orchards, generally choosing a forked or horizontal branch of an apple-tree, some ten or twelve feet from the ground. Outwardly and at the bottom is laid a mass of coarse dry stalks of grass; the inside is lined entirely with very fine stalks of the same material. The eggs are three or four, of a dingy bluish-white, thick at the great end, tapering suddenly, and becoming very narrow at the other, marked with small roundish spots of black of various sizes and shades; and the great end is of a pale dull purple tinge, marked likewise with touches of various shades of purple and black. About the last week in June the young are hatched, and are at first fed on insects and their larvæ, but as they advance in growth on berries of various kinds.

The following is Nuttall's account of the manners of this bird in captivity:—

"A young bird from one of the nests described in the hemlock was thrown upon my protection, having been by some means ejected from his cradle. In this critical situation however he had been well fed or rather gorged with berries, and was merely scratched by the fall he had received. Fed on cherries and mulberries he was soon well fledged, while his mate in the nest was suffered to perish by the forgetfulness of his natural protectors. Coeval with the growth of his wing-feathers were already seen the remarkable red waxen appendages, showing that their appearance indicates no particular age or sex; many birds, in fact, being without these ornaments during their whole lives. I soon found my interesting protégé impatient of the cage, and extremely voracious, gorging himself to the very mouth with the soft fruits on which he was often fed. The throat, in fact, like a craw admits of distension, and the contents are only gradually passed off into the stomach. I now suffered the bird to fly at large, and for several days he descended from the trees in which he perched to my arm for food; but the moment he was satisfied he avoided the cage, and appeared by his restlessness unable to survive the loss of liberty. He now came seldomer to me, and finally joined the lisping muster-cry of 'tze, tze, tzé,' and was enticed away after two or three attempts by his more attractive and suitable associates. When young, nature provided him with a loud impatient voice, and 'té-did, té-did, kai-té-did' (often also the clamorous cry of the young Baltimore) was his deafening and almost incessant call for food. Another young bird of the first brood, probably neglected, cried so loud and plaintively to a male Baltimore bred in the same tree, that he commenced feeding it. Mr. Winship of Brighton informs me that one of the young Cedar-Birds which frequented the front of his house in quest of honeysuckle-berries, at length on receiving food, probably also abandoned by his roving parents, threw himself wholly on his protection. At large day and night, he still regularly attended the dessert of the dinner-table for his portion of fruit, and remained steadfast in his attachment to Mr. Winship till killed by an accident, being unfortunately trodden under foot."

American Wax-Wing (*Bombycilla Carolinensis*), male.

The following is Wilson's description:—"Length seven inches, extent eleven inches; head, neck, breast, upper part of the back and wing-coverts, a dark fawn colour, darkest on the back and brightest on the front; head ornamented with a high, pointed, almost upright crest; line from the nostril over the eye to the hind head velvety black, bordered above with a fine line of white, and another line of white passes from the lower mandible; chin black, gradually brightening into fawn-colour, the feathers there lying extremely close; bill black, upper mandible nearly triangular at the base, without bristles, short, rounding at the point, where it is deeply notched; the lower scolloped at the tip, and turning up; tongue as in the rest of the genus, broad, thin, cartilaginous, and lacerated at the end; belly yellow; vent white; wings deep slate, except the two secondaries next the body, whose exterior vanes are of a fawn-colour, and interior ones white, forming two whitish strips there, which are very conspicuous; rump and tail-coverts pale light blue; tail the same, gradually deepening into black, and tipped for half an inch with rich yellow. Six or seven and sometimes the whole nine secondary feathers of the wings are ornamented at the tips with small red oblong appendages, resembling red sealing-wax; these appear to be a prolongation of the shafts, and to be intended for preserving the ends and consequently the vanes of the quills from being broken and worn away by the almost continual fluttering of the bird among the thick branches of the cedar. The feathers of those birds which are without these appendages are uniformly found ragged on the edges, but smooth and perfect in those on whom the marks are full and numerous. These singular marks have been considered as belonging to the male alone, from the circumstance perhaps of finding female birds without them. They are however common to both male and female. Six of the latter are now lying before me, each with large and numerous clusters of eggs, and having the waxen appendages in full perfection. The young birds do not receive them until the second fall, when in moulting time they may be seen fully formed, as the feather is developed from its sheath. I have once or twice found a solitary one on the extremity of one of the tail-feathers. The eye is of a dark blood-colour; the legs and claws black; the inside of the mouth orange; gape wide; and the gullet capable of such distension as often to contain twelve or fifteen cedar-berries, and serving as a kind of craw to prepare them for digestion. The chief difference in the plumage of the male and female consists in the dulness of the tints of the latter, the inferior appearance of the crest, and the narrowness of the yellow bar at the tip of the tail."

B. phœnicoptera, the Asiatic Wax-Wing. The discovery of the Red-Winged Chatterer, or Japanese Wax-Wing, is one of the fruits of Dr. Siebold's scientific mission to Japan by the government of the Netherlands. In size it bears a greater resemblance to the Cedar-Bird than to the Bohemian Wax-Wing, but differs from both in the nakedness of the nostrils (which are not hidden by the small feathers of the front, like the nostrils of the other two species of this small but natural group), in the length of the crest, and the beautiful black plumes with which it is ornamented, and by the entire absence of the wax-like appendages that tip the secondaries of its congeners.

The length of the Japanese Wax-Wing is six inches and six lines. The base of the bill is bordered by a black band, which passes to the back of the head, surrounding the eye in its way, and terminates in the lower crest-feathers, which are of the same colour throughout; the chin and throat are black; the crest is long, composed above of feathers of an ashy-reddish colour with an inferior layer of the black plumes already alluded to; the breast, upper parts, and wing-coverts are of a brownish-ash, and a red band traverses the wing about the middle of it; all the quills are of an ashy-black, the greater quills terminated with black and tipped with white; the tail is of an ashy-black, tipped with vivid red; the middle of the belly is of a whitish-yellow; and the lower tail-coverts chestnut; shanks and feet black.

Asiatic Wax-Wing (*Bombycilla phœnicoptera*), male.

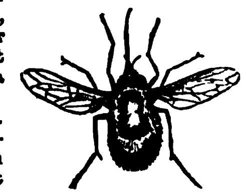
The species is found in the neighbourhood of Nangasaki.

Temminck, to whom we are indebted for our knowledge of the bird, which is described and figured in his 'Planches Coloriées,' says that there is a specimen in the galleries of the museum of the Pays-Bas, and another in the collection of M. Blomhof, the resident at Japan; and he observes that the absence of the nostril-plumes furnishes a proof, also afforded in the genera *Corvus* and *Garrula*, in contradiction to the opinion of those systematists who would separate the omnivorous birds with covered nostrils from those which have those organs smooth or naked, and divide them into distinct groups. He also considers the proper position of the genus to be near the *Pirolles* (Kitta), and the *Rolles* (*Colaris* of Cuvier, *Eurystomus* of Vieillot).

BOMBY'LIDÆ, a family of Insects of the order *Diptera*, distinguished chiefly by having a long proboscis. The body is short and very hairy. Antennæ moderate, four-jointed, the basal joint long, second very short, third longest, the apical joint minute and tapering to a fine point. The legs are long and very slender. Wings horizontal.

The species of this tribe are all remarkable for their great swiftness of flight; two species of the genus *Bombylius* are not uncommon in open parts of woods, frequenting sunny banks, where they may be seen, in the month of April, hovering over flowers, from which they sip the sweets by means of their long proboscis, which enables them to do this without settling on the flowers.

At one time they will be seen apparently quite motionless in the air—for their wings vibrate so rapidly that they cannot be discerned—a moment after they will make their appearance at a few yards' distance, having darted from one spot to the other with such rapidity that the eye cannot follow them. In their flight they emit a humming sound.



Bombylius medius.

The two species here spoken of are *B. major* and *B. medius;* they are about one-third of an inch long and of a brown colour; the former has the anterior part of its wings clouded with an opaque brown colour, and the posterior part transparent—the latter has the wings adorned with numerous brown spots, and their anterior portion but slightly clouded.

Mr. Stephens enumerates seven species of this genus as indigenous to this country; they are sometimes called Humble-Bee Flies.

BOMBYX. [BOMBYCIDÆ.]

BONA'SIA, a genus of Birds belonging to the *Tetraonidæ* (Grouse Family). It is thus characterised by C. L. Bonaparte:—

Lower portion of the tarsus or shank and the toes naked; tail long and rounded; the head adorned with a crest, and the sides of the neck with a ruff. The plumage of the female nearly the same as that of the male, and varying but little throughout the year.

Swainson retains the Linnæan name for the bird, and makes *Tetrao* the typical group of the subgenera into which he divides the genus, expressing however considerable doubt on the value of the types.

The Ruffed Grouse (*Bonasia Umbellus* of Bonaparte; *Tetrao Umbellus* and *Tetrao togatus* of Linnæus; *Tetrao Umbellus* of Linnæus and Swainson) is the Shoulder-Knot Grouse of Latham; the Ruffed Heathcock or Grouse of Edwards; La Gelinote Hupée de Pensilvanie of Brisson; La Grosse Gelinotte de Canada and Le Coq de Bruyère à Fraise of Buffon; the Pheasant of the Pennsylvanians, and of the inhabitants of the southern States; the White Flesher and Pheasant of the Anglo-Americans generally.

Audubon says that to the west of the Alleghanies, and on those mountains, the term Pheasant is generally used to designate the bird, and that the same appellation is employed in the middle States to the east of the mountains, till the State of Connecticut is entered, where the name of Partridge prevails. Lawson uses the term Pheasant. "The pheasant of Carolina differs some small matter from the English pheasant, being not so big, and having some difference in feather; yet he is not any wise inferior in delicacy, but is as good meat or rather finer. He haunts the back-woods, and is seldom found near the inhabitants." Wilson calls it throughout Pheasant, except in one place, where he terms it the Pheasant or Partridge of New England.

According to the author last quoted, this bird is known in almost every quarter of the United States; is common at Moose Fort, on Hudson's Bay, in lat. 51°; frequent in the upper part of Georgia, and very abundant in Kentucky and Indiana. In the lower parts of Carolina, Georgia, and Florida, according to the same authority, it is very seldom observed, but on advancing inland to the mountains it again makes its appearance; and though it is occasionally met with in the lower parts of New Jersey, its occurrence there is considered to be owing to the more northerly situation of the country; for even here they are far less numerous than among the mountains.

Captains Lewis and Clarke found it in crossing the Rocky Mountains which divide the basin of the Columbia from that of the Mississippi, more than 3000 miles by their measurement from the mouth of the latter river. Sir John Richardson says that it exists as far north as the 56th parallel, and that it is very plentiful on the banks of the Saskatchewan; adding in a note, that Mr. Drummond procured specimens at the sources of the Peace River, in the valleys of the Rocky Mountains, which do not differ from those killed on the Saskatchewan. The limit of its southern range has been stated to be the Gulf of Mexico. Audubon found these birds most numerous in the States of Pennsylvania and new York, and says that they are to be met with as you travel towards the south, through the whole of Tennessee and the Choctaw territory; but that as you approach the city of Natchez they disappear; nor had he ever heard of one of these birds having been seen in the State of Louisiana.

"The manners of the pheasant," says, Wilson, "are solitary; they are seldom found in coveys of more than four or five together, and more usually in pairs or singly. They leave their sequestered haunts in the woods early in the morning, and seek the path or road to pick up gravel, and glean among the droppings of the horses. In travelling among the mountains that bound Susquehanna, I was always able to furnish myself with an abundant supply of these birds every morning without leaving the path. If the weather be foggy or lowering, they are sure to be seen in such situations. They generally move along with great stateliness, with their broad fan-like tail spread out."

Audubon states that, although they are attached to the craggy sides of mountains and hills, and rocky borders of small streams thickly mantled with evergreen trees and shrubs, they at times remove to the lowlands, and even enter the thickest cane-brakes, where they sometimes breed, and where he shot some, and heard them drumming when there were no hills nearer than 15 or 20 miles. The lower parts of the State of Indiana, and also those of Kentucky, were amongst the places where he so discovered them. The following is his account of their autumnal migrations, which he seems to have first observed:—

"The ruffed grouse although a constant resident in the districts which it frequents, performs partial sorties at the approach of autumn. These are not equal in extent to the peregrinations of the wild turkey, our little partridge, or the pinnated grouse, but are sufficiently so to become observable during the seasons when certain portions of the mountainous districts which they inhabit become less abundantly supplied with food than others. These partial movings might not be noticed, were not the birds obliged to fly across rivers of great breadth, as whilst in the mountain lands their groups are as numerous as those which attempt these migrations; but on the north-west banks of the Ohio and Susquehanna rivers, no one who pays the least attention to the manners and habits of our birds can fail to observe them. The grouse approach the banks of the Ohio in parties of eight or ten, now and then of twelve or fifteen, and on arriving there linger in the woods close by for a week or a fortnight, as if fearful of encountering the danger to be incurred in crossing the stream. This usually happens in the beginning of October, when these birds are in the very best order for the table, and at this period great numbers of them are killed. If started from the ground, with or without the assistance of a dog, they immediately alight on the nearest trees, and are easily shot. At length however they resolve upon crossing the river; and this they accomplish with so much ease that I never saw any of them drop into the water. Not more than two or three days elapse after they have reached the opposite shore, when they at once proceed to the interior of the forests in search of places congenial to the general character of their habits. They now resume their ordinary manner of living, which they continue until the approach of spring, when the males, as if leading the way, proceed singly towards the country from which they had retreated. The females follow in small parties of three or four. In the month of October, 1820, I observed a larger number of ruffed grouse migrating thus from the states of Ohio, Illinois, and Indiana into Kentucky, than I had ever before remarked. During the short period of their lingering along the north-west shore of the Ohio that season, a great number of them was killed, and they were sold in the Cincinnati market for so small a sum as 12½ cents each."

Wilson says that the Ruffed Grouse is in the best order for the table in September and October. At this season they feed chiefly on whortleberries, and the little red aromatic Partridge-Berries (*Gaultheria procumbens*), the last of which give their flesh a peculiarly delicate flavour. With the former the mountains are literally covered from August to November; and these constitute at that season the greater part of their food. During the deep snows of winter they have recourse to the buds of alder, and the tender buds of the laurel (*Kalmia*). He frequently found their crops distended with a large handful of these latter alone; and adds, that it has been confidently asserted, that after having fed for some time on the laurel-buds, their flesh becomes highly dangerous to eat of, partaking of the poisonous qualities of the plant. The same has been asserted of the flesh of the deer, when in severe weather and deep snows they subsist on the leaves and bark of the laurel. "Though," continues Wilson, "I have myself eat freely of the flesh of the pheasant after emptying it of large quantities of laurel buds, without experiencing any bad consequences, yet from the respectability of those, some of them eminent physicians, who have particularised cases in which it has proved deleterious, and even fatal, I am inclined to believe that in certain cases where this kind of food has been long continued, and the birds allowed to remain undrawn for several days, until the contents of the crop and stomach have had time to diffuse themselves through the flesh, as is too often the case, it may be unwholesome and dangerous. Great numbers of these birds are brought to our markets at all times during fall and winter, some of which are brought from a distance of more than a hundred miles, and have been probably dead a week or two, unpicked and undrawn, before they are purchased for the table. Regulations prohibiting them from being brought to market unless picked and drawn would very probably be a sufficient security from all danger. At these inclement seasons however they are generally lean and dry, and indeed at all times their flesh is far inferior to that of the quail or of the pinnated grouse. They are usually sold in Philadelphia market at from three-quarters of a dollar to a dollar and a quarter a pair, and sometimes higher."

Audubon observes that they are brought to the market in great numbers during the winter months, and sell at from 75 cents to a dollar a-piece in the eastern cities. At Pittsburg he bought them some years ago at 12½ cents the pair. Nuttall says, when he wrote, that they were greatly thinned throughout the more populous parts of the Union, and that they sold in Philadelphia and New York at from 75 cents to a dollar a-piece.

The food of the Ruffed Grouse consists commonly in the spring and fall, according to the author last quoted, of the buds of trees, the catkins of the hazel and alder, even fern-buds, acorns, and seeds of various kinds, among which he detected the capsules, including the seeds, of the common small Canadian Cistus (*Helianthemum*). At times he has seen the crop almost entirely filled with the buds of the apple-tree, each connected with a portion of the twig, the wood of which appears to remain a good while undigested; cinquefoil and strawberry leaves, buds of the Azaleas and of the broad-leaved Kalmia, with the favourite Partridge-Berries (*Gaultheria procumbens*), Ivy-Berries (*Cissus hederacea*), and gravel pebbles, are also some of the many articles which form the winter fare of the bird. In summer they seem often to prefer berries of various kinds, particularly dew-berries, strawberries, grapes, and whortleberries.

We will now lay before the reader the modes of capturing the bird. The following is Wilson's account:—

"The pheasant generally springs within a few yards, with a loud whirring noise, and flies with great vigour through the woods beyond reach of view, before it alights. With a good dog however they are easily found; and at some times exhibit a singular degree of infatuation, by looking down from the branches where they sit on the dog below, who, the more noise he keeps up, seems the more to confuse and stupify them, so that they may be shot down one by one till the whole are killed, without attempting to fly off. In such cases those on the lower limbs must be taken first, for should the upper ones be first killed, in their fall they alarm those below, who immediately fly off. In deep snows they are usually taken in traps, commonly dead traps, supported by a figure 4 trigger. At this season when suddenly alarmed, they frequently dive into the snow, particularly when it is newly fallen, and coming out at a considerable distance, again take wing. They are pretty hard to kill, and will often carry off a large load to the distance of two hundred yards and drop down dead. Sometimes in the depth of winter they approach the farm-house and lurk near the barn, or about the garden. They have also been often taken young and tamed, so as to associate with fowls; and their eggs have frequently been hatched under the common hen; but these rarely survive until full grown. They are exceedingly fond of the seeds of grapes; occasionally eat ants, chestnuts, blackberries, and various vegetables. Formerly they were numerous in the immediate vicinity of Philadelphia; but as the woods were cleared and population increased they retreated to the interior. At present (1812) there are very few to be found within several miles of the city, and those only singly, in the most solitary and retired woody recesses."

Audubon denies that they are ever so easily shot as stated above.

The pairing time of these birds is marked by a curious and sonorous act on the part of the male. Most of the grouse family gesticulate considerably at this period, and some produce very peculiar vocal noises; but the Ruffed Grouse makes the woods echo with the vibrations of his wings. The following is Audubon's account of this fact:—

"Early in April the ruffed grouse begins to drum immediately after dawn, and again towards the close of the day. As the season advances, the drumming is repeated more frequently at all hours of the day; and where these birds are abundant this curious sound is heard from all parts of the woods in which they reside. The drumming is performed in the following manner:—The male bird, standing erect on a prostrate decayed trunk, raises the feathers of its body in the manner of a turkey-cock, draws its head towards its tail, erecting the feathers of the latter at the same time, and raising its ruff around the neck, suffers its wings to droop, and struts about on the log. A few moments elapse, when the bird draws the whole of its feathers close to its body, and stretching itself out, beats its sides with its wings, in the manner of the domestic cock, but more loudly, and with such rapidity of motion after a few of the first strokes, as to cause a tremor in the air not unlike the rumbling of distant thunder. In perfectly calm weather it may be heard at the distance of two hundred yards, but might be supposed to proceed from a much greater distance. The female, which never drums, flies directly to the place where the male is thus engaged, and on approaching him, opens her wings before him, balances her body to the right and left, and then receives his caresses. . . . I have shot many a fine cock by imitating the sound of its own wings striking against the body, which I did by beating a large inflated bullock's bladder with a stick, keeping up as much as possible the same time as that in which the bird beats. At the sound produced by the bladder and the stick, the male grouse, inflamed with jealousy, has flown directly towards me, when being prepared I have easily shot it."

The pairing time in April is succeeded by the nidification in the early part of May. The root of a bush, the side of a fallen log, or some other sheltered nook in the thickest part of the woods, is selected by the hen, and there she forms a rude nest of withered leaves and grass on the ground. The eggs, from nine to fifteen in number, are of a uniform dull yellowish colour, or brownish-white, and are nearly as large as those of a pullet. As soon as the young are out of the shell they begin to run about, and are conducted by the mother, clucking as she goes, very much like the domestic hen. Like her too at night and in bad weather she covers her young ones beneath her wings, and in a week or ten days they begin to try their powers of flight. Her manœuvres to decoy the intruder from the spot where her young are concealed, by counterfeiting lameness and by mimicry of distress, are well known.

The Ruffed Grouse is surrounded by enemies. In addition to the common persecutor, man, the different species of hawks are on the watch for these birds, and particularly the red-tailed hawk and the Stanley hawk, according to Audubon. The former of these hawks, silently perched on the tops of trees, seizes his opportunity and dashes irresistibly down upon them; the latter gliding rapidly through the woods pounces upon them before they are aware of their danger. Among the quadrupeds, pole-cats, weasels, racoons, opossums, and foxes, are said by the same author to be destructive foes to them.

The following is Sir John Richardson's description of a male killed on the 4th of May, on the Saskatchewan plains:—

"Back, rump, and upper tail-coverts chestnut-brown, mottled and finely undulated with blackish-brown; the broad tips and a cordiform central mark on each feather pale-gray. Back of the neck, scapulars, and wing-coverts having the same colours; but the gray tips very narrow, the blackish-brown in large blotches, and instead of central marks, stripes along the shafts of orange-brown and brownish-white. Top and sides of the head, the tertiaries, and outer edges of the secondaries, mottled with the same. Eye stripe from the nostrils whitish. Shoulder-tufts velvet-black, glossed with dark-green. Quills liver-brown, the outer webs barred near the base and mottled towards the tips with cream-yellow. Tail gray, finely undulated, and also crossed by about nine narrow bars and a broad subterminal one of blackish-brown. Throat and breast yellowish-brown, belly and vent brownish-white; are remotely barred, but most broadly on the sides of the belly, with blackish-brown, which also forms a band across the upper part of the breast between the ruffs. Inner wing-coverts and axillaries clove-brown, barred and tipped with white. Bills and nails dark horn-colour. A male killed at the same time with the preceding, and of equal dimensions, shows more of the chestnut or orange-brown in its plumage, and the ground colour of its tail is yellowish-brown, the extreme tips and a bar next the broad subterminal dark one being gray. Females have less of the blackish-brown colour; the shoulder-tufts are orange-brown instead of black; and the subterminal bar on the tail is chestnut-coloured. In young birds orange-brown is the prevailing tint of colour. They have a short crest on the top of the head: a fringed comb over the eye in

Ruffed Grouse (*Bonasia Umbellus*), male.

the male. Shoulder tufts consisting of about fifteen fan-shaped feathers. Fourth quill the longest, slightly exceeding the third and fifth. Tail fan-shaped, of eighteen feathers, the central pair more than half an inch longer than the outer ones; the individual feathers nearly square at the end. Tarsus feathered more than halfway down anteriorly, and about half an inch lower posteriorly. All the toes strongly pectinated."

The dimensions on an average may be taken as 18 inches in length, and 23 or 24 inches in extent.

Sir John Richardson states, that after a careful comparison of the specimens of Mr. Douglas's *Tetrao Sabini*, deposited in the Edinburgh Museum, they appeared to differ in no respect from the young of *Tetrao Umbellus* (*Bonasia*), and that the characters by which Mr. Douglas distinguishes his bird are equally applicable to the latter.

Douglas also found in the valleys of the Rocky Mountains, 54° N. lat., and a few miles northward, near the sources of Peace River, a bird which he regarded as a variety of *B. Umbellus*.

BONASSUS. [BISON.]

BONE, the organ which in higher animals forms the basis of the fabric of the body. Many of the creatures placed at the bottom of the animal scale, composed of soft gelatinous matter, and buoyant in water, need no solid support; but all animals that possess solid organs, and whose body rests upon particular points, must have some substance of a dense and inflexible nature to afford to their various tissues and structures the requisite resistance and support. The substances that serve this purpose are various, but the most common are the salts of lime, sometimes the carbonate, sometimes the phosphate, and at other times both combined in different proportions. Carbonate of lime constitutes the solid basis of many of the compound zoophytes and the corals. It also constitutes the principal part of the fabric of the shells of *Mollusca*. It is found also in the external skeleton of the *Crustacea*, as the crabs and lobsters, but in this instance the phosphate of lime is also present, and predominates. It is in the skeletons of the Vertebrate animals that we find the phosphate of lime greatly preponderating. This is characteristic of bone.

When an animal possesses bone as the solid support of its fabric it indicates a high degree in the scale of organisation. Bone is an elaborate structure found in no class below the *Vertebrata*. Even the lowest order of this, which is the highest class of animals, is wholly destitute of it; for it is not found in large tribes of fishes, the shark, the sturgeon, the ray, &c. In these the less highly-organised substance called cartilage is substituted, and accordingly these fishes are called cartilaginous in contradistinction to the osseous; and in all classes below the cartilaginous fishes the dense and inflexible substance which sustains the soft parts of the body, and which affords points of resistance for the action of those parts, consists either of shells or of some modification, and not of true organised bone.

In general the structure which performs the office of bone in the lower animals is placed on the exterior of the body, and often indeed forms its external envelope; true bone, on the contrary, is always placed in the interior. Even when it approaches the surface bone is always covered by some soft part, as muscle, membrane, skin, &c. Crust, shell, horn—the substances which form the skeleton of the inferior animals—are thus external, the soft parts being internal; but in the higher animals the skeleton is always internal, and the soft parts, which are sustained by it and which re-act upon it, are external.

The office of bone in the animal economy is chiefly mechanical, and the mechanical purposes to which it is subservient require that it should be of different sizes and forms. In the human skeleton there are commonly enumerated 260 different bones, which present every variety of size and figure. But all these varieties may be reduced to three classes: the long and round, as the bones of the upper and lower extremities; the broad and flat, as the bones of the skull; or the short and square, as the separate bones that compose the vertebral column. The long bones are adapted for motion, the flat for protection, and the square for motion combined with strength. Accordingly the long bones, which are adapted to communicate a free range of motion, are moulded into lengthened cylinders, and form so many levers, constituting organs of locomotion exquisitely constructed and combined for the accomplishment of their office, as is seen in the fin of the fish, in the wing of the bird, and in the limb of the quadruped. In the employment of the flat bones for the covering of some of the more tender and delicate organs, as the brain and spinal cord, the form of these bones is such as to add to their strength, as is manifest in the vaulted roof of the skull; while in the construction of the vertebral column, composed of the short and square bones, which are so adjusted as to afford a limited range of motion with a great degree of strength, many and opposite purposes are effected.

The structure, disposition, and connection of the individual bones accomplish in the most perfect manner the following mechanical uses:—1. By their hardness and firmness they afford a support to the soft parts, forming pillars to which the more delicate and flexible organs are attached, and kept in their relative positions. 2. By the same properties of hardness and firmness they defend the soft and tender organs, by forming solid and strong cases in which such organs are lodged and protected; as the case formed by the bones of the cranium for the lodgment and protection of the brain; by the bones of the vertebral column for the lodgment and protection of the spinal cord; and by the bones of the thorax for the lodgment and protection of the lungs, the heart, and the great vessels connected with it. 3. By affording fixed points for the action of the muscles, and by assisting in the formation of joints, they aid and are indeed indispensable adjuncts to the muscles in accomplishing the function of locomotion.

Bone is a complex organ, and the arrangement and combination of its constituent parts are highly curious. It is composed essentially of two distinct substances, an animal and an earthy matter. The animal matter is composed of gelatine; the earthy matter consists principally of phosphoric acid combined with lime, forming phosphate of lime.

This structure of bone is rendered manifest by subjecting it to certain chemical processes. If a bone be placed in a charcoal fire, and the heat be gradually raised to whiteness, it appears on cooling as white as chalk; it is extremely brittle; it has lost very much of its weight, yet its bulk and shape are little changed. In this case the membranous matter is wholly consumed by the fire, while the earth is left unaltered. Over the surface of a bone so treated are visible a number of minute crevices, the spaces which were filled in the natural state of the bone with the animal matter; and on breaking the bone across, the size and shape of the cavities which contained the marrow become manifest. If on the other hand the same bone be placed in an acid sufficiently diluted to prevent its injuring the animal membrane, and yet strong enough to dissolve the phosphate of lime—if for this purpose it be macerated in diluted nitric or hydrochloric acid—every particle of the phosphate of lime may be removed, and the animal matter alone will remain perfectly uninjured and unaltered. Accordingly the remaining substance retains the exact figure and dimensions of the original bone, but it has lost all its other mechanical properties. It is so soft and flexible that if either of the long bones of the human arm—that, for example, called the radius—be treated in this manner, it can with the utmost ease be tied in a knot. By the first process the earth is obtained, deprived of its animal constituent; by the second, the membranous matter free from the earth. In the bone both are combined; in every constituent atom of it there is an earthy in intimate combination with an animal matter. The first gives it hardness, the second tenacity; and thus by the intimate combination of these elements two qualities which in unorganised matter are scarcely compatible are combined. By increasing the proportion of phosphate of lime any degree of hardness can be obtained: the bony portions of the ear, the bony portions of the teeth, for example, are as hard as marble, or even flint; but substances so hard would not do for the ordinary purposes of bone, because they would be brittle in proportion to their hardness, and would be productive of fatal mischief whenever they were subject to any sudden and violent concussion.

In certain diseased states of the human system the earthy matter preponderates in the whole osseous system, and in this condition persons are liable to fracture their bones by the slightest accident. On the other hand, the earthy matter is sometimes deficient; then the bones give way and become bent, and ultimately the body becomes an immoveable mass.

Bones not only differ so much from one another in their comparative hardness according to the office which each has to serve that no two bones possess the same degree of rigidity, but no bone is equally hard in its entire substance. When a section of a bone is made in such a manner as to show its structure throughout, it is seen to consist of two varieties, a hard or compact and an alveolar or spongy substance. In general the compact forms the external and the spongy the internal portion of the bone; the compactest part of the bone forms a completely solid body, exhibiting scarcely any visible arrangement, without apparent fibres and laminæ; but towards the inner part of the bone the substance becomes less and less dense, until at length it presents the appearance of minute and delicate fibres, which intersect each other in every direction, forming the cells termed cancelli (lattice-work). The transition from the compact to the spongy or cancellated part is not marked by any distinct boundary; the one passes into the other by insensible degrees, showing that there is no essential difference between them; and indeed the evidence is complete that, although in the densest part of the bone there is scarcely any trace of specific organisation, it is made up of fibres and plates perfectly similar to those of the spongy or cancellated part, differing from it principally in its greater degree of condensation. Often in the centre of the bone there is scarcely any even of the spongy matter, but a hollow space is left, which is filled up with a series of membranous cells in which the substance called marrow is lodged.

In the arrangement of the fibres in different bones, so as to adapt them to the specific offices they have to serve, there is exquisite mechanism. Where the principal object is either extensive protection, or the provision of broad surfaces for the attachment of muscles, the osseous fibres are so disposed as to form flattened plates, as in the bones of the skull. When on the other hand a system of levers is wanted, as in the limbs which have to sustain the weight of the trunk, and to confer extensive powers of locomotion, the bones are modelled into lengthened cylinders, generally somewhat expanded at the extremities for greater convenience of mutual connection. The shank or body of this hollow cylinder consists principally of compact with but little spongy matter, while the extremity or head of it is principally composed of spongy matter, with only a thin crust of compact substance. The principal mechanical property required in every cylindrical lever is rigidity, and more especially the power of resisting forces applied transversely, that is, tending to break the cylinder across; it has been often stated that a given quantity of materials could not possibly have been disposed in a manner better calculated for such resistance than those in the form of a tube or hollow cylinder. The hollow stems of vegetables derive their chief strength from possessing this form. Bones also are rendered both lighter and stronger by being made hollow than if the cylinder had been solid; and as it is in the middle of the shaft that the strain is greatest, so it is here that the cavity is largest and the resistance most effectual.

Bone has been recently submitted to rigid chemical analysis, and the result is that in healthy bone about two-thirds, or 66·7 per cent., consist of saline or earthy matters, and 33·3 per cent., or one-third, of animal matter. The bones of children contain more animal matter, and of aged persons more earth. Different bones also in the same skeleton contain different proportions of these constituents. Thus, according to Dr. G. O. Rees, the bones of the head and the limbs contain more earth than those of the trunk. The following are two ultimate analyses of bone from Dr. Sharpey's Introduction to 'Quain's Anatomy:' the one is by Berzelius, the other by Mr. Middleton of University College:—

	Berzelius.	Middleton.
Animal Matter	33·30	33·43
Phosphate of Lime	51·04	51·11
Carbonate of Lime	11·30	10·31
Fluoride of Calcium	2·00	1·99
Magnesia, wholly or partially in the state of a phosphate	1·16	1·67
Soda and Chloride of Sodium	1·20	1·68

The phosphate of lime in bones is peculiar, and is known amongst chemists as the 'bone-earth phosphate.' It is what is called a tribasic phosphate, consisting of 8 equivalents of lime, 3 of phosphoric acid, and 10 of water. Fluoride of calcium is found in larger quantities in fossil than in recent bones; and such is its abundance in some fossils, as those brought from the Sevalik Hills, in India, by Dr. Falconer, that we must have recourse to the supposition of a substitution of this substance for phosphate of lime, in order to account for its presence.

We have referred to the statement that the bones of the limbs contain more earth than the trunk. The following analysis by Lehmann shows that the bones of the arms and legs have a different compostion:—

	Humerus.	Femur.
Phosphate of Lime and Fluoride of Calcium	56·61	58·93
Carbonate of Lime	9·20	9·28
Phosphate of Magnesia	1·08	1·09
Chloride of Sodium	0·37	0·40
Soda	1·35	1·04
Organic Matter	31·52	28·61

When examined under the microscope, sections of the different bones present very different appearances, not at first easily reconciled with a common mode of origin or growth. The result of a close investigation, however, shows that the osseous tissue like all other parts of the body originates in cells. This fact is not easily traced,

Fig. 1.—Transverse Section of the dense portion of the Femur.
a, Haversian Canals; *b*, concentric laminæ; *c*, laminæ of connection; *d*, corpuscles with their system of tubes. The parts marked *a*, *b*, and *d*, constitute an Haversian system.

and we shall first speak here of the appearances presented on a minute examination of the texture of the bone.

The canals which are everywhere found traversing variously the substance of bone, and giving passage to the blood-vessels for the nourishment of the tissue, are called Haversian Canals, a name given them in consequence of Clopton Havers having been the first who gave a full account of them. The parietes of these canals have a laminated arrangement. The laminæ themselves are numerous and placed concentrically; the internal lamina, that which is in immediate contact with the vessel or vessels, being the most distinctly marked, and each succeeding one having a less distinct outline.

Besides the concentric laminæ, there are others which surround the exterior of the bone, and may be known as the superficial laminæ. In connection with both the concentric and superficial laminæ are a third set, which cannot belong to either of the other orders, but which are placed between them, and form the bond of union between each system.

Much has been lately written on the bone-corpuscles. These are small cells of oval form placed between the laminæ, and having numerous distinct tubes running from them in almost every direction. They have been sometimes compared to a spider with many legs. The corpuscles, or as they are occasionally called the calcigerous cells, have a definite relation to the Haversian Canals and to each other.

The Haversian Canals, the Osseous Laminæ, and the Bone-Corpuscles are therefore the leading points to be mentioned in treating of the structure of the bone. Upon a closer view, however, it will be seen that it is only the laminæ which are bone; the canals and corpuscles are spaces existing in bone, and are not really necessary to the existence of osseous tissue, though they are requisite where the amount of substance is appreciable to the unaided senses.

Of the Substance of Bone, or Hyalitic Substance.—The substance of bone has been considered, with but one or two exceptions, as homogeneous, and without appreciable structure. If it be examined however under advantageous circumstances, with high magnifying powers, there will be no difficulty in detecting a very definite though delicate structure. A very small portion of a thin plate of bone should be taken for the purpose of examination: such may be found in the ethmoid bone of small animals, as of the rat. If the piece is properly chosen it will be found to contain no Haversian Canals nor corpuscles, but will be extremely thin and transparent. A piece of this kind will present a delicate granular aspect with the surface nodulated. This granular appearance proceeds from the substance of the bone being composed of minute irregularly spherical granules. This structure may be traced without much difficulty in any specimen of bone, although it varies much in distinctness in different specimens. The object should be placed between two slips of glass with a little plain water for examination. A delicate spiculum from the point where ossification is going on illustrates the granular tissue exceedingly well. The granules may be obtained separated from each other, so that each individual may be examined independently of the others. When seen in this manner they exhibit a tolerably regular character, being mostly spherical, though a few have an oval form. In a few specimens the oval form predominates.

Fig. 2.—Ultimate osseous granules, obtained by depriving bone of its animal matter.

Of the Laminæ.—The form assumed by the osseous tissue is that of laminæ, and these laminæ have a definite arrangement, so much so that three distinct systems are recognised, namely, laminæ of the Haversian Canals; secondly, the laminæ which connect the Haversian systems; and, thirdly, the laminæ which form the surface of the bone, and inclose the two previous orders. The laminæ of the Haversian Canals have a concentric arrangement, and when divided transversely present a series of more or less distinct and perfect rings. They vary very much in number, but the most common amount is ten or twelve. Of these, the internal lamina, that which forms the parieties of the Haversian Canal, is most distinctly marked, while each succeeding one as we proceed outwards becomes less distinct. Connecting these Haversian systems is a second series of laminæ, without which the former would exist but as a bundle of loose tubes (*fig.* 1, *c*). In this substance we find the laminated arrangement less distinct, far less regular, and the laminæ individually subject to great irregularity of thickness. They are generally more transparent than either the Haversian or external system. The last division consists of those laminæ which surround the exterior of the bone. These have greater individual extent, but are the least numerous. They are continuous with the laminæ of the Haversian system whenever the latter arrive at the surface of the bone; the external laminæ in this case being continuous with the inner laminæ of the Haversian system.

The effect of madder upon the osseous system, when given to an animal with its food, may here be noticed, since the colour is imparted to the laminæ. By introducing madder into the stomach, a deep red tinge is very soon observed: in a pigeon the bones were rendered brilliantly red in 24 hours. A similar effect was produced on a young pig in three weeks. On making sections of bone so affected, the colour is found to be present in the external laminæ of the bone, and in the inner laminæ of the Haversian system, thereby proving that the action of colouring takes place upon those surfaces which lie in contact with vessels.

Of the Haversian Canals.—These canals must be considered in relation to their number, their size, and the parts which they contain. The number of canals in a given space varies perhaps a little, but this variation will be regulated in some degree by the situation of the bone, but more especially by its age. Thus the transverse section of the femur of a human fœtus of seven months will present many more canals than a section of equal measurement from the femur of an adult. The size of the Haversian Canals takes a considerable range, varying from the 300th to the 500th of an inch. The Haversian Canals undoubtedly give passage to blood-vessels, this being their principal if not only purpose.

The Corpuscles or *Cells of Bone* cannot be described as having any definite unvarying shape or size. The general form is a compressed oval, though not unfrequently they are circular. Again, they are sometimes almost triangular in their outline, while in other instances they approach a linear shape. These are the most common varieties of outline to which the bone-cells are subject, as they occur in the bones of man and the higher animals. In the four great classes of

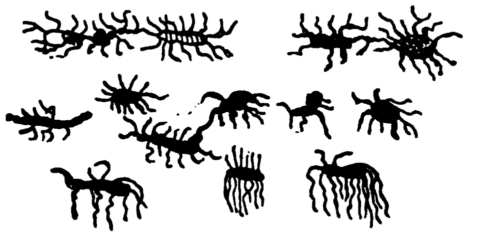


Fig. 3.—The Forms assumed by the Bone-Cells in Man.

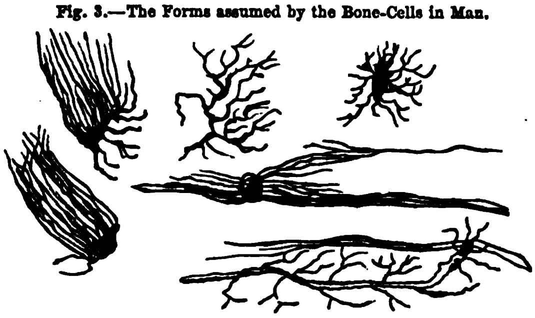


Fig. 4.—Various Forms of Bone-Cells in the Bone of the *Boa Constrictor*.

animals, namely, mammalia, birds, reptiles, and fishes, it has been shown by Professor Quekett that there are certain characters connected with these cells by which a bone of one class of animals may be distinguished from that of another, and that the size of these cells bears a direct relative proportion to that of the blood-corpuscles. He has shown that they are smallest in birds, a little larger in mammals, and largest of all in the reptiles; while in fishes they are altogether unlike those in the preceding classes. The importance of this observation in relation to fossil osteology is obvious. Connected with the cells are numerous delicate branching tubes, called canaliculi, which are slightly dilated as they enter the cells. The number arising from each cell does not allow of any very definite enumeration, since no two cells will be found possessed of a like number of branching tubes. The general arrangement of the tubes is radiate as regards the cells which form their common centre. The connections are so numerous between the tubes and between the cells through the tubes, that a fluid introduced into one cell in a bone, may enter every other cell in that bone. The cells are situated between the laminæ, or on their surface; but where concentric laminæ occur, as in the Haversian system, the cells are placed in circular lines between the laminæ, each line of cells having the Haversian Canal as an exit common to it and the connecting laminæ. When the canals for vessels are in great abundance, the bone-cells are more rarely met with; indeed in some cases they are almost entirely absent. When the cells are seen by transmitted light, particularly in a transverse section of bone, they are frequently opaque. There is no doubt that the bone-cells perform the function of circulation.

Formation of Bone.—The commencement of the growth of bone is generally preceded by the formation of a cartilaginous matter which occupies the place afterwards taken by bone. From this circumstance it has been supposed that bone is formed from the ossification of cartilage. This however is not the case, as it is found that although ossification takes place in the first instance in cartilage, the bony matter thus formed has not a permanent character. The formation of bone always takes place in the first instance in the immediate neighbourhood of blood-vessels in canals excavated in the cartilaginous substance, and the spots where these canals are formed are called centres of ossification. There is usually one of these in the centre of a long bone and one at each end, and frequently another for any considerable process or projection, such as the trochanter in the femur of the human body. Up to the time that the bone is fully formed these centres are only connected by cartilage, and this arrangement serves the obvious purpose of allowing the increase of the whole bone by means of cartilage until the time comes when no further increase of size is needed. In the early conditions of the skeleton of the vertebrate animals there is a much closer correspondence in this respect than is subsequently seen; for according to the habits of the animal the whole of the cartilage is converted into bone, or by its absorption and disappearance separate bones are formed. It is upon this fact that the science of transcendental anatomy rests, in which the whole of the modifications of the vertebrate skeleton are referred to departures from a type which is found generally to exist in the embryo condition of the whole class. Thus it is found, from an extensive comparison, that the regular number of distinct bones in the wrist (carpus) and instep (tarsus) is ten, but in the human wrist the number is reduced to eight and in the instep to seven, whilst the reduction is still greater in the hoofed mammalia. [SKELETON.]

The structure of the temporary cartilage of bone is precisely the same as permanent cartilage. The first calcareous deposit is made in the space between the proper cells of the cartilage. These cells subsequently disappear leaving large open areolæ having no very definite form. In these areolæ there is subsequently deposited a fluid blastema containing cells, and through the agency of this blastema the Haversian canals and cancelli appear to be formed, whilst the interspersed cells are changed into the bone-cells and their projecting canaliculi. Although in most instances the formation of bone is preceded by that of cartilage, yet this is not universally the case, as we see bone formed in the substance of the tissues, as for instance the fibrous membrane. This is seen in the development of the bones of the roof of the skull, and also in the growth of bones subsequently to their first development by the progressive calcification of the inner layers of the periosteum, or fibrous covering of the bones.

It has been stated that the central cavities of some of the larger bones are filled with the substance called marrow, an oily matter contained in a series of membranous cells, which, like those in which the fat is deposited do not communicate with each other. Even the pores and cancelli of bone also contain a kind of oily matter, which is supposed to differ from marrow only in possessing a greater degree of fluidity. This oily matter is deposited in longitudinal canals, which pass through the solid substance of the bone, together with its nutrient vessels. The use of the marrow, and of the modification of it which constitutes the oily matter, is not well understood. Without doubt it serves the same general use in the economy as the other oily secretions. [ADIPOSE TISSUE.]

All bones are covered by a membrane, named, on account of its affording them an external envelope, Periosteum. The outer surface of this enveloping membrane is connected to the surrounding parts by cellular tissue, but its inner surface is firmly adherent to the substance of the bone. This adhesion is effected by innumerable fibres or threads, which on examination are found to consist of blood-vessels. The periosteum is in fact the membrane on which the nutrient arteries of the bone rest, divide, and ramify in order to enter the osseous substance. These threads are much more numerous in the child than in the adult; and accordingly the adhesion of the periosteum to the bone is much firmer in the former than in the latter, as the quantity of blood distributed to the bone is greater. Moreover, in general the inner surface of bones is also lined by a fine and delicate membrane, commonly termed the internal periosteum, the continuation of which forms the membranous bags in which the marrow is contained.

(Roget, *Animal and Vegetable Physiology;* Southwood Smith, *Philosophy of Health;* Simon, *Animal Chemistry;* Sharpey, *Quain's Anatomy; Cyclopædia of Anatomy and Physiology,* articles '*Bone,*' '*Osseous Tissue*'; Todd and Bowman, *Physiological Anatomy;* Carpenter, *Principles of Physiology, General and Comparative;* Tomes and De Morgan, *Structure of Bone, Phil. Trans.;* Quekett, *Lectures on Histology.*)

BONE-BEDS. Accumulations of the bones of extinct animals, more especially of fish and Saurian reptiles, are not uncommon in various strata, and have had this name given them by geologists. They generally occur at the termination of one formation and the commencement of another. These Bone-Beds are local, and are not in any case very extensive. The thickest and most widely-distributed is that of the Lias, which seems to mark the commencement of the New Red-Sandstone epoch. The most remarkable Bone-Beds are the following:—

Bone-Bed at the base of the Lower Greensand at its junction with the Wealden; at the base of the Inferior Oolite, at its junction with the Lias; at the base of the Lias, at its junction with the New Red-Marl; at the base of the Mountain Limestone, at its junction with the Old Red-Sandstone; at the base of the Old Red-Sandstone, at its junction with the Ludlow Rock of the Silurian System.

(Brodie, *On the Basement-Beds of the Inferior Oolite; Proc. Geol. Soc.*)

BONE-DOG, a name given in Sussex to the picked Dog-Fish (*Acanthias vulgaris,* Risso). [SQUALIDÆ.]

BONE'LLIA, a genus of *Echinodermata,* formed by Rolando, and placed by Cuvier in the tenth order of his first class of Zoophytes, the

Echinoderms (*Echinodermatous Radiaria*) of Lamarck. This tenth order consists of the Footless Echinoderms, and *Bonellia* forms its sixth genus. Cuvier says that *Bonellia* has an oval body and a proboscis formed of a folded fleshy plate (lame) susceptible of great elongation and forked at its extremity. The vent is at the opposite end of the body; the intestine is very long, being folded several times, and near the vent are two ramified organs for the purpose of respiration. The eggs are contained in an oblong sac which has its opening near the base of the proboscis.

The animal is described as living deep in the sand, and projecting its proboscis till it arrives at the water when it is high, or till it reaches the air when the water is low.

The cut represents *Bonellia viridis*, which is found in the Mediterranean.

Bonellia viridis.

BONGAR, a name given to the Rock-Snake of the East Indies. [BOIDÆ.]

BONGARDIA, a genus of plants belonging to the natural order *Berberidaceæ*. [BERBERIDACEÆ.]

BONITO, the name of Fishes belonging to the family *Scombridæ*. They resemble the Tunny. The Bonito is the *Thynnus pelamys*, Cuv.; the Belted Bonito, *Pelamys Sarda*, Cuv.; the Plain Bonito, *Auxis vulgaris*, Cuv. [SCOMBRIDÆ.]

BONPLANDIA, a genus of plants belonging to the natural order *Rutaceæ*. The only species described, *B. trifoliata*, yields the Angostura Bark. The genus is now referred to *Galipæa*. [GALIPÆA.]

BONSDORFITE, a mineral belonging to the group of double hydrous Silicates of Alumina, to which the term *Zeolites* has been applied. The following is the analysis of this mineral by Bonsdorf, after whom it is named:—

Silica	45·05
Alumina	30·05
Magnesia, with a trace of Manganese	9·00
Protoxide of Iron	5·30
Water	10·60
	100·00

It occurs crystallised in regular six-sided prisms, the lateral edges of the prism being usually replaced by so many planes that the prism appears almost cylindrical. The cross fracture is conchoidal. The texture foliated, the foliations being perpendicular to the axis of the prism. The colour is a greenish-brown or dark olive-green. Lustre of the faces like that of talc, of the cross fracture waxy. Opaque in thick plates, translucent in thin plates. This mineral is found in a red granite, at Birkopsokern near Abo in Finland.

BONUS HENRI'CUS, a kind of weed, formerly supposed to possess medicinal properties. [CHENOPODIUM.]

BOOBY, the English name for a genus of *Pelecanidæ* (*Dysporus* of Illiger, *Morus* of Vieillot, Les Fous of the French), separated with good reason from the true Pelicans by Brisson under the name of *Sula*.

The term Booby is more particularly applied by navigators to that species (*Sula fusca* of Brisson) which inhabits the desolate islands and coasts where the climate is warm or even temperate throughout the greater part of the globe. The apparent stupidity of the Boobies is proverbial; calmly waiting to be knocked on the head as they sit on shore, or perching on the yard of a ship till the sailor climbs to their resting-place and takes them off with his hand, they fall an easy prey to the most artless bird-catcher. Even Byron's shipwrecked wretches, though

———"Stagnant on the sea
They lay like carcases,"

"caught two boobies and a noddy;" and the incident actually did occur in Bligh's celebrated boat-voyage, consequent on the mutiny on board the Bounty, when he and his boat's crew were in a most deplorable state.

"Monday, the 25th," says Bligh, "at noon, some noddies came so near to us that one of them was caught by hand. . . . In the evening, several boobies flying very near to us, we had the good fortune to catch one of them. . . . I directed the bird to be killed for supper, and the blood to be given to three of the people who were the most distressed for want of food. The body, with the entrails, beak, and feet, I divided into eighteen shares. . . . Tuesday, the 26th. In the morning we caught another booby, so that Providence appeared to be relieving our wants in an extraordinary manner. The people were overjoyed at the addition to their dinner, which was distributed in the same manner as on the preceding evening, giving the blood to those who were the most in want of food."

Dampier says that in the Alcrane Islands (Alacranes), on the coast of Yucatan, the crowds of these birds were so great that he could not pass their haunts without being incommoded by their pecking. He observed that they were ranged in pairs, and conjectured that they were male and female. He succeeded in making some fly away by the blows he bestowed on them, but the greater part remained in spite of his efforts to compel them to take flight. De Gennes, in his voyage to the Straits of Magalhaens, says that in the Island of Ascension there were such quantities of Boobies that the sailors killed five or six at a time with one blow of a stick. The Vicomte de Querhoent says that the French soldiers killed an immense quantity at this same island, and that their loud cries when disturbed at night were quite overpowering.

This apparent exception to the general rule of self-preserving instinct is so remarkable, that we are led to look for some cause, and perhaps this is to be found in the structure of the animal; for according to many writers whose veracity cannot be questioned, the Boobies stay to be taken and killed after they have become familiar with the effect produced by the blows or shot of their persecutors. In the case of most other animals, which, from not knowing his power, have suffered man to approach them to their destruction, alarm has been soon taken, the idea of danger has been speedily associated with his appearance, and safety has been sought in flight; but the wings of the Booby are so long and its legs so short, that when once at rest on level ground the bird has great difficulty in bringing the former into action, and when so surprised it has no resource but to put on a show of resistance with its beak, which is to be sure generally despised by the aggressor.

In the cases recorded by Bligh the birds were probably fatigued by wandering too far from the rocky shores, which are their ordinary haunts. There they are generally to be seen constantly on the wing over the waves which beat at the foot of the crags, intent on fishing. Though so well furnished with oars, they are said to swim but seldom, and never to dive. Their mode of taking their prey is by dashing down from on high with unerring aim upon those fishes which frequent the surface, and instantly rising again into the air. They walk with difficulty, and when at rest on land their attitude is nearly vertical, and they lean on the stiff feathers of the tail, like the cormorants, as a third point of support. The ledges of rocks or cliffs covered with herbage are the places generally selected for the nest, and there in great companies they lay their eggs, each hen bird depositing from two to three. The young birds for some days after their exclusion are covered with a down, so long and thick that they resemble powder-puffs made of swan's down.

The Boobies seldom wander more than twenty leagues from land, to which they usually return every evening, and their appearance is considered by mariners as a sure token of their vicinity to some island or coast.

The colour of the *Sula fusca*, or Brown Booby, is blackish-brown, or ashy-brown above and whitish beneath; the primaries are black, and the naked skin about the face is reddish; the orbits and base of the bill are yellow, and the point of the bill is brown; the legs are of a straw colour.

In length the Brown Booby is about 2 feet 5 inches, the bill measuring 4½ inches or thereabout, and the tail 10 inches: the young birds are spotted with white and brown.

It is almost impossible to open the pages of the old voyagers who have fallen in with these Boobies without finding some entertaining accounts of the constant persecution to which the latter are subjected by the Frigates or Man-of-War Birds. Lesson indeed doubts this. He says, "The boobies have been so named because it has been supposed that the frigates compelled them to disgorge the fish which they had taken; but this appears to us to be erroneous. The booby is warlike, he lives fearlessly near the frigate, and swallows the fish which he has captured in peace." Buffon, Cuvier, and Temminck, on the contrary, evidently give credence to the narratives of the Frigate-persecution, and indeed it is difficult to believe that so many eye-witnesses should be mistaken.

Brown Booby (*Sula fusca*).

Feuillée says, "I have had the pleasure of seeing the frigates give chase to the boobies. When they return in bands towards evening from their fishing, the frigates are in waiting, and dashing upon them compel them all to cry for succour, as it were, and, in crying, to disgorge some of the fish which they are carrying to their young ones. Thus do the frigates profit by the fishing of the boobies, which they then leave to pursue their route." Leguat in his voyage thus writes:—"The boobies come to repose at night upon the Island Rodriguez, and the frigates, which are large birds, so called from their lightness and speed in sailing through the air, wait for the boobies every evening on the tops of the trees. They rise on the approach of the latter very high in the air and dash down upon them like a falcon on his prey, not to kill them but to make them disgorge. The booby, struck in this manner by the frigate, gives up his fish, which the frigate catches in the air. The booby often shrieks and shows his unwillingness to abandon his prey, but the frigate mocks at his cries, and rising dashes down upon him anew till he has compelled the booby to obey." William Dampier observes that he remarked that the man-of-war birds and the boobies always left sentinels near their young ones, especially while the old birds were gone to sea on their fishing expeditions; and that there were a great number of sick or crippled man-of-war birds which appeared to be no longer in a state to go out for provision. They dwelt not with the rest of their species, and whether they were excluded from their society or had separated themselves voluntarily, they were dispersed in various places waiting apparently for an opportunity of pillage. He adds that one day he saw more than twenty on one of the islands (the Alcranes), which from time to time made sorties to procure booty. The man-of-war bird that surprised a young booby without its guard gave it a great peck upon the back to make it disgorge (which it instantly did) a fish or two as big as one's wrist, which the old man-of-war bird quickly swallowed. He further speaks of the persecution of the parent boobies by the able-bodied frigates, and says that he himself saw a frigate fly right against a booby, and with one blow of its bill make the booby give up a fish just swallowed, upon which the frigate darted with such celerity that he seized it before it reached the water. Catesby and others mention similar encounters. Nuttall says, "The boobies have a domestic enemy more steady, though less sanguine in his persecutions, than man; this is the frigate pelican or man-of-war bird, who with a keen eye descrying his humble vassal at a distance, pursues him without intermission, and obliges him by blows with its wings and bill to surrender his finny prey, which the pirate instantly seizes and swallows. . . . . The booby utters a loud cry, something in sound betwixt that of the raven and the goose; and this quailing is heard more particularly when they are pursued by the frigate, or, when assembled together, they happen to be seized by any sudden panic."

Their nests, according to Dampier, are built in trees in the Isle of Aves, though they have been observed in other places to nestle on the ground. They always associate in numbers in the same spot, and lay one or two eggs. The young are covered with a very soft and white down. Nuttall says that they abound on rocky islets off the coast of Cayenne and along the shores of New Spain and Caracas, as well as in Brazil and on the Bahamas, where they are said to breed almost every month in the year. In summer, he adds, they are not uncommon on the coasts of the Southern States of North America. The flesh he describes as black and unsavoury.

Other species of *Sula* are also called Boobies. [Sula.]

BO'OPS, a genus of Fishes of the order *Acanthopterygii*, and, according to Cuvier's arrangement, belonging to the fourth family of that tribe called *Sparoïdes* or *Sparidæ*.

This genus is chiefly characterised by the species possessing trenchant teeth; the mouth is small and not protractile. The species are generally of brilliant colouring. Most of them occur in the Mediterranean.

Boops salpa (*Sparus salpa* of Linnæus) is of an oblong-ovate form. The ground colour of its body is bluish, on which are several longitudinal yellow stripes.

BOOTTIA, a genus of plants belonging to the natural order *Hydrocharidaceæ*, the species of which are eaten as pot-herbs.

BORACITE. [Boron.]

BORAGE. [Borago.]

BORAGINA'CEÆ, *Borage-Worts*, the Borage Tribe, a natural order of regular-flowered Monopetalous Dicotyledons, which are readily distinguished from all others by having their ovary deeply divided into four lobes, from the middle of which arises a single style. They are moreover characterised by their flowers being arranged in a gyrate manner before they expand. The Common Borage is often taken as the type of this order, and in fact represents not only its peculiarities of structure, but sensible properties; for all the known species agree in having an insipid juice, and their surface covered over with stiff white hairs, which communicate a peculiar asperity to the skin, whence these plants were formerly called *Asperifoliæ*, or 'rough-leaved.' In the structure of their ovary these plants are closely allied with *Lamiaceæ*. Their regular flowers and the absence of volatile oil in

Lung-Wort (*Pulmonaria angustifolia*).

1, A corolla; 2, the same cut open; 3, the tube of the same; 4, the base of the same with the ovary and its four lobes; 5, an anther; 6, calyx; 7, a section of the calyx, showing the four-lobed fruit; 8, a ripe calyx; 9, an achenium.

their leaves, and five stamens, at once distinguish them. They also resemble *Nolanaceæ*, but from these they are distinguished by their gyrate inflorescence. The species are principally natives of the temperate countries of the northern hemisphere. The properties of this order are not active. Nevertheless several have been used in medicine; one species yields alkanet, and many of them are cultivated. It contains 53 genera and about 600 species. [ANCHUSA; ECHIUM; PULMONARIA; STEENHAMMARIA; LITHOSPERMUM; MYOSOTIS; SYMPHYTUM; BORAGO; CYNOGLOSSUM.]

BORA'GO, a genus of plants, the type of the natural order *Boraginaceæ*, and placed in the tribe *Anchuseæ*. This tribe is distinguished by possessing four nuts affixed to an hypogynous disk, with an excavated space surrounded by a tumid ring at their base. The genus *Borago* has a calyx with five deep segments; a rotate corolla with the tube very short, the throat with short erect emarginate scales; exserted stamens, the filaments bifid, the inner fork bearing the anther; the anthers linear, lanceolate, connivent in the form of a cone. All the species are rough plants, with fusiform roots, oblong or lanceolate leaves, and blue panicled drooping flowers.

B. officinalis, Common Borage, has the lower leaves obovate, obtuse, attenuated below; the segments of the corolla ovate, acute, flat, spreading. The flowers are blue, and the whole plant is hispid, with tubercled hairs. This plant appears to be originally a native of Aleppo, but is now naturalised in most countries of Europe. In Great Britain it is not uncommon on rubbish and in waste places. Borage had formerly a great reputation as a cordial. Its virtues in this respect must have been overrated, as in common with the whole family to which it belongs it possesses no very active properties. The tissues contain gum, and on this account it may be used as a demulcent. It also possesses nitrate of potash, as well as other plants of the order, which renders it slightly febrifuge. Withering says the young tender leaves may be used as salads or as a pot-herb. Three other species are described: *B. crassifolia*, a native of Persia; *B. longifolia*, from Numidia; and *B. laxiflora*, a native of Corsica. They are all plants of the easiest culture. They may be always propagated by seed, which should be sown in the open ground. They form pretty border-flowers.

(Babington, *Manual of British Botany;* G. Don, *Gardener's Dictionary.*)

BORA'SSUS, a genus of Palms, called Tala in Sanscrit and Palmyra by the English, in imitation of the Portuguese, who name it Palmeira Brava. It is defined by Roxburgh as having diœcious hexandrous flowers; the calyx and corolla in the males consisting each of three distinct pieces, and in the females of from eight to twelve in a confused state; and the ovary of three cells, changing to a three-seeded drupe. There is but one species according to writers on Indian botany; but it is not certain that more than one distinct palm is not confounded under the common name of Palmyra.

Borassus flabelliformis is the only species. This plant grows all over India, both on the continent and in the islands, where it is esteemed of the greatest use on account of the vinous sap and the sugar which are extracted from it. Its trunk is from 25 to 40 feet high when full grown, and is perceptibly thicker at the base than at the summit. The leaves are fan-shaped, about 4 feet long, and placed upon stalks of about the same length, which are spiny at their edges; each leaf is divided into from 70 to 80 rays, which are ragged at the end, and the largest of which are placed in the centre. The fruit is about as big as a child's head, three-cornered, with the angles rounded off, and a little furrowed. It consists of a thick, fibrous, rather succulent, yellowish-brown rind, containing three seeds the size of a goose-egg. When young the shell of the seed is so soft that it may be readily pierced by the finger, and the pulpy matter which it then contains is cool and sweet and refreshing; but when ripe all this changes to a hard bluish albumen, which is insipid and uneatable. The outer wood of the stem when old becomes very hard and brown, and although scarcely to be cut transversely, nevertheless divides freely in a longitudinal direction: it is capable of taking a fine polish, and is frequently made use of for bows. The young wood in the centre is white, soft, and worthless. "This magnificent palm," says Sir William Jones, "is justly considered the king of its order, which the Hindoos call 'trina drums,' or grass-trees. Van Rheede mentions the bluish, gelatinous, pellucid substance of the young seeds, which in the hot season is cooling and rather agreeable to the taste; but the liquor extracted from the tree is the most seducing and pernicious of intoxicating juices. When just drawn it is as pleasant as Pouhon water fresh from the spring, and almost equal to the best mild champagne. From this liquor, according to Rheede, sugar is extracted; and it would be happy for these provinces if it were always applied to so innocent a purpose."

The mode of obtaining the sap of this palm is stated by Rumf to be by crushing the young inflorescence and amputating the upper half; the lower is then tied to a leafstalk, and has a vessel usually of bamboo attached to its end. The vessel gradually fills with sap, and is removed every morning; when replaced a fresh slice is cut from the wounded end of the inflorescence—an operation which is repeated daily until the whole of the raceme is sliced away. In procuring the sugar exactly the same process is followed, but the inside of the receiver is powdered with lime, which prevents fermentation taking place: the juice is afterwards boiled down and finally dried by exposure to smoke in little baskets.

Palmyra (*Borassus flabelliformis*).

1, A male spadix; 2, a female spadix, inflorescence with the spathes at its base; 3, the back of a male flower; 4, the front of the same; 5, a female flower; 6, the same stripped of its scales and showing barren stamens enveloping the ovary.

BORAX. [BORON.]

BO'RBORUS (*Iphærocera* of Latreille), a genus of Dipterous or Two-Winged Flies, of the family *Muscidæ*. Its chief characters exist in the posterior thighs, which are much compressed, and the two basal joints of the posterior tarsi, which are considerably larger than the following. The head is concave in front and reflexed towards the mouth: the antennæ diverge, and are sometimes almost as long as the fore part of the head. The second cell of the posterior extremity of the wing (the last of the two which occupy the middle of its length) is closed before it reaches the margin.

These little flies are found in marshy places, and on putrid substances, but more particularly dung-heaps, in which probably their larvæ reside; they are always abundant about cucumber frames, and are of a brownish colour; most of the species when expanded would scarcely measure a quarter of an inch.

BORECOLE, a variety of *Brassica oleracea*, also called Sprouts. [BRASSICACEÆ.]

BORER, a name for the worm-like fish, known also by the name of the Myxine, the Glutinous Hag, and Blind Fish. [MYXINE.]

BO'REUS (Latreille), a genus of Insects of the order *Neuroptera*, and family *Panorpidæ*. This genus, of which only one species is known (*B. hyemalis*), is not only remarkable for its structure, but from the curious circumstance of its having been found in the winter months only, and is said even to have been seen on the Alps running about on the snow: its most common abode however appears to be in moss.

B. hyemalis is about one quarter of an inch long and of a greenish colour, with the legs inclining to red; and, unlike the rest of its tribe, the female possesses no wings, and those of the male are only rudimentary. The antennæ are long and thread-like, the parts of the mouth are produced into a kind of proboscis; the abdomen of the female is furnished with a large ovipositor. It is rather a scarce insect in this country.

BORNIA, a genus of Fossil Plants from the Coal Formation, including *Bornia equisetiformis*, which Lindley ranks in *Asterophyllites* ('Foss. Flora,' t. 124).

BORON. Minerals containing Boron or any of its compounds as an essential component part are comparatively few in number, and only found in a few spots; it may be therefore considered as one of the least predominating of the elements. It is the basis of *Sassoline*, or native boracic acid; *Borax*, or borate of soda; *Boracite*, or borate of magnesia; *Datholite*, or borate and silicate of lime; and *Botryolite*.

It also enters as boracic acid into the composition of *Axinite* and *Tourmaline*, but only in small quantity, most analyses giving between two and three per cent. of the acid in the former mineral, and between four and five per cent. in the latter.

The presence of Boron in any mineral may be readily detected with the blow-pipe, owing to the beautiful green tint communicated to the flame by the boracic acid. The facility with which the tint is obtained depends on the element with which the boracic acid is combined; in every instance however it may be detected by the following process:—Let a flux, composed of 4½ parts of bisulphate of potash and one of finely-powdered fluor-spar, be well mixed with about an equal quantity of the assay, which must then be formed into a paste by the addition of a little moisture. A small quantity of this being taken up on the extremity of a platinum wire must first be dried, and then exposed to a high temperature until it is fused, being held within but near the extremity of the blue flame. When the mass is fused it appears for a few moments enveloped in a pure green flame, which soon disappears, and cannot be again produced. The theory of the changes is this:—The fluorine of the flux being set free by the excess of sulphuric acid unites with the boron of the assay, forming the fluoboracic acid, which at the moment of its volatilisation communicates the green tint to the flame. This process is, however, only necessary for the detection of the boracic acid in axinite and tourmaline, as the flame is permanently coloured by sassoline, boracite, datholite, and botryolite; and the same effect is produced by moistening the glass of boron with sulphuric acid and again fusing it.

The native boracic acid is found as a deposit in several of the lagunes of Tuscany, and also in considerable abundance in the hot springs near Sasso in the same country, whence it has been called *Sassoline*. It occurs in the form of thin scaly particles, or crystalline grains either loose or aggregated in the form of a crust. These crystalline grains are hydrated boracic acid, the constitution of which may be expressed by the formula—

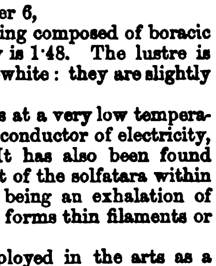
Boron 1; Oxygen 6; Water 6,

as given by Berzelius, 100 parts of sassoline being composed of boracic acid 56·37, water 43·63: their specific gravity is 1·48. The lustre is pearly, and the colour is grayish or yellowish-white: they are slightly translucent.

It loses its water of crystallisation and fuses at a very low temperature, forming a glassy globule, which is a non-conductor of electricity, and becomes resinously electric on friction. It has also been found more recently by Dr. Holland to be a deposit of the solfatara within the crater of Volcano, one of the Lipari Isles, being an exhalation of the fumaroles, around the edges of which it forms thin filaments or cakes on the surface of the sulphur.

Borax, or borate of soda, is principally employed in the arts as a flux in several metallurgical processes, and is very advantageously used in the process of soldering metals. To the chemist it is an invaluable re-agent in experimenting with the blow-pipe.

Borax is soluble in twelve times its weight of cold and twice its weight of boiling water, from which it may be readily obtained in very perfect crystals of the oblique prismatic system. The more usual form of these is represented in the accompanying figure, where the faces *r* are the vertical prism, the angles of which are, according to the measurements of Phillips, 86° 30′ and 93° 30′, the acuter edge of which is truncated by M, the obtuser by T, while P is the inclined terminal plane, and makes with M an angle of 106° 30′; O are the faces of a hemi-octohedron.



The following are the measurements given by Phillips:—

r on *r*	86° 30′
P on *r*	101° 30′
M on *r*	133° 20′
P on M	106° 30′
P on O	139° 15′
O on O	122° 34′

It is very common to find the edges between O and *r* truncated. The specific gravity varies from 1·5 to 1·7; the hardness from 2 to 2·5. When coloured it is of a light yellowish-green: the fracture is conchoidal and of a resinous lustre.

The chemical composition as given by Berzelius is—

Boracic Acid	36·52
Soda	16·37
Water	47·11

Boracite is in many respects one of the most interesting bodies of the inorganic kingdom. It was first described by Lasius in 1787 under the name of cubic quartz, and was found in the gypsum rocks near Lüneburg in Brunswick, where it occurs in small crystals, which are perfectly developed on every side and imbedded in the gypsum. The crystals usually present a combination of the cube, dodecahedron, and the two hemi-octohedrons, in which combinations sometimes the one sometimes the other form predominates. The locality was for some time the only spot where boracite was found, until the crystals were discovered in a gypsum rock called Segeberg in Holstein, at the foot of which is situated a small village of the same name. The crystals of the *Boracite* of this spot possess the same characters as those of Lüneburg, and add considerable interest to the very peculiar rock in which they are found, which is itself a very remarkable object from its abrupt elevation over the sandy plain of Holstein. It is described in the 'Geognostischen Aufsätzen' of Steffens, who considers it to be of the same formation as the gypsum of the Paris basin.

Boracite has been analysed by Stromeyer, who found it to be composed of boracic acid 67, magnesia 33. The specific gravity is 2·9; it is transparent, but also frequently opaque; the hardness is 6·5 to 7; it is brittle, and has a conchoidal fracture. The lustre is vitreous, inclining to adamantine. The colour is usually a yellowish or greenish gray.

It fuses easily before the blowpipe, at first with much foam, and then forms a glass globule, which crystallises on cooling, so that the surface is covered with fine acicular points. When just so much soda is added as will form with it a clear glass, it will then crystallise as perfectly as the phosphate of lead.

BORRERA, a genus of plants belonging to the natural order of *Lichens*, named by Acharius in honour of William Borrer, F.L.S., who has very successfully cultivated Cryptogamic Botany, especially that of Great Britain. One species *B. furfuracea* has the reputation of being astringent and febrifuge. A genus of Cinchonaceous plants has also been named after Mr. Borrer. [BORRERIA.]

BORRERIA, a genus of plants named in honour of William Borrer, F.L.S. It belongs to the natural order *Cinchonaceæ*, and has the following characters:—Calyx with an ovate tube, and a permanent limb which is parted into 2-4 teeth; corolla salver-shaped or funnel-shaped, 4-lobed; stamens 4, exserted or inclosed; stigma bifid or undivided; capsule crowned by the limb of the calyx, 2-celled, opening from the apex at the dissepiment when mature, but without any dissepiment; coccæ or nuts 1-seeded, opening by a longitudinal chink inside. The species, which are very numerous, are most of them herbs or undershrubs, and are nearly all natives of tropical America.

B. ferruginea, has a herbaceous, hard, erect, branched stem; tetragonal hairy branches; oblong, acute, obliquely 3-4-nerved leaves, scabrous above and pale beneath, and scabrous on the nerves from hairs; bristles of the stipules the length of the sheath; whorls of flowers globose, terminal, and axillary; capsule downy, crowned by the four subulate teeth of the calyx. This plant is a native of Brazil, in elevated pastures in the provinces of Minas Geraes and St. Paul. The plant is called Poaya, and Poaya da Maya at Cape Frio. This is one of the plants which yield a bastard ipecacuanha. The roots are of a brown colour, and when taken produce sickness and vomiting.

B. Poaya is glabrous, and has a herbaceous simple tetragonal stem; sessile oblong-elliptic acute leaves, obliquely 6-nerved on both sides of the midrib; the stipules cleft into many long bristles; whorls of flowers capitate, sessile, few, axillary, and a larger terminal one; lobes of calyx 4, lanceolate linear acute, longer than the ovarium; corolla smooth; anthers exserted. A native of Brazil in elevated pastures. It has blue flowers. The roots are white, and produce sickness when taken, and are consequently frequently substituted for ipecacuanha. The leaves when chewed have a sweet taste at first, and afterwards an acid one; a decoction of them is sometimes employed in the cure of colic. Upwards of 80 species of this genus have been described, of which only the above two appear to be used by man. They may be cultivated in this country in greenhouses. A light soil suits them best, and cuttings of the shrubby pieces readily strike root under a hand-glass in heat. The herbaceous species require the same treatment as other tender annuals.

(Don, *Gardener's Dictionary*.)

BOS. [BOVIDÆ.]

BOSTRICHUS (Latreille), a genus of Insects belonging to the order *Coleoptera*, of the family *Xylophagi*. Generic characters:—Body oblong, cylindrical, or nearly so; head rounded, capable of being retracted within the thorax as far as the eyes; eyes distinctly projecting; antennæ ten-jointed, short, the three terminal joints large and distinct, twice as broad as the remainder; the five following joints small and close together; the two remaining, or two basal joints, slightly thickened; palpi tolerably distinct, about equal in length to the mandibles, short, and three-jointed; thorax convex above, the anterior part humped; legs rather short, tarsi four-jointed, simple. The insects of this tribe are found on old trees, upon which their larvæ feed, and in so doing they generally construct their burrows under the bark.

Bostrichus capucinus (a rare species in this country) is about half an inch long; the head, antennæ, thorax, and legs are black; the rest of the body is red.

BOSWELLIA, a genus of balsamic plants belonging to the natural order *Amyridaceæ*. One of the species is believed by Colebrooke to be the Λίβανος of Theophrastus, and the *Thurea virga* of the Romans. ('Asiatic Researches,' vol. ix.)

It appears that the gum-resin called olibanum is the frankincense that was used by the ancients in their religious ceremonies. Linnæus was of opinion that it was yielded by the Lycian juniper; but that plant is a native of the south of France as well as of the Levant, and the botanists of that country deny that any such substance is produced by their juniper. The Greeks obtained their frankincense from Arabia. The Arabians call olibanum both Lubán and Cundur; but as benzoin is most used at the present day for religious purposes, the Mohammedan writers of India on Materia Medica apply only the term Cundur to olibanum. This Cundur has been ascertained by Messrs. Colebrooke, Hunter, and Roxburgh to be yielded by *Boswellia thurifera* or *B. serrata*. It is a large timber-tree found in the mountainous parts of India, yielding a most fragrant resin from wounds made in the bark. Its leaves are pinnate, and consist of about ten pairs of hairy serrated oblong leaflets, each of which is from an inch to an inch and a half in length. The flowers are pale pink, small, and numerous. The calyx is 5-lobed, the corolla of 5 downy petals, the disk a fleshy crenelled cup, and the stamens 10, alternately shorter. The fruit is a 3-sided, 3-valved, 3-celled capsule, containing a single-winged pendulous seed in each cell.

From this Roxburgh distinguishes as a different species *Boswellia glabra*, a plant also yielding a resin which is used for incense and as pitch in some parts of India. It differs from the last in having no hairs on its leaves, in its leaflets being often toothless, and in its flowers being panicled.

A substance analogous to olibanum, and used in a similar way in various parts of the world, is procured from several different trees, such as, in America, the *Croton nitens* (Schwartz), *C. thurifer* (Kunth), *C. adipatus* (Kunth): in Columbia, *Baillieria nervifolia* (Kunth) yields the American frankincense; the *Amyris* (*Icica Tacamahaca*, Kunth) *ambrosiaca* (Linn.), yields also the resin coumier, likewise called American frankincense.

Lïstia apetala (Jacq.) also yields a substance similar to frankincense.

Olibanum occurs in commerce of two kinds, the Arabian and East Indian. The former kind is now seldom met with, and its origin is a subject of doubt; the latter is obtained from the tree above described, and to it we limit our remarks. There are two varieties or degrees of fineness of it, the best called 'olibanum electrum,' or 'in granis,' sometimes called 'thus mannæ' or 'thus masculum': the other is termed 'olibanum commune,' or 'in sortis,' also 'fœmineum.' The first occurs in pieces varying from the size of a hazel-nut to that of a walnut, or larger, which are roundish or irregular in shape, of a light yellowish colour, varying to red or brown in some pieces, opaque or semi-transparent, the outside often covered with a white powder, and upon being pounded the whole becomes a white powder. It is very friable, and breaks with a dull, sometimes even, sometimes splintery fracture.

The second sort is generally in larger pieces, mostly of a dirty-gray or fawn-colour, and intermingled with pieces of wood and other impurities.

BOTANY is that branch of science which comprehends all that relates to the Vegetable Kingdom. The term Botany is derived from the Greek, in which βοτάνη signifies any kind of grass or herb, and βοτανικη the art which teaches the nature of plants and herbs. The structure of plants, their mode of growth, their habits of life, their mutual relations, their uses to man or the danger that results from their employment, the station they occupy in the scale of the creation, and many other similar considerations, form each an extensive field of inquiry which botany combines into one connected whole.

Although the limits of the science of Botany can be easily defined to be the structure and functions of plants, it is not so easy to define the nature of a plant. It is true that with regard to the great mass of organic forms which belong to the vegetable kingdom there is no difficulty in at once assigning them their position, but there are a very large number of organised bodies that stand in such intimate relations with the animal kingdom as to create a perpetual difficulty with regard to their real nature. At the time when it was considered a sufficient distinction between plants and animals that the former were fixed and the latter had the power of locomotion, large orders of beings which are now classed with plants were regarded as animals. To some of these it may be interesting to draw attention, as it is amongst them that the naturalist is enabled to observe in its simplest forms the true nature of the functions of vegetable structure. It was in the large order *Algæ* [ALGÆ], to which belong the various forms of sea-weeds, and the lowest orders of plants inhabiting fresh-water, that those functions were first observed that were supposed to be peculiar to animals. Amongst the *Oscillatoriæ* it was found that a number had a distinct power of self-movement, so that as far as these were concerned it became evident that locomotion would not distinguish plants from animals. Many of the early observers with the microscope had also seen that the spores or cells that represented seeds in the higher plants had the power of motion. In order to distinguish between these movements and those possessed by the ova of animals, it was supposed that the latter had cilia whilst the former had not. Unger and Thuret however, in 1843, both announced the fact that the spores of many *Algæ* possess vibratile cilia, not to be distinguished from those on animal bodies. This important discovery has been followed by a very rigid examination of the various organised bodies admitted by Ehrenberg into the class of Animalcules, in his 'Infusionsthierchen,' on account of their locomotion by means of cilia. The consequence has been that large numbers of the *Infusoria* of Ehrenberg are now regarded as plants. One of the most remarkable of these is the *Volvox globator*, or Globe Animalcule, which, although endowed with cilia and possessing the most active powers of motion, has through the recent researches of Professor Williamson and Mr. Busk been shown to be an undoubted plant. Not only does the history of its development and its mode of reproduction bear out this conclusion, but also the presence of starch, detected by Mr. Busk during the growth of the young *Volvox* ('Microscopical Transactions,' vol. i. New Series). The placing this form in the vegetable kingdom is important, as a large number of the forms placed by Ehrenberg near *Volvox* must now be regarded also as plants. This serves to remove the anomaly which has sometimes been insisted on, that the lower animals perform the functions of the higher plants, that is, take up carbonic acid and throw out oxygen. The fact is, these lower animals are plants. [ANIMAL KINGDOM.]

Ehrenberg also describes and figures the families of *Diatomaceæ* and *Desmideæ* in his *Infusoria*. They have the power of movement but are destitute of cilia. The *Desmideæ* contain chlorophyle, are developed similar to the *Algæ*, and the fact of their conjugating after the manner of the *Zygnæmata* amongst the *Algæ*, first observed by Mr. Thwaites, has led naturalists to place them amongst plants. Mr. Ralfs, whose work on the 'British Desmideæ' is one of the best on the subject, states that he has found starch universally present amongst them. The *Diatomaceæ* are not so decidedly vegetable in their nature. Lindley in his 'Vegetable Kingdom,' however, admits *Diatomaceæ*, and regards *Desmideæ* as a sub-kingdom. The presence of a shell or frustule of silica, sometimes very complicated in its structure, has led Schleiden to reject the *Diatomaceæ* as plants, whilst Kützing admits some and rejects others. Their general resemblance to *Desmideæ* has given them their position in the vegetable kingdom.

On the other hand the Sponges (*Spongiadæ*), which were placed amongst animals on account of the active motile habits of their ova, seemed to be destined to classification again with plants when motility no longer became the distinguishing mark of the two kingdoms. There are, however, other points of structure which still induce the zoologist to lay claim to the sponges. The corallines (*Corallina*) which were formerly classed with the sponges, first as plants, then as animals, are now again placed with the *Ceramiaceæ* amongst the sea-weeds, and have a decided relation to the vegetable kingdom.

From these facts it is very evident that no mere technical definition will enable the naturalist to separate the animal and vegetable kingdoms, and that it is only by observing the structure and functions of organic beings through the whole course of their existence that we can hope to assign them their right position as plants or animals.

In determining the sphere of Botany by the inquiry into the nature of the plant, it will at once be seen that the study of plants cannot be successfully prosecuted without inquiry into the nature of animals. Again, the chemical elements of which plants and animals are formed, exert a great influence through their peculiar properties on the life of these beings. These must be always taken into consideration in speaking of the structure of a plant or the functions it performs. Hence we see that Botany is but the part of a great series of facts in which the inorganic elements, the cells of plants, and the cells of animals, are constantly taking a part.

In order to study Botany therefore successfully, the first knowledge that is necessary is that of the properties of the elements which enter into the composition of plants and animals. These are more especially four, carbon, hydrogen, oxygen, and nitrogen, which on account of their universal presence in plants and animals have been called organic or necessary elements. In addition to these are found twelve or thirteen other elements, which not being universally present may be called occasional or inorganic elements. Sulphur, phosphorus, calcium, potassium, sodium, iron, magnesium, iodine, and bromine, are the most conspicuous of these elements. The organic elements enter into various compounds which are found in plants, as sugar, starch, cellulose, protein, chlorophyle, gums, resins, alkaloids, acids, &c.; whose properties should be studied in order that their presence may be readily recognised in the dissection of plants. In order to accomplish this, re-agents must be employed, as iodine, potassa, sulphuric acid, iron, and many others, which on being applied to the parts of plants reveal by their action the nature of the vegetable compounds.

One of the most important aids to the study of the structure of plants, and by which the great recent progress in physiology has been made, is the microscope. The textures of plants as well as animals take their origin in cells so minute that they cannot be seen by the naked eye. It is in and around these cells that the active functions of every part of an animal or plant are going on; and it is only as the botanist gets to know the nature of the changes which the vegetable elements and their compounds undergo in the cells of plants, that he can comprehend the general laws of vegetable life. Not only is it necessary to the botanist to study these laws by the aid of the microscope, but the general physiologist and student of the functions of the human body will find it necessary to begin his inquiries by the study of the nature of vegetable cells. It was by following up the researches made by Schleiden on vegetable cells, that Schwann was enabled to demonstrate the cellular structure of the animal body, and thus to initiate a new era in physiology. It is still in the plant that the simplest condition of the cell is observed. It is also in the plant that the greatest chemical activity of the cell exists. The food of animals, and that which constitutes the substance of the tissues of animals, are all formed in the interior of the cells of plants. It is the cell of the plant which appropriates the carbonic acid of the atmosphere, and throws back again into it oxygen gas; on the one hand depriving it of an agent destructive to animal life, and on the other supplying the agent by which alone animal life could be carried on. It is also in the vegetable cell that the chemist must seek the solution of some of the most difficult problems of his science. The chemist cannot convert carbonic acid and ammonia into protein, sugar, starch, &c.—processes which are going on in every vegetable cell; he must therefore regard attentively the changes going on in the cells of plants, if he would manufacture the products of the vegetable kingdom independent of its aid.

Amongst the practical arts of life a knowledge of Botany is important to many. Agriculture and Horticulture are the two arts with which its relation is the most obvious; for although a considerable part of all the practices in each of them grew out of mere experience, or was discovered by chance, yet there is no possibility of improving them except by other fortunate accidents, or of advancing them at a more rapid rate, unless by the application of vegetable physiology. The world, especially that part of it to which these arts belong, is little accustomed to trace to their source the common practices with which it has been familiar from its infancy; and it is far from suspecting that many of the operations which are intrusted to the most ignorant rustics have one by one and piecemeal been hit upon during the careful study of nature by philosophers whose names it never heard. Gardening and Husbandry may be defined as the arts, firstly, of improving the quality of various useful plants, and secondly, of increasing the quantity which a given space of earth is capable of producing.

To improve the quality of any one plant, and to render it better adapted to the uses of mankind upon scientific principles, is a very complicated process, and is to be effected in many different ways, all of which require an intimate knowledge of the nature of the vital actions of plants, and of the degree in which they are affected by either external or internal causes. For example, a particular kind of flax produces fibres which are too coarse for the manufacturer; it is impossible to know how those delicate elementary tubes are to be rendered fine without being aware of the manner in which vegetable tissue is affected by light, air, and earth. The flavour of some fruit is too acid; it is the botanist only who could have discovered how to increase the quantity of saccharine matter. Potatoes are sometimes watery and unfit for food; we learn from vegetable physiology that this is often caused by the leaves not being sufficiently exposed to solar light, the great agent in causing the production of vegetable secretions. The leaves of the tea plant are harmless and only slightly stimulating in certain latitudes; they become narcotic and unwholesome in others; this apparent puzzle is explained by the connection that exists between climate and vegetation, a purely botanical question. Certain races of plants may exist, of which one is too vigorous, the other too debilitated for the purposes of the cultivator; the botanist shows how an intermediate race may be created, having the best qualites of both.

Certain vegetable productions are susceptible of being produced in particular latitudes, others are not, or not to any useful purpose: for instance, in England, on account of the want of the necessary heat at the period of ripening the grape, the vine will never yield grapes capable of making such wine as even that of champagne, nor will tobacco ever acquire that peculiar principle which gives it so great a value in tropical and subtropical climates when grown in other countries; and yet both these plants flourish in the soil of England. The botanist can explain the cause of this, and thus prevent the commencement of speculations which can never end except in loss and disappointment.

The quantity of produce which may be procured from a given space of ground varies very much according to the skill of the cultivator, but that skill is in reality the mere application of the rules of vegetable physiology to each particular case; an application that is most frequently made unconsciously, but which nevertheless is made. We are too apt to overlook causes in effects, and to ascribe the improvements we witness to a mere advance in art, without considering that that advance must have had a cause, and that the cause can only be the working of some master-hand which is afterwards blindly followed by the community. The crops of orchard-fruit are doubled and trebled in many places: old exhausted races are replaced by young, vigorous, and prolific ones; the cider and perry farmer will feel the benefit of this, but he will forget that he owes the change to the patient skill of a vegetable physiologist. The produce of the potato is augmented in the same proportion; twice at least the ordinary quantity of this important article of food may now be obtained from every field. The peasant will feel the additional comfort thus diffused around him, but he will never have heard of the name of Knight; nor will he know, after a few years, that the produce of the land was ever smaller.

Nor is it alone to articles of food that this science is to be applied. Next in importance to food are fire and shelter, both of which are mainly furnished by timber. The laws of nature which regulate the production of this substance are among the most curious in science: we possess the most absolute control over them; we hold in our very hands the means of regulating their action; and if we neglect them, as is too often the case, it is not science which is to blame, but those who undervalue and neglect her. Because trees will grow without assistance, and because in spite of neglect and ignorance timber is perpetually renewing itself upon the earth, we forget that either its rate of production may be accelerated or its quality improved. Instances are not wanting where plantations in this country made for particular purposes at a large expense have been totally ruined, with reference to the objects of those who planted them, from ignorance of the simplest laws of vegetable physiology.

Some allusion has already been made to the important results which arise out of the study of the connection between vegetation and climate. The quality of all vegetable productions is influenced essentially by external causes; intensity of light, atmospheric pressure, humidity, temperature, and seasons, are the great agents which modify the tissue, which control development, and which regulate the formation of sensible properties. Various combinations of these and other external causes are what constitute diversities of climate, and it is therefore obvious that the connection between the latter and vegetation is of the most intimate nature. But as this is a branch of the science of comparatively modern origin there are few instances of its application: one of the most striking was the declaration of Dr. Royle, that cotton might be obtained in the East Indies equal to the finest from America—a prophecy which has already been fulfilled, in consequence of the practical adoption of plans similar to those which he theoretically suggested. Can tea be cultivated as advantageously elsewhere as in China? Here is a single question of immense importance, involving the interests of millions of human beings, and affecting the pecuniary interests of Great Britain as much as any commercial problem ever did. This question has been answered by the botanist in the affirmative, and already the natives of the East Indies are supplied with tea from the Himalaya, and Asam tea may be bought in the shops of London.

To the medical man the study of botany is of the highest interest, as the members of the vegetable kingdom yield to him the most important means of his art. It is only as the properties of plants are studied that new agents for the alleviation of disease can be expected, or that substitutes for those already in use can be employed.

Thus far we have more especially referred to the study of vegetable physiology. Systematic Botany bears upon practice not less usefully, but in a different way. If the only advantage of classifying plants were to acquire the power of discovering their scientific names, even that would have a certain kind of interest, because it would ensure a uniformity of language in speaking of them; if it had the additional property of demonstrating the gradual connection that is discoverable between all the beings in the organised part of the creation, of proving that there is an insensible transition from one form of living matter to another without break or interruption, and of explaining in a clear and intelligible manner the nature of that universal harmony of which philosophers are used to talk, the interest and importance of botanical classifications would be still further enhanced; but the practical importance of them would still be extremely limited. It is only when we look to the coincidence between botanical affinities and sensible properties, and to the external indications of internal qualities, that we perceive the great features of its utility to man. If the qualities of every plant required to be ascertained by a circuitous and tedious series of experiments, no life could be long enough for the task, nor, if it were, could any memory however powerful remember so extensive a series of facts; and if under such circumstances botanists whose whole life is occupied in the study should be unable to master the difficulties, systematic botany could never be applied at all to any useful purpose, because it must of necessity be far beyond the acquirement of those persons who would be most likely to have occasion to employ it. But it was long since suspected that plants which agree with each other in organisation also agree in the secretions which may be supposed to be the result of that organisation. Linnæus, in his dissertation upon the properties of plants, declares that species of the same genus possess similar virtues, that those of the same natural order are near each other in properties, and that those which belong to the same natural class have also some relation to each other in their sensible properties. This doctrine is now admitted on all hands among men of science to be incontrovertible, and places the practical utility of systematic botany in the most striking light. Instead of endless experiments leading to multitudes of incongruous and isolated facts, the whole history of the medicinal or economical uses of the vegetable kingdom is reduced to a comparatively small number of general laws; and a student instead of being compelled to entangle himself in a mass of specific distinctions, is only obliged in practice to make himself acquainted with the more striking groups; and having accomplished this he is enabled to judge of the properties of a species he had never seen before, by what he knows of some other species to which it is related. Some idea of the extent to which this power of judging of plants à priori is practically useful may be formed from this—that supposing the vegetable kingdom to consist of 100,000 species arranged in 6000 or 7000 genera, the vast mass of characters required to distinguish them will be collected under about 300 heads, a knowledge of not more than two-thirds of which will be required for the purposes of the general observer. Thus the common hedge-mallow is a mucilaginous inert plant, whose woody tissue is tough enough to be manufactured into cordage; it has certain botanical characters, which are readily observed and remembered; and it belongs to a group of plants consisting of not fewer than 700 species. It is only necessary to understand the structure of the common mallow to recognise all the remainder of the group, and to be aware of their uses and properties; so that a person in a foreign country who finds a plant agreeing with the mallow in those marks by which the *Malvaceæ* are known, although he should never have seen or heard of the plant before, would immediately recognise it to be mucilaginous and inert, and would expect to find its vegetable fibre tough enough to be manufactured into cordage. It is this class of facts which alone can lead with any certainty to the discovery in one country of substitutes for the useful plants of another; it has shown the similarity between the violet roots of Europe and one of the kinds of ipecacuanha of South America; that the astringency of the alum-root of the United States finds a parallel in those of the geraniums of England; that madder has its representative in the Isle of France, cinchona in India, and that India-rubber trees exist in the east as well as in the west.

The artist also would confer an advantage on his art by the study of Botany. It is on account of the utter neglect of any attention to vegetable forms that in almost all objects of art where plants are introduced they are ridiculously wrong. Not only are these monstrous caricatures of the vegetable kingdom introduced upon our walls, carpets, plates, dishes, saucers, &c., but into many of the great works of art. Paintings strictly correct in regard to general outline and colour are filled up with botanical impossibilities. The plants of tropical climates are found flourishing in the forests of Great Britain, and an Assyrian monarch is surrounded with the vegetation of the New World. Such anomalies could not exist if the artist studied as attentively the structure of the vegetable kingdom as he does that of the human body.

The study of Botany may be divided and pursued under the following heads:—

1. The Chemistry of Plants, including a knowledge of the physical and chemical properties of the elements which enter into the composition of plants. [SECRETIONS, VEGETABLE.]

2. The Histology of Plants, including the facts connected with the origin of the vegetable cell, the various functions it performs, and its life in connection with others in the formation of organs. [CELL, VEGETABLE; TISSUES, VEGETABLE.]

3. The Morphology of Plants, embracing the history of the origin and growth of the individual organs of plants, and the relation of all forms of organs to one another, and the laws which regulate the changes which the same organ undergoes in the same and in different families of plants. [STAMEN; PISTIL; SEED; FLOWER; FRUIT; OVULE.]

4. The Organology of Plants, including the general phenomena of the entire life of the plant, and the consideration of the relations which animals bear to plants, and the way in which they take part in the great changes going on in the surface of the earth. [STEM; ROOT; LEAF.]

5. Systematic Botany, embracing the principles of classification and the arrangement of plants in groups according to their relations to each other. This department of botany has been only gradually developed. Under the heads of EXOGENS, ENDOGENS, and ACROGENS will be found in this work the subdivisions proposed by the most recent writers on systematic botany. In order however to facilitate the student in discovering the order to which any plant he may possess belongs, we give here an analysis of the orders contained in the ENGLISH CYCLOPÆDIA upon the plan followed by Dr. Lindley in his 'Vegetable Kingdom.'

Class, EXOGENS.

Sub-Class, POLYPETALÆ. (Petals not united).

I. Stamens more than 20 (Polyandrous).

- A. Ovary wholly or partly inferior
  - a. Stipules present
    - 1. Carpels more or less distinct or solitary . . . . . . *Pomaceæ.* (*Rosaceæ.*)
    - 2. Carpels combined
      - Placentas central
        - Leaves opposite . . . *Rhizophoraceæ.*
        - Leaves alternate . . . *Lecythidaceæ.*
      - Placentas on the side . . . *Homaliaceæ.*
  - b. Stipules absent
    - 1. Carpels more or less distinct . . *Anonaceæ.*
    - 2. Carpels united
      - Placentas spread about . . . *Nymphæaceæ.*
      - Placentas on sides
        - Petals definite, distinct . . *Loasaceæ.*
        - Petals indefinite, confused . *Cactaceæ.*
      - Placentas in the centre
        - Leaves dotted
          - Ovary 1-celled . . . *Chamælauciaceæ.*
          - Ovary more than 1-celled . *Myrtaceæ.*
        - Leaves dotless
          - Petals numerous . . *Mesembryaceæ.*
          - Petals few
            - Petals narrow . . *Alangiaceæ.* (*Nyssaceæ.*)
            - Petals round
              - Style 1 . . . *Barringtoniaceæ.* (*Myrtaceæ.*)
              - Styles separate . *Philadelphaceæ.*
- B. Ovary superior
  - a. Stipules present
    - 1. Carpels more or less distinct or solitary
      - Stamens hypogynous
        - Carpel solitary . . . *Leguminosæ.*
        - Carpels 00 . . . . *Magnoliaceæ.*
      - Stamens perigynous
        - Styles coming from apex of carpels
          - Carpel 1 . . . . *Drupaceæ.* (*Rosaceæ*).
          - Carpels more than 1. . *Rosaceæ.*
        - Styles coming from base of carpels. . . . . *Chrysobalanaceæ.*
    - 2. Carpels united; placentas more than 1
      - Placentas on the side (parietal)
        - Leaves dotted, dots round . *Flacourtiaceæ.*
        - Leaves dotted, dots linear and round, mixed . . . *Samydaceæ.*
      - Placentas in the centre
        - Calyx imbricated
          - Flowers unisexual . . *Euphorbiaceæ.*
          - Flowers hermaphrodite
            - Ovary 1-celled; sepals 2 *Portulacaceæ.*
            - Ovary 2 or more celled
              - Calyx double . . *Chlænaceæ.*
              - Calyx single . . *Cistaceæ.*
        - Calyx valvate
          - Stamens monadelphous; anthers 2-celled
            - Stamens columnar . *Sterculiaceæ.*
            - Stamens not columnar . *Byttneriaceæ.*
          - Stamens monadelphous; anthers 1-celled . . *Malvaceæ.*
          - Stamens monadelphous; calyx irregular . . *Dipteraceæ.*
          - Stamens distinct . . *Tiliaceæ.*
  - b. Stipules absent
    - 1. Carpels more or less distinct or solitary
      - Carpels immersed in a disk . . *Nelumbiaceæ.*
      - Carpels not immersed
        - Stamens perigynous . . . *Rosaceæ.*
        - Stamens hypogynous
          - Embryo in a vitellus . . *Cabombaceæ.*
          - Embryo naked, very minute
            - Seeds with an aril . . *Dilleniaceæ.*
            - Exarillate; albumen fleshy
              - Flowers hermaphrodite *Ranunculaceæ.*
              - Flowers unisexual . *Schizandraceæ.*
            - Exarillate; albumen ruminated . . . . *Anonaceæ.*
          - Embryo nearly as long as seed
            - Calyx much imbricated
              - Fruit a legume . . *Leguminosæ.*
              - Fruit not a legume
                - Seeds smooth . *Hypericaceæ.*
                - Seeds hairy . . *Reaumuriaceæ.*
            - Calyx little imbricated
              - Fruit not a legume . *Anacardiaceæ.*
              - Fruit a legume . *Leguminosæ.*
    - 2. Carpels united; placentas more than 1
      - Placentas parietal, in lines
        - Anthers versatile; juice watery *Capparidaceæ.*
        - Anthers innate; juice milky . *Papaveraceæ.*
      - Placentas parietal, spread over the lining of the fruit . . . *Flacourtiaceæ.*
      - Placentas spread over dissepiments *Nymphæaceæ.*
      - Placentas central
        - Stigma broad and petaloid . *Sarraceniaceæ.*
        - Stigma simple
          - Ovary 1-celled . . . *Portulacaceæ.*
          - Ovary many-celled
            - Calyx much imbricated
              - Leaves compound . *Rhizobolaceæ.*

Leaves simple
Petals equal to sepals
Seeds few . *Clusiaceæ.*
Seeds numerous; petals flat . . } *Marcgraaviaceæ.*
Seeds numerous; petals crumpled . } *Cistaceæ.*
Calyx little or not at all imbricated
Stamens perigynous; calyx tubular . } *Lythraceæ.*
Stamens hypogynous; calyx many-leaved. } *Humiriaceæ.*

II. Stamens fewer than 20 (Oligandrous).

A. Ovary wholly or partly inferior
a. Stipules present
Placentas parietal . . . . . *Homaliaceæ.*
Placentas in the centre
Flowers unisexual . . . . *Begoniaceæ.*
Flowers hermaphrodite
Stamens opposite petals . . *Rhamnaceæ.*
Stamens alternate with petals
Leaves opposite . . . *Rhizophoraceæ.*
Leaves alternate . . . *Hamamelidaceæ.*
b. Stipules absent
Placentas parietal
Flowers unisexual . . . . *Cucurbitaceæ.*
Flowers hermaphrodite . . . *Grossulaceæ.*
Placentas in the centre
Flowers in umbels; styles 2 . . *Umbelliferæ.*
Flowers in umbels; styles 3 . . *Araliaceæ.*
Flowers not in umbels
Carpels solitary
Petals strap-shaped; stamens distinct . . . . . } *Alangiaceæ. (Nyssaceæ.)*
Petals very narrow; stamens growing on them } *Loranthaceæ.*
Petals oblong; leaves hispid
Cotyledons convolute . *Combretaceæ.*
Cotyledons flat . . *Haloragaceæ.*
Petals oblong; leaves balsamic *Anacardiaceæ.*
Carpels divaricating
Leaves alternate: herbs . *Saxifragaceæ.*
Leaves opposite: shrubs . *Hydrangeaceæ.*
Carpels parallel, combined
Calyx valvate; petals opposite stamens . . . } *Rhamnaceæ.*
Calyx valvate; petals alternate with stamens
Albumen none . . *Onagraceæ.*
Albumen copious . . *Cornaceæ.*
Calyx not valvate
Stamens doubled . . *Melastomaceæ.*
Stamens curved
Leaves dotted . . *Myrtaceæ.*
Leaves not dotted
Parts of flower 4
Ovules ascending *Onagraceæ.*
Ovules pendulous *Haloragaceæ.*
Parts of flower not 4; seeds many
Leafy . . *Escalloniaceæ.*
Scaly . . *Monotropaceæ.*
Parts of flower not 4; seeds few . } *Bruniaceæ.*

B. Ovary wholly superior
a. Leaves stipulate
1. Carpels distinct or solitary
Anthers with recurved valves . *Berberidaceæ.*
Anthers with longitudinal valves
Style from the base of the carpel *Chrysobalanaceæ.*
Style from apex of carpel; fruit a legume . . . } *Leguminosæ.*
Style from apex of carpel; fruit a drupe or capsule . } *Rosaceæ.*
2. Carpels wholly combined
Placentas parietal
Flowers with appendages . *Passifloraceæ.*
Flowers without appendages
Leaves with round and oblong transparent dots . } *Samydaceæ.*
Leaves dotless, circinate when young . . } *Droseraceæ.*

Leaves dotless, straight when young; fruit capsular . . . . } *Violaceæ.*
Leaves dotless, straight when young; fruit siliquose . . . } *Moringaceæ.*
Placentas central
Styles distinct
Calyx in a broken whorl . *Elatinaceæ.*
Calyx in a complete whorl
Flowers unisexual . *Euphorbiaceæ.*
Flowers hermaphrodite
Petals minute . *Illecebraceæ.*
Petals large; stamens hypogynous . . } *Malpighiaceæ.*
Petals large; stamens perigynous; leaves opposite . . } *Cunoniaceæ.*
Petals large; stamens perigynous; leaves alternate . . } *Saxifragaceæ.*
Calyx valvate . . . *Tiliaceæ.*
Styles more or less combined, gynobasic
Gynobase fleshy . . *Ochnaceæ.*
Gynobase dry; leaves opposite . . . } *Zygophyllaceæ.*
Gynobase dry; leaves alternate
Fruit beaked . . *Geraniaceæ.*
Fruit not beaked . . *Oxalidaceæ.*
Styles more or less combined, not gynobasic
Calyx in a broken whorl
Flowers spurred . . *Vochyaceæ.*
Flowers not spurred, calyculate . . . } *Chlænaceæ.*
Flowers not spurred, naked *Sapindaceæ.*
Calyx in a complete whorl
Leaves compound; sepals more than 2 . . } *Staphyleaceæ.*
Leaves simple; sepals about 2 . . . } *Malpighiaceæ.*
Leaves simple; sepals 2. *Portulacaceæ.*
Calyx valvate or open
Stamens columnar . *Sterculiaceæ.*
Stamens not columnar
Stamens opposite petals
Perigynous . . *Rhamnaceæ.*
Hypogynous . . *Vitaceæ.*
Stamens alternate with petals
Anthers porous . *Tiliaceæ.*
Anthers slit; petals split . . . } *Chailletiaceæ.*
Anthers slit; petals undivided . . } *Amyridaceæ.*
b. Stipules absent
1. Carpels distinct or solitary
Anther-valves recurved. . . *Berberidaceæ.*
Anther-valves longitudinal
Fruit a legume; radicle next hilum . . . . . } *Leguminosæ.*
Fruit a legume; radicle away from hilum . . . . } *Connaraceæ.*
Fruit not leguminous
Carpels with 1 scale . . *Crassulaceæ.*
Carpels with two scales . *Francoaceæ.*
Carpels without scales
Albumen abundant; embryo minute
Flowers unisexual . *Lardizabalaceæ.*
Flowers hermaphrodite
Embryo in vitellus *Cabombaceæ.*
Embryo naked
Albumen solid *Ranunculaceæ.*
Albumen ruminate . } *Anonaceæ.*
Albumen small or none
Carpels several
Enclosed . . *Calycanthaceæ.*
Naked . . *Menispermaceæ.*
Carpels solitary
Leaves dotted . *Amyridaceæ.*
Leaves dotless . *Anacardiaceæ.*
2. Carpels combined into a solid pistil
Placentas parietal
Stamens tetradynamous . *Cruciferæ.*

- Stamens not tetradynamous
  - Flowers with sterile stamens
    - Stamens and pistils on distinct flowers
      - Pistil-flower crowned . . . *Pangiaceæ.*
      - Pistil-flower not crowned . . . *Papayaceæ.*
    - Stamens and pistils together; placentæ lining the fruit . . . *Flacourtiaceæ.*
    - Stamens and pistils together; placentæ in rows . . . *Malesherbiaceæ.*
  - Flowers without sterile stamens
    - Disk of flower large; stamens indefinite . . . *Capparidaceæ.*
    - Disk of flower large; stamens definite . . . *Resedaceæ.*
    - Disk of flower small or none
      - Albumen large . . . *Papaveraceæ.*
      - Albumen small
        - Calyx 5-leaved . . . *Turneraceæ.*
        - Calyx tubular . . . *Frankeniaceæ.*
- Placentas covering dissepiments . . . *Nymphæaceæ.*
- Placentas central
  - Styles distinct
    - Calyx valvate . . . *Vivianaceæ.*
    - Calyx in a broken whorl
      - Seeds hairy . . . *Reaumuriaceæ.*
      - Seeds smooth; stamens polyadelphous . . . *Hypericaceæ.*
      - Seeds smooth; stamens monadelphous, or free . . . *Linaceæ.*
    - Calyx in a complete whorl
      - Carpels with a scale . . . *Crassulaceæ.*
      - Carpels without scales
        - Carpels divaricating . . . *Saxifragaceæ.*
        - Carpels not divaricating . . . *Caryophyllaceæ.*
  - Styles united, gynobasic
    - Stamens arising from scales . . . *Simarubaceæ.*
    - Stamens not arising from scales
      - Styles combined; flowers hermaphrodite . . . *Rutaceæ.*
      - Styles combined; flowers unisexual . . . *Xanthoxylaceæ.*
      - Styles divided; flowers irregular . . . *Balsaminaceæ.*
  - Styles united, not gynobasic
    - Calyx in a broken whorl
      - Flowers symmetrical . . . *Clusiaceæ.*
      - Flowers unsymmetrical
        - Flowers regular
          - Petals without appendages . . . *Aceraceæ.*
          - Petals with appendages . . . *Sapindaceæ.*
        - Flowers papilionaceous . . . *Polygalaceæ.*
    - Calyx in a complete whorl
      - Carpels 4 or more; anthers porous
        - Embryo in the axis . . . *Ericaceæ.*
        - Embryo at the base . . . *Pyrolaceæ.*
      - Carpels 4 or more; anthers slit
        - Seeds winged
          - Leafy . . . *Cedrelaceæ.*
          - Scaly . . . *Monotropaceæ.*
        - Seeds wingless
          - Stamens united . . . *Meliaceæ.*
          - Stamens free
            - Leaves dotted . . . *Aurantiaceæ.*
            - Leaves dotless
              - Leafy . . . *Brexiaceæ.*
              - Scaly . . . *Monotropaceæ.*
      - Carpels fewer than 4
        - Flowers unisexual . . . *Empetraceæ.*
        - Flowers hermaphrodite
          - Sepals 2 . . . *Portulacaceæ.*
          - Sepals above 2
            - Stamens hypogynous
              - Seeds comose . . . *Tamaricaceæ.*
              - Seeds naked
                - Ovules ascending . . . *Pittosporaceæ.*
                - Ovules pendulous . . . *Cyrillaceæ.*
            - Stamens perigynous
              - Ovules ascending . . . *Celastraceæ.*
              - Ovules suspended . . . *Bruniaceæ.*
    - Calyx valvate or open
      - Anthers porous . . . *Tremandraceæ.*
      - Anthers slit
        - Stamens opposite petals . . . *Rhamnaceæ.*
        - Stamens alternate to petals
          - Leaves pinnate . . . *Amyridaceæ.*
          - Leaves simple; calyx tubular; stamens hypogynous . . . *Olacaceæ.*
          - Leaves simple; calyx tubular; stamens perigynous . . . *Lythraceæ.*

Sub-Class, MONOPETALÆ. (Petals united into a Tube).

I. Ovary superior.

- A. Flowers regular
  - *a.* 3- 4- 5-lobed
    - Leaves dotted . . . *Rutaceæ.*
    - Leaves dotless
      - Inflorescence gyrate . . . *Boraginaceæ.*
      - Inflorescence straight
        - Corolla plaited in æstivation . . . *Nolanaceæ.*
        - Corolla flat in æstivation . . . *Stackhousiaceæ.*
  - *b.* Ovary not lobed
    - Carpels 4 or 5, or none
      - Anthers porous
        - Seeds winged . . . *Pyrolaceæ.*
        - Seeds wingless
          - Anthers biporous . . . *Ericaceæ.*
          - Anthers uniporous . . . *Epacridaceæ.*
      - Anthers slit
        - Stamens opposite petals
          - Shrubs . . . *Myrsinaceæ.*
          - Herbs . . . *Primulaceæ.*
        - Stamens not opposite petals
          - Seeds numerous
            - Carpels distinct . . . *Crassulaceæ.*
            - Carpels combined . . . *Monotropaceæ.*
          - Seeds few
            - Carpels distinct . . . *Anonaceæ.*
            - Carpels combined
              - Ovules erect
                - Æstivation imbricate *Sapotaceæ.*
                - Æstivation plicate *Convolvulaceæ.*
              - Ovules pendulous
                - Number of stamens same as petals . . . *Aquifoliaceæ.*
                - Number of stamens double petals . . . *Ebenaceæ.*
    - Carpels usually 3
      - Inflorescence gyrate . . . *Hydrophyllaceæ.*
      - Inflorescence straight
        - Flowers unisexual . . . *Papayaceæ.*
        - Flowers hermaphrodite
          - An hypogynous disk . . . *Polemoniaceæ.*
          - No hypogynous disk . . . *Diapensiaceæ.*
    - Carpels 2
      - Stamens 2
        - Corolla valvate . . . *Oleaceæ.*
        - Corolla imbricate . . . *Jasminaceæ.*
      - Stamens 4
        - Inflorescence gyrate
          - Fruit 1-celled . . . *Hydrophyllaceæ.*
          - Fruit 2-celled
            - Style bifid . . . *Ehretiaceæ.*
            - Style dichotomous . . . *Cordiaceæ.*
        - Inflorescence straight
          - Calyx in a broken whorl
            - Leafy . . . *Convolvulaceæ.*
            - Scaly . . . *Cuscutaceæ.*
          - Calyx in a complete whorl
            - Flowers symmetrical
              - Carpels ⬭ . . . *Solanaceæ.*

Carpels ()
Anthers and stigma united . } *Asclepiadaceæ.*
Anthers and stigma separate
Corolla imbricate . } *Gentianaceæ.*
Corolla valvate *Loganiaceæ.*
Corolla contorted . } *Apocynaceæ.*
Flowers unsymmetrical
Stipules . . . *Loganiaceæ.*
No stipules . . *Stilbaceæ.*
Carpel single
Stigma simple
Style 1
Fruit spuriously 2-celled . *Plantaginaceæ.*
Fruit 1-celled; seed 1 . . *Salvadoraceæ.*
Styles 5 . . . . . *Plumbaginaceæ.*
Stigma indusiate . . . . *Brunoniaceæ.*
B. Flowers irregular
a. Ovary 4-lobed . . . . . { *Lamiaceæ.* (*Labiatæ.*)
b. Ovary undivided
Carpel solitary . . . . . *Selaginaceæ.*
Carpels 2
Fruit capsular or succulent
Placentas parietal
Seeds amygdaloid
Fruit succulent, many-seeded . . . . } *Crescentiaceæ.*
Fruit bony, few-seeded . *Pedaliaceæ.*
Seeds not amygdaloid
Leafy
Seeds winged . . *Bignoniaceæ.*
Seeds wingless . . *Gesneraceæ.*
Scaly . . . . *Orobanchaceæ.*
Placentas in centre
Albumen large . . . *Scrophulariaceæ.*
Albumen none
Seeds winged . . . *Bignoniaceæ.*
Seeds wingless . . *Acanthaceæ.*
Placentas free, central . . *Lentibulariaceæ.*
Fruit nucamentaceous, 2-celled
Anthers 1-celled . . . *Selaginaceæ.*
Anthers 2-celled . . . *Stilbaceæ.*
Fruit nucamentaceous, 4-celled
Radicle inferior . . . *Verbenaceæ.*
Radicle superior . . . *Myoporaceæ.*

II. Ovary inferior.

A. Carpel single
Anthers united
Ovule pendulous . . . . . . *Calyceraceæ.*
Ovule erect . . . . *Compositæ.*
Anthers free
Carpel 1 . . . . *Dipsaceæ.*
Carpels 3, 2 abortive . . . . *Valerianaceæ.*
B. Carpels more than 1
Anthers united . . . . *Lobeliaceæ.*
Anthers free
Stamens 2 . . . . *Columelliaceæ.*
Stamens more than 2
Anthers porous . . . . . *Vacciniaceæ.*
Anthers slit
Stigma naked
Stamens 4, 5 . . . . . *Campanulaceæ.*
Stamens numerous . . . . *Belvisiaceæ.*
Anthers and stigmas united . *Stylidiaceæ.*
Stigma indusiate . . . *Goodeniaceæ.*
Stigma simple .
Stipules . . . . *Cinchonaceæ.*
Without stipules
Leaves opposite
Stem square . *Galiaceæ.*
Stem round . *Caprifoliaceæ.*

Sub-Class, Apetalæ, or Incompletæ. (Without Petals, sometimes without Calyx.)

I. Without a Calyx (Achlamydeæ).

A. Stipules present
Ovules numerous . . . . . . *Balsamifluæ.*
Seeds winged . . . . *Salicaceæ.*
Seeds comose
Ovules solitary or very few
Flowers with stamens and pistils
Stamens unilateral . . . . . *Chloranthaceæ.*
Stamens whorled . . . . . *Saururaceæ.*

Flowers unisexual
Carpel solitary; ovules erect . *Myricaceæ.*
Carpel solitary; ovules pendulous *Platanaceæ.*
Carpels tricoccous . . . *Euphorbiaceæ.*
B. Stipules absent
Ovules very numerous . . . *Podostemaceæ.*
Ovules single or few
Flowers hermaphrodite
Embryo in vitellus . . . . *Piperaceæ.*
Embryo without vitellus . . . *Oleaceæ.*
Flowers unisexual
Flowers naked; carpel single . . *Myricaceæ.*
Flowers naked; carpel double . . *Callitrichaceæ.*
Flowers covered; anther-valves recurved . . . . . } *Atherospermaceæ.* (*Calycanthaceæ.*)
Flowers covered; anther-valves slit . *Monimiaceæ.*

II. Calyx present (Monochlamydæ).

A. Ovary inferior
a. Stipules present
Flowers with stamens and pistils . *Aristolochiaceæ.*
Flowers unisexual; fruit in a cup . *Corylaceæ.*
Flowers unisexual; fruit naked
Many-seeded . . . . . *Begoniaceæ.*
1-seeded . . . . *Artocarpaceæ.*
b. Stipules absent
Flowers unisexual, in catkins
Leaves simple, alternate . . . *Myricaceæ.*
Leaves simple, opposite . . . *Garryaceæ.*
Leaves compound . . . . *Juglandaceæ.*
Flowers unisexual, not in catkins
Seeds in a pulp . . . . *Cucurbitaceæ.*
Seeds dry
Numerous . . . . . . *Datiscaceæ.*
Solitary . . . . . . *Helwingiaceæ.*
Flowers hermaphrodite
Leaves dotted . . . . . *Myrtaceæ.*
Leaves not dotted
Ovary 3- 6-celled . . . *Aristolochiaceæ.*
Ovary 1-celled
Embryo straight; cotyledons convoluted . . . } *Combretaceæ.*
Embryo straight; cotyledons flat
Albumen absent . . *Haloragaceæ.*
Albumen fleshy . . *Santalaceæ.*
Embryo curved . . . *Chenopodiaceæ.*
Ovary 1-celled; anthers many-celled . . . . . } *Loranthaceæ.*
Ovary more than 1, but not 3 or 6-celled
Embryo straight . . . *Haloragaceæ.*
Embryo curved . . . *Tetragoniaceæ.*
B. Ovary superior
a. Stipules absent
Flowers hermaphrodite
Sepals 2 . . . . *Portulacaceæ.*
Sepals more than 2
Carpels several, united
Placentas parietal, in lines . *Papaveraceæ.*
Placentas parietal, diffused . *Flacourtiaceæ.*
Placentas in centre
Ovules few
Calyx short, with a gynobase . . } *Rutaceæ.*
Calyx short, no gynobase
Embryo curved . *Phytolaccaceæ.*
Embryo straight . *Celastraceæ.*
Calyx tubular . . *Penæaceæ.*
Ovules numerous
Carpels 2, divaricating *Saxifragaceæ.*
Carpels not divaricating; stamens hypogynous
Leaves opposite . *Caryophyllaceæ.*
Leaves alternate . *Podostemaceæ.*
Carpels not divaricating; stamens perigynous
Fruit 1-celled . *Primulaceæ.*
Fruit many-celled *Lythraceæ.*
Carpels solitary or separate
Carpels several . *Ranunculaceæ.*
Carpel single
Anther - valves recurved, leafy } *Lauraceæ.*

- Anther-valves recurved, scaly . . . . *Cassythaceæ.*
- Anther-valves slit
  - Fruit a legume . . *Leguminosæ.*
  - Fruit not a legume
    - Calyx long or tubular
      - Base hardened . *Nyctaginaceæ.*
      - Tube hardened . *Scleranthaceæ.*
      - Not hardened
        - Stamens embedded in sepals . . *Proteaceæ.*
        - Stamens not so
          - Ovules erect . *Elæagnaceæ.*
          - Ovules pendulous
            - Fruit 2-valved *Aquilariaceæ.*
            - Fruit indehiscent . . *Thymelaceæ.*
    - Calyx short
      - Leaves with scales . *Elæagnaceæ.*
      - Leaves dotted . *Amyridaceæ.*
      - Leaves smooth
        - Flowers in involucels *Polygonaceæ.*
        - Flowers naked
          - Calyx dry . *Amarantaceæ.*
          - Calyx herbaceous
            - Stamens hypogynous . *Chenopodiaceæ.*
            - Stamens perigynous . *Basellaceæ.* (*Chenopodiaceæ.*)
- Flowers unisexual
  - Carpels several, united
    - Ovules numerous
      - Stamens columnar . . *Nepenthaceæ.*
    - Ovules few
      - Leaves alternate
        - Dotted . . . . *Xanthoxylaceæ.*
        - Not dotted . . . *Euphorbiaceæ.*
  - Carpel solitary
    - Calyx tubular . . . . *Myristicaceæ.*
    - Calyx open
      - Carpels several . . . *Menispermaceæ.*
      - Carpel solitary
        - Embryo straight . . *Casuarinaceæ.*
        - Embryo curved . . *Chenopodiaceæ.*

b. Stipules present

- Flowers hermaphrodite
  - Sepals 2 . . . . . . *Portulacaceæ.*
  - Sepals more than 2
    - Carpels several, united
      - Stamens hypogynous
        - Placentas parietal . . *Flacourtiaceæ.*
        - Placentas central
          - Calyx valvate; stamens monadelphous
            - Partly sterile . *Byttneriaceæ.*
            - All fertile . . *Sterculiaceæ.*
          - Calyx valvate; stamens distinct . . *Tiliaceæ.*
          - Calyx imbricated
            - Fruit beaked . *Geraniaceæ.*
            - Not beaked . . *Malpighiaceæ.*
      - Stamens perigynous
        - Placentas parietal . . *Passifloraceæ.*
        - Placentas central
          - Leaves opposite . *Cunoniaceæ.*
          - Leaves alternate
            - Stamens alternate to sepals . . *Rhamnaceæ.*
            - Calyx membranous . *Ulmaceæ.*
    - Carpels solitary or separate
      - Calyx membranous . . *Illecebraceæ.*
      - Calyx herbaceous
        - Styles basal . . . *Chrysobalanaceæ.*
        - Styles terminal, 1 to an ovary
          - Fruit a legume . . *Leguminosæ.*
          - Fruit not a legume . *Sanguisorbaceæ.*
        - Styles terminal, 3 to an ovary
          - Stipules ochreate . . *Polygonaceæ.*
          - Stipules simple . . *Phytolaccaceæ.*
- Flowers unisexual
  - Carpels several, united
    - Flowers in catkins
      - Aril present . . . *Scepaceæ.*
      - No aril . . . . *Betulaceæ.*
        - Seeds numerous . . *Lacistemaceæ.*
    - Flowers not in catkins . . *Euphorbiaceæ.*

- Carpel solitary
  - Cells of anthers perpendicular to filament . . . . *Stilaginaceæ.*
  - Cells of anthers parallel to filament
    - Embryo straight
      - Albumen present . . *Urticaceæ.*
      - No albumen . . . *Artocarpaceæ.*
    - Embryo hooked
      - Albumen present . . *Moraceæ.*
      - Albumen none . . *Cannabinaceæ.*

Sub-Class, DICTYOGENS (Lindley).

- Ovary inferior . . . . *Dioscoreaceæ.*
- Ovary superior
  - Carpels distinct . . . . . . *Triuridaceæ.*
  - Carpels united
    - Placentas central
      - Flowers 6-petalled . . . . *Smilaceæ.*
      - Flowers 3-petalled . . . . *Trilliaceæ.*
    - Placentas below . . . . . *Roxburghiaceæ.*
    - Placentas on the sides . . . . *Philesiaceæ.*

Sub-Class, GYMNOGENS (Lindley).

- Stem jointed . . . . *Gnetaceæ.*
- Stem continuous
  - Leaves pinnate . . . . . . *Cycadaceæ.*
  - Leaves simple
    - Ovules in cones . . . . . . *Pinaceæ.* (*Coniferæ.*)
    - Ovules solitary . . . . . . *Taxaceæ.*

Class, ENDOGENS.

I. Flowers complete (having distinct Floral Envelopes).

- A. Ovary inferior
  - Flowers gynandrous . . . . . *Orchidaceæ.*
  - Flowers not gynandrous
    - Veins of leaves diverging from the midrib
      - Anther 1, with 1 cell . . . . *Marantaceæ.*
      - Anther 1, with 2 cells . . . *Zingiberaceæ.*
      - Anthers 5 or 6 . . . . . *Musaceæ.*
    - Veins of leaves parallel with midribs
      - Stamens 3
        - Anthers turned outwards . . *Iridaceæ.*
        - Anthers turned inwards . . *Burmanniaceæ.*
      - Stamens 6
        - Leaves flat
          - Fruit 3-celled; sepals corolla-like
            - Radicle remote from hilum *Hypoxidaceæ.*
            - Radicle next hilum . . *Amaryllidaceæ.*
          - Fruit 3-celled; sepals calycine *Bromeliaceæ.*
          - Fruit 1-celled . . . . *Taccaceæ.*
        - Leaves equitant . . . . *Hæmodoraceæ.*
      - Stamens more than 6 . . . *Hydrocharaceæ.*
- B. Ovary superior
  - Sepals calyx-like or glumaceous
    - Carpels separate, more or less
      - Placentas diffused . . . . *Butomaceæ.*
      - Placentas narrow . . . . *Alismaceæ.*
    - Carpels in a solid pistil
      - Petals distinct from calyx
        - Placentas central . . . *Commelinaceæ.*
        - Placentas parietal . . . *Mayaceæ.*
      - Petals not distinct from calyx
        - Flowers scattered . . . *Juncaceæ.*
        - Flowers spadicose . . . *Orontiaceæ.*
  - Sepals corolla-like
    - Carpels more or less separate
      - Seed solitary . . . . . *Palmaceæ.*
      - Seeds numerous
        - Anthers turned outwards . . *Melanthaceæ.*
        - Anthers turned inwards
          - Parts of flower 6 . . . *Butomaceæ.*
          - Parts of flower 2 . . . *Philydraceæ.*
    - Carpels combined
      - Petals rolled inwards . . . *Pontederaceæ.*
      - Petals not rolled inwards
        - Flowers with appendages . . *Gilliesiaceæ.*
        - Flowers without appendages . *Liliaceæ.*

II. Flowers incomplete (Floral Envelopes not distinct).

- A. Flowers in glumes
  - Stems hollow . . . . . . *Graminaceæ.*
  - Stems solid
    - Carpel solitary; seed erect . . . *Cyperaceæ.*
    - Carpel solitary; seed pendulous . . *Restiaceæ.*
    - Carpels several, distinct
      - Glumes only . . . . . *Desvauxiaceæ.*

Cup within glumes	*Eriocaulaceæ.*
Carpels several, combined	
Placentas parietal	*Xyridaceæ.*
Placentas central	*Restiaceæ.*
B. Flowers, or with a few verticillate leaves	
a. Flowers on a spadix	
Fruit a drupe	*Pandanaceæ.*
Fruit berried; leaves in bud, convolute	*Araceæ.*
Fruit dry; anthers clavate, on weak filaments	*Typhaceæ.*
b. Flowers not on a spadix	
Aquatic, with pendulous ovules	
Pollen globose	*Naiadaceæ.*
Pollen confervoid	*Zosteraceæ.*
Terrestrial; ovules erect	*Juncaginaceæ.*
Aquatic; ovules erect	*Pistiaceæ.*

Sub-Class Rhizogens (Rhizanthæ).

Ovules indefinite	
Anthers opening by slits	*Cytinaceæ.*
Anthers bursting by pores	*Rafflesiaceæ.*
Ovules solitary	*Balanophoraceæ.*

Class, ACROGENS.

I. With Stems.

A. No distinct axis of growth	
Spores without elaters	*Ricciaceæ.*
Spores with elaters	
Spore-case with valves	*Jungermanniaceæ.*
Spore-case valveless	*Marchantiaceæ.*
B. A distinct axis of growth	
Spores with elaters	
Spore-case with valves	*Jungermanniaceæ.*
Spore-case in cones	*Equisetaceæ.*
Spores without elaters	
Spore-case on fronds	
Ringed	*Polypodiaceæ.*
Ringless	*Danæaceæ.*
Spore-case on edge of frond	*Ophioglossaceæ.*
Spore-case in an involucre	*Marsileaceæ.*
Spore-case naked	
Sessile in the axil of frond	*Lycopodiaceæ.*
Stalked	
Valves	*Andræaceæ.* (*Musci.*)
Without valves	*Bryaceæ.* (*Musci.*)

II. Without Stems.

Mycelium present	
Spores in fours	
Hymenium naked	*Agaricaceæ.* (*Fungi.*)
Hymenium inclosed	*Lycoperdaceæ.*
Spore-case single	
Sporules naked	
Thallus obsolete	*Uredinaceæ.*
Thallus floccose	*Botrytaceæ.*
Sporules inclosed	
In asci	*Helvellaceæ.*
In a veil	*Mucoraceæ.*
Mycelium absent	
Aquatic	
Crystalline	*Diatomaceæ.*
Cellular or membranous	
Fresh-water chiefly	
Multiplied by zoospores	*Confervaceæ.*
Multiplied by spiral nucules	*Characeæ.*
Salt-water	
Multiplied by simple spores	*Fucaceæ.*
Multiplied by tetraspores	*Ceramiaceæ.*
Terrestrial	
Spores naked	*Graphidaceæ.*
Spores in asci	
Thallus gelatinous	*Collemaceæ.*
Thallus pulverulent	*Parmeliaceæ.*

It will be seen that many of the orders are repeated in this analysis under different divisions; and this arises from the fact that this analysis is artificial, and only expresses the general characters of each order. Besides this, in the strongest orders, exceptions to some very general points of structure frequently occur. Thus we have apetalous and irregular-flowered plants in the polypetalous regular-flowered order *Ranunculaceæ*. With a little practice such an analysis as the foregoing will enable any one acquainted with the structure of plants to refer any particular plant to its right order, and on turning to the order in the alphabetical part of this work he will find a detailed account of its structure and properties.

Before concluding this general article it may not be uninteresting just to glance at the steps by which the Science of Botany, more particularly the systematic department, has attained its present position. In doing this we shall confine ourselves to a mere sketch of the progress that has been made in elucidating the great principles of Botany by which its rank as a branch of philosophy is to be determined.

It is obvious, from various passages in the most ancient writers, that the art of distinguishing certain plants having medical virtues was taught at the earliest period of which we have any written record; and that the cultivation of something more than corn was already understood in the Homeric days, is sufficiently attested by the references to the vineyards of Laërtes and the gardens of Alcinous, and by the employment assigned to Lycaon, the son of Priam, of pruning figs in his father's garden.

The earliest tangible evidence that we possess of the real state of knowledge upon this subject is afforded by the remains of the writings of Aristotle and his school. From the absurd superstitions of the root-cutters (*rhizotomi*) of this period, it might be imagined that at this time botany was far from having any real existence; for it is to them that we have to trace the belief in the necessity of magical ceremonies and personal purification or preparation in collecting herbs: some sorts they tell us are to be cut against the wind, others after the body of the rhizotomist has been well oiled, some at night, some by day. Alliaceous food was a necessary preparation for procuring this herb, a draught of wine for that, and so on. But in fact at this very time the Peripatetic philosophers were in possession of a considerable mass of correct information concerning the nature of vegetable life, mixed up indeed with much that was fanciful and hypothetical, but calculated to give us a high opinion of their acuteness and of the amount of positive knowledge upon such subjects which had by that time been collected. It is by this school that botany must be considered to have been first formed into a science. Aristotle, in all probability, was its founder; for it is obvious, from the remarks upon plants scattered through his books concerning animals, that his knowledge of vegetable physiology was for his day of a most remarkable kind. But as the books immediately concerning plants ascribed to this philosopher are undoubted forgeries, it will be more convenient to take the works of Theophrastus as our principal guide to a determination of the state of botany at the commencement of this—

The First Era.—At the time when Theophrastus succeeded to the the chair of Aristotle (B.C. 324) no idea seems to have existed of classification, nor indeed was its necessity by any means apparent, for Theophrastus does not appear to have been acquainted with above 355 plants in all. In the application of their names, even to these, there was so much uncertainty, that the labours of commentators must be to a great extent bestowed in vain in endeavouring to elucidate them: for instance, Sprengel asserts that the name Aphake is applied indifferently to the dandelion and to a kind of vetch (*Lathyrus aphaca*), and Scorpios to a species of broom, to *Arnica Scorpioides*, and to a kind of ranunculus. But while Theophrastus was thus careless in his denominations of species, he has the great credit of having attended accurately to differences in the organs of plants, to some of which he gave new and special names; the form of leaves, their margin, the manner of their indentation, and the nature of the leaf-stalk, especially attracted his attention. He distinguished naked-seeded from capsular plants, and he demonstrated the absence of all philosophical distinction between trees, shrubs, and herbs, for he saw that myrtle-trees would degenerate into shrubs, and certain oleraceous plants become arborescent. Cellular tissue is spoken of as a sort of flesh interposed between the woody tissue or vegetable fibre; and even spiral vessels appear to be indicated under the name of *Ives*; leaves are correctly said to have their veins composed both of woody tissue and spiral vessels, and the parallelism of the veins of grasses is particularly pointed out; palm-wood is shown to be extremely different from that of trees with concentric layers; bark is correctly divided into liber and cortical integument, and the loss of the former is said to be usually destructive of life. The nutritive properties of leaves are clearly pointed out, and the power which both surfaces possess of absorbing atmospheric nourishment. Some notion appears to have existed of the sexes of plants, contrary to the opinion of Aristotle, who denied them to the vegetable kingdom. In particular Theophrastus speaks of the necessity of bringing the male dates into contact with the females, a fact which had been stated quite as clearly by Herodotus (i. 193) 100 years before; but it is plain that he had no correct idea upon this subject, for in another place he compares the male catkins of the hazel to the galls of the Kermes oak.

These points are abundantly sufficient to show that among the Peripatetics a considerable amount of tolerably exact knowledge of botany really existed, and that a solid foundation had been laid for their successors.

And in fact it appears that the impulse they gave to investigation did for some considerable time afterwards produce a perceptible effect; for by the time of Pliny it is evident that a considerable addition had been made to the stock of botanical knowledge. It is true that it was much disfigured by the poets, who then as now appear to have had only a smattering of the science of their day; but it is incredible that they should have been able to glean that smattering out of any other field than a very rich one. For example, the sexuality of plants, which Aristotle had denied, which Theophrastus had adverted to, is spoken of in positive terms; grafting, in more ways than one, and even budding, are spoken of in language which is remarkably precise for the words of a poet; and although to these operations were attributed powers which they did not possess, yet it is abundantly plain that the processes were thoroughly understood. The

"Angustus in ipso
Fit nodo sinus; huc aliena ex arbore germen
Includunt udoque docent inolescere libro,"

is as correct a description of the operation called budding as any modern could give in so many words; and it is impossible that such an operation should ever have been devised without a much more large and accurate knowledge of vegetable physiology than it is generally believed that the ancients possessed.

From this time forward all inquiry into matters of science began to decline. Under the later Roman emperors science became gradually extinguished; under the Byzantine princes it can scarcely be said to have been preserved; and the little attention it subsequently received from a few obscure writers rather hastened than arrested its downfall.

Upon the revival of science in Europe the writings of the classical and Arabian herbalists were taken as the text-books of the schools, but their errors were multiplied by false translations, their superstitions were admitted without question; and so little was added by the monkish authors, that between the time of Ebn Beithar, who flourished in the 13th century, and the year 1532, when the 'Herbarum Vivæ Eicones' of Otho Brunfels, a Bernese physician, made their appearance, scarcely a single addition had been made to the slender stock of knowledge of about 1400 species, which are computed by Sprengel to have formed the total amount discovered by all botanists, Greek, Roman, and Arabian, up to the death of Abdallatif of Baghdad. Brunsfels describes the state of botany as being in his day most deplorable, as being principally in the hands of the most ignorant persons, and as consisting of a farrago of long and idle commentaries, disfigured "by myriads of barbarous, obsolete, and ridiculous names." He deserves to be mentioned as the first reformer in this science, and as the earliest writer who earnestly endeavoured to purify the corrupted streams which had flowed through so many ages of barbarism from the ancient Greek and Roman fountains. His example was speedily followed by Tragus, Fuchsius, Matthiolus, and others. The knowledge of species rapidly augmented, partly by the examination of indigenous plants and partly by the remarks of the earlier travellers, who about the year 1460 began to turn their attention to the vegetable kingdom; till at last their abundance became so great as to call for the assistance of compilers capable of digesting what had already begun to be scattered through numberless works. The first undertaking of the kind was by Conrad Gesner, a native of Zürich, who died in the year 1565. This excellent man spent the latter part of his life in collecting materials for a general history of plants. He is stated to have caused above 1500 drawings to be prepared for the illustration of his undertaking, but unfortunately he died before his project was executed, and his materials were afterwards dispersed. He appears however to have brought about one most important change in science, by discovering that the distinctions and true nature of plants were to be sought in their organs of reproduction rather than in those of nutrition. This was assuredly the first step that had been taken forward in the science since the fall of the Roman empire, and is abundant evidence of the great superiority of Gesner over all those who had preceded him. From this time collections of species were made by numerous writers; our countryman Turner, Dodoens, Lobel, Clusius Cæsalpinus, and the Bauhins, were the most distinguished writers between the years 1550 and 1600; and among them the number of known species was so exceedingly increased, especially by the discoveries of Clusius, that it became impossible to reduce them into any order without the adoption of some principle of classification. Hence originated the first attempts at systematical arrangement with which commences

The Second Era.—It is to Matthew Lobel, a Dutch physician residing in England in the time of Elizabeth, that the honour is to be ascribed of having been the first to strike out a method by which plants could be so arranged, that those which are most alike should be placed next to each other, or in other words, which should be an expression of their natural relations. As may be supposed this early attempt at the discovery of a natural system was exceedingly rude and imperfect; it is however remarkable for having comprehended several combinations which are recognised at the present day: *Cucurbitaceæ, Stellatæ, Gramineæ, Labiatæ, Boragineæ, Leguminosæ, Filices*, were all distinctly indicated; and it may be added, that under the name of *Asphodels* he grouped the principal part of modern petaloid monocotyledons. The reasons however why such groups were constituted were not then susceptible of definition; the true principles of classification had to be elicited by the long and patient study of succeeding ages. Among the foremost to take up this important subject was Cæsalpinus, a Roman physician attached to the court of Pope Sixtus V. This naturalist possessed a degree of insight into the science far beyond that of his age, and is memorable for the justness with which he appreciated many of the less obvious circumstances which his predecessors had overlooked. For example, he was aware of the circulation of the sap: he believed that its ascent from the roots was caused by heat; he knew that leaves are cortical expansions traversed by veins proceeding in part from the liber; he estimated the pith of plants at its true value, and seeds he compared to eggs, in which there exists a vital principle without life; but he denied the existence of sexes in the vegetable kingdom. Improving upon the views of Gesner, he showed how great is the value of the fructification in systematic botany; the flower he said was nothing but the wrapper of the fruit; the essential part of the seed he considered to be what is called the corculum, that is, the double cone of plumule and radicle which connects the cotyledons. In general his views of vegetable physiology were much more just than those of his predecessors, and if he did not avoid the error of supposing certain plants to be mere abortions of more perfect species, as many grasses of corn, he amply redeemed his fame by the correction of other mistakes. From differences in the fruit and the seed of plants he formed a system which, though purely artificial and never much employed, had the merit of calling attention strongly to the existence of a class of important characters which had previously been either overlooked or undervalued.

But notwithstanding the attempts thus made by a few distinguished men to elevate the science to a higher station, and to reduce it to some general principles, it still continued to languish and to remain for the most part in the hands of the most ignorant pretenders, and in no country more so than in England. We find upon the authority of the celebrated Ray, that in this country in the middle of the 17th century it was in the most lamentable state. At that time the standard book of English botanists was a publication called Gerarde's 'Herbal,' which was, as Ray tells us, the production of a man almost entirely ignorant of the learned languages, in which nevertheless all books on science were at that time written. The principal part of the work was pirated from the 'Pemptades' of Dodoens, turned into English by one Priest, and in order to conceal the plunder the arrangement of Dodoens was exchanged for that of Lobel, while the whole was made up with the wood-blocks of Tabernæmontanus's 'Kräuterbuch,' often unskilfully transposed and confounded. At last a change as sudden as it was important was produced in the science by the application of the microscope to botanical purposes.

The Third Era.—About the middle of the 17th century this instrument was first employed in the examination of the elementary organs of plants, about which nothing had been previously learned since the time of Theophrastus. The discovery of spiral vessels by Henshaw in 1661, the examination of the cellular tissue by Hook at a somewhat later date, at once excited the attention of observers and led at nearly the same time to the appearance of two works upon vegetable anatomy, which at once so nearly exhausted the subject that it can scarcely be said to have again advanced till the beginning of the present century. Grew and Malpighi, the writers here adverted to, but more especially the former, combined with rare powers of observation a degree of patience which few men have ever possessed. They each examined the anatomy of vegetation in its minutest details, the former principally in the abstract, the latter more comparatively with the animal kingdom. Various forms of cellular tissue, intercellular passages, spiral vessels, woody tubes, ducts, the nature of hairs, the true structure of wood, were made at once familiar to the botanist; the real nature of sexes in plants was demonstrated; and it is quite surprising to look back on those days from the present high ground on which botany has taken its stand, and to see how little the views of Grew at least have subsequently required correction. From him physiological botany properly speaking took its origin. Clear and distinct ideas of the true causes of vegetable phenomena gradually arose out of a consideration of the physical properties of the minute parts through whose combined action they are brought about; and a solid foundation was laid for the theories of vegetation which subsequent botanists have propounded: to Grew may also be ascribed the honour of having first pointed out the important difference between seeds with one cotyledon and those with two, and of having thus been the discoverer of the two great natural classes into which the flowering part of the vegetable kingdom is now divided. Grew however was no systematist; it was reserved for another Englishman to discover the true principles of classification, and thus to commence

The Fourth Era.—John Ray, a man of capacious mind, of singular powers of observation and of extensive learning, driven from his collegiate employments by the infamous commands of a profligate prince, sought consolation in the study of natural history, to which he had been attached from his youth. Botany he found was fast settling back into the chaos of the middle ages, partly beneath the weight of undigested materials, but more from the want of some fixed principles by which the knowledge of the day should be methodised. Profiting by the discoveries of Grew and the other vegetable anatomists, to which he added a great store of original observation, he in his 'Historia Plantarum,' the first volume of which appeared in 1686, embodied in one connected series all the facts that had been collected concerning the structure and functions of plants: to these he added an exposition of what he considered the philosophy of classification, as indicated partly by human reason and partly by experience; and from the whole he deduced a classification which is unquestionably the basis of that which, under the name of the system of Jussieu, is everywhere recognised at the present day. For proofs of this we refer to the memoir of RAY in the HIST., BIOG., &c. DIVISION. We will only observe here that he separated flowering from flowerless plants; that he divided the former into monocotyledons and dicotyledons, and that under these three heads he arranged a considerable number of groups, partly his own, partly taken from Lobel and others; which are substantially the same as what are received by botanists of the present day under the name of natural orders. It is singular enough that the merits of this arrangement of John Ray should have been so little appreciated by his contemporaries and immediate successors as to have been but little adopted; and that instead of endeavouring to correct its errors and to remove its imperfections, botanists occupied themselves for several succeeding years in attempts at discovering other systems, the greater part of which were abandoned almost as soon as they were made known. Rivinus, Magnol, Tournefort, and Linnæus were the most celebrated of these writers; but the two last alone have had any permanent reputation. Tournefort, who for a long time stood at the head of the French school of botany, proposed in 1694 a method of arrangement, in its principles entirely artificial, but which in some cases was accidentally in accordance with natural affinities. It was founded chiefly upon differences in the corolla, without the slightest reference to physiological peculiarities; and is now forgotten, except in consequence of its having furnished some useful ideas to Jussieu, as will be hereafter shown.

The Fifth Era.—Linnæus was a genius of a different and a higher order. Educated in the severe school of adversity, accustomed from his earliest youth to estimate higher than all other things verbal accuracy and a logical precision, which are often most seductive when least applicable; endowed by nature with a most brilliant understanding, and capable, from constitutional strength, of any fatigue either of mind or body, this extraordinary man was destined to produce a revolution in botany, among other branches of natural history, which in some respects advanced and in others retarded its progress far more than the acts of any one who had preceded him. He found the phraseology bad, and he improved it; the nomenclature was awkward and inconvenient, he simplified it; the distinctions of genera and species, however much the former had been improved by Tournefort, were vague and too often empirical—he defined them with an apparent rigour which the world thought admirable, but which nature spurned; he found the classifications of his day so vague and uncertain that no two persons were agreed as to their value, and for them he substituted a scheme of the most specious aspect, in which all things seemed as clearly circumscribed by rule and line as the fields in the map of an estate; he fancied he had gained the mastery over nature, that he had discovered a mighty spell that would bind her down to be dissected and anatomised, and the world believed him; in short, he seized upon all the wardrobe of creation, and his followers never doubted that the bodiless puppets which he set in action were really the divine soul and essence of the organic world. Such was Linnæus, the mighty spirit of his day. Let us do this great man that justice which exaggeration on the one hand and detraction on the other have too often refused to him, and let us view his character soberly and without prejudice. We shall then admit that no naturalist has ever been his superior; and that he richly merited that high station in science which he held for so many years. His verbal accuracy, upon which his fame greatly depends, together with the remarkable terseness of his technical language, reduced the crude matter that was stored up in the folios of his predecessors into a form that was accessible to all men. He separated with singular skill the important from the unimportant in their descriptions. He arranged their endless synonyms with a patience and lucid order that were quite inimitable. By requiring all species to be capable of a rigorous definition not exceeding twelve words, he purified botany of the endless varieties of the gardeners and herbalists; by applying the same strict principles to genera, and reducing every character to its differential terms, he got rid of all the cumbrous descriptions of the old writers. Finally, by the invention of an artificial system, every division of which was defined in the most rigorous manner, he was able so to classify all the materials thus purified and simplified that it seemed as if every one could become a botanist without more previous study than would be required to learn how to discover words in a dictionary. Add to all this the liveliness of his imagination, the skill with which he applied his botanical knowledge to practical objects, and the ingenuity he showed in turning to the purposes of his classification the newly-discovered sexes of plants, and we shall at once comprehend what it was that exalted Linnæus so far above his contemporaries. But great as the impulse undoubtedly was which Linnæus gave to botany, there were vices in his principles which although overlooked during his life have subsequently been productive of infinite evil. There is no such thing as a rigorous definition in natural history; this fact Ray had demonstrated to arise out of the very nature of things; and consequently the short phrases by which species and genera were characterised by Linnæus were found equally applicable to many other plants besides those for which they were intended: hence arose a new source of confusion, inferior only to that which it was intended to correct. Differential characters, which would be invaluable if we had all nature before us, were found in practice to lead to incessant errors, so soon as some new species was introduced into the calculation: they also laboured under the great fault of conveying no idea whatever of the general nature of the plants to which they related: thus the Portuguese botanist Loureiro, who attempted to determine the plants of China by the systematic writings of Linnæus, fell into the singular error that the hydrangea was a primrose. With regard to his artificial system of classification, it was found that it looked better in the closet than in the field; that the neatness and accuracy of the distinctions upon which it was divided into groups existed only upon paper, and that exceptions without end encumbered it at every turn. This, which is perhaps inseparable from all systematic arrangements, would not have been felt as so great an evil if there had been any secondary characters by which the primary ones could be checked, or if the system had really led with all its difficulties to a knowledge of things. But it was impossible not to perceive that it led in reality to little more than a knowledge of names, and that it could be looked upon as nothing beyond an index of genera and species.

The maxims however of Ray, and the great general views of that illustrious naturalist, were destined not to fade even before the meteoric brilliancy that surrounded the throne of Linnæus. A French botanist, Antoine Laurent de Jussieu, soon entered the field to oppose the latter. In the year 1789, just eleven years after the death of Linnæus, he produced under the name of 'Genera Plantarum' an arrangement of plants according to their natural relations, in which the principles of the great English botanist are tacitly admitted, and his fundamental divisions adopted, in combination, in part with those of Tournefort, in part with those which had been proposed by Adanson in his remarkable work on the 'Familles des Plantes,' and the rest with what are peculiar to the author himself. Jussieu possessed in a happier degree than any man that has succeeded him the art of adapting the simplicity and accuracy of the language of Linnæus to the exigencies of science, without encumbering himself with its pedantry. He knew the impossibility of employing any single characters to distinguish objects so variable in their nature as plants; and he clearly saw to what evils all artificial systems must of necessity give rise. Without pretending then to the conciseness of Linnæus in forming his generic characters, he rendered them as brief as was consistent with clearness; without peremptorily excluding all distinctions not derived from the fructification, he nevertheless made the latter the essential consideration; instead of defining his classes and orders by a few artificial marks, he formed them from a view of all the most essential parts of structure; and thus he collected under the same divisions all those plants which are most nearly allied to each other. Hence, while a knowledge of one plant does not by any means lead to that of another in the system of Linnæus, it leads directly to the knowledge of many more in the classification of Jussieu, which has accordingly gained the name of the 'Natural System.' This at once brought the science back to a healthy state; it demonstrated the possibilty of reducing the characters of natural groups to words, contrary to the opinion of Linnæus, who found that task altogether beyond his powers; it did away with the necessity of artificial arrangements, and, giving a death-blow to verbal botany, it laid the foundation of that beautiful but still imperfect superstructure which has been erected by the labours of Brown, De Candolle, Lindley, and others. If the system of Jussieu were not a return to that of Ray, modified only and improved by modern discoveries, we should certainly have taken this period for the commencement of

The Sixth and latest *Era* in our science. But it was reserved for a man whose fame lies chiefly in the literary world to effect the last great revolution that the ideas of botanists have undergone. In 1790, one year after the appearance of Jussieu's 'Genera Plantarum,' the German poet Göthe published a pamphlet called 'The Metamorphosis of Plants.' At that time the various organs of which plants consist had been pretty well ascertained, the distinctions between the leaf, the calyx, the corolla, the stamens, and the pistil were in a great measure understood, and the botanists were not a few who fancied there was nothing more to learn about them. Nevertheless even in the time of Theophrastus a notion had existed that certain forms of leaves were mere modifications of others that appeared very different, as the angular leaves in croton of the round cotyledons or seminal leaves of that plant. Linnæus himself had entertained the opinion that all the parts of a flower are mere modifications of leaves whose period of development is anticipated ('Prolepsis Plantarum'); Ludwig in 1757, and more especially Wolff in 1768, had stated in express terms that all the organs of plants are reducible to the axis and its appendages, of the latter of which the leaf is to be taken as the universal type. But the theory of Linnæus was fanciful; Ludwig was a writer of too little authority in his day to succeed in establishing a doctrine so much at variance with received opinions; and the theory of Wolff was propounded in a paper upon the formation of the intestines in animals, which seems altogether to have escaped the observation of botanists. Entirely unacquainted with the writings of the two latter naturalists, but aware of the 'Prolepsis Plantarum' of Linnæus, Göthe took up this important theory, and demonstrated that all those organs to which so many different names were applied, and which in fact have so many dissimilar functions to perform, were all modifications of one common type—the leaf; that the bract is a contracted leaf, the calyx a combination of several, the corolla a union of several more in a coloured state, the stamens contracted and coloured leaves with their parenchyma in a state of disintegration, and the pistil another arrangement of leaves rolled up and combined according to certain invariable laws.

Although at first Göthe's views were disregarded, they were gradually adopted, and formed the basis of inquiries in that department of botany called the Morphology of Plants. To no one is the science of Botany more indebted, from his early adoption of the generalisation of Göthe, than Robert Brown. In his 'Prodromus of the Flora of New Holland,' and in a multitude of papers in the 'Philosophical' and 'Linnæan Transactions,' he proved not only the truth of Göthe's law but practically demonstrated its importance. It was never with him a theory, as it was with its discoverer, but a great generalisation which every new fact in the vegetable kingdom served to confirm. Nor did he apply it to the superficial facts of the structure of plants, but working with the microscope he applied it to the development of the tissues of plants, and in every department of botany has made it to bear most abundant fruit. With the name of Brown in the modern history of botany we must also associate the name of another Englishman—Dr. Lindley, who, by his extensive knowledge of vegetable structures, his indefatigable industry, and power of generalisation, has contributed very largely to the perfection of the present classification of plants, as well as to the diffusion of sound general views on the subject of botany and its practical applications. To De Candolle also in recent times the progress of botany is deeply indebted, more especially for his laborious 'Prodromus of the Vegetable Kingdom,' in which not only are the orders described, but the genera and species. We can only add that in recent times the science of Botany has been indebted to the labours of the following amongst other observers:—Schleiden, Richard, Brongniart, Tulasne, Unger, Endlicher, Schacht, Von Mohl, Bischoff, Treviranus, Lehmann, Suminski, Hoffmeister, Sir W. J. Hooker, J. D. Hooker, Henfrey, Bentham, Walker Arnott, Wright, Wallich, Royle, Balfour, Babington, Leighton, Miers, J. J. Bennett, T. Thomson, Asa Gray, Henslow, Berkeley.

In order to facilitate the study of Botany by the aid of this work, we give the following Glossary of the terms employed when describing the parts of plants.

A GLOSSARY OF THE TECHNICAL TERMS MOST COMMONLY EMPLOYED IN BOTANY.

Abnormal, contrary to general rules.
Accumbent, lying against anything, in distinction to lying upon; as the cotyledons of some cruciferous plants.
Acerose, stiff and slender and sharp-pointed, as the leaves of a pine-tree.
Achenium, a small, hard, one-seeded fruit, resembling a seed.
Aciculate, needle-shaped.
Acinaciform, scymitar-shaped.
Acinus, a bunch of succulent berries; as of grapes.
Acrogen, a plant which grows at its end only, without increasing in diameter; as ferns, and all flowerless plants.
Aculeate, covered with prickles.
Aculeus, a prickle.
Acuminate, tapering to the point, but flat.
Adnate, growing to anything by the whole length.
Adventitious, appearing accidentally.
Æstivation, the arrangement of the parts of the flower before they expand.
Alabastrus, a flower-bud.
Albumen, a substance interposed in some seeds between the embryo and the seed coats.
Alburnum, the young wood; sap-wood.
Amentum, a catkin; the male inflorescence of the hazel, &c.
Amplexicaul, clasping a stem.
Anastomosing, the growing together of two parts which meet from different directions.
Androus, a Greek termination expressive of the male sex.
Anfractuous, doubled abruptly in several different directions.
Angiocarpous, having seeds inclosed in a pericarp.
Annotinous, a year old.
Anther, the case containing pollen.
Apetalous, having no petals.
Apiculate, abruptly pointed.
Apocarpous, where the carpels are distinct from each other.
Apophysis, the enlarged base of the theca of some mosses.
Apothecium, the shield, or mass of reproductive matter of a lichen.
Appendiculate, having some kind of appendages.
Arachnoid, resembling a spider's web.
Areolate, divided into little spaces.
Aril, a peculiar wrapper of some seeds; as the mace of the nutmeg.
Arista, the beard or awn of grasses.
Asci, the cases in which the spores of lichens are inclosed.
Ascidium, a hollow leaf looking like a water vessel; as the pitcher of Nepenthes.
Attenuated, gradually tapering to a point without becoming flat.
Auriculate, having two lobes (like ears) at the base.
Awn. See *Arista*.
Axil, the acute angle formed by the junction of the leaf, &c., to its axis.
Axillary, growing in an axil.
Axis, the root and stem either taken together or separately.

Baccate, fruit covered with soft flesh.
Barbate, covered with long hairs resembling a beard.
Beard, a tuft of long hairs.
Biconjugate, in two pairs, placed side by side.
Bidentate, having two teeth.
Bifarious, arranged in two rows.
Bifid, divided into two shallow lobes.
Bifoliate, having two leaflets.
Bifurcate, twice forked.
Bijugous, in two pairs, placed end to end.
Binate, growing in pairs.
Bipartite, divided into two deep lobes.
Bipinnate, twice pinnate.
Biserrate, twice serrate.
Brachiate, when branches stand nearly at right angles to the stem from which they proceed.
Bract, the leaf or leaflet from the axil of which a flower grows.
Bulb, a scaly, underground bud.
Bulbotuber, a short, roundish, underground stem resembling a bulb.

Caducous, falling off sooner or later.
Cæsious, of a bluish-gray colour.
Cæspitose, growing in tufts.
Calcar, a spur or horn; as in the nasturtium.
Calcarate, having a spur or horn.
Calyculate, having a whorl of bracts on the outside of a calyx, or of an involucre.
Calyptra, the hood of a moss.
Calyx, the external envelope of a flower.
Cambium, a viscid secretion formed in the spring between the bark and wood of Exogens.
Campanulate, bell-shaped.
Canaliculate, channeled.
Cancellate, a leaf which has veins without connecting parenchyma.
Capitate, growing in a head.
Capitulum, a collection of flowers in a head.
Capsule, any dry many-seeded fruit.
Carinate, having a kind of keel.
Carnose, fleshy.
Carpel, one of the parts of a compound pistil; a single leaf rolled up into one of the integers of a pistil.
Carunculate, a seed having fungous excrescences growing near its hilum.
Caryopsis, a dry one-seeded fruit resembling a seed, but with no distinction between the seed-coat and pericarp.
Caudate, prolonged into a sort of tail.
Cauline, of or belonging to the stem.
Cernuous, drooping.
Chalaza, a spot on a seed indicating the place where the nucleus is united to the seminal integuments.
Ciliated, fringed with hairs like an eyelash.
Cinereous, ash-coloured.
Circinate, rolled inwards from the point to the base.
Circumscissile, dividing into two parts by a spontaneous transverse separation.
Cirrhous, terminating in a tendril.
Clavate, club-shaped.
Claw, the stalk of a petal.
Clypeate, resembling a round buckler.
Cochleate, resembling the bowl of a spoon.
Collum, the point where the stem and root are combined.
Columella, a central part of the fruit of a moss, round which the spores are deposited.
Column, the combination of stamens and style in Orchideous and other plants.
Comose, having hairs at one or both ends, if speaking of seeds; being terminated by coloured empty bracts, if applied to inflorescences.
Conduplicate, doubled together.
Confluent, growing together so that the line of junction is lost to the sight.
Conjugate, growing in pairs.
Connate, growing together so that the line of junction remains perceptible.
Connective, the fleshy part that combines the two lobes of an anther.
Connivent, converging, as the anther of a potato blossom.
Conoidal, approaching a conical form.
Continuous, proceeding from something else without apparent interruption.
Contorted, twisted in such a way that all the parts have a similar direction, as the segments of the flower of an Oleander.
Convolute, rolled together.
Corculum, the rudimentary axis which connects the cotyledons of the embryo.
Cordate, heart-shaped.
Coriaceous, of a leathery texture.
Cormus, a solid, roundish, underground stem; as in Crocus.
Corneous, of a horny texture.
Corniculate, shaped like a slender horn.
Corolla, the second of the two envelopes that surround the stamens and pistil.
Corona, a combination of fertile and barren stamens into a disk; as in Stapelia.
Corymbose, when the branches surrounding a common axis are shortest at the top and longest at the bottom, so as to form a level-topped whole.
Costa, the midrib of a leaf.
Cotyledons, the leaves of the embryo.
Crateriform, shaped like a goblet.
Crenelled or *Crenated*, having rounded notches at the edges.
Crested, having some unusual and striking appendage arising from the middle.
Cruciate, when four parts are so arranged as to resemble the arms of a Maltese cross.
Cucullate, hooded, rolled inwards so as to conceal anything lying within.
Culm, the straw of grasses.
Cuneate, wedge-shaped.
Cupule, the cup of the acorn, the husk of the filbert, chestnut, &c.; a peculiar combination of bracts.
Cuspidate, abruptly rounded off with a projecting point in the middle.
Cuticle, the external skin.
Cyathiform, cup-shaped, more contracted at the orifice than crateriform.
Cymbiform, having the form of a boat.
Cyme, an inflorescence having a corymbose form, but consisting of repeatedly-branched divisions.
Cymose, resembling a cyme in appearance.

Decandrous, having 10 stamens.
Deciduous, falling off.
Declinate, curved downwards.
Decumbent, lying prostrate, but rising again.
Decurrent, produced downwards, as the base of a leaf down the stem.
Decussate, crossing at right angles.
Dehiscence, the act of opening of anther or fruit.
Deltoid, having the form of a triangle or Greek Δ.
Dendroidal, resembling a small tree.
Dentate, with sharp-pointed notches and intermediate curves instead of re-entering angles.
Depauperated, imperfectly developed; looking as if ill-formed from want of sufficient nutriment.
Depressed, flattened from point to base.
Diadelphous, having the stamens in two parcels.
Diandrous, having two stamens.
Dichotomous, repeatedly divided into two branches.
Dicotyledonous, having two cotyledons.
Didynamous, having two pairs of stamens of unequal length.
Didymous, growing in pairs, or twins; only applied to solids and not to flat surfaces.
Digitate, fingered, diverging from a common centre, as the fingers from the palm.
Dimidiate, half-formed, or halved, or split into halves.
Diœcious, having stamens on one plant and pistils on another.
Dipterous, having two wings.
Discoidal, with the central part of a flat body differently coloured or marked from the margin.
Disk, a fleshy circle interposed between the stamens and pistils.
Dissepiments, the vertical partitions of a compound fruit.
Distichous, arranged in two rows.
Divaricating, diverging at an obtuse angle.
Dodecandrous, having 12 stamens.
Dolabriform, hatchet-shaped.
Drupe, such a fruit as the peach, consisting of a stem surrounded by fleshy or fibrous matter.
Ducts, spiral vessels that will not unroll.
Dumose, having a compact bushy form.
Duramen, the heart-wood of timber.

Echinate, covered with hard sharp points.
Elaters, little spirally-twisted hygrometrical threads that disperse the spores of Jungermannias.
Elementary organs, the minute parts of which the texture of plants is composed.
Emarginate, having a notch at the point.
Embryo, the rudimentary plant before germination commences.
Endocarp, the hard lining of some pericarps.
Endogen, a plant which increases in diameter by addition to its centre; as a palm-tree.
Enneandrous, having 9 stamens.
Ensiform, having the form of a straight and narrow sword-blade.
Epicarp, the external layer of the pericarp.
Epidermis, the skin of a plant, in the language of some writers; the cortical integument according to others.
Epigynous, growing upon the top of the ovary, or seeming to do so.
Equitant, when leaves are so arranged that the base of each is inclosed within the opposite base of that which is next below it; as in Iris.
Estivation. See *Æstivation*.
Exogen, a plant which increases in diameter by the addition of new wood to the outside of the old wood; as an oak-tree.

Farinaceous, mealy.
Fasciated, banded.
Fasiculated, collected in clusters.
Fastigiate, when the branches of any plant are pressed close to the main stem; as in the Lombardy poplar.
Filament, the stalk of the anther.
Filiform, slender and round like a thread.
Fistular, tubular but closed at each end; as the leaf of an onion.
Flabelliform, fan-shaped.
Flagelliform, resembling the thong of a whip.
Flexuose, wavy.
Floccose, covered with little irregular patches of woolliness.
Floret, a little flower.
Floscule, ditto.
Foliaceous, having the colour and texture of a common green leaf.
Foliation, the arrangement of young leaves within the leaf-bud.
Follicle, a simple fruit opening by its ventral suture only.
Foramen, the passage through the integuments of an ovule by which impregnating matter is introduced into the nucleus.
Fovilla, the fertilising principle of pollen.
Frond, the leaf of a fern or of a palm.
Fruit, the full-grown ripened pistil.
Fugacious, lasting but a short time.
Fungoid, resembling a fungus; that is, irregular in form and fleshy in texture.
Funiculus, the stalk by which some seeds are attached to the placenta.
Fusiform, spindle-shaped, thickest in the middle, and tapering to each end.

Galbulus, a small cone whose scales are all consolidated into a fleshy ball; as in Juniper.
Galea, the upper lip of a labiate flower.
Geniculate, knee-jointed, when a stem bends suddenly in its middle.
Gibbous, prominent, projecting.
Glabrous, having no hairs.
Gladiate, the same as ensiform, but broader and shorter.
Gland, 1, the fruit of the oak, the hazel, &c.; 2, an elevation of the cuticle which usually secretes either acrid or resinous matter.
Glandular, covered with glands of the second kind.
Glaucous, covered with bloom like a plum.
Glochidate, covered with hairs which are rigid and hooked at their point.
Glume, one of the bracts of grasses.
Gymnospermous, having seeds which ripen without being inclosed in a pericarp.
Gynobase, an elevated part of the growing point of a flower-bud, rising between the carpels and throwing them into an oblique position.
Gyrate, same as *Circinate*. Also, surrounded by an elastic ring; as the theca of ferns.

Hastate, having the form of a halbert-head; that is, with a lance-shaped centre crossed at the base by two lobes of a similar form standing at right angles with the centre.
Helmet, the hooded upper lip of some flowers.
Heptandrous, having 7 stamens.
Hexandrous, having 6 stamens.
Hilum, the scar left upon a seed when it is separated from the placenta.
Hirsute, covered with harsh long hairs.
Hymenium, the gills of a mushroom; that part in Fungi where the spores are placed.
Hypocrateriform, salver-shaped; having a cylindrical tube and a flat border spreading away from it.
Hypogynous, arising from immediately below the pistil.

Icosandrous, having 20 or more perigynous stamens.
Imbricated, overlapping, as tiles overlie each other on the roof of a house.
Incumbent, lying upon anything.
Indehiscent, not opening when ripe.
Induplicate, doubled inwards.
Indusium, the membrane that overlies the sori of ferns.
Inferior, is said of a calyx when it does not adhere to the ovary; is said of an ovary when it does adhere to the calyx.
Inflorescence, the collection of flowers upon a plant.
Infundibuliform, shaped like a funnel.
Innate, growing upon anything by one end.
Innovations, the young shoots of mosses.
Intercellular, that which lies between the cells or elementary bladders of plants.
Internode, the space between two nodes.
Interrupted, when variations in continuity, size, or development alternately occur in parts which are sometimes uniform; as when pinnated leaves have the alternate leaflets much the smallest, and when dense spikes are here and there broken by the extension of internodes.
Involucre, a collection of bracts placed in a whorl on the outside a calyx or flower-head.
Involute, rolled inwards.

Labellum, one segment of a corolla, which is lower than the others, and often pendulous.
Labiate, divided into an upper and a lower lip; as the corolla of dead nettle.
Lacunose, having numerous large deep depressions or excavations on its surface.
Lamina, the blade of a leaf.
Lanceolate, shaped like a lance-head; that is, oval, tapering to both extremities.
Lateral, originating from the side of anything.
Latex, the vital fluid of vegetation.
Lax, not compact or dense.
Leaflet, a division of a compound leaf.
Legume, a kind of fruit like the pod of a pea.
Lenticular, small, depressed, and doubly convex.
Lepidote, covered with a sort of scurfiness.
Leprous, the same.
Liber, the newly-formed inner bark of Exogens.
Ligula, a membranous expansion from the top of the petiole in grasses.
Limb, the blade or expanded part of a petal.
Linear, very narrow, with the two sides nearly parallel.
Lip, same as *Labellum*.
Loculicidal, when the carpels of a compound fruit dehisce in such a way that the cells are broken through at their back.
Locusta, the spikelet, or collection of florets of a grass.
Lomentum, a legume which is interrupted between the seeds, so as to separate into numerous transverse portions.
Lunate, formed like a crescent.

Manicate, when hairs are interwoven into a mass that can be easily separated from the surface.
Marginal, of or belonging to the edge of anything.
Medullary, of or belonging to the pith.
Micropyle, a small passage through the seed, called the foramen when speaking of the ovule. See *Foramen*.
Mitriform, conical, hollow, open at the base, and either entire there or irregularly cut.
Monadelphous, with the stamens united into one parcel.
Monandrous, with one stamen only.
Moniliform, shaped like a necklace.
Monopetalous, with several petals united into one body by their edges.
Mucronate, tipped by a hard point.
Multifid, divided into many shallow lobes.
Multipartite, divided into many deep lobes.
Muricated, covered with short, broad, sharp-pointed tubercles.
Muriform, resembling the bricks in the wall of a house.

Navicular, shaped like a very small boat.
Nectary, any organ that secretes honey.
Nerves, the stronger veins of a leaf.
Node, the part of a stem from which a normal leaf-bud arises.
Normal, according to general rules.
Nucleus, the central part of an ovule, or a seed.
Nucule, a small hard seed-like pericarp.

Oblique, larger on one side than on the other.
Ochrea, two stipules united round the stem into a kind of sheath.
Octandrous, having 8 stamens.
Operculum, the lid of the theca of a moss.
Ovary, the hollow part of a pistil containing the ovules.
Ovate, having the figure of an egg.
Ovule, a rudimentary seed.

Palate, the lower surface of the throat of a labiate corolla.
Palea, either the inner bracts of the inflorescence of a grass, or the bracts upon the receptacle of the flower-head of a Composita.
Paleaceous, covered with paleæ.
Palmate, the same as *Digitate*, only the divisions more shallow and broader.
Panduriform, oblong, narrowing towards the base, and contracted below the middle.
Panicle, a compound raceme; a loose kind of inflorescence.
Papilionaceous, a flower consisting of standard, wings, and keel, like that of a pea.
Pappus, the calyx of a Composita; as of a dandelion.
Parenchyma, the pulp that connects the veins of leaves.
Parietal, growing from the lining of anything.
Pectinate, divided into long, close, narrow teeth like a comb.
Pedate, palmate, with the lateral segments lengthened and lobed.
Pedicel, one of a great many peduncles.
Peduncle, a flower-stalk.
Peltate, attached within the margin.
Pentandrous, having 5 stamens.
Perfoliate, surrounding a stem by the base, which grows together where the margins touch.
Perianth, a collection of floral envelopes, among which the calyx cannot be distinguished from the corolla, though both are present.
Pericarp, the shell of a fruit of any kind.
Perichætium, the leaves at the base of the stalk of the fruit of a moss.
Perigone, same as *Perianth*.
Perigynous, growing from the sides of a calyx.
Perisperm, same as *Albumen*.
Peristome, a curious set of processes surrounding the orifice of the theca of a moss.
Peronate, laid thickly over with a woolly substance ending in a sort of meal.
Personate, labiate, with the palate of the lower lip pressing against the upper lip.
Petal, one of the parts of a corolla.
Petaloid, resembling a petal in colour and texture.
Petiolar, of or belonging to the petiole.
Petiole, the stalk of a leaf.
Phyllodium, a petiole transformed into a flat leaf-like body.
Pileus, the cap of a mushroom.
Pilose, covered with short fine hairs.
Pinnate, divided into a number of pairs of leaflets; *bipinnate*, each leaflet is also pinnate; *tripinnate*, each secondary leaflet pinnated also.
Pinnatifid, divided in a pinnated manner nearly down to the midrib.
Pistil, the combination of ovary, style, and stigma.
Pith, the central column of cellular tissue in an Exogen.
Placenta, the part of the ovary to which the ovules are attached.
Plane, quite flat.
Plumule, the rudiment of a stem in the embryo.
Pollen, the powder contained in an anther.
Pollen-Tubes, the membranous tubes emitted by pollen after they fall on the stigma.
Polyadelphous, when the stamens are combined into more than two parcels.
Polyandrous, when there are more than 20 hypogynous stamens.
Polypetalous, when the petals are all distinct.
Pome, a fruit like that of the apple, pear, &c.
Præfloration, same as *Æstivation*.
Prickle, same as *Aculeus*.
Primine, the external integument of the ovule.
Pseudobulb, the solid above-ground tuber of some Orchideæ.
Pubescent, covered with very fine soft down.
Pulverulent, covered with a powdery appearance.
Putamen, same as *Endocarp*.
Pyriform, shaped like a pear.

Quartine, the innermost integument but one of the ovule.
Quinate, combined in fives.
Quintine, the innermost integument of the ovule.

Raceme, an inflorescence like that of the currant.
Rachis, the axis of inflorescence.
Radical, arising from the root.
Radicle, the rudimentary root in the embryo.
Ramenta, soft, ragged, chaff-like hairs growing upon the petiole of ferns.
Raphe, the line of communicat' tween the hilum and chalaza.

Raphides, acicular or other crystals scattered among vegetable tissue.
Reniform, kidney-shaped.
Resupinate, inverted, so that the part which is naturally lowermost becomes uppermost.
Reticulated, traversed by veins having the appearance of network.
Retuse, blunt, and turned inwards more than obtuse.
Rhizoma, a creeping stem like that of Iris.
Ringent, same as *Personate*.
Root-Stock, same as *Rhizoma*.
Rostrate, furnished with a sort of beak.
Rosulate, having the leaves arranged in little rose-like clusters.
Ruminated, pierced by numerous perforations full of chaffy matter like a nutmeg.
Runner, the prostrate stem of such plants as the strawberry.

Sagittate, resembling the head of an ancient arrow.
Samara, a kind of one-seeded indehiscent pericarp, with a wing at one end.
Sap-Wood, the newly formed wood, which has not been hardened by the deposit of secreted matter.
Sarcocarp, the intermediate fleshy layer between the epicarp and endocarp.
Scale, an abortive leaf.
Scape, the flowering stem of a plant.
Scarious, dry, thin, and shrivelled.
Scrobiculate, irregularly pitted.
Scutellum, the fructifying space upon the thallus of a lichen.
Secund, arranged or turned to one side.
Secundine, the second integument of the ovule.
Sepals, the leaves of the calyx.
Septa, same as *Dissepiment*.
Septicidal, when the dissepiments of a fruit are divided into two plates at the period of dehiscence.
Septifragal, when the dissepiments of a fruit are broken through their middle by the separation of the back of the carpels from the centre.
Sericeous, silky.
Serrate, toothed like the edge of a saw.
Sessile, seated close upon anything, without a stalk.
Setose, covered with setæ or bristles.
Shield, the fructification of lichens.
Sigmoid, bent like the letter S.
Silicle, a short two-valved pod, such as is found in garden cress.
Silique, the same but longer; as in the cabbage.
Sinuate, turning in and out in an irregular manner.
Sori, the fructification of ferns.
Spadiceous, resembling a spadix, or bearing that kind of inflorescence.
Spadix, the inflorescence of an arum; an axis closely covered with sessile flowers, and inclosed in a spathe.
Spathaceous, inclosed within a spathe, or bearing that kind of bract.
Spathe, a large coloured bract which incloses a spadix.
Spatulate, shaped like a druggist's spatula; that is, long, narrow, and broadest at the point.
Spike, an inflorescence in which the flowers are sessile upon their axis.
Spikelet, one of a great many small spikes collected in a mass; as in grasses.
Spine, a stiff, sharp-pointed, leafless branch.
Spongiole, or *Spongelet*, the tender growing tip of the root.
Spore, or *Sporule*, the reproductive body of flowerless plants, analogous to the seed of flowering plants.
Squarrose, composed of parts which diverge at right angles, and are irregular in size and direction.
Stamen, the fertilising organ of a flower, consisting of filament and anther.
Standard, the upper single petal of a papilionaceous flower.
Stellate, arranged in the form of a star.
Stigma, the upper end of the style, on which the pollen falls.
Stipe, the stalk that bears the head of a mushroom; also the stalk of the leaf of a fern; also the stalk of anything except of a leaf or a flower.
Stipulate, furnished with stipules; *exstipulate*, having no stipules.
Stipule, the scale at the base of some leaf-stalks.
Stomate, a minute hole in a leaf, through which respiration is supposed to be carried on; a breathing pore.
Strigose, covered with stiff unequal hairs.
Strophiolate, having little fungous excrescences surrounding the hilum.
Stupose, having a tuft of hairs in the middle or at the end.
Style, the stalk of the stigma.
Subulate, awl-shaped.
Syncarpous, having the carpels consolidated.

Terete, taper.
Ternate, united in threes.
Testa, the skin of the seed.
Tetradynamous, having 6 stamens in four parcels; two of which consist of two stamens, and two of one each.
Tetrandrous, having 4 stamens.
Thallus, the leafy part of a lichen; the union of stem and leaf in those and some other tribes of imperfect plants.
Theca, the case which contains the sporules of flowerless plants.
Tomentose, covered with short close down.
Toothed, the same as *Dentate*.
Torulose, alternately contracted and distended.
Torus, the growing point of a flower on which the carpels are placed.
Triandrous, having 3 stamens.
Trifarious, arranged in three rows.
Trifid, divided into three lobes.
Trifoliolate, having three leaflets.
Tripartite, divided into three deep divisions.
Tripinnate, when each leaflet of a pinnated leaf is pinnate; and the leaflets of the latter are pinnate also.
Triternate, when each leaflet of a ternate leaf is ternate; and the leaflets of the latter are ternate also.
Truncate, abruptly cut off.
Tube, the part of a flower where the bases of the sepals, petals, or stamens are united.
Tuber, a deformed, fleshy kind of underground stem.
Turbinate, shaped like a spinning top.

Umbel, an inflorescence whose branches all radiate from one common point.
Umbilicate, having a depression in the middle.
Umbonate, having a boss or elevated point in the middle.
Undulated, wavy.
Unguiculate, furnished with a claw, or short stalk.
Urceolate, shaped like a pitcher.
Utricle, a small bladder.

Vagina, the sheath formed by the convolution of a flat petiole round a stem.
Valve, one of the parts into which any dehiscent body divides.
Vascular, containing vessels; that is, spiral vessels or ducts.
Ventricose, inflated.
Vernation, the manner in which the young leaves are arranged in their leaf-bud.
Verrucose, covered with warts.
Versatile, swinging lightly upon a sort of pivot.
Verticillate, arranged in a whorl.
Vexillum, same as *Standard*.
Villous, covered with long soft shaggy hair.
Virgate, having long slender rod-like shoots.
Vitellus, a fleshy bag, interposed between the embryo and albumen in some seeds.
Vittate, striped, as distinguished from fasciate, or banded.
Whorl, an arrangement of more leaves than two around a common centre upon the same plane.

BOTAURUS. [BITTERN.]

BOTHRIOCEPHALUS. [ENTOZOA.]

BOTHYNO'DERES, a genus of Coleopterous Insects of the family *Curculionidæ*. It is known by the following characters:—Body oblong; rostrum thick, longer than the head, bent downwards, and having a longitudinal elevated line above. Antennæ geniculated, rather short and thick, twelve-jointed; the basal joint long, thickened towards the apex; the second joint short and stout; the third twice as long as the last; the four following short; the eighth rather broader than the last; the remaining or terminal joints form a spindle-shaped club. Thorax narrower before than behind, the base with an impression in the middle. Elytra oblong, with an obtuse tubercle towards the apex. Legs moderate; femora simple.

This genus apparently links the genera *Cleonus* and *Lixus* together. The species are in general very prettily mottled, the common colours being black, or gray, and white. In this country but one species has yet been discovered, and of that only two or three specimens have been found: it is about half an inch long and of a white colour, having the central part of the thorax, together with a fascia and four spots on the wing-cases, black. The species here described is the *Bothynoderes albidus* (*Curculio albidus* of Fabricius).

BOTIA, a genus proposed by Dr. J. E. Gray for the Spined Loche, or Groundling, usually included under *Cobitis*. [COBITIS.]

BOTRY'CHIUM, a genus of Ferns belonging to the sub-order *Osmundaceæ* and the tribe *Ophioglosseæ* of that family. It has distinct thecæ disposed in a compound spike attached to a pinnate or bipinnate frond. There is only one species a native of Great Britain, the *B. Lunaria*, Common Moonwort. It has a solitary pinnate frond, with notched or crenate, lunate or fan-shaped pinnæ. This is not a very conspicuous fern, but has been observed in almost every part of Great Britain. It grows on dry open heaths, elevated pastures, and waste lands which are generally shunned by other species of ferns.

In former times the ferns had a great reputation in medicine, not so much on account of their obvious as their supposed virtues. The lunate-shape of the pinnæ of this fern gave it its common name, and was the origin of much of the superstitious veneration with which it was regarded. When used it was gathered by the light of the moon. Gerarde says:—"It is singular to heal green and fresh wounds. It hath been used among the alchymists and witches to do wonders withall, who say that it will loose locks and make them to fall from the feet of horses that graze where it doth grow, and hath been called of them Martagon, whereas in truth they are all but drowsy dreams and illusions; but it is singular for wounds as aforesaid." Its healing powers are now however as much disregarded as its magical ones.

B. Virginicum, the Rattlesnake Fern, is a native of North America, and is the largest of the species. It is called Rattlesnake Fern from the fact of its growing in places where this venomous reptile is usually found. The other species of *Botrychium* are mostly natives of North America. (Loudon, *Encyclopædia of Plants*; Newman, *History of British Ferns*).

BOTRYLLIDÆ, a tribe of Tunicated *Mollusca*, of which the genus *Botryllus* is the type. The species are not uncommon on the coasts of Britain. They form translucent jelly-like masses of various hues, sometimes uniform in tint and sometimes beautifully variegated, and are found encrusting the surface of rocks or attached to the fronds of some of the large sea-weeds that grow at the bottom of the sea, or not unfrequently attached to the other forms of *Mollusca*. On examining one of these gelatinous masses closely they present the appearance of stars, having a central point and numerous radii. Unless examined closely they present little signs of life, but when a magnifying power is applied currents of water are seen passing to and from small apertures with which the surface is covered. Savigny, the illustrious French naturalist, was the first observer who apprehended the nature of these curious beings, and gave an account of their structure in his celebrated 'Mémoires sur les Animaux sans Vertèbres.' Before his time the *Botryllidæ* had been confounded with the *Polypes*, and regarded as analogous to *Alcyonium*. The earliest figures of them are to be found in the 'Philosophical Transactions' for 1757 by Schlosser, who was a correspondent and friend of John Ellis. The latest researches upon these creatures are those of Milne-Edwards in 1839, who in a paper read before the Institute of France fully confirmed the correctness of Savigny's views. The animals of this tribe have been divided into several genera, of which the following are British:—

Aplidium, Sav. Gelatinous or cartilaginous, with no central cavity, but a distinct circumscription. Animals 3 to 25 in number, in a single row, at equal distances from the centre of their common axis. Three species are given by Forbes and Hanley in the 'British Mollusca,' but with the statement that they require "careful re-examination." These are *A. Ficus*, Linn.; *A. fallax*, Johnston; *A. nutans*, Johnston.

Sidnyum, Sav. The mass presents the appearance of a number of heads of Madrepore or Cladocora, each formed of a simple cone truncated and starred at the summit, rising from a common encrusting base, the whole being grouped closely together. There is but one species, *S. turbinatum*, which occurs abundantly on the north coast of the Isle of Man and other parts of the British Islands.

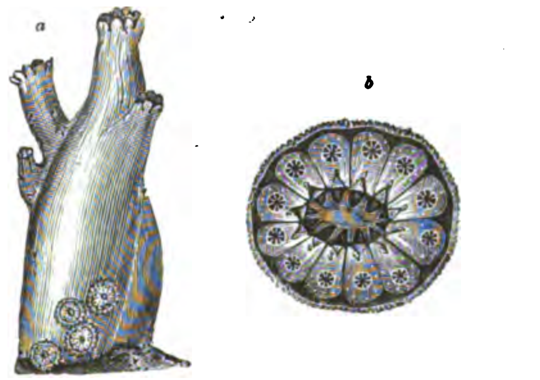
Polyclinum, Sav. Mass sessile, gelatinous, or cartilaginous; polymorphous, composed of more or less multiplied systems, convex, radiated, each having a central cavity, and being more or less distinctly circumscribed. Individuals 10 to 150, placed at unequal distances from a common centre. *P. aurantium*, Milne-Edwards, has been found at Cullercoats.

Amouroucium, Milne-Edwards. Mass lobed or encrusting, sessile or pedunculated, fleshy or cartilaginous, composed of many systems, each having a central cavity. *A. proliferum*, M. Edwards, has been found in Belfast Bay. *A. Nordmanni*, M. Edwards, and *A. Argus*, M. Edwards, have been taken at Falmouth by Mr. Alder.

Leptoclinum, Milne-Edwards. Mass thin, sessile, encrusting, polymorphous, coriaceous or gelatinous, composed of many systems; vents opening into a common cloaca. The following species have been taken on various parts of the British coasts:—*L. maculosum*, *L. asperum*, *L. aureum*, *L. gelatinosum*, *L. Listarianum*, *L. punctatum*.

Distoma, Gaertner. Mass sessile, semicartilaginous, polymorphous, composed of many systems, usually circular. Anal and branchial orifices regularly and equally 6-rayed. Two species, *D. rubrum* and *D. variolosum*, are British.

Botryllus, Gaertner. The animals are grouped in single stars, and lie horizontally with the vent far from the branchial orifice. The branchial orifices simple and arranged around a common cloaca. *B. Schlosseri*, Pallas. This is the species figured by Schlosser in the 'Philosophical Transactions.' It is one of the most beautiful, as it is one of the most common species of the family. Living specimens of this and the other species of *Botryllidæ* are now in the Aquavivarium



a, A group of *Botryllus Schlosseri* upon *Ascidia intestinalis*; *b*, a disk magnified.

of the Zoological Society in the Regent's Park Gardens. The other British species are *B. polycyclus*, Savigny; *B. gemmeus*, Sav.; *B. violaceus*, Milne-Edwards; *B. Smaragdus*, M. Edwards; *B. bivittatus*, M. Edwards.

Botrylloides, Milne-Edwards. The stars formed by the systems of these animals are irregular and ramifying. The bodies are placed vertically and the two orifices approximate. The following species are British:—*B. Leachii*, Sav.; *B. albicans*, M. Edwards; *B. rotifera*, M. Edwards; *B. rubrum*, M. Edwards.

(Forbes and Hanley, *History of British Mollusca.*)

BOTRYOGENE, native red Sulphate of Iron. It occurs crystallised, the crystals being usually aggregated in globular reniform and botryoidal masses. The primary form is that of an oblique rhombic prism. The colour is deep hyacinth-red and ochre-yellow with a yellow streak. The hardness is from 2·25 to 2·5. The lustre vitreous; translucent. The taste slightly astringent. The specific gravity 2·039. It is composed of—

Sulphuric Acid	32·55
Peroxide of Iron	23·86
Protoxide of Iron	10·71
Water	32·85

It is found in the great copper-mine of Fahlun in Sweden.

BOTRY'TIS, one of the obscure parasitical genera of *Fungi*, to which what is called Mildew is often attributable. The plants consist of little cells adhering end to end; of these a part lies prostrate on the surface of the plant that bears them, the other rises erect from the surface and bears a collection of roundish seed-cases at the extremity. From the spores contained in these cases the plants are propagated, and seeing that their size is so microscopic in all cases as to escape our vision unaided by glasses, and that what seems to the naked eye a thin brownish white patch upon a leaf is in reality a dense forest of such plants, their power of dissemination must be very great. They attack the fibres of vegetable fabrics, such as linen and cotton when placed in damp places, and the decayed stems of various plants, decaying apples, pears, grapes, &c. They are always superficial, and never intestinal.

BOTS are the Larvæ or Caterpillars of the Gad-Fly, belonging to the order *Diptera* and the genus *Œstrus*, and distinguished by this peculiarity, that they pass the larval state of their existence within some living animal, and feed on the juices or substance of that animal. There are numerous species of them. Every quadruped on which they prey has its peculiar fly. The notice of a few of those most commonly known will suffice.

The *Œstrus Equi*, or Gad-Fly of the Horse, belongs to the genus *Gasterophilus* of some entomologists, so called from its larvæ inhabiting the stomach of that animal. It is distinguished from the other *Œstri* by the smoothness of the thorax, and by the eyes in both sexes being equidistant from each other, not quite half an inch in length, with gauze-like yellow and brown wings, its chest of a rusty colour approaching to a brown hue on the sides and with a yellow tinge posteriorly, its belly of a reddish-brown superiorly and a dirty gray beneath, with its extremity almost black. The whole insect is thickly covered with down. The Gad-Fly is seen in the latter part of the summer very busy about horses: this is the impregnated female depositing her eggs. She approaches the horse, selects some part which he can reach with his tongue, and which he is in the frequent habit of licking; she balances herself for a moment, and then suddenly darting down, deposits an egg on one of the hairs, which adheres by a glutinous substance that surrounds it. She continues her labour with wonderful perseverance until she has parted with fifty or a hundred eggs, and then having exhausted herself, she slowly flies away, or drops at once and dies.

If a horse at grass is carefully examined in August, some hundreds of these minute eggs will be found about its legs and the back part of the shoulder, and few or none out of the reach of his tongue. In two or three days these eggs are sufficiently matured to be hatched. Possibly the horse feels a little inconvenience from all this glutinous matter sticking about and stiffening the hair, and he licks the part, and by the pressure of the tongue, and the mingled influence of the warmth and moisture of it, the ova are burst, and a small worm escapes from each. It clings to the tongue, and is thus conveyed into the mouth; thence it is either carried with the food into the stomach, or, impelled by instinct, it travels down the gullet, being too small to inconvenience or annoy the horse. Thus it reaches the stomach, and by means of a hook on each side of its mouth affixes itself to the cuticular or insensible coat of that viscus. It scoops out a little hole, into which its muzzle is plunged, and there it remains until the early part of the summer of the following year, feeding on the mucous or other matter which the coats of the stomach afford. It has now become an inch in length and of corresponding bulk, and ready to undergo its change of form. It detaches itself from the cuticular coat to which it had adhered, and plunges into the food which the other and digestive portion of the stomach contains; it passes with the food through the whole length of the intestines, and is discharged with the dung. Sometimes it is not perfectly enveloped in the fecal mass; it then clings to the sides of the anus, and hangs there firmly until there is a soft place beneath on which it may drop; it then hastens to burrow into the earth, and, if it has escaped the birds that are eagerly watching for it, it has no sooner hollowed for itself a convenient habitation than a shelly covering is formed around it, and it appears in the state of a pupa or chrysalis.

It here lies torpid for a few weeks, preparing to undergo its last change. It assumes the form of a perfect fly; it then bursts from its prison, rises in the air, and seeks its mate. The work of fecundation being accomplished, the male immediately dies: the female lingers a day or two in order to find the proper deposit for her eggs, and her short life also terminates.

It is in the larva or caterpillar state that the Bot is most known. The stomach of the horse sometimes contains an almost incredible number of them, the cuticular portion of that organ being in a manner covered with them. In a few instances they have been decidedly injurious. Having mistaken the upper part of the windpipe for their residence, and fastening themselves on the edges of the opening into it, have produced a cough which no medicine could alleviate, and which increased with the growth of the Bot, until a degree of irritation was excited under which the animal sunk. They have also travelled farther than the stomach, and have irritated and choked the first intestine, and thus destroyed the horse; and, even in their natural habitation, under probably some diseased state of the stomach arising from other causes, they have perforated it and caused death.

These however are rare occurrences; they are exceptions to a general rule. The plain matter of fact is, that a horse that has been turned out in July and August, and therefore almost necessarily has bots, enjoys just as good health as another that has been stabled during this period. He is in as good condition, and as fully capable of work when the cuticular coat is crowded with full-formed bots as he is at any other time; and his health is unaffected when they are passing through the intestines to seek a new habitation.

A smaller species of Bot, called from its colour the Red-Bot, is occasionally found in the stomach; but the fly from which it proceeds has never been accurately described. There is no ground for the assertion that the red-bot is more injurious than the common bot.

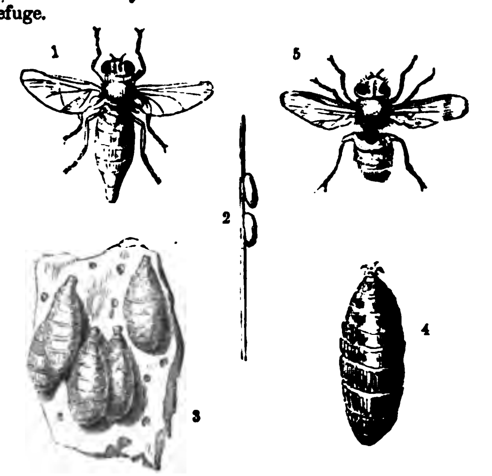
A third species, the *Œstrus hemorrhoidalis*, or Fundament-Bot, is better known. The fly is considerably smaller than the common *Œstrus Equi*. It is of a brown colour, with the extremity of the body rounded and yellow, and the mouth is furnished with exceedingly sharp pincers. This fly may be seen darting between the thighs of the horse and around its croup, and following the motions of the tail until the animal is preparing to dung. During the evacuation of the dung, and the subsequent protrusion of the intestine, it darts upon and tears the gut with its pincers, and deposits an egg in every wound. The horse does not seem to suffer any pain during this operation, for he stands passive; and the little worm, soon produced from the egg, establishes its abode in the place in which it was deposited. It likewise remains its stated time in the intestine, and escapes at the same time that the common bot does from the stomach. These bots are often seen within the verge of the anus, and occasionally seem to be productive of a slight degree of irritation. They are smaller than the common bot, and distinguished from the red-bot by their colour. An injection of linseed-oil will generally dislodge them.

The *Œstrus Ovis*, or Gad-Fly of the Sheep, is a more formidable insect. It is smaller than the *Œstrus* of the Horse: its body is of a dark-brown colour, spotted with white, the white sometimes so much prevailing as to give a grayish hue to the fly. It may often be seen in copses, and particularly on rails in the neighbourhood of a copse. Every shepherd ought to make himself acquainted with it, for it may then be easily crushed and destroyed. It prevails most in June and July, and is sometimes an intolerable nuisance in woody countries. If only one of them appears the whole flock is struck with terror; and if there is any place in the field devoid of pasture the sheep crowd to it, turning their heads towards the centre of the group, with their muzzles to the sand, and their feet in continual motion in order to secure themselves from the attack of their foe. The *Œstrus* endeavours to get at the inner margin of the nostril, and, darting upon it with the quickness of lightning, deposits her egg. The warmth and moisture of the part speedily hatch it, and the little worm escapes. It crawls up the nostril, it threads all the sinuosities of the passage, and finds its way to some of the sinuses connected with the nose. The irritation which it occasions as it travels up the nose seems to be exceedingly great. The poor animal gallops furiously about, snorting violently, and almost maddened by the annoyance. At length the worm reaches some of the convolutions of the turbinated bones of the nose, or the antrum or cavity of the upper jaw, or the frontal sinuses; it fastens itself on the membrane by the two hooks with which, like the others, it is provided, and there it remains until April or May in the succeeding year.

There are seldom more than three or four of these bots in each sheep; and when they have reached their appointed home, like the bots in the stomach of the horse, they are harmless. Some strange but groundless stories have been told of gleet from the nose, giddiness, and inflammation of the brain having been produced by them.

The larva or bot remains in the sinus until it has fully grown. It then detaches itself from the membrane, creeps out the same way by which it entered, and again sadly annoys the animal for a little while, the sheep making the most violent efforts to sneeze it out. At length the grub being dropped, burrows in the earth, becomes an oval and motionless chrysalis, and six weeks or two months afterwards it breaks from its prison a perfect fly. The work of propagation being effected the male, like that of the *Œstrus Equi*, dies; the female lingers on a little while until she has safely deposited her ova. She takes no food, for she has no organs to receive or digest it. She accomplishes her task and expires.

The *Œstrus Bovis*, or Gad-Fly of the Ox, is larger than either of the others. Its chest is dark-brown with a yellow patch on the back, and the rounded abdomen has alternate rings of a brown and orange colour. The fatty and cellular substance beneath the skin of the ox is the residence of its larvæ. The fly almost uniformly selects a young beast in good condition, and, alighting on the back a little on one side of the spine, it punctures the skin and drops one of its eggs into the perforation, and with it probably some acrid fluid which causes temporary but intense pain. The ox darts away, and runs bellowing over the field with his head protruded and his tail extended. His companions smarting from the same pain or dreading a similar attack also gallop wildly in every direction, hastening if it be in their power to some pond or stream where their enemy is afraid to follow them. A small tumour—a warble—presently appears on the back, which being carefully examined is found to contain a little white worm. This worm grows and assumes a darker colour, and becomes a perfect bot; and there it remains abundantly nourished by the fatty matter around it until the following June, when it begins to eat its way through the wall of its cell. Many a bird aware from the uneasiness of the beast of what is going forward is ready to seize the bot as it is forcing itself through the aperture which it has made, and the cattle too instinctively crowd to the water in order that the intruder may fall into the stream and thus be lost. In one of these ways the great majority of the larvæ perish, but a few reach the ground, speedily burrow into it, pass through their chrysalis state, and reappear in August in their last and perfect form. They also immediately set to work to secure the perpetuation of their species, regardless of the annoyance to the animals within whose frame they find a refuge.



1, The female of the *Œstrus Equi* nearly double its natural size; 2, the eggs, also magnified, deposited on and adhering to the hair; 3, the bots, one-half of their natural size, adhering by their tentacula, or hooked mouths, to the cuticular portion of the stomach. Some of them are supposed to be recently detached, and the excavations which they had made in the cuticular coat are seen; 4, the full-grown bot detached; 5, the *Œstrus Ovis*, or Gad-Fly of the Sheep.

The farmer does not pay the attention which he ought to these warbles. It is true that the cattle when the tumour has once formed do not appear to suffer any inconvenience from its existence, and the farmer is accustomed to associate with the appearance of a few warbles the certainty of the thriving condition of the beasts; but he forgets the pain and terror which the animal has already suffered and that which it has yet to undergo, and he also forgets the deterioration of the hide. The hole made by the bot in its escape will apparently close, but not until after a considerable period has elapsed, and never with a substance so firm and durable as the first. It is easy to destroy the creature in its cell. The pressure of the finger and thumb will effect it, and while the beast will escape considerable annoyance the hide will not be damaged.

The goat and the different species of deer, and in fact almost all animals, have their peculiar tormentors, but the distinctions and habits of these varieties of the *Œstrus* are not well known.

BOTTLE-GOURD. [LAGENARIA.]

BOTTLE-HEAD. [DELPHINUS.]

BOTTLE-TIT. [PARUS.]

BOULANGERITE, a native Sulphuret of Lead and Antimony. It occurs massive. The colour is bluish-gray. The fracture exhibits a crystalline structure. The lustre is metallic. Specific gravity 5·97. It is found at Molières in France and at Nertschinsk. The analysis of the ore from Molières by Boulanger gives the following:—

Lead	53.9
Antimony	25·5
Sulphur	18·5
Iron	1·2
Copper	0·9
	100.0

BOULDER-FORMATION, in Geology, a title which has been introduced to supplant that of Diluvial Deposits. Till is an equivalent term employed in Scotland. By various writers these accumulations are ranked in the ill-defined class of Pleistocene Deposits. [SUPP.]

BOULDERS. Of the materials of which superficial deposits of the debris of ancient rocks are composed some are of large size, and have been called Boulders or Erratic Blocks. The portions of smaller size are called Gravel. Boulders are generally found not far from the rocks from which they have been broken, whilst gravel is carried to a great distance. Instances however are not wanting in which boulders have been transported an immense distance. They have been transported from Norway and Sweden to the plains of Germany, and from the mountains of Scotland and Cumberland to the centre and south of England. So large are some of these boulders, and the obstacles such as intervening hills, valleys, and seas so great, that the mode of their transportation can be accounted for in no other way than by supposing that they have been floated across them in masses of ice, which as they have melted have dropped them in the places where they are now found when those places were at the bottom of a sea. The largest boulders seem to have drifted in all cases from northern and southern points towards the warmer districts in the temperate and tropical parts of the earth.

BOUNCE, a name given to the large spotted Dog-Fish (*Scyllium Catulus*, Cuvier). [SQUALIDÆ.]

BOURNONITE, a compound of the sulphurets of lead, antimony, and copper. It occurs massive and crystallised. The primary form is a right rhombic prism. The cleavage is parallel to the primary planes and to both the diagonals of the prism. Colour, steel or blackish-gray; streak similar. The fracture uneven, conchoidal. Hardness 2·5 to 3·0. Lustre metallic. Opaque. Specific gravity 5·79 to 5·83. It is found in Cornwall, Clausthal, Pfaffenberg, Mexico, and Peru. The following analysis of the mineral from Cornwall is by Hatchett:—

Sulphur	17·00
Lead	42·62
Antimony	24·23
Copper	12·80
Iron	1·20
	97·85

BOVIDÆ, a family of the Ungulate or Hoofed division of the *Mammalia*, is thus characterised by Dr. J. E. Gray in the 'Catalogue of the Mammalia in the British Museum':—

Two middle toes separate; cutting teeth eight below; upper jaw callous; grinders six in each jaw. Frontal bones produced, generally bearing horns, especially in the males. Gullet with two long pouches just before the stomach, used for holding and soaking the food before it is chewed. Using their head and horns in defence.

The *Bovidæ* include the following tribes:—

Bovina, Cervina, Giraffina, Moschina, Camelina.

The tribe *Bovina* is again divided into the sub-tribes:—

Boveæ, Strepsicereæ, Antilopeæ, Capreæ, Oveæ.

In this article the species of the sub-tribe *Boveæ* which includes our common Oxen will be described. The *Antilopeæ* and *Strepsicereæ* are described under ANTILOPEÆ, and the other sub-tribes under OVEÆ and CAPREÆ.

The *Boveæ* are characterised by having the horns smoothish, spread out on the sides, cylindrical or depressed at the base, situated on the frontal ridge, and bent laterally outward and recurved at the tips. The nose is broad, with the nostrils on the side. The skull has no suborbital pit or fissure; the cutting teeth are nearly equal-sized, and slightly shelving outwards. The knee (or wrist) is below the middle of the fore leg, the cannon bone being shorter than the fore-arm bone.

Dr. Gray observes that the genera of *Boveæ* may be divided into groups by the condition of the muffle. Thus *Bos, Bibos, Bison, Bubalus,* and *Anoa* have a naked moist muffle, whilst *Poephagus, Ovibos,* and *Budorcas* have a hairy ovine muzzle. The first series are characterised in their habits by living on the plains of warm or temperate regions, whilst the last are inhabitants of mountainous and snowy regions.

The genera *Bos, Bubalus, Bibos,* and *Anoa* are the true Oxen, and are distinguished from *Bison* (the Bisons) by having their bodies covered with rather stiff hair; the shoulder proportionate to the haunches, and the cannon bone of the hind and fore legs of equal length.

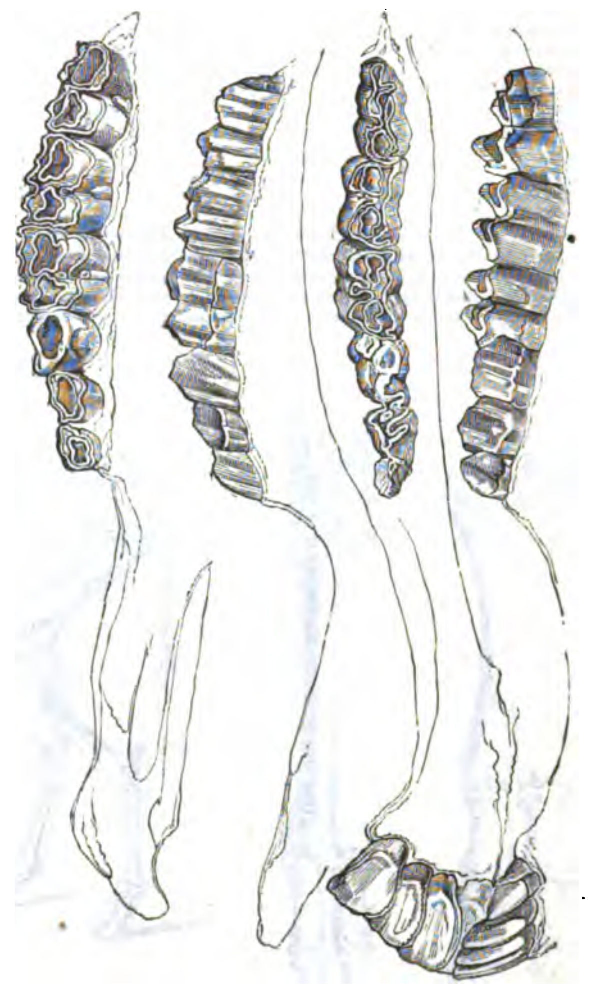
Bos. Horns cylindrical, conical, nearly circular at the base, curved upwards and outwards, far apart at the base, on the sides of the upper part of the ridge at the hinder end of the occipital plane. The facial and frontal portion of the skull equal. Dorsal ridge distinct, sometimes produced into a dorsal hump.

Bos Taurus, the Bull. The forehead is flat; the withers not humped.

This species is the common Ox, which is so widely diffused over the surface of the earth, and of whose utility to man we have very early records. Dr. Gray gives upwards of forty synonyms for this species. It is the *Bos Taurus* of Pliny; *Taurus castratus* of Johnston; *Vacca* of Gesner; *Bos domesticus* and *Bos Taurus* of Linnæus; the Bull, Ox, and Common Ox of Pennant and Shaw; the Stier and Ochs of German writers; and Bœuf of the French; it is the White Scotch Bull, the *Bisontes jubati* of Boethius; the White Urus of Colonel H. Smith; the Chillingham Bull of Gray; the Wild or White-Forest Cow and Bull of Low; the Wild Cattle of Bewick. Varieties of this species are known to the grazier by a large number of names: some of these are generally recognised, and have characteristic types, as the Pembroke Bull, the West Highland Bull, the Zetland Cow, the Kerry Cow, the Alderney Cow, the Fifeshire Cow, Long-Horned or Lancashire Bull, the English Short-Horn Cattle, the Short-Horn Ox, the Polled Suffolk Cow, the Sussex Ox, the Yorkshire Cow. Amongst those recognised of foreign rearing we may mention the Holstein or Dutch Bull, the Polish Bull, the Hungarian Bull, the South African Long-Horned Cattle, Swiss Cattle, Alpine Cattle, the Syrian Ox, Moldavian Cattle, the Italian Campagna Bull, Spanish Bulls, Egyptian Cattle, the Laut of Africa—*Bos humilis* of Frisch, the Galla Ox—*Bos Taurus Abyssinicus* of Gmelin, the Cattle of Peauby, the Cattle of Brazil, the Cattle of Chili, the Nata or Niata of Buenos Ayres, and the Falkland Islands Wild Cattle.

As this species may be taken as the type of the tribe, we shall here present a sketch of its organisation.

We shall first speak of the skeleton. The front or forehead is wide and flattened; the lacrymal bone is enlarged below, and leaves no open space between it and the nasal bone. The upper occipital and parietal bones unite at so early a period into a single bone, that the calf almost at its birth has them already in the confluent state; but in the earlier stages of the fœtus the two parietal and the two interparietal bones are distinguishable. The occipital suture remains strong below the occipital crest, and so differs from the other ruminants; and the frontal suture reaches up to this crest, thus forming the principal character of the physiognomy of the Ox. The hole analogous to the sphæno-palatine aperture is enormous, and is hidden in the sunken space behind the orbital or supermolar prominence of the maxillary bone; at its superior border a small portion only of the vomer is perceptible. The tympanic cavities terminate in long sharp points, and between them the basilary bone presents two strong prominences. The temporal ala of the anterior sphenoid bone, which in the antelopes and stags has the crest but slightly projecting, has in the Oxen a strong and sharp projection.



Teeth of Ox.

The rest of the skeleton is much like that of the other Ruminants, and the following cuts will give a better idea than words of the construction of the extremities.

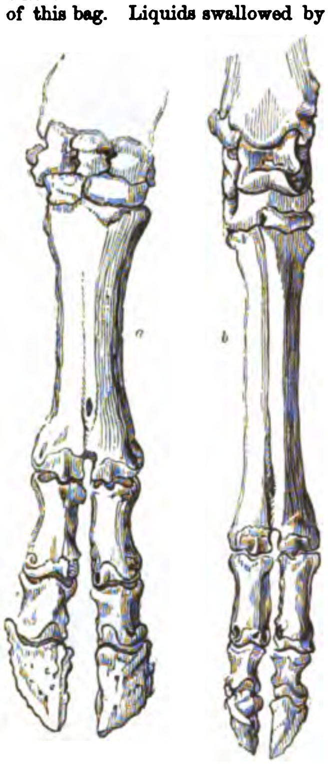
The anterior angle of the spine of the scapula is prolonged as in the camels into an acromial apophysis, and the spinal border is rounded; moreover in the Ox the base of the spine towards the neck of the bone is blended with the anterior border. In the pelvis of the Ruminants generally the spinal angle of the ossa ilii is wider and placed more backwards than the external angle, the truncation of which is oblique and nearly continuous to the anterior border of the bone. The pelvis of the Ox may thus be easily distinguished from that of the horse, which has its spinal angle pointed and as forward as the external angle, which last is more truncated, so as to be nearly square. The ischium of the Ox moreover is much more elevated above the cotyloid cavity, the ischial tuberosity is truncated so as to present three angles, and the posterior edge of the pelvis forms a well-marked re-entering angle, whilst in the horse the same part is nearly rectilinear.

The following table of the number of Vertebræ in the *Boveæ* is given in Mr. Vasey's 'Delineations of the Ox-Tribe,' and he adds that the statements, except that with regard to the Yak, are from his own observations:—

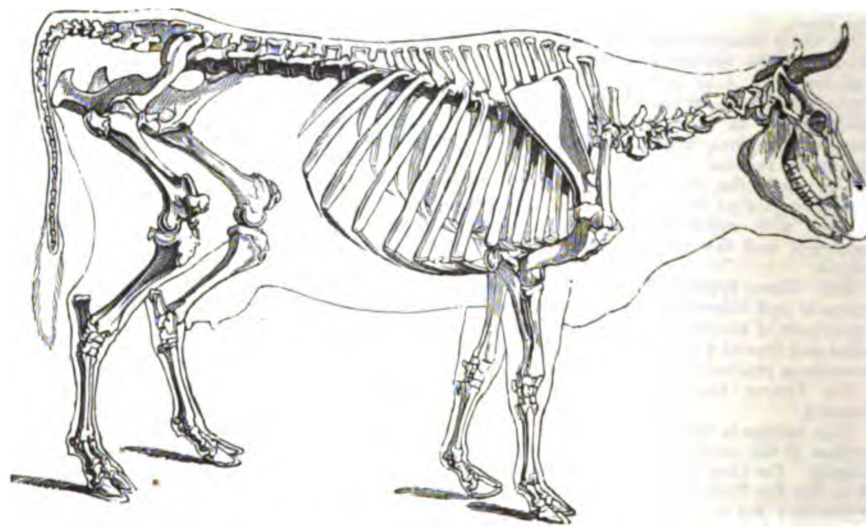
	Cervical.	Dorsal.	Lumber.	Sacral.	Caudal.	Total.
American Bison	7	14	5	5	12	
European Bison	7	14	5	5	19	50
Yak	7	14	5	5	14	45
Gayál (Domestic)	7	14	5	5	16	47
Gayál (Asseel)						
Gyall						
Jungli Gau						
Italian Buffalo						
Indian Buffalo						
Buffalo (in Coll. Surg. Mus.)	7	13	6	5	16	47
Gaur	7	13	6	5	19	50
Domestic Ox	7	13	6	5	21	52
Condore Buffalo						
Manilla Buffalo	7	13	6			
Pegasse						
Arnee						
Cape Buffalo	7	13	6	4	19	49
Zamouse	7	13	6	4	20	50
Banting	7	13	6	4	18	48
Zebu	7	13	6	4	18	48
Galla Ox						
Backeley						
Musk Ox						

The organs of digestion of the Ox are formed on the same type as those of the other *Ruminantia*. The food on passing down the œsophagus enters the large cavity called the ingluvies, or paunch, where it remains till it is moistened with fluid secreted from the walls of this bag. Liquids swallowed by the animal appear to be directed

lower jaw and the unarmed front of the upper one, and the muscles immediately aiding with the upward jerk to separate the bite from the roots on which it was growing. In a state of domesticated nature, that is, where the animal roams at large and is not stall-fed or confined to what are called artificial grasses, or to artificial food, we are told in 'The Swedish Pan' ('Amœn. Acad.' vol. ii.) that oxen eat 276 plants and refuse 218; that heifers waste away in inclosures where the Meadow-Sweet (*Spiræa Ulmaria*) grows in abundance and covers the ground so that they can scarce make their way through it: "the country people," says the author, "are amazed, and imagine that the Meadow-Sweet affords them no nourishment; whereas the goat which is bleating on the other side of the hedge is not suffered to go in, though he longs to be browsing on this plant, which to him is delicate and nourishing food." The leaves of the Long-Leaved Water-Hemlock (*Cicuta virosa*) are fatal to oxen, whilst the goat feeds heartily and safely upon it. Linnæus found that this plant was the cause of the terrible disease that raged among the horned cattle at Tornea. He had scarcely left the boat which carried him over the river to the fatal meadow before he was convinced. The cattle it appeared died as soon as they left off their winter fodder and returned to grazing; the disease diminished as the summer came on, at which time as well as in the autumn few died. The distemper was propagated irregularly and not by contagion: the cows were driven in the spring to the meadow where Linnæus landed and where he saw plenty of the Long-Leaved Water-Hemlock, and there they died swollen and in convulsions. In other places the plant was scarce. "The least attention will convince us," says Linnæus, "that brutes spurn whatever is hurtful to them, and distinguish poisonous plants from salutary by natural instinct; so that this plant is not eaten by them in the summer and autumn, which is the reason that in those seasons so few cattle die, namely, only such as either accidentally or pressed by extreme hunger eat of it. But when they are let into the pastures in spring, partly from their greediness after fresh herbs and partly from the emptiness and hunger which they have undergone during a long winter, they devour every green thing which comes in their way. It happens moreover that herbs at this time are small and scarcely



a, Fore-foot of Ox; *b*, hind foot of the same.



Skeleton of a Cow.

into a second cavity called the reticulum, or honey-comb stomach, into which also the food passes from the first. The food is then returned in the form of little pellets into the mouth, where it is again masticated and moistened with salivary fluid. It once more passes down the œsophagus into a third cavity, the omasum, called the 'manyplies,' from its plicated structure, and finally passes in a pulpy state into the reed, or abomasum, from which it is projected into the intestines.

With regard to their food Oxen are eminently herbivorous, for though they will browse upon shrubs and trees, grass and herbage is their staple. No one can watch a cow grazing without observing how perfectly the whole mechanism works together—the tongue sweeping in a wisp of herbage into the vice formed by the cutting-teeth of the

supply food in sufficient quantity. They are besides more juicy, are covered with water, and smell less strong, so that what is noxious is not easily discerned from what is wholesome. I observed likewise that the radical leaves were always bitten, the others not, which confirms what I have just said. I saw this plant in an adjoining meadow mowed along with grass for winter fodder, and therefore it is not wonderful that some cattle though but a few should die of it in winter. After I left Tornea I saw no more of this plant till I came to the vast meadows near Limmingen, where it appeared along the road; and when I got into the town I heard the same complaints as at Tornea of the annual loss of cattle with the same circumstances." The author of the 'Swedish Pan' also observes that a hungry stomach will often drive animals to feed upon plants that were not intended for them by nature. But whenever this has happened they, if they escape, become more cautious for the future, and acquire a certain kind of experience; and he instances the Monk's-Hood (*Aconitum*), which grows near Fahluna, and is generally left untouched by all the animals that are accustomed to these places; but if foreign cattle are brought thither and meet with this vegetable, they venture to take too large a quantity of it, and are killed. He adds that the cattle that have been reared in the plains of Schonen and Westragothia commonly fall into a dysentery when they come into the woodland parts, because they feed upon some plants which the cattle used to those places have learned to avoid. Meadow-Saffron (*Colchicum autumnale*) is among the plants deleterious to oxen if taken in any large quantity, and Hellebore (*Helleborus*) is also said to be poisonous to them. Yew (*Taxus baccata*) is fatal, as it is to herbivorous quadrupeds generally, the green temptation being probably too strong for cattle kept on short allowance. Actions-at-law in this country have not been uncommon against a defendant for not keeping up bounds or hedges whereby the plaintiff's cattle strayed into places where yew-trees grew, fed on the branches, and so died.

The period of gestation of the cow is nine months. The normal number of the offspring is one, though there are not uncommon instances of the cow bringing forth twins, and rare cases of her producing three and even more at a birth. In the case of twins, if they be male and female apparently, the apparent female is generally barren, and is called a Free Martin (*Taura* probably of Columella, Varro, and the ancient Romans).

Mr. Jesse ('Gleanings of Natural History,' 1838) states that if the cow has twins, one of them a male and the other a female, the latter is always barren; but this is an error. "It is a fact known and I believe almost universally understood," writes John Hunter in his 'Account of the Free Martin,' "that when a cow brings forth two calves, and one of them a bull-calf, and the other to appearance a cow, that the cow-calf is unfit for propagation, but the bull-calf grows up into a very proper bull. Such a cow-calf is called in this country a Free Martin, and is commonly as well known among the farmers as either cow or bull. Although it will appear from the description of this animal that it is a hermaphrodite (being in no respect different from other hermaphrodites), yet I shall retain the term free martin to distinguish the hermaphrodite produced in this way from those which resemble the hermaphrodite of other animals; for I know that in black cattle such a deviation may be produced without the circumstance of twins, and even where there are twins, the one a male the other a female, they may both have the organs of generation perfectly formed."

Professor Owen in his valuable edition of Hunter's 'Observations' (1837) adds a note from Loudon's 'Magazine of Natural History;' which states that Joseph Holroyd, Esq., of Withers, near Leeds, had a cow which calved twins, a bull-calf and a cow-calf. As popular opinion was against the cow-calf breeding, it being considered a Free Martin, Mr. Holroyd was determined to make an experiment of them, and reared them together. In due time the heifer brought forth a bull-calf, and she regularly had calves for six or seven years afterwards. Nor are there wanting other cases of fertility under similar circumstances.

When a cow has twins and they are both bull-calves the calves are in every respect perfect bulls, and if cow-calves they are both perfect cows.

In the 'Nouveau Bulletin des Sciences' is given an account of a cow which produced nine calves at three successive births: first, four cow-calves, in 1817; second, three, two of them females, in 1818; third, two females, in 1819. With the exception of two belonging to the first birth all were nursed by the mother.

The origin of our present breeds of domestic cattle has been a subject of much difference of opinion, arising from the existence of certain cattle in an apparently wild condition, and which have been supposed to be descendants of the gigantic *Urus* described by Cæsar as existing in England during the Roman invasion. The existence also of the remains of the Bison (*Bison priscus*) [BISON] in the Tertiary Beds of Great Britain have also served to confuse this question. As this question is not yet perhaps generally regarded as settled, we shall give the opinions of some of those who have written on the subject.

Colonel Hamilton Smith, who appears to have taken considerable pains in investigating the history of the *Ruminantia* generally, and of the Bovine family particularly, places the fossil species (*Bos primigenius*, Bojanus and Owen) under *Bos* (*Taurus*) *Urus*, considering the wild cattle of Chillingham and other parks as the white variety.

Mr. Swainson, in his 'Classification of Quadrupeds,' observes that all writers agree that the large skulls of oxen found in the more recent formations belonged to a formidable race of these animals which existed in Britain in a wild state; that they belonged without doubt to the species named *Urus* by Cæsar and other ancient writers; and that these skulls not only possess a specific distinction, but exhibit the type of a form essentially different from that of the Domestic Ox. "All these skulls," he continues, "are nearly one-third larger than those of the *Bos Taurus*; they are square from the orbits to the occipital crest, and somewhat hollow at the forehead. The horns, placed at the side of the above crest, show a peculiar rise from their roots upwards; then bending outwards, and then forwards and inwards. No domestic races show this turn; but numerous specimens of inferior sizes, found fossil in the Cornish mines, have this shape, and the wild bull of Scotland, the only example of this type now known to exist, retains it. The domestic oxen, on the contrary, of whatsoever country or breed they may be, have the square concave forehead, with the horns rising from the ends of the frontal ridge. . . . It appears then that the ancient *Urus*, or Wild Bull, was a perfectly wild, savage, and untameable animal. Not only does every account handed down from remote antiquity assure us of this, but it is even verified by the only living example of this form we possess, the *Bos Scoticus*, still preserved in one or two of the northern parks. Although domesticated so far as to live within such precincts without absolute unprovoked violence to its keepers, it retains essentially all the savage characters ascribed to the more powerful species mentioned by the ancients. Like that also it possesses when at a mature age a kind of mane about two inches long, and its throat and breast are covered with coarse hair. These characters, which are never found in the domesticated breeds of oxen, were no doubt much more highly developed in the ancient *Urus*. The second type is the domestic ox; the external characters of which, to use the words of Colonel Smith, are 'absolutely the same as the fossil *Urus*, and the wild breeds differ only in the flexure of the horns.' But though these two types come so near each other in external appearance, nothing can be more different than their moral character; the *Urus*, wild, savage, and untameable, remains with all these propensities unimpaired and undiminished from the period of its first creation down to the present day. The other, tame, harmless, and enduring, has voluntarily submitted to the service of man from the most remote antiquity, and seems to have been a companion of the earliest inhabitants of the earth."

The allusion here to the *Bos Scoticus*, the name for the Chillingham and other wild cattle of this country, is hardly correct. Mr. Vasey, a recent observer, says, in his 'Ox-Tribe,' that they do not exhibit more wildness than most domesticated animals when allowed to roam without restraint; and that their young, when properly reared, are as docile as those of the ordinary domestic cattle. Nor do they possess a mane, as has been frequently asserted. The wild cattle breed with the domestic cattle. The cow goes the same period with young. They have the same number of ribs, and even their white colour at Chillingham is the result of the destruction by order of the owner of all spotted calves that are produced. The following account is given by Mr. Culley, in Bewick, and, as an early description of these animals, is interesting; but it is evidently highly coloured, and has misled those who have relied upon it:—

"Their colour is invariably of a creamy white, muzzle black; the whole of the inside of the ear, and about one-third of the outside, from the tips downwards, red; horns white with black tips, very fine and bent upwards; some of the bulls have a thin upright mane, about an inch and a half or two inches long. At the first appearance of any person they set off in full gallop, and at the distance of two or three hundred yards make a wheel round, and come boldly up again, tossing their heads in a menacing manner: on a sudden they make a full stop, at the distance of forty or fifty yards, looking wildly at the object of their surprise; but upon the least motion being made, they all again turn round and fly off with equal speed, but not to the same distance; forming a shorter circle and again returning with a bolder and more threatening aspect than before, they approach much nearer, probably within thirty yards, when they make another stand, and again fly off; this they do several times, shortening their distance and advancing nearer till they come within ten yards, when most people think it prudent to leave them, not choosing to provoke them further; for there is little doubt but in two or three turns more they would make an attack. The mode of killing them was perhaps the only modern remains of the grandeur of ancient hunting. On notice being given that a wild bull would be killed on a certain day, the inhabitants of the neighbourhood came armed with guns, &c., sometimes to the amount of a hundred horse, and four or five hundred foot, who stood upon walls or got into trees, while the horsemen rode off the bull from the rest of the herd, until he stood at bay, when a marksman dismounted and shot. At some of these huntings twenty or thirty shots have been fired before he was subdued. On such occasions the bleeding victim grew desperately furious from the smarting of his wounds and the shouts of savage joy that were echoing from every side; but from the number of accidents that happened this dangerous mode has been little practised of late years, the park-keeper alone generally shooting them with a rifled gun at one shot. When the cows calve they hide their calves for a week or ten days in some sequestered situation, and go and suckle them two or three times a day. If any person come near the calves, they clap their heads close to the ground, and lie like a hare in form to hide themselves: this is a proof of their native wildness, and is corroborated by the following circumstance that happened to the writer of this narrative, who found a hidden calf, two days old, very lean and very weak. On stroking its head it got up, pawed two or three times like an old bull, bellowed very loud, stepped back a few steps, and bolted at his legs with all its force; it then began to paw again, bellowed, stepped back, and bolted as before; but knowing its intention, and stepping aside, it missed him, fell, and was so very weak that it could not rise, though it made several efforts. But it had done enough, the whole herd were alarmed, and coming to its rescue obliged him to retire; for the dams will allow no person to touch their calves without attacking them with impetuous ferocity. When any one happens to be wounded, or is grown weak and feeble through age or sickness, the rest of the herd set upon it and gore it to death. The weight of the oxen is generally from forty to fifty stones the four quarters; the cows about thirty. The beef is finely marbled and of excellent flavour. Those at Burton-Constable in the county of York were all destroyed by a distemper a few years since. They varied slightly from those at Chillingham, having black ears and muzzles, and the tips of their tails of the same colour: they were also much larger, many of them weighing sixty stones; probably owing to the richness of the pasturage in Holderness, but generally attributed to the difference of kind between those with black and with red ears, the former of which they studiously endeavour to preserve. The breed which was at Drumlanrig in Scotland had also black ears."

Mr. Bell ('British Quadrupeds,' 1839—the 'Ox'), after referring to Griffith's ed. of Cuvier for Colonel Hamilton Smith's interesting and learned dissertation upon the mythology and ancient history of the Ox, says, "Whether the ox exist now or has existed within the range of sound historical testimony, in its original state, or whether, as in the case of the horse, all the instances of the occurrence of wild oxen of this species now on record have not been derived from the domestic race, fortuitously escaped from servitude and become wild, is a question which it is difficult if not impossible satisfactorily to solve. The ancient accounts of the *Urus*, or Wild Ox, declare it to have been an animal of enormous size and great fierceness; and the horns are described as being large, spreading, and acute. In this country and in many parts of the Continent have occurred numerous fossil bones of oxen, with large horns, having the form and direction of those of certain breeds only of our present cattle, particularly of such as are most wild; as for instance the celebrated wild white oxen of Craven, of Chillingham Park, and of Scotland (the *Bos Scoticus* of some authors). I cannot but consider it as extremely probable that these fossil remains belonged to the original wild condition of our domestic ox, an opinion which Cuvier appears to have entertained, who calls the skulls 'Crânes semblables à ceaux d'un bœuf domestique.' They are found only in very recent deposits, frequently in caverns mingled with the remains of various other animals, as in the celebrated cave of Kirkdale, and in different parts of Cornwall and of Devonshire. I have several teeth and some fragments of bones from Kent's Hole, in the latter county, where they were found in the same mass with the remains of the elephant, the rhinoceros, the deer, the bear, and the hyæna. Cuvier however considers that they existed after the destruction of the latter species. It has indeed been attempted to prove that the ancient remains alluded to, together with the Chillingham and Scottish breed, belong to a distinct specific type from the common domestic ox; and some modifications of structure have been cited in proof of this opinion. It does not appear to me however that these modifications are of sufficient value to constitute specific distinction, as they appertain only to parts which are very variable in particular breeds of the domestic cattle; they are, some slight differences in the form and direction of the horns, and the existence in old bulls of a short rudimentary mane and some hair upon the breast. Now, there is certainly no point of sufficient importance to form a specific distinction, even were the form of the horns less variable than they are in our domestic oxen. We require yet a series of well-authenticated and well-directed experiments on the intermixture of the Scottish or Chillingham cattle with the domestic breeds, and the fertile or infertile character of the progeny; which, if the views I have so repeatedly stated be correct, would at once decide the question. Even Colonel Smith himself, a high authority in these matters, although he urges the specific distinction of the two animals, says, 'The character of the domestic oxen is absolutely the same as the fossil, and the wild breeds differ only in the flexure of the horns and external appearance, occasioned by the variations of climate, food, and treatment.' But, it may be asked, do variations of climate, food, and treatment produce specific distinctions? And yet this distinction is, as I have just stated, held both by Colonel Smith and Mr. Swainson. Upon the whole I cannot but believe that the fossil bones belonged to the original stock of our domestic ox, and that the wild white cattle (the *Bos Scoticus* and *Urus Scoticus* of the authors just named) approach so near to it as to leave it a matter of doubt, not whether they all belong to the same species, but whether this breed be the actual remnant of that original stock, or the descendants of domesticated individuals which have resumed in a great degree their wild character from having ceased through many generations to feel the effects of human domination."

In his 'History of British Fossil Mammals,' speaking of the *Bos primigenius*, Professor Owen says—

"Of this species we have the same examples, short of the still preserved living animal, as of the bison; and it is most satisfactory to find such proof of the general accuracy of the brief but most interesting indications of the primitive mammalian fauna of those regions of Europe, which may be supposed to have presented to the Roman cohorts the same aspect as America did to the first colonists of New England.

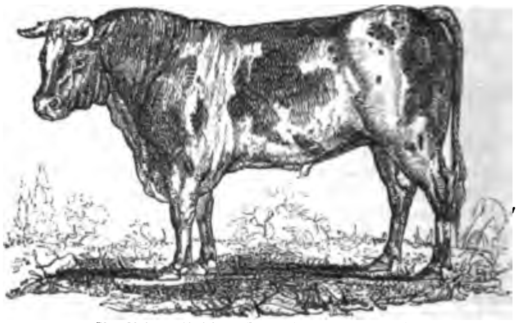
"In the same deposits and localities which have yielded remains of the Aurochs (*Bison priscus*) there have been found the remains of another bovine animal, its equal or superior in size, but differing from the Aurochs, precisely as the Roman poets and historians have indicated, by the greater length of its horns.

"The persistent bony supports or cores of the horns likewise demonstrate by their place of origin and curvature, the sub-generic distinction of the great Urus from the bison, and its nearer affinity to the domestic ox; whence we may infer that it resembled the ox in the close nature of its hairy covering, which would make the shaggy coat and the mane of the Aurochs more remarkable by comparison. It is much to be regretted, for the interests of zoology, that the great Hercynian Uri have been less favoured than their contemporary *Bisontes jubati* in the progress of human civilisation, and that no individuals now remain for study and comparison like the Aurochs of Lithuania.

"My esteemed friend Professor Bell, who has written the 'History of Existing British Quadrupeds,' is disposed to believe with Cuvier and most other naturalists, that our domestic cattle are the degenerative descendants of the great Urus. But it seems to me more probable that the herds of the newly conquered regions would be derived from the already domesticated cattle of the Roman colonists of those 'boves nostri,' for example, by comparison with which Cæsar endeavoured to convey to his countrymen an idea of the stupendous and formidable Uri of the Hercynian forests. The taming of such a species would be much more difficult, and his certain mode of supplying the exigencies of the agriculturist, than the importation of the breeds of oxen already domesticated and in use by the founders of the new colonies. And that the latter was the chief if not the sole source of the ox of England, when its soil began to be cultivated under the Roman sway, is strongly indicated by the analogy of modern colonies. The domestic cattle, for example, of the Anglo-Americans have not been derived from tame descendants of the original wild cattle of North America; there, on the contrary, the bison is fast disappearing before the advance of the agricultural settlers, just as the Aurochs and its contemporary the Urus have given way before a similar progress in Europe.

"With regard to the great Urus I believe that this progress has caused its utter extirpation, and that our knowledge of it is now limited to deductions from its fossil or semi-fossil remains."

There seems to be little doubt then that the Fossil Ox (*Bos primigenius*) is entirely extinct, and that all our domestic and wild cattle belong to *Bos Taurus*.



English Bull (*Bos Taurus*), short-horned.

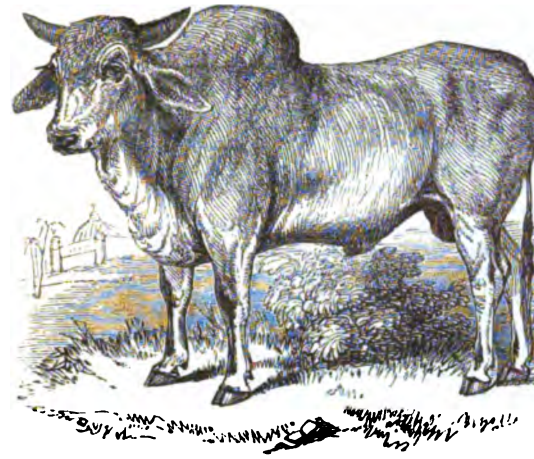
B. Indicus, the Zebu, has the following specific characters:—Forehead convex; withers with a more or less large fleshy hump; dewlap deep, waved; the upper part of the rump shelving very much. Amongst scientific writers this animal has had many designations. It is the *Bos Indicus* of Linnæus, the *Bos domesticus* of Hodgson, the *Bos Taurus Indicus* of Fischer, *Bos Zebu* of J. Brookes, *Bos Taurus Zebu* of Wagner. Varieties or particular breeds have also obtained a number of distinct appellations,—Little Indian Buffalo, Indian Bull, Great Indian Ox, Gun Bullock, Sacred Bull, Madras Ox, Madhu Givi Oxen, Seringapatam Oxen, Two-Humped Zebu, Hornless Zebu, Bucharian Ox, Nepaul Ox, and Javanese Cow.

The domesticated Zebus vary much in their size and the direction of their horns, but are generally distinguished by a fatty elevated hump below the neck and over the withers.

The horns of some are short and suberect (Indian Ox), in others comparatively long and pointed backwards, with an inclination to curve inwards, as in the more common breeds (Zebu). The ears of some are of ordinary size and position (Zebu); in others pendulous (Indian Ox). The dewlap is more or less developed, in some very largely. Their colour varies from a light ashy-gray to a milk-white, and their size from the stature of an ordinary bull to that of a large mastiff. Many of these varieties may be seen in the gardens of the Zoological Society in the Regent's Park. The limbs of all are deer-like and elegant. They "are spread," says Mr. Bennett, "over the whole of southern Asia, the islands of the Indian Archipelago, and the eastern coast of Africa, from Abyssinia to the Cape of Good Hope."

In many parts of India the Zebu is placed under the saddle or harnessed to a carriage, and travels at an easy rate. It must have lost much of its fleetness, if the more ancient writers are to be credited; for they speak of 50 or 60 miles a day as its usual pace, whilst the moderns only allow it 20 or 30 miles. The beef is not bad, but is neither so sweet nor so good as that of the common Ox, the hump always excepted, which when well cooked is very delicate.

The Zebus bear a charmed life among the Hindoos, who venerate them and hold their slaughter to be a sin; though they do not object to work them. There are however some particularly sanctified Zebus, who lead an easy life, wandering about the villages at their ease, and taking their pleasure and their food where they list, if not prevented by the contributions of the devout.



Indian Ox, or Zebu (*Bos Indicus*) large variety.

They may be seen every day wandering at large in the streets of Calcutta eating rice, grain, and flour in the bazaar; and the utmost a native does when he sees them honouring his goods too much, is to urge them by the gentlest hints to taste some of the good things on his neighbour's stall. The superstitious regard for these animals accounts for the use of cow-dung in the representation of objects on the walls. This substance is also collected and dried and used for cooking food, apparently with a religious object in view, as it is used in Calcutta where wood is in abundance.

Mr. Bennett in his work on the 'Gardens and Menagerie of the Zoological Society,' has expressed an opinion that the Zebu is but a variety of the common Ox, but Mr. Vasey observes that the number of the vertebræ and the period of gestation both differ from that of the Ox.

B. Dante, the Dante. Face rather narrow; forehead very flat, with the horns on the side of the high occipital ridge; withers with a small but distinct hump. This animal is not so well known as the preceding. It is the *Bos elegans et parvus Africanus* of Belon; *Juvenca sylvestris* of Alpinus, *Bos Bubalus Africanus* of Brisson; Salam Buffalo, Dwarf Bull, Egyptian Zebu, of various writers. Long in his 'Egypt' says that this animal agrees better with the humped cattle on the ancient Egyptian tombs than with the Zebus. Mr. Whitfield brought a pair of these animals to England. The bull is still living in the gardens of the Zoological Society. He is white, with a few brown specks on the head. The female is yellow-brown, with a very narrow head.

Bubalus. Horns depressed or subtrigonal at the base, inclining upwards and backwards, conical, and bending upwards at the tip on a plane rather in front of the occipital ridge; forehead rather transverse, convex, shelving before and behind; the intermaxillaries elongate, extending back, and between the nasal and cheek-bones; teats in a cross series, the outer one rather before the others.

B. brachycerus, the Zamouse, or Bush Cow. Forehead flat; horns short, thick, depressed at the base; ears very large, strongly fringed on the edge, and with two diverging strongly-fringed lines within; fur short, close, brown. This is the *Bos Bubalus* of Children, and *Bos Caffer* of Ruppell. This animal, according to Dr. Gray, who has described one in the Surrey Zoological Gardens, differs from the buffalo and all other oxen in several important characters, especially in the large size and particular bearding of the ears, and in being totally deficient of any dewlap. It also differs from the buffalo in its forehead being flatter, and quite destitute of the convex form, which is so striking in all the varieties of that animal.

B. Buffalus, the Buffalo. Forehead convex, rounded; horns large, flattened at the base, black on the plane of the face, bent down and recurved at the tip; ears quite half the length of the head, slightly ciliated; fur rough, irregular, bristly, often very far apart, on the face before the eyes two-rowed. This animal is the *Bos Bubalus* of Brisson; the *Bos Bubalis* of Linnæus; Buffle, French; and Büffel, German. A variety was called by Shaw *Bos Arnee*, which is the *Bubalus Arna* of Hodgson.

Mr. B. H. Hodgson, who has by his labours thrown so much light upon Indian zoology, says of the Indian Buffaloes: "The Bhainsa, or Tame Buffalo, is universal in India. The Arna, or Wild Buffalo, inhabits the margins rather than the interior of primæval forests. They never ascend the mountains, and adhere like the rhinoceros to the most swampy sites of the district they inhabit. There is no animal upon which ages of domesticity have made so small an

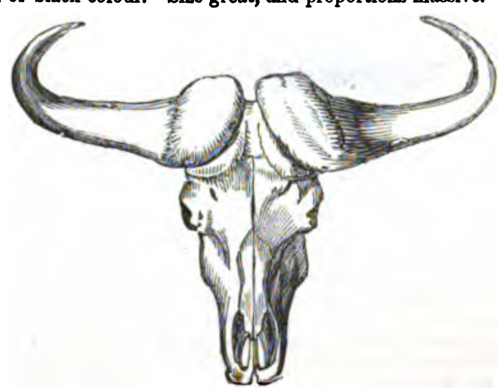
Skull and Horns of the Arnee.

impression as upon the Buffalo, the tame being still most clearly referrible to the wild ones at present frequenting all the great swampy jungles of India. In the wilderness as in the cow-house there is a marked distinction between the long (*macrocerus*) and curved-horned (*spirocerus*) buffaloes.

"The Arna ruts in autumn, gestating ten months, and produces one or two young in summer. It lives in large herds, but in the season of love the most lusty males lead off and appropriate several females, with which they form small herds for the time. The Wild Buffalo is fully one-third larger than the largest tame breeds, measuring 10½ feet from snout to vent, and 6 or 6½ feet high at the shoulders, and is of such power and vigour as by his charge frequently to prostrate a well-sized elephant. It is remarkable for the uniform shortness of the tail, which does not extend lower than the hock, for the tufts which cover the forehead and knees, and lastly for the great size of its horns. They are uniformly in high condition, so unlike the leanness and angularity of the Domestic Buffalo, even at its best."

The Buffalo has been introduced into Italy, where it is made very useful as a beast of burden, its great strength giving it an advantage over horses and ordinary oxen, in the marshy and swampy districts where the roads are frequently two or three feet deep with mud. A singular fact with regard to them is, that they thrive best in those districts which are most infected with malaria. The Manilla Buffalo is also a variety of this species.

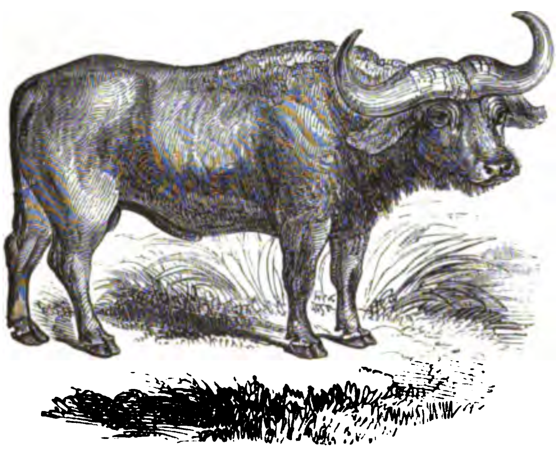
B. Caffer, the Cape Buffalo. Horns black, extremely large, and flattened at their base, where they cover the front, having a direction from within outwards and downwards, and then again elevated at their point; ears rather pendant, and covered by the horns; dewlap large and pendant; skin with harsh hairs an inch long of a deep brown or black colour. Size great, and proportions massive.



Skull of Cape Buffalo (*Bubalus Caffer*).

This is the *Bos Caffer* of Sparrmann and other naturalists. Also known by the name of the Cape Ox. It is a native of South Africa.

The Cape Buffalo congregates in large herds. Thunberg and his companions came suddenly upon a mass of 500 or 600, which were grazing in a plain skirted by a wood. The beasts did not see the intruders till they came within three hundred paces, when the whole herd lifted their heads and stood at a gaze. After a while the buffaloes stooped their heads again to feed, and six of the party (three Europeans and three Hottentots), who carried muskets and were accompanied by others armed with javelins, marched up to them within forty paces, when the herd again lifted their heads and were saluted with a volley, which instantaneously dispersed them, leaving their wounded to follow as they could. One of these, an old bull, made the travellers fly, but fell before he reached the wood. This beast was very thick in the body, with short legs, of a dark-gray colour, and almost destitute of hairs. But if a herd may be approached thus safely, a single outlying bull or a wounded one appears to be a most formidable antagonist. The author last quoted was botanising in a wood rather behind his companions, when Auge, the gardener of the expedition who went first, suddenly encountered a large old male buffalo, which was lying down quite alone in a spot of a few square yards free from bushes. No sooner did the beast discover the poor gardener than he rushed upon him with a terrible roar. Auge turned his horse short round behind a great tree, so as in some measure to get out of the sight of the buffalo, which now charged straight towards the sergeant who followed, and gored his horse in the belly so terribly that it instantly fell on its back, with its feet turned up in the air and its entrails hanging out, in which state it lived almost half an hour. In the meantime the gardener and sergeant had climbed up into trees for safety. Thunberg intent upon his botanising, and with his ears filled with the rustling of the branches in the narrow pass where he was against his saddle and baggage, heard nothing of all this, though so near. But the buffalo had not done yet. The sergeant had brought two horses with him for his journey. One of them, as we have seen, had been already dispatched; the other now stood just in the way of the buffalo as he was going out of the wood. As soon as the infuriated beast saw this second horse he attacked it so furiously that he not only drove his horns into the horse's breast and out again through the very saddle, but threw it to the ground with such violence that it instantly expired, and all the bones of its body were broken. Just as the buffalo was thus engaged with this last horse, Thunberg came up to the opening and beheld the frightful scene. The wood was so thick that he had neither room to turn his horse round, nor to get on one side; he therefore was obliged to take refuge upon a tree into which he climbed, leaving his horse to its fate. But the buffalo had satiated his rage, or did not distinctly see the new object, for after his second exploit he turned suddenly round and went off. Thunberg found his companions half dead with fear, indeed the gardener was so affected that he could scarcely speak for some days after, and the two surviving horses were discovered shivering with fear, and unable to make their escape. ('Travels.')



Cape Buffalo (*Bubalus Caffer*).

Sparrmann ('Voyage to the Cape,' vol. ii.) gives a graphic description of the shooting of one, and of the unconquerable spirit of the animal even in death. We can only find room for the final act of the tragedy. "During his fall, and before he died," writes Sparrmann, "he bellowed in a most stupendous manner; and this death-song of his inspired every one of us with no small degree of joy on account of the victory we had gained: and so thoroughly steeled frequently is the human heart against the sufferings of the brute creation, that we hastened forward in order to enjoy the pleasure of seeing the buffalo struggle with the pangs of death. I happened to be the foremost amongst them; but think it impossible ever to behold anguish, accompanied by a savage fierceness, painted in stronger colours than they were in the countenance of this buffalo. I was within ten steps of him, when he perceived me, and, bellowing, raised himself suddenly again on his legs. I have had reason to believe since, that I was at the time very much frightened; for before I could well take my aim I fired off my gun, and the shot missed the whole of his huge body, and only hit him in the hind legs, as we afterwards discovered by the size of the ball. Immediately upon this I fled away like lightning in order to look out for some tree to climb up into." The same author gives the following as the measurement of a buffalo:—Length 8 feet, height 5½ feet, and the fore legs 2½ feet long: the larger hoofs 5 inches over. The distance between the points of the horns he states to be frequently 5 feet. They are black, and the surface, to within about a third part of them, measured from the base, is very rough and craggy. A very lively account of a buffalo-hunt is also given by Bruce. He guesses the weight of a bull that he assisted in killing at nearer 50 than 40 stones. The horns, from the root, following the line of their curve, were about 52 inches, and nearly 9 inches where thickest in circumference.

The Cape Buffalo delights in wallowing in the mire, and when heated by hunting throws himself into the first water he reaches.

The flesh is described by some as good and high flavoured, by others as ill-grained and coarse. The difference in these accounts is probably to be traced to the sex, age, and condition of the animals eaten. The rhinoceros-like hide is much sought after for harness, &c.

The horns of the domesticated oxen of the Cape grow to an enormous size.

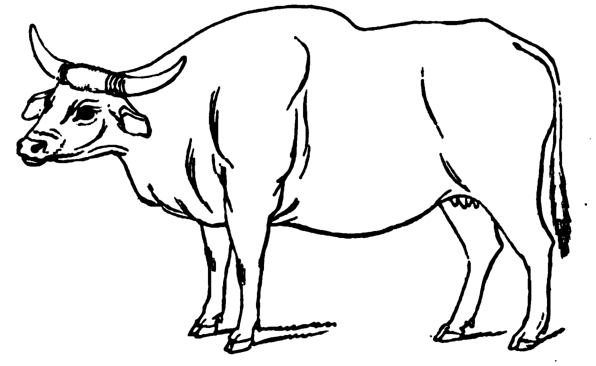
Anoa. Horns subtrigonal, nearly parallel, round at the tip, depressed at the base, and slightly keeled on the inner edge, straight nearly on the plane of the face on the hinder edge of the frontal ridge. *A. depressicornis*, the Anoa. Reddish-brown, with three small white spots on the cheek. Male black, spot on cheek white. Female and young brownish-black. This animal was first described by Colonel H. Smith from a head and horns in the College of Surgeons. [ANOA.] He regarded it as an antelope. Since then Quoy and Gaimard have figured the whole animal, and a specimen exists in the British Museum. This was brought from Celebes.

Bibos. Horns depressed at the base, directed outwards, posterior on the hinder ridge of the frontal bone, which is often very prominent, recurved at the tips. Withers high, keeled, supported by the spinous processes of the dorsal vertebræ, and suddenly lower behind. The intermaxillaries are short and triangular, and do not reach to the nasals. There are three species which Professor Sundevall regards as subvarieties of a variety of the common bull. *B. frontalis*, the Gayál. It is the *Bos frontalis* of Lambert; the *Bos Gayeus* of Colebrooke; Gavaya, Sansc.; Gavaï or Gayál, Hind.; Gobaygoru, Beng.; Gaujangalí, Pers.; Methana, Mountaineers (Cúcís, &c.) east of Silhet; Shiál, Mountaineers (Cúcís) east of Chatgaon; J'hongnua, Mugs; Núnec, Birmas; Gauvera, Ceylon.

It is nearly of the size and shape of the English bull. It has short horns, which are distant at their bases, and rise in a gentle curve directly out and up: a transverse section near the base is ovate, the thick end of the section being on the inside. The front is broad, and crowned with a tuft of lighter coloured long curved hair. The dewlap is deep and pendant. It has no mane nor hump, but a considerable elevation over the withers. The tail is short, the body covered with a tolerable coat of straight dark-brown hair; on the belly it is lighter coloured; and the legs and face are sometimes white. (Roxburgh.)

Dr. Buchanan states that the cry of the Gayál has no resemblance to the grunt of the Indian Ox; but a good deal resembles that of the buffalo. It is a kind of lowing, but shriller, and not near so loud as that of the European Ox. To this the Gayál, in Dr. Buchanan's opinion, approaches much nearer than it does to the buffalo. Mr. Macrae states that the Gayál is found wild in the range of mountains that form the eastern boundary of the provinces of Aracan, Chittagong, Tippera, and Silhet. The Cúcís, or Lunetas, a race of people inhabiting the hills immediately to the eastward of Chittagong, have herds of them in a domesticated state. The animal is called Gabay in the Hindoo 'Sástra,' but seems however to be little known beyond the limits of its native mountains, except to the inhabitants of the provinces above mentioned. The same author informs us that the Gayál is of a dull heavy appearance; but at the same time of a form that indicates much strength and activity, like that of the wild buffalo. Its disposition is gentle; even in the wild state on its native hills it is not considered dangerous, never standing the approach of man, much less sustaining his attack. The Cúcís hunt the wild ones for the sake of their flesh. The Gayál is a forest animal, and prefers the tender shoots and leaves of shrubs to grass; it never wallows in mud like the buffalo. It is domesticated by the Cúcís, but does not undergo any labour. The cow goes 11 (?) months with young, gives but little milk, and does not yield it long; but that little is remarkably rich, almost equalling cream, which it resembles in colour; the Cúcís however do not make any use of the milk, but rear the Gayáls entirely for their flesh and skins, of which last, or rather their hides, they form their shields. These domesticated herds roam at large in the forests near their village during the day, but return of their own accord at evening, being early taught to do this by being fed when young every night with salt, of which these animals are very fond. The Hindoos, in the province of Chittagong, will not kill this Gayál (their Gabay), which they hold in equal veneration with the cow, but they hunt and kill another Gayál (As'l Gayál or Seloï) as they do the wild buffalo. The form of the animal, and the way in which it carries its head, will be understood from the following figure, which is reduced from that by a native artist, prefixed to

Mr. Colebrooke's paper ('Asiatic Researches,' vol. viii.), to which we refer the reader for further interesting particulars.



The Gayâl (*Bibos frontalis*).

Mr. Bird proved that the Gayâl will breed with the common Indian bull. He brought a domesticated female Gayâl from Chittagong to Dacca, directed a common bull (of the breed Déswâli, a Zebu of the common kind found in the middle districts of Bengal), which the female received upon being blinded with a cloth thrown over her eyes. The offspring was a cow resembling mostly the Gayâl mother; and from that cow, impregnated by a bull of the same common breed, another cow was produced, which also had grown up, and was in calf by a common bull when Mr. Bird wrote his account. ('Asiatic Researches,' vol. viii.)

General Hardwicke gives a figure of the head of the true wild Gayâl, or as the natives term it, the Asseel Gayâl (a female), from the south-east frontier of Bengal. The space between the points of the horns was 14 inches.

Head of true or Asseel Gayâl, female (*Bibos frontalis*). South-east frontier of Bengal (from Hardwicke).

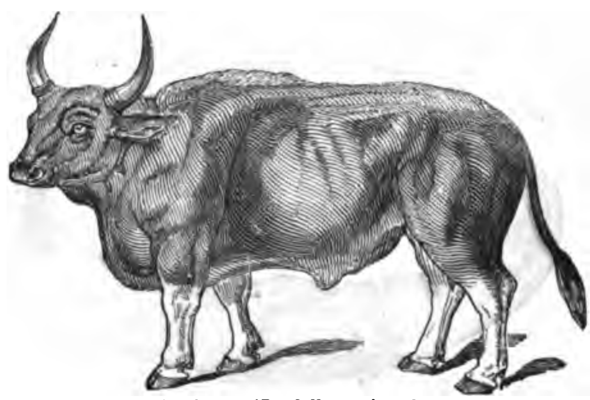
The Gyall (*Bos frontalis*, Lambert) is evidently not a distinct species.

Mr. Lambert observes that the hair of the hide is soft; there is no crest; the lower lip is white at the apex, and bristled with hairs. The band of the forehead, including the bases of the horns, is lead-colour; the horns themselves are pale. Length from the tip of the nose to the end of the tail 9 feet 2 inches; from the tip of the hoof of the fore foot to the top of the rising of the back 4 feet 1½ inches; from the tip of the hoof of the hind leg to the highest part of the rump 4½ feet.

Mr. Harris, in his letter to Mr. Lambert, after identifying his animal with Mr. Lambert's drawing, writes thus:—"The animal . . . which I have kept and reared these last seven years, and know by the name of the Gyall, is a native of the hills to the north-east and east of the Company's province of Chittagong, in Bengal, inhabiting that range of hills which separates it from the country of Aracan. The male Gyall is like our bull in shape and appearance, but I conceive not quite so tall; is of a blackish-brown colour; the horns short, but thick and strong towards the base, round which and across the frons the hair is bushy and of a dirty-white colour; the chest and forehead are broad and thick. He is naturally very bold, and will defend himself against any of the beasts of prey. The female differs little in appearance; her horns are not quite so large, and her make is somewhat more slender; she is very quiet, is used for all the purposes of the dairy, as also (I have been informed by the natives) for tilling the ground, and is more tractable than the buffalo. The milk which these cows give has a peculiar richness in it, arising, I should conceive, from their mode of feeding, which is always on the young shoots and branches of trees in preference to grass. I constantly made it a practice to allow them to range abroad amongst the hills and jungles at Chittagong during the day to browse, a keeper attending to prevent their straying so far as to endanger losing them. They do not thrive in any part of Bengal so well as in the aforementioned province and in the adjoining one, Tipperah, where I believe the animal is also to be found. I have heard of one instance of a female Gyall breeding with a common bull."

Head of Gyall (*Bos frontalis*). 'Linn. Trans.'

The Jungly-Gau, Bœuf des Jongles of M. Duvaucel, *Bos Sylhetanus* of F. Cuvier, is not a distinct species. Dr. Gray says that Duvaucel's drawing was taken from a hybrid specimen bred between a domestic Gyall and a Zebu. It was never alive in Paris, nor seen alive by M. Duvaucel.



Jungly-Gau (*Bos Sylhetanus*), male.

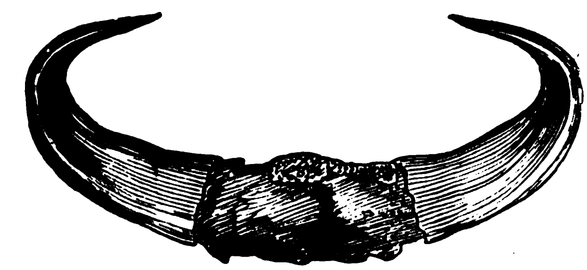
B. Gaurus, the Gour or Gaur. Hind hoof only half the size of the front hoof. Colour brown; legs white. This is the *Bos Gour*, Traill; *Bos Gaurus*, Col. Smith; *Bos aculeatus*, Cuvier.

Dr. Traill remarks that the only animal which appears to have affinity with the Gour is the *Bos Gavæus* of Colebrooke, but the very different form of its head, the presence of a distinct dewlap, and the general habit of the Gaijal or Gayâl, distinguish it from the Gour. Captain Rogers assured Dr. Traill that neither the descriptions in Mr. Colebrooke's communication nor the figure of the Gayal that accompanies them had any greater resemblance to the Gour than that general one which subsists between all the animals of this genus.

The size of the animal is considerable. Dr. Traill gives the dimensions of one not fully grown, which measured from tip of nose to end of tail 11 feet 11¾ inches; from the hoof to the withers 5 feet 11¾ inches; and from the withers to the sternum 3 feet 6 inches. "The limbs have more of the form of the deer than any other of the bovine genus."

The Gour, according to Captain Rogers, occurs in several mountainous parts of Central India, but is chiefly found in Myn Pât or Mine Paut, a high insulated mountain with a tabular summit, in the province of Sergojah, in South Bahar. "This table-land is about 36 miles in length by 24 or 25 miles in medial breadth, and rises above the neighbouring plains probably 2000 feet. The sides of the mountain slope with considerable steepness, and are furrowed by streams that water narrow valleys, the verdant banks of which are the favourite haunts of Gours. On being disturbed they retreat into the thick jungles of saul-trees which cover the sides of the whole range. The south-east side of the mountain presents an extensive mural precipice from 20 to 40 feet high. The rugged slopes at its foot are covered by impenetrable green jungle, and abound with dens formed of fallen blocks of rock, the suitable retreats of tigers, bears, and hyenas. The western slopes are less rugged, but the soil is parched, and the forests seem withered by excess of heat. The summit of the mountain presents a mixture of open lawns and woods. There were once twenty-five villages on Myn Pât, but these have been long deserted, on account of the number and ferocity of the beasts of prey. On this mountain however the Gour maintains his seat. The Indians assert that even the tiger has no chance in combat with the full-grown Gour, though he may occasionally succeed in carrying off an unprotected calf. The Wild Buffalo abounds in the plains below the mountains, but he so much dreads the Gour, according to the natives, that he rarely attempts to invade its haunts; and the hunting-party only met with three or four urnas on the mountain. The forests which shield the Gour abound however with Hog-Deer, Saumurs (Sambur Deer), and Porcupines." Captain Rogers, who furnished the above account, hunted the Gour in these wild and romantic retreats, and the animal, it appears, when hit faces his adversary, ready to do battle. A short bellow, imitated best by the syllables ugh-ugh, was the only cry heard from the Gour, and that not until after it had been wounded. August is the month in which the calf is generally dropped, and the period of gestation is twelve months. The large quantity of milk given by the cow is averred to be occasionally so rich as to cause the calf's death. The first year the native name of the bull-calf is Purórah; the cow-calf is called Paréeah; and the full-grown cow Goúrin. The Gours herd together in parties varying from ten to twenty; they browse on the leaves and tender shoots of trees and shrubs, and also graze on the banks of the streams. In the cold weather the saul-forests are their places of concealment, and the heats bring them out to feed in the green lawns and valleys. They do not it seems wallow in swamp and mire like the Buffalo. If the natives are to be credited the Gour will not brook captivity; even if taken very young the mountain-calf droops and dies. ('Edinburgh Philosophical Journal,' vol. xi.) Mr. Hodgson says it is exceedingly difficult to rear the Gour in confinement, although attempts are constantly being made by the Court of Nepaul.

General Hardwicke ('Zoological Journal,' vol. iii.) gives a figure of a pair of horns of the "*Bos Gour*, or wild bull of the mountainous district of Ramgurh, and table-land of Sirgoojahs," from which our cut is taken. The Gour to which they belonged was killed, as General Hardwicke believed, by the same hunting-party described by Captain Rogers, and they were presented to the General by the principal member of that party, Major Roughsedge. These horns were 15 inches between the tips.



Horns of Gour (*Bos Gour*). Hardwicke.

B. Banting, the Banting, or Sumatran Ox. Colour black, distinct large spot on rump, and legs white. This is the *Bos Banting* of Sir Stamford Raffles, *Bos leucoprymnus* of Quoy and Gaimard, *Bos Sondaicus* of Müller. It is a native of Java, Borneo, and Bali. There is a stuffed specimen and skeleton in the British Museum. Vasey in his 'Ox-Tribe,' has given a figure, and observes that it "bears some resemblance to the Gour, but in the skeleton of the Gour the sacrum consists of 5 vertebræ and the tail of 19, while in the skeleton of the Banting the sacrum consists of but 4 vertebræ and the tail of 18."

The next genus is *Bison*, of which there are two species, one European, the other American. [BISON.]

Poëphagus. Horns subcylindrical, curved outward on the front of the occipital ridge; nose hairy, with a narrow bald muffle between the nostrils; hoofs moderately thick, not dilated or expanded on the outer side, square and straight in front; tail moderate, not reaching to the hocks, and covered with long hair; teats four, narrowing behind. There is but one species, *P. grunniens*, the Yak, or Sarlyk. It is black; the back and tail often white. It is the *Bos grunniens* of Linnæus; *Bos Poëphagus* of Colonel H. Smith. It has also been called the Grunting Ox, the Grunting Bull, Svora-Goy, and Bubul. There are several varieties, called the Noble Yak, the Plough Yak, the Ghainorik, and Wild Yak. The following notices of the Yak are given in the Catalogue of the British Museum:—

"The Yaks dislike the warmth of summer, and hide themselves in the shade and water; they swim well; both sexes grunt like a pig. The calves are covered with rough black curled hair, like a curled haired dog. When of three months old they obtain the long hair on the body and tail. They willingly live with the common cows, and breed with them. The long white hairs of the tail are dyed red to form the tufts of hair on the caps of the Chinese. (Pallas, 'Act. Acad. Petrop.' 1777, 250.)

"The Yaks used for the plough are ugly and short-legged, and hold their heads very low. The beautiful long silky hair hanging from below the belly is almost if not entirely wanting in them, no less than the bushy tail, which their avaricious owners commonly cut off as an article of trade. They are guided by the nose. (Hoffmeister, 'Travels in Ceylon,' &c., 441.)

"The Yak-Ox used in riding is an infinitely handsomer animal. It has a stately hump, a rich silky hanging tail nearly reaching the ground, twisted horns, a noble bearing, and an erect head (p. 441). They are very shy, and kick with their hind feet, turning their head round perpetually, as if about to gore their riders (p. 443).

"Our broad-footed Yak-Ox is the beast with the thick silky white fringe under the body, and the bushy tail, both of which sweep the ground. . . . . As the steepness increased, these poor animals began to moan, or rather grunt, in the most melancholy manner, and this unearthly music gradually rose to such a violent rattle, that driven rather by its irksome sound than by the discomfort of our saddleless seat, we dismounted at the end of the first half-hour (p. 443)."

The Yak, or Chauri Gau, inhabits all the loftiest plateaus of high Asia, between the Altai and the Himalaya, the Belur Tag, and the Peling Mountains, and is found tame as well as wild. It cannot live on the south side of the Himalaya beyond the immediate vicinity of the snow, where the tribes of Cachars on the juxta-nivean regions of the sub-Himalayas rear large herds of it, and cross-breed with the common-ox. They rut in winter, and produce young in autumn. Cœcum simple, not sacked, nor banded, four inches long; ribs 14 or 15 pairs; true dorsal ridge confined to the withers; dewlap none. (Hodgson.)

Ovibos. Horns very wide, and touching each other at their base, then applied to the sides of the head, and having the points suddenly turned up; no naked muzzle, and no furrow on the upper lip; chanfrein narrow at the end, very square, resembling that of the sheep; ears short; limbs robust; tail very short.

O. moschatus, the Musk Ox. Size of Highland cattle; horns broad at origin, covering the brow and whole crown of the head, and touching each other throughout from before backwards. As each horn rises from its flatly convex base, it becomes round and tapering, curving directly downwards between the eye and the ear, until it reaches the angle of the mouth, when it turns upwards in the segment of a circle to above the level of the eye; for half its length it is dull, white, and rough, and beyond smooth and shining; near the point it becomes black.

Musk-Ox (*Ovibos moschatus*).

General colour of the hair brown, long, matted, and rather curled on the neck and between the shoulders, where it is rather grizzled, on the back and hips long but lying smoothly; on the shoulders, sides, and thighs it is so long as to hang down below the middle of the leg. There is on the centre of the back a mark of a soiled brownish-white, called by Captain Parry the saddle. On the throat and chest the hair is very straight and long, and together with the long hair on the lower jaw, hangs down like a beard and dewlap. The short tail is concealed by the fur of the hips. There is a large quantity of fine brownish ash-coloured wool or down among the hair covering the body. The hair on the legs is short, dull brownish-white, unmixed with wool. The hoofs are longer than those of the Caribou, but so similar in form that it requires the eye of a practised hunter to distinguish the impressions. In the cow, which is smaller than the bull, the horns are smaller, and their bases, instead of touching, are separated by a hairy space. The hair on the throat and chest is also shorter.

This is the Bœuf Musqué of Jeremie; Musk-Ox of Drage, Dobbs, Ellis, Pennant, Hearne, and Parry; *Bos moschatus* of Gmelin, Sabine, and Richardson (Parry's 'Second Voyage'); Mateeh Moostoos (Ugly Bison) of the Cree Indians; Adgiddah-yawseh (Little Bison) of the Chepewyans and Copper Indians; and Oomingmak of the Esquimaux.

The Barren Lands of America lying to the northward of the 60th parallel are the principal habitations of the Musk-Ox. Tracks were once seen by Hearne within a few miles of Fort Churchill, in lat. 59°; and he saw many in his first northern journey, in about lat. 61°. Richardson was informed that they do not now come so far to the southward even on the Hudson's Bay shore; and he adds that farther to the westward they are rarely seen in any numbers lower than lat. 67°, although, from portions of their skulls and horns which are occasionally found near the northern borders of the Great Slave Lake, he thinks it probable that they ranged at no very distant period over the whole country lying between that great sheet of water and the Polar Sea. He had not heard of their having been seen on the banks of Mackenzie's River to the southward of Great Bear Lake, and he states that they do not come to the south-western end of that lake, although they existed in numbers on its north-eastern arm. "They range," continues he, "over the islands which lie to the north of the American continent, so far as Melville Island, in lat. 75°, but they do not, like the rein-deer, extend to Greenland, Spitzbergen, or Lapland. From Indian information we learn that to the westward of the Rocky Mountains which skirt the Mackenzie there is an extensive tract of barren country, which is also inhabited by the musk-ox and rein-deer. It is to the Russian traders that we must look for information on this head; but it is probable that, owing to the greater mildness of the climate to the westward of the Rocky Mountains, the musk-ox, which affects a cold barren district, where grass is replaced by lichens, does not range so far to the southward on the Pacific coast as it does on the shores of Hudson's Bay. It is not known in New Caledonia nor on the banks of the Columbia, nor is it found on the Rocky Mountain ridge at the usual crossing places near the sources of the Peace, Elk, and Saskatchewan rivers. It is therefore fair to conclude that the animal described by Fathers Marco de Niça and Gomara as an inhabitant of New Mexico, and which Pennant refers to the musk-ox, is of a different species. The musk-ox has not crossed over to the Asiatic shore, and does not exist in Siberia, although fossil skulls have been found there of a species nearly allied, which has been enumerated in systematic works under the name of *Ovibos Pallantis*. The appearance of musk-oxen on Melville Island in the month of May, as ascertained on Captain Parry's first voyage, is interesting, not merely as a part of their natural history, but as giving us reason to infer that a chain of islands lies between Melville Island and Cape Lyon, or that Wollaston and Banks' Lands form one great island, over which the migrations of the animals must have been performed. The districts inhabited by the musk-ox are the proper lands of the Esquimaux; and neither the northern Indians nor the Crees have an original name for it, both terming it Bison with an additional epithet."

Sir. John Richardson, who had the best opportunities of coming at the truth, informs us that the country frequented by the Musk-Ox is mostly rocky, and destitute of wood, except on the banks of the larger rivers, which are more or less thickly clothed with spruce-trees. Their food, he tells us, is similar to that of the Caribou, grass at one season and lichens at another; and the contents of its paunch are eaten by the natives with the same relish as that with which they devour the 'nerrooks' of the Caribou. The dung is voided in round pellets, which are larger than those which come from the Caribou. The animal runs fast, short as are its legs, and hills and rocks are easily climbed by this ox of the northern deserts. One pursued by Richardson's party on the banks of the Coppermine River scaled a lofty sand-cliff with so great a declivity that they were obliged to crawl on hands and knees to follow the chase. The musk-oxen assemble in herds of from twenty to thirty, are in their rut about the end of August and beginning of September, and bring forth one calf about the latter end of May or beginning of June. Hearne accounts for the few bulls which are seen by supposing that they kill each other in their contests for the cows.

Richardson thus graphically describes the terror of a huddled herd:—"If the hunters keep themselves concealed when they fire upon a herd of musk-oxen, the poor animals mistake the noise for thunder, and, forming themselves into a group, crowd nearer and nearer together as their companions fall around them; but should they discover their enemies by sight, or by their sense of smell, which is very acute, the whole herd seek for safety by instant flight. The bulls however are very irascible, and particularly when wounded, will often attack the hunter, and endanger his life unless he possesses both activity and presence of mind. The Esquimaux, who are well accustomed to the pursuit of this animal, sometimes turn its irritable disposition to good account; for an expert hunter having provoked a bull to attack him, wheels round it more quickly than it can turn, and by repeated stabs in the belly puts an end to its life."

Mr. Jeremie, who first brought the animal into notice, carried some of its wool to France, where some stockings were made of it, said to have been equal to the finest silk. Sir John Richardson says that this wool resembles that of the Bison, but is perhaps finer, and would in his opinion be highly useful in the arts, if it could be procured in sufficient quantity. The same author informs us that when the animal is fat its flesh is well tasted, and resembles that of the Caribou, but has a coarser grain. The flesh of the bulls is high flavoured, and both bulls and cows when lean smell strongly of musk, their flesh at the same time being very dark and tough, and certainly far inferior to that of any other ruminating animal in North America. The carcass of a Musk-Ox weighs, exclusive of the offal, about three hundred-weight, or nearly three times as much as a Barren-Ground Caribou, and twice as much as one of the Woodland Caribou. (Richardson, 'Fauna Boreali-Americana.')

Budorcas. Muzzle hairy, with a small naked muffle only edging the nostrils; ears narrow, pointed. The fur consists of short, harsh, adpressed hair; the tail is short, very depressed, and hairy, like the tail of a goat; the head is large and heavy; the lips taper, and are clad with hair like sheep; the horns are round, smooth, lunate; they are nearly in contact on the top of the head; their direction is vertically upward, then horizontally outward, or to the sides, and then almost as horizontally backward; the limbs short and straight; the hoofs broad. The only species of this genus is the *B. taxicola*, the Takin. It is the *Nemorhædus* of Turner. It is an inhabitant of the Eastern Himalaya. It is called Takin by the Mishmis, and Ken by the Khamtis. There has been some difference of opinion as to the proper position of this animal, but we have followed Dr. J. E. Gray in placing it amongst the *Boveæ.*

Fossil Boveæ.

Remains of oxen and deer occur abundantly in the Tertiary Beds, with extinct species of existing genera of *Pachydermata*, such as the elephant, rhinoceros, hippopotamus, and horse, the extinct genus *Mastodon*, and large *Carnivora*, as the tiger, hyæna, and bear.

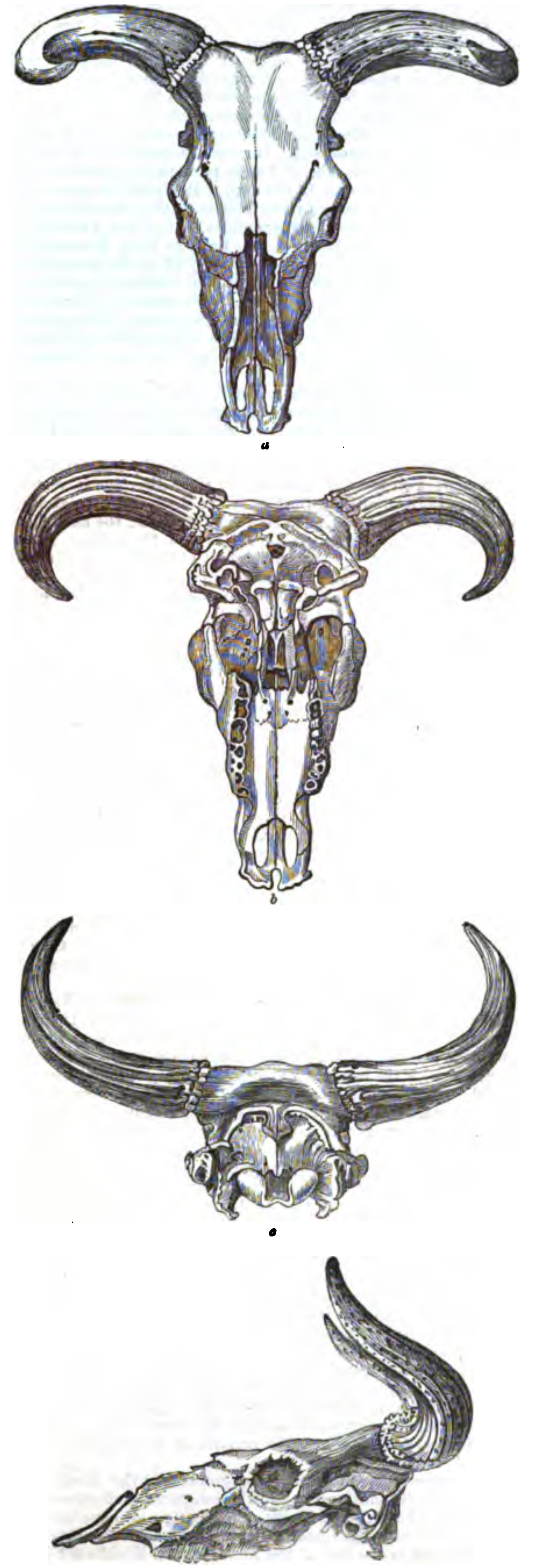
The most interesting of these is the *Bos primigenius.*

Mr. Woods, in a paper on some fossil bones found in Wiltshire, says, "It has occasioned some speculation among zoologists to appropriate to the large herbivorous animals, of which these skulls and scattered bones are now the only vestiges, their proper place in the system of nature. Cuvier however has fixed their characters, and has declared them to resemble the skulls of the present oxen so closely, that there can be little doubt of their having belonged to the stock from which the latter have all proceeded; these having however degenerated in size, and varied from them and from each other in minor points, owing to differences in climate, food, and other causes depending upon domestication, their magnitude is at least one-third greater than that of the largest breed of modern oxen, and their horns are much more massive."

We have seen that Professor Owen is of opinion that the *Bos primigenius* is a distinct species from the Common Ox. That it is distinct from the Bison or Aurochs was pointed out by Bojanus, at the same time we have abundant evidence that it existed in Great Britain with the Aurochs, with the bones of which its remains are found constantly associated. "The characters of *Bos primigenius*," says Professor Owen, "as contrasted with the *Bison priscus*, may be advantageously studied in the magnificent specimen of an entire skull, from near Athol in Perthshire, now in the British Museum. The concave forehead, with its slight median longitudinal ridge; the origin of the horns at the extremities of the sharp ridge which divides the frontal from the occipital regions; the acute angle at which these two surfaces of the cranium meet to form the above ridge, all identify this specimen with the *Bos primigenius* described by Cuvier, Bojanus, and Fremery. The cores of the horns bend at first slightly backward and upward, then downward and forward, and finally inward and upward, describing a graceful double curvature; they are tuberculate at the base, moderately impressed by longitudinal grooves, and irregularly perforated. The skull is one yard in length, and the span of the horn-cores is 3 feet 6 inches; but other British specimens of the *Bos primigenius* have shown superior dimensions of the bony supports of the horns. The breadth of the forehead between the horns is 10½ inches; from the middle of the occipital ridge to the back part of the orbit it measures 13 inches; the length of the series of the upper molar teeth is 6¼ inches, the breadth of the occipital condyles is 6 inches."

The difference between the *B. primigenius* and the domestic ox is seen most in its diminutive size and the comparative shortness as well as fineness of its horns. Specimens of *B. primigenius* have been found by Mr. John Brown in the London Clay of Clacton, on the Essex coast, by Mr. H. Woods in the bed of the Avon, by Mr. Wickham Flower in the London Clay of Herne Bay, and in many other places.

In addition to this species Professor Owen describes another fossil species which he has named *B. longifrons.* The first known specimen



Bos primigenius.

a, Front view; b, seen from below; c, seen from behind; d, profile. (Cuvier.)

of this species was obtained by John Hunter from a bog in Ireland, and was described by Professor Owen as a distinct species. Other specimens have since been brought to light. Dr. Robert Ball described, in the 'Proceedings of the Royal Irish Academy,' for 1839, remains of this species, obtained from considerable depths in bogs in Westmeath, Tyrone, and Longford. Remains of it have also been found in Essex, Middlesex, Devonshire, and other parts of England.

Of this species Professor Owen says, "It has been remarked in a former section that the domesticated descendants of a primitive wild race of cattle were more likely to be met with in the mountains than in the lowlands of Britain, because the aborigines, retaining their ground longest in the mountain fastnesses, may be supposed to have driven thither such domestic cattle as they possessed before the foreign invasion, and which we may presume therefore to have been derived from the subjugation of a native species of *Bos*.

"In this field of conjecture the most probable one will be admitted to be that which points to the *Bos longifrons* as the species which would be domesticated by the aborigines of Britain before the Roman invasion. Had the *Bos primigenius* been the source we might have expected the Highland and Welsh cattle to have retained some of the characteristics of their great progenitors, and to have been distinguished from other domestic breeds by their superior size and the length of their horns. The Kyloes and the Runts are, on the contrary, remarkable for their small size, and are characterised either by short horns, as in the *Bos longifrons*, or by the entire absence of these weapons."

The following fossil species have been also named:—*Bos trochocerus* (Hermann von Meyer), sub-Apennine beds; Buffle Fossile de Sibérie (Cuv.); *Bos* (*Bison?*) *bombifrons* (Harlan), Big-Bone-Lick, North America; *Bos Pallasii* (Dekay), *Bos moschatus fossilis* (?), *Bos canaliculatus* (?) (Fischer), Siberia and North America; *Bos velaunus* (Robert), Cussac, Haute Loire.

Abundant remains of the Ox were found by Captain Cautley in the Sewalik Mountains, at the southern foot of the Himalayas, between the Sutlej and the Ganges, partly lying on the slopes among the ruins of fallen cliffs, and partly in situ in the sandstone, in company with the bones of mastodon, elephant, rhinoceros, hippopotamus, hog, horse (comparatively scarce), elk, deer (several varieties); *Carnivora*, canine and feline (comparatively scarce); crocodile, gavial, *Emys*, *Trionyx*, and fishes. There were also portions of undescribed *Mammalia*.

BOVISTA, a genus of plants belonging to the natural order *Fungi*. This name was given it by Dillenius, and is a Latinised version of Bofist, its German name. In many parts of England its common name is Bullfice, and some writers call it Bull Puff-Ball. The genus Bovista was at one time included under *Lycoperdon* [LYCOPERDON], and the type of the genus, *Bovista gigantea*, was called by Linnæus *Lycoperdon Bovista*. The present *Lycoperdon Bovista* is the common or Wolf Puff-Ball. The difference between the genera is, that *Lycoperdon* has a single peridium, while *Bovista* has a double one.

The *Bovista gigantea*, Bull Puff-Ball, Frog's Cheese, and Bullfice, is interesting on account of the enormous size it attains. It has the form of a flattened ball, at first of a perfectly white colour. Specimens have been gathered measuring as much as 9 feet in circumference. When they have attained their full size, they begin to change colour; the external peridium cracks and peels off, the inner one also bursts at the apex. The interior is composed of a mass of tissue, which when young is white and moist, but at length becomes coloured and dry, and on being pressed emits a large quantity of powdery matter, which on being examined is found to consist entirely of sporules. On examining the mass inside it is found to consist of filaments which are mixed with sporules. Burnett says, "It is probably the smoke that arises from these fungi when burned, or some of their allies, the Lycoperdons, which forms the secret method advantageously employed by some persons who keep bees, in order to stupify the insects without killing them, while their hives are being robbed of all their honey." Gerarde says, "The common people use this fungus to kill or smoulder their bees." This practice has recently led to a curious discovery. Mr. H. B. W. Richardson, a surgeon, living at Mortlake, struck with the fact of its stupifying bees, was induced to try its effects upon other animals. Cats and dogs having been submitted to the action of smoke from the burning fungus, they were found to be narcotised in the same manner as if under the influence of ether or chloroform. A dog with a large tumour of the abdomen was narcotised, and whilst under its influence the tumour was removed, the animal giving no sign of pain. The narcotic principle seems to be formed during the process of combustion. Mr. Richardson found that it was capable of producing the death of animals. At present no advantage seems to be gained by administering this vapour instead of ether or chloroform; at the same time, it is an interesting fact in the history of the properties of plants. It is curious that this fungus is stated by Dr. Badham to be amongst those which are eatable. He says however that "no fungus requires to be eaten so soon after gathering as this," and adds, in a note, that he has been informed that it is sometimes served on state occasions at the Freemasons' Tavern. The best way of cooking it is "to cut it into slices, and fry these in egg and bread crumbs." In Mr. Richardson's experiments the dried fungus was employed. An Italian species, the *B. furfuracea*, which grows in great abundance on the heaths near Florence, is collected and sold in the markets, and, according to Micheli, is an esteemed article of food.

(Bischoff, *Medicinisch-Pharmaceutische Botanik; Burnett, Outlines of Botany; Association Medical Journal*, No. xxii.)

BOWERBANKIA, a genus of Ascidioid Polypes, or *Polyzoa*, belonging to the family *Vesiculariadæ*. It was named by Dr. Farre in honour of Mr. J. S. Bowerbank. The following character is given by Dr. Johnston in his 'British Zoophytes:'—Polypidom confervoid, matted or irregularly branched; the cells sessile, unilateral, irregular; the inflected portion with a spinous or filamentous rim. The polypes ascidian, with ten ciliated tentacula, and a strong gizzard. There is but one British species, *B. imbricata*. It has ovate or ovato-cylindrical cells, which are irregularly scattered on the polypidom in dense clusters. In its young state the polypidom is creeping and matted; but as it arrives at maturity it becomes arbuscular and erect. From this circumstance several names have been given to this species. It is found growing on the *Fuci* and corallines which are exposed at low water, and very generally distributed on the British coast. It grows in profusion on the chains of the steam-ferries at Southampton and Portsmouth. (Johnston, *British Zoophytes*.)

BOWSTRING-HEMP. [SANSEVIERA.]

BRACHE'LYTRA, a division of the order *Coleoptera*. The insects of this section (which answers to Linnæus's genus *Staphylinus*) may be distinguished by the elongate form of the body and the shortness of the wing-cases, which in most instances scarcely cover one-third of the length of the abdomen: their maxillæ are furnished with only one palpus. The apex of the abdomen is provided with two vesicles, which can be protruded at the will of the animal.

The habits of the *Brachelytra* are very various, but the greater number of the species are found in putrid animal or vegetable substances, upon which they feed; some are carnivorous. The shortness of the wing-cases probably allows of a greater flexibility in the body.

BRA'CHINUS, a genus of Insects belonging to the order *Coleoptera* and the section *Truncatipennes*. Generic characters:—Body oblong; head and thorax comparatively narrow, the latter generally somewhat of a truncated heart-shape; palpi and antennæ rather thick, the terminal joint of the former is slightly thicker than the basal joints, and has its apex truncated; mentum emarginate, and furnished with a small tooth-like process in the middle.

The *Brachini* possess a remarkable power of violently expelling from the anus a pungent acrid fluid, which, if the species be large, has the power of producing a discoloration of the skin similar to that caused by nitric acid. A loud report, considering the size of the insect, accompanies the expulsion of this fluid, which being discharged instantly evaporates.

About five species of the genus *Brachinus* have been found in this country, of which *B. crepitans* is the most common. It is found under stones, and occurs plentifully in chalky districts. This species is rather less than half an inch long; the head, thorax, and legs are of a yellowish-red colour; the wing-cases are greenish, or blue-black; the antennæ are reddish, with the third and fourth joints black. Many of the species of *Brachinus* resemble the above in colour. The species of the genus *Aptinus* (a genus very closely allied and differing chiefly in being apterous) are generally of a yellow colour, having four black spots on the elytra; the head and thorax are also often more or less suffused with black; they are likewise of a larger size for the most part, and abound more particularly in warm climates.

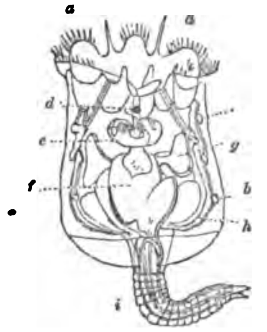
BRACHIOBDELLA. [ANNELIDA.]

BRACHIONÆA, a family of animals belonging to the order *Rotifera*. It embraces a large number of species formerly included under the genus *Brachionus*. It is distinguished from other families of *Rotifera* by the possession of two rotatory organs, and a lorica or shell. The wheels, or rotatory organs, are apparently composed of five parts, three of which are central, and two lateral; the latter of which alone form the true rotatory organs, the others being only ciliated frontal portions. Some have two setæ proceeding from the rotatory apparatus, as in *Synchæta*. The jaws are supplied with teeth and four muscles. They are supplied with biliary glands and ovary, male organs, and a contractile vesicle. Ehrenberg regards a red spot in them as indicative of the presence of a nervous system.

This family comprises the following genera:—*Pterodina, Anourella, Brachionus, Lepadella, Euchlanis, Dinocharis, Salpina, Colmella, Rutulus, Polyarthra.*

Ehrenberg makes seventeen genera; but Dujardin has reduced the number to ten, on account of the insignificant characters on which Ehrenberg's genera are founded.

Brachionus may be taken as a type of the family, and *B. urceolaris* is one of its most characteristic species. The genus *Brachionus* has a single eye (*d*), and a furcate foot or tail (*i*). It has a reddish colour, the shield smooth, with six short spines in front; the posterior extremity rounded. The jaws have each five teeth. Both male and female organs are present. It is a very common species in both brackish and fresh waters. Dujardin says he has constantly found it in the cisterns of the Jardin des Plantes, in Paris, and especially in that in which the aquatic plants grow. A few years ago the waters of the Serpentine, in Hyde Park, swarmed with this species, and it is very constantly present in the waters supplied to the cisterns of London for drinking purposes.



Brachionus urceolaris, highly magnified.

a, Rotatory cilia; *b*, internal branchial organs; *d*, eye; *e*, pharynx and jaws; *f*, stomach; *g*, appendages of stomach; *h*, ovary; *i*, tail.

BRACHIONUS. [BRACHIONÆA.]

BRACHIO'PODA, or *Brachiopodous Mollusca*, Cuvier's fifth class of Mollusks, the Palliobranchians (*Palliobranchiata* of De Blainville), being the first order of De Blainville's third class of Mollusks (*Acephalophora*).

This class, though comparatively low in the scale of creation, is interesting to the physiologist, and of considerable value to the geologist, who finds in the fossil forms no small portion of those natural medals which indicate the history of the stratification of our globe. Comparatively few of the species exist in the seas of the present day, but in former periods of the earth's surface they occupied the position now taken by the Lamellibranchiate *Mollusca*.

Cuvier, in his anatomy of *Lingula anatina*, in the 'Annales du Muséum,' first made known that organisation by which the mantle, in addition to its office of secreting the shelly defence of these bivalves, is made subservient to the circulating system. Instead of the branchiæ of the ordinary bivalves he found in the situation usually occupied by them two fringed and spirally-disposed arms, and that the branchiæ presented themselves on the internal surface of both lobes of the mantle in oblique parallel lines. He further found that these lobes were traversed by vessels of considerable size, which returned the blood from the organs of respiration, and that these branchial veins terminated in two symmetrical systemic hearts. Here was a new type of circulation, and to the mollusks which presented these interesting and important modifications he gave the name at the head of our article, significative of the fringed arms which in this class took the place of the foot or organ of progression in the cockle, &c.

Lamanon and Walsh had previously taken the analogous parts of *Terebratula* for branchiæ, and Pallas, who is not quoted by Cuvier, describes the arms of *Terebratula* with minuteness and accuracy, but considers them as branchiæ, and compares them to those of a fish.

De Blainville, in the 'Dictionnaire des Sciences Naturelles,' gives an account of the organisation of *Terebratula*. But both Cuvier and De Blainville were led into error in their attempts to trace out some parts of the organisation of *Terebratula*; and it was reserved for Mr. Owen, in his acute, accurate, and interesting paper 'On the Anatomy of the *Brachiopoda* of Cuvier, and more especially of the Genera *Terebratula* and *Orbicula*,' published in the 'Transactions of the Zoological Society of London' (vol. i. p. 145), and derived from the dissection of specimens brought to this country by Mr. Cuming and Captain James Ross, R.N., fully to investigate the subject so as to leave little or nothing to be desired upon the subject of the anatomy of *Lingula* and of the two genera last named. Our limits will not permit us to follow the learned author through his memoir, the whole of which, together with the beautiful illustrations that accompany it, is worthy of the most attentive perusal by the physiologist and zoologist. The following general remarks from Professor Owen's paper illustrate his views. It should be premised that the *Brachiopoda* are cryptandrous.

"On comparing together," says Mr. Owen, "the three genera of *Brachiopoda* above described, we find that although *Orbicula*, in the muscular structure of its arms and the proportion of the shell occupied by its viscera, is intermediate to *Lingula* and *Terebratula*, yet that in the structure of its respiratory organs, its simple alimentary canal, and its mode of attachment to foreign bodies, it has a greater affinity to the latter genus. The modifications that can be traced in the organisation of these genera have an evident reference to the different situations which they occupy in the watery element. *Lingula*, living more commonly near the surface, and sometimes where it would be left exposed by the retreating tide, were it not buried in the sand of the shore, must meet with a greater variety and abundance of animal nutriment than can be found in those abysses in which *Terebratula* is destined to reside. Hence its powers of prehension are greater, and Cuvier suspects it may enjoy a species of locomotion from the superior length of its pedicle. The organisation of its mouth and stomach indicates however that it is confined to food of a minute description; but its convoluted intestine shows a capacity for extracting a quantity of nutriment proportioned to its superior activity and the extent of its soft parts. A more complex and obvious respiratory apparatus was therefore indispensable, and it is not surprising that the earlier observers failed to detect a corresponding organisation in genera destined to a more limited sphere of action. The respiration indeed as well as the nutrition of animals living beneath a pressure of from 60 to 90 fathoms of sea water, are subjects of peculiar interest, and prepare the mind to contemplate with less surprise the wonderful complexity exhibited in the minutest parts of these diminutive creatures. In the stillness pervading these abysses they can only maintain existence by exciting a perpetual current around them in order to dissipate the water already loaded with their effete particles, and bring within the reach of their prehensile organs the animalcula adapted for their support. The actions of *Terebratula* and *Orbicula*, from the firm attachment of their shells to foreign substances, are thus confined to the movements of their brachial and branchial filaments, and to a slight divarication or sliding motion of their protecting valves; and the simplicity of their digestive apparatus, the corresponding simplicity of their branchiæ, and the diminished proportion of their soft to their hard parts, are in harmony with such limited powers. The soft parts in both genera are however remarkable for the strong and unyielding manner in which they are connected together. The muscular parts are in great proportion and of singular complexity, as compared with ordinary bivalves; and the tendinous and aponeurotic parts are remarkable for the similarity of their texture and appearance to those of the highest classes. By means of all this strength they are enabled to perform the requisite motions of the valves at the depths in which they are met with. *Terebratula*, which is more remarkable for its habitat, has an internal skeleton superadded to its outward defence, by means of which additional support is afforded to the shell, a stronger defence to the viscera, and a more fixed point of attachment to the brachial cirri.

"The spiral disposition of the arms is common to the whole of the brachiopodous genera whose organisation has hitherto been examined; and it is therefore probable that in that remarkable genus *Spirifer*, the entire brachia were similarly disposed, and that the internal calcareous spiral appendages were their supports. If, indeed, the brachia of *Terebratula psittacea* had been so obtained, this species would have presented in a fossil state an internal structure very similar to that of *Spirifer*.

"In considering the affinities of the *Brachiopoda* to the other orders of *Mollusca*, I shall compare them, in the first place, with the Lamellibranchiate Bivalves, to which they present the most obvious relations in the nature and forms of their organs of defence. To these they are in some respects superior. The labial arms are more complex prehensile organs than the corresponding vascular laminæ on either side of the mouth of the *Lamellibranchiata*. The whole muscular system is more complex; and the opening as well as the closing of the shell being regulated by muscular action, indicates a higher degree of organisation than where the antagonising power results from a property of the cardinal ligament, which is independent of vitality, viz. elasticity. With respect however to the respiratory organs, the modifications which these have presented in *Orbicula* and *Terebratula* show the Brachiopods to be still more inferior to the *Lamellibranchiata* than was to be inferred from the structure of the branchiæ in *Lingula*; and notwithstanding the division of the systemic heart, I consider that there is also an inferiority in the vascular system. Each heart, for example, in the *Brachiopoda* is as simple as in *Ascidia*, consisting of a single elongated cavity, and not composed of a distinct auricle and ventricle, as in the ordinary bivalves; for in these, even when, as in the genus *Arca*, the ventricles are double, the auricles are also distinctly two in number; and in the other genera, where the ventricle is single, it is mostly supplied by a double auricle. The two hearts of the *Brachiopoda*, which in structure resemble the two auricles in the above bivalves, form therefore a complexity or superiority of organisation more apparent than real. Having been thus led to consider the circulating as well as respiratory systems as constructed on an inferior plan to that which pervades the same important systems in the Lamellibranchiate Bivalves, I infer that the position of the *Brachiopoda* in the natural system is inferior to that order of *Acephala*.

"Among the relations of the *Brachiopoda* to the Tunicated *Acephala*, and more especially to the *Ascidiæ*, we may first notice an almost similar position of the extended respiratory membranes in relation to the mouth, so that the currents containing the nutrient molecules must first traverse the vascular surface of that membrane before reaching the mouth; the simple condition, also, to which the branchiæ are reduced in *Orbicula* and *Terebratula* indicates their close affinity to the *Ascidiæ*. But in consequence of the form of the respiratory membranes in the *Brachiopoda*, which is so opposite to that of the sacciform branchiæ of the *Ascidiæ*, the digestive system derives no assistance from that part as a receptacle for the food, and the superaddition of prehensile organs about the mouth became a necessary consequence. The Brachiopods again are stationary, like the *Ascidiæ*, and resemble the *Boltenia* in the pedunculated mode of their attachmant to foreign bodies.

"With the *Cirripeda* their relation is one of very remote analogy, their generative, nervous, and respiratory organs being constructed on a different type, and their brachia manifesting no trace of their articulate structure. In all essential points the *Brachiopoda* closely correspond with the Acephalous *Mollusca*, and we consider them as being intermediate to the Lamellibranchiate and Tunicate orders; not however possessing, so far as they are at present known, a distinctive character of sufficient importance to justify their being regarded as a distinct class of Mollusks, but forming a separate group of equal value with the *Lamellibranchiata*."

The structure of the shells of the *Brachiopoda* has been attentively studied by Dr. Carpenter, and the results of his investigations have been published in his 'Report on the Microscopic Structure of Shells,' made to the British Association.

The following is De Blainville's arrangement of the *Brachiopoda*, slightly modified:—

Shell Symmetrical.

Terebratula (Bruguières). Animal depressed, circular or oval, more or less elongated. Shell delicate, equilateral, subtriangular, inequivalve, one of the valves larger and more rounded (bombée) than the other, prolonged backwards into a sort of heel, which is sometimes recurved into a kind of hook-like process, and pierced at its extremity by a round hole, but more frequently divided into a fissure more or less large and of variable form. The opposite valve generally smaller, flatter, and sometimes operculiform. Of that complicated loop or internal support to which the arms are attached we shall presently speak at large. Hinge on the border, condyloid, placed on a straight line, and formed by the two oblique articulating surfaces of the one valve placed between the corresponding projections of the other. A sort of tendinous ligament comes forth from the hole or fissure above described, by which the animal fixes itself to submarine bodies.

The following is Mr. Owen's description of the peculiar, complex, and extremely delicate testaceous apparatus, sometimes called 'the carriage-spring' by collectors, attached to the internal surface of the imperforate valve:—

"The principal part of this internal skeleton, as it may be termed, consists of a slender, flattened, calcareous loop, the extremities of which are attached to the lateral elevated ridges of the hinge; the crura of the loop diverge, but again approximate to each other as they advance for a greater or less distance towards the opposite margin of the valve; the loop then suddenly turns towards the perforate valve, and is bent back upon itself for a greater or less extent in different species. When the loop is very short and narrow, as in *T. vitrea*, Brug., there is but a small tendency towards a reflected portion; but where the loop is of great length and width, as in *T. Chilensis*, Brod., *T. dorsata*, Lam., and *T. Sowerbii*, King., the reflected portion is considerable. The loop, besides being fixed by its origins or crura, is commonly attached to two processes going off at right angles from the sides, or formed by a bifurcation of the extremity, of a central process, which is continued forwards to a greater or less extent from the hinge; but it is sometimes entirely free, except at its origins, as, for example, in *T. vitrea*. This reflected loop, forming two arches on either side the mesial plane, towards which their concavities are directed, I have figured as it exists in *T. Chilensis* and *T. Sowerbii*. It is represented of a similarly perfect form in *T. dentata*, by M. De Blainville in his 'Malacologie;' and the same apparatus in *T. dorsata* is very well figured by Chemnitz, by Sowerby, and more recently by G. Fischer de Waldheim. A similar form is also figured in another species of *Terebratula* by Poli.

"The arches of the loop are so slender that, notwithstanding their calcareous nature, they possess a slight degree of elasticity and yield a little to pressure; but for the same reason they readily break if the experiment be not made with due caution. The interspace between the two folds of the calcareous loop is filled up by a strong but extensile membrane, which binds them together, and forms a protecting wall to the viscera: the space between the bifurcated process in *T. Chilensis* is also similarly occupied by a strong aponeurosis. In this species the muscular stem of each arm is attached to the outer sides of the loop and the intervening membrane. They commence at the pointed processes at the origins of the loop, advance along the lower portion, turn round upon the upper one, and are continued along it till they reach the transverse connecting bar, where they advance again forwards, and terminate by making a half-spiral twist in front of the mouth. It is these free extremities which form the third arm mentioned by Cuvier. These arms are ciliate on their outer side for their entire length, but the cilia are longer and much finer than the brachial fringes of *Lingula*; and except at the extreme ends, which have a slight incurvation, they are uniformly straight. There is thus an important difference between *Lingula* and those species of *Terebratula* which resemble *T. Chilensis* in the powers of motion with which the arms are endowed; since, from their attachment to the calcareous loop, they are fixed, and cannot be unfolded outwards as in *Lingula*. Owing to this mode of connection, and their ciliated structure, their true nature was much more liable to be mistaken by the early observers, though it appears not to have escaped the discrimination of Linnæus, who, as Cuvier has observed, founded his character of the animal of *Anomia* on the organisation of one of the *Terebratulæ* which he included in that genus."

The recent species are numerous and widely diffused, and the genus appears to be capable of flourishing in extremely warm and extremely cold regions, as well as in more temperate climates. Thus some of the species have been found in the Indian seas and at Java (*T. flavescens*, Lam., for example), and *T. psittacea*, brought home from the late expedition by Captain James Ross, R.N., was fished up from a depth of twenty-two fathoms near Felix Harbour, in lat. 70° N., on the east side of Boothia. The average depth at which *Terebratula* has been found ranges from ten to ninety fathoms. De Blainville has thus subdivided the species :—

A. Summit of the larger valve pierced with a round hole, well defined.

1. Valves triangular, with a straight anterior border.
Example, *Terebratula digona* (fossil).

Terebratula digona.

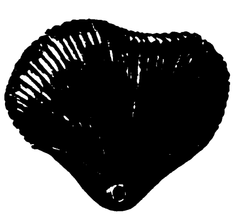
2. Valves rounded at their anterior border.
Example, *Terebratula globosa* (recent).

Terebratula globosa.

3. Valves raised as it were, or hollowed on the mesial line.
Examples, *Terebratula sanguinea*, and *Terebratula dorsata* (recent).

Terebratula dorsata. Internal views.

Bilobated, the valves striated from the summit to the circumference, and deformed as it were at the junction of their border.
Example, *Terebratula deformis* (fossil).



Terebratula deformis.

5. Trilobated as it were by the projection of the mesial part.
Example, *Terebratula alata* (fossil).

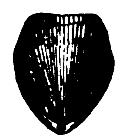
Terebratula alata.

B. The heel of the larger valve deeply notched up to the border of articulation ; notch or fissure rounded.

1. Valves rounded at their anterior border.
Example, *Terebratula rubra* (recent).

Terebratula rubra.

2. Valves sub-bilobated by the depression or emargination, which is apparent at the anterior border.
Example, *Terebratula Caput Serpentis* (recent).



Terebratula Caput Serpentis.

C. The opening of the heel of the larger valve, marginal, triangular, and elongated.

1. Valves rounded.
Example, *Terebratula Lyra* (fossil).

Terebratula Lyra. *a*, Front view ; *b*, side view.

2. The valves sub-bilobated.
Example, *Terebratula canalifera* (fossil).

Terebratula canalifera.

3. The valves rounded ; a mesial partition (*cloison*) in the larger valve, placed between two in the smaller, so as to give in the cast the representation of five distinct pieces, three for one valve and two for the other.
Genus *Pentastera*, Sowerby.—Fossil.

D. Opening of the heel marginal, triangular, but much larger transversely than longitudinally. Line of articulation quite straight.

1. The small valve provided in its mesial portion with a straight flattened support, bifurcated at its free extremity ; a partition (*cloison*) in the other valve penetrating into this bifurcation.
Genus *Strygocephalus*, Defrance.—Fossil.
Example, *Strygocephalus Burtini*.

Strygocephalus Burtini.

2. The lateral parts of the support formed of a very fine spiral filament, so as to produce two hollow somewhat conical masses which nearly fill the whole of the shell.

Genus *Spirifer*, Sowerby.

Example, *Spirifer trigonalis* (fossil).

Internal view of *Spirifer trigonalis*, showing the spiral processes.

E. The upper valve operculiform or very flat, system of support beginning to disappear.

1. Upper valve very flat.

Genus *Magas*, Sowerby.—Fossil.

Example, *Magas pumilus.*

Magas pumilus.

2. Upper valve very much excavated above, summit of the lower valve not pierced, and divided into two nearly equal parts by a well-developed mesial furrow.

Genus *Producta*, Sowerby.—Fossil. (See 'Min. Con.,' pl. 320.)

Example, *Producta Martini.*

Producta Martini.

The fossil *Terebratulæ* (properly so called) are extremely numerous, and assist in the identification of strata from the supracretaceous group to some of the lowest formations in the grauwacke series, both inclusive.

As neither *Pentastera, Strygocephalus, Spirifer, Magas*, nor *Producta* has living representatives, they are placed here from the structure of their shells, which, judging from analogy, would indicate a brachiopodous construction allied to *Terebratula.* Indeed De Blainville retains that name throughout; but we think the differences of conformation warrant the separation of the fossils above distinguished, as subgenera of the *Terebratulinæ.* They occur principally in the more ancient fossiliferous beds.

Thecidea, Defrance (*Thecidium*, Sowerby). De Blainville thus describes the genus :—"Animal entirely unknown, but very probably differing but little from that of *Orbicula.* Shell equilateral, regular, very inequivalve, and sufficiently similar to the *Terebratulæ* of the latter sections; one valve hollowed, the heel or hook recurved, entire, without a fissure and adhering; the other flat, operculiform, and without any trace of the internal support.

Hinge longitudinal; articulation by two distant condyles, as in the *Terebratulæ*, with a large mesial tooth in the flat valve fitting between the condyloid teeth of the concave valve.

Example, *Thecidium radiatum.*

The recent species above mentioned is an inhabitant of the Mediterranean, and found among the common red coral of the Tuscan seas.

The fossil species are tolerably numerous, and Sowerby says that those which he had seen appeared to belong to the chalk, and were brought from Maastricht, and from Orglandes in Normandy.

Thecidium radiatum, viewed from above. *a*, nat. size.

Lingula (Brugières). Shell subequivalve, equilateral, depressed, a little elongated, truncated anteriorly; the summit mesial and posterior, with no trace of a ligament, but joined at the extremity to a long fibro-gelatinous peduncle, which is supposed to fix it vertically to submarine bodies; but in the specimen of *Lingula Audebardii* examined by Mr. Owen, there was no trace of the adhesion of any foreign body to the end of this peduncle. Muscular impressions multiple.

Example, *Lingula anatina.*

Lingula anatina.

The recent species have been found at depths ranging from the surface to seventeen fathoms; and specimens have been taken in hard coarse sand from four to six inches below the surface of the sand.

Lingula has been found in a fossil state in the Inferior Oolite of Yorkshire, in the Old Red-Sandstone formation, and in other old fossiliferous beds.

Strophomena, Rafinesque (fossil). Shell regular, equilateral, subequivalve; one valve flat, the other slightly excavated : articulation straight, transverse, with a small projection notched or dentelated transversely. No trace of an internal support.

Example, *Strophomena rugosa.*

Strophomena rugosa. View of lower side.

As *Strophomena* has no living representatives, at least none yet discovered, there can be no description of the animal, which is, however, judging from the construction of the shell, most probably brachiopodous.

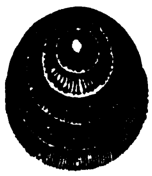
The fossil genera *Plagiostoma, Dianchora*, and *Podopsis* are placed by De Blainville under this section. [PLAGIOSTOMA; DIANCHORA; PODOPSIS.] We do not however think that there is such pregnant evidence of a true and entire brachiopodous organisation as to warrant this decided position under the Brachiopoda. Indeed De Blainville himself says that some of the *Plagiostomata* are of the family *Terebratulæ*, and that the others (the instances *Plagiostoma Mantellii*) are entirely different, and he allows that these last ought to form a distinct genus of the family of Subostraceans. Defrance places *Podopsis* among the oysters.

* *

Shell Unsymmetrical, Irregular, always Adherent.

Orbicula (Lamarck). Shell orbicular, very much compressed; inequilateral, very inequivalve; the lower valve very delicate, adhering; the upper valve patelliform, with the summit more or less inclined towards the posterior side. Fissure of adhesion in the lower valve subcentral. Hinge toothless.

Example, *Orbicula lamellosa.*



Orbicula lamellosa. A single specimen, showing the cilia.

The recent species are found attached to stones, shells, sunken wrecks, &c., and have been found at depths ranging from not far below the surface to seventeen fathoms.

Fossil species are said to have been found in the Lower Greensand of Sussex, in the Speeton Clay of Yorkshire, in both the great and the inferior Oolite, in the carboniferous limestone, and in the Ludlow Rock below the Old Red-Sandstone.

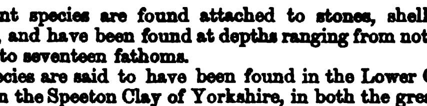
G. B. Sowerby has satisfactorily proved that Lamarck's genus *Discina* must be expunged, it having been formed from specimens of *Orbicula Norvegica*, sent by Sowerby to Lamarck.

Crania (Retzius and others). G. B. Sowerby, who has done so much in the thirteenth volume of the 'Linnæan Transactions' to unravel the confusion which had previously been created by authors, gives the following generic characters:—

Shell inequivalve, generally equilateral, rather irregular, orbicularly subquadrate, and flattish; the upper valve patelliform, having its umbo or vertex rather behind the centre; the lower valve attached by its outside, the greater part of it being generally extended over the substance to which it adheres; and in this respect it differs greatly from *Orbicula*, which is attached by means of a ligament which passes through a fissure in the centre of the lower valve. There are four muscular impressions in each valve; of those in the upper valve two are in the posterior margin and the other two nearer the centre, but not always very near to each other; of those in the lower valve two are nearly marginal and rather distant, but the other two are nearly central, and so close together that they appear to form but one: they in general have a small projection between them; and the whole of the muscular impressions in the lower valve are frequently lost by decomposition in the fossil species, so as to appear only three oblique perforations, as Lamarck has described them.

Example, *Crania personata.*

1 2 3



Crania personata. 1, external view; 2, 3, internal view.

The recent species (and this is the only one known) is found adhering to stones and shells at very great depths. It is stated in the 'Zoological Journal,' by the Rev. M. J. Berkeley, that a specimen of *Crania personata* was taken by Captain Vidal at the depth of 255 fathoms.

There are several fossil species, mostly from the Chalk.

The species of *Brachiopoda* in the British seas are not numerous. The following are given in Forbes and Hanley's 'History of British Mollusca:'—

Terebratula (*Hypothyris*) *psittacea.* Undoubtedly indigenous, but very rare.

Terebratula Caput Serpentis. It was first described as British by Dr. Fleming, and has recently been dredged up in considerable numbers in deep water on various parts of the coast.

Terebratula Cranium. But one specimen of this has been obtained, which is now in the possession of Dr. Fleming.

Terebratula (*Megathyris*) *cistellula.* This species, which for some time was only known as a Crag-Fossil, has been taken in the Isle of Skye and in the deep-water fishing-grounds of Zetland.

Crania anomala. This species has been taken several times on various parts of the British coast. [*See* SUPPLEMENT.]

BRACHY'CERUS, a genus of Coleopterous Insects of the family *Curculionidæ* (included in the genus *Curculio* by Linnæus). Generic characters:—Rostrum short; antennæ inserted towards the apex of the rostrum, short, 9-jointed, the basal joint longest, the terminal joint forming a knob; tarsi with all the joints entire, and without pubescence beneath. The species of this genus are apterous, and generally very rough. They appear to be peculiar to the south of Europe and Africa, and live upon the ground.

BRACHYPHY'LLUM, a genus of fossil plants, supposed to belong to the *Coniferæ*. One species, *B. mammillare* of Brongniart, occurs in the carbonaceous beds of the Bath Oolite Formation on the Yorkshire coast.

BRACHYPODI'NÆ, Swainson's name for a sub-family of Birds belonging to the *Merulidæ*, containing the following genera, or rather sub-genera:—

Brachypus, Swainson, thus characterised by him:—Bill short; rictus (gape) bristled; feet small, weak; lateral toes equal; hinder toe as long as the tarsus. Type, *Brachypus dispar*, Sw. (*Turdus dispar*, Horsfield).

Chloropsis, Jardine and Selby. Bill more lengthened; the tip much hooked; the notch forming a small distinct tooth; rictus smooth; feet small; lateral toes unequal; the hinder toe rather shorter than the tarsus.

Iöra, Horsfield. Bill nearly as long as the head, lengthened, conic; rictus smooth; tarsi somewhat lengthened, the anterior scales divided; tail even. Type, *Iöra scapularis*, Horsfield.

Andropadus, Swainson. Bill short; the upper mandible serrated near the tip; neck with setaceous hairs. Type, L'Importan, Le Vaillant.

Hæmatornis, Swainson. Bill short; rictus bristled; lateral toes unequal; hinder toe shorter than the tarsus. Types:—1. *Chrysorrhoëus*, Le Vaillant. 2. *Turdus hæmarrhous* of authors. 3. *Turdus bimaculatus* of Horsfield. 4. *Erythrotis* of Swainson (*Lanius jocosus* of Linnæus).

Mr. Swainson does not seem to have been aware that the appellation *Brachypus* had previously been conferred by Fitzinger on a sub-genus of *Saurians*, belonging to the *Chalcides* of Daudin, and it should therefore be no longer used to distinguish a sub-genus of birds. The term at the head of this article, which Mr. Swainson has applied to the sub-family, might be changed with advantage; for it may be liable to create confusion when unexplained by contexts, and leave the reader in doubt whether a sub-family of birds or reptiles is intended.

BRACHYPO'DIUM, a genus of Grasses [GRAMINACEÆ] belonging to the tribe *Festucineæ* of that order. It has unequal many-flowered glumes; the outer palea rounded on the back, setigerous at the summit, lateral nerves slightly converging, not vanishing upwards; the inner palea fringed on the ribs with rigid setæ; the styles terminal. Two of the species, *B. sylvaticum* and *B. pinnatum*, are British. This genus is distinguished from *Triticum* (Wheat) by the unequal glumes alone. (Babington, *Manual of British Botany.*)

BRACHYPTE'RES (Short-Winged Birds), Cuvier's name for those birds generally known by the name of Divers. [COLYMBIDÆ.]

BRACHY'PTERYX, a genus of Birds approaching to *Saxicola*, thus defined by Dr. Horsfield:—

Bill with the culmen carinated between the nostrils, the sides being flattened, and rounded towards the apex, with the sides convex; edges subinflected; wings very short and obtuse: tail moderate and rounded; feet elongated and weak; the tarsi slender; the toes very slender, and the claws very much compressed; hallux or hind toe comparatively large.

Brachypteryx montana, Horsfield. The species on which the genus is founded has the following characters:—Weight of the male five, and of the female six drachms. In the male, the head, neck, and breast have a dark indigo-blue tint, inclining to black, with a grayish reflection on the surface, variegated with lighter and darker shades; on the throat and the lower part of the neck this colour passes into gray; on the forehead it is more intense, inclining to black. Above the eyes is an oblong white spot. The back, the wings above the shoulders, the coverts of the tail, the vent, hypochondriæ, and thighs are deep chestnut-brown, with a ferruginous reflection. The wings underneath, and the tail at the extremity and underneath, are pure blackish-brown; the shafts of the quill- and tail-feathers are black and shining. The inner vanes of the quills and the tail-feathers generally have a very deep brown colour. The exterior vanes of the tail-feathers are slightly tinted with the ferruginous lustre of the upper parts. The lower parts of the breast and abdomen are whitish. The plumes on the posterior portion of the body are very thickly disposed; the vanes consist of long, delicate, silky, pendulous laminæ or filaments, forming a lax covering about the lower parts of the abdomen, the hypochondriæ, and the root of the tail. The irides have a dark hue. The bill is black, and the tarsi are deep brown. The tint of the claws is somewhat lighter.

In the female, the dark blue tint, which in the male covers the head and neck, extends over the body generally, and also marks the exterior vanes of the quills. The interior vanes of the latter and the tail-feathers are dark brown, inclining to black. The throat and neck underneath have a dark grayish tint. The abdomen is grayish-white. Over the eyes it has, like the male, a white spot, and the bill and tarsi also agree with that. The covering of the abdomen, vent, and thighs is likewise long, delicate, silky, and pendulous.

Dr. Horsfield met with this species in one situation only, at an elevation of about 7000 feet above the level of the sea. He thinks it probable that it may he found on all the peaks of Java, which are covered with thick forests, accommodated to its peculiar habits. The recurrence, he observes, of several quadrupeds and birds, at a certain elevation, is as regular in that island as that of many plants and insects. Although local in its residence, Dr. Horsfield found the bird very numerous on Mount Prahu, which, he says, in the luxuriance of its vegetation and gloomy thickets, is probably not surpassed

Mountaineer Warbler (*Brachypteryx montana*).
The upper figure represents the female; the lower, the male.

in any portion of the globe. In his daily excursions he uniformly observed and occasionally surprised it in its short sallies among the openings of the forest. It was chiefly found on the lowest branches of trees or on the ground. As the shortness of its wings incapacitates it for elevated or distant flights, its motions are low, short, and made with great exertion. It lives in the thickest coverts, feeding on the larvæ of insects, worms, &c., and there it forms its nest on the ground. "It utters," says Dr. Horsfield, "almost without interruption, a varied song. Its common note is a quickly reiterated babbling, resembling that of the *Curruca garrula* of Brisson, and other birds of this family: it also has a protracted plaintive note, but it sometimes rises to higher and melodious warblings, which, in the general silence of these elevated regions, afford an inexpressible sensation of delight to the mind of the solitary traveller."

This bird is the Ketek of the Javanese and Mountaineer Warbler of Latham.

(Horsfield, *Zoological Researches in Java and the neighbouring Islands*, and *Transactions of the Linnæan Society*, vol. xiii.)

BRACHYPUS. [BRACHYPODINÆ; CHALCIDES.]

BRACHY'TELES, a genus of *Quadrumana*, separated from *Ateles* by Spix, on account (among other differences) of the very small development of the thumb. [ATELES.]

BRACKEN. [PTERIS.]

BRA'CON, a genus of Insects of the order *Hymenoptera* and family *Ichneumonidæ*. The insects of this genus are remarkable for the hiatus which there exists between the mandibles and the clypeus. The maxillæ are prolonged inferiorly; the second cubital cell of the wing is tolerably large and square; the ovipositor is long.

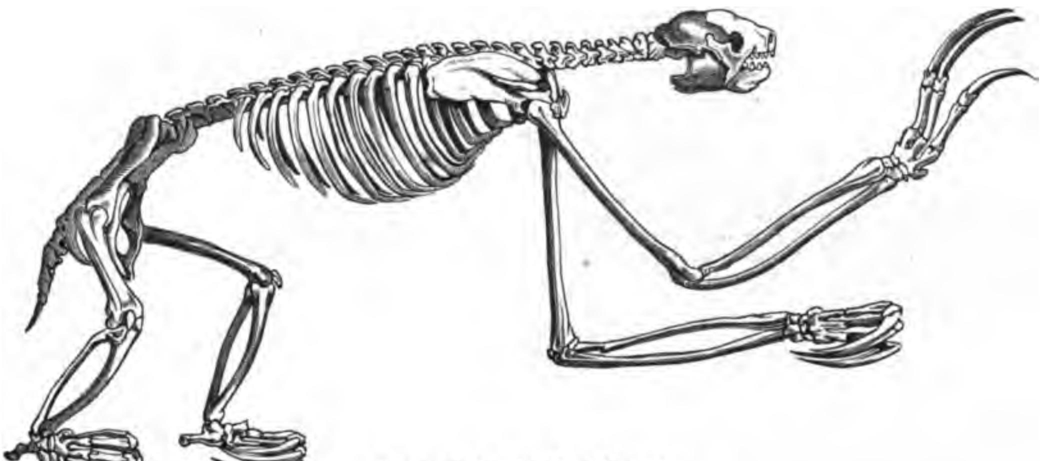
BRACT, the last leaf or set of leaves that intervenes between the true leaves and the calyx of a plant. When the time arrives for a plant to fructify, a change comes over its constitution, and parts are expanded, which, although under ordinary circumstances they would have become leaves, yet at this peculiar time are less developed, and appear in the form of scales or half-formed leaves. Of these the external are bracts, the next combine with each other and become calyx, the next assume the form of petals, and so on. Therefore whatever intervenes between the true leaves and the calyx is bract.

BRADYPUS, a genus of Mammals belonging to the order *Edentata* of Cuvier, and together with the genus *Unau*, or *Cholœpus*, composing a small family to which Cuvier gave the appellation of *Tardigrada*, from the peculiar conformation of their extremities, and the remarkable slowness of their pace. Both these genera were formerly included by Linnæus in the same group, under the common name of *Bradypus*, or Sloth; but later zoologists have separated them, on account of certain anomalies in their organic structure. It must however be confessed that the two genera of Sloths are closely approximated to one another in many essential details both of structure and economy; and this fact is the more remarkable and interesting since the modifications upon which their generic distinction has been founded are greater, and, as we might naturally presume, more influential, than those which frequently characterise two different families.

The order *Edentata* comprises a number of genera, perhaps the most singular and anomalous among Mammals, differing widely from all other quadrupeds, but unfortunately possessing so few natural affinities or relations of resemblance among themselves, that the order *Edentata* is sometimes regarded as the most arbitrary and artificial of all the primary groups into which Cuvier and Geoffroy have divided the *Mammalia*. The family *Tardigrada*, or Sloths, are more especially deserving of attention, as well from the singularity of their physical structure, and the mistakes which have hitherto prevailed among naturalists concerning the habits and manners of these singular animals, as on account of the relation which they present in their osteological details to the *Megatherium*, the most curious and anomalous of extinct animals. This family is distinguished from the other *Edentata* by a short round head, and the presence both of molar and canine teeth, the incisors alone being deficient; but above all by the great length and singular structure of their arms, which, adapting them to a mode of progression altogether peculiar to themselves, and consequently disqualifying them for the exercise of that species of locomotion common to ordinary quadrupeds, have caused them to be considered as the most miserable and unfortunate of beings, imperfect monsters of creation, equally remarkable for their disgusting appearance and helpless condition.

Sloth (*Bradypus tridactylus*).

To enable us clearly to comprehend the nature and functions of these animals, it will be necessary to enter into a short description of parts of their osteological structure. The view here given of the skeleton of the Sloth (*Bradypus tridactylus*) seems to indicate a distortion of certain parts and proportions altogether opposed to freedom of motion, at least of that kind of motion with which we are familiar in ordinary quadrupeds. The arm and fore-arm taken together are nearly twice as long as the leg and thigh, so that if the animal attempts to walk on all-fours it is obliged to trail itself painfully and slowly on its elbows, and if it stands upright on the hind legs the arms are so long that the fore fingers touch the ground. This disproportion between the anterior and posterior extremities, obviously deprives these animals of the power of moving on a plain surface with that speed which is so admirable in the generality of quadrupeds; and accordingly we are assured by all observers, that their mode of progression under these circumstances is of the most slow and painful nature. The Sloths however are not terrestrial animals, but live entirely among the thick branches of trees in the most extensive and solitary forests. This remarkable disproportion of their fore-arms is common to another genus of arboreal mammals, the real apes, in which, far from retarding their motions, this peculiar structure is of the most essential importance in adding to their agility. But the Sloths partake of none of the accessory advantages which the Apes possess. They have no opposeable thumb; their fingers are short, and so perfectly rigid that the joints ossify at a very early period of the animal's life, leaving them totally incapable of individual motion, whilst they are at the same time so completely enveloped in the common integuments of the hand that nothing is to be seen externally except the immense crooked claws with which they are provided. The wrist and ankle also are articulated or joined to the fore-arm and leg in an oblique direction; so that the palm or sole, instead of being directed downwards towards the surface of the ground, as in other animals, is turned inwards towards the body, in such a manner as to render it impossible for the Sloth to place the sole of its foot straight down upon a level surface, but to compel it, under such circumstances, to rest upon the external edge of the foot. This position is obviously but ill adapted for ease or facility of motion. But there is still another singularity in the structure of the foot of this animal which materially increases its difficulties of progression on a plain surface. This arises from the peculiar form of the last phalanx or joint of the fingers and toes, that, namely, which gives insertion to the claws, and which is articulated with the second phalanx in such a manner as to permit the fingers and claws to be strongly bent inwards along the palm and arm, but at the same time prevents the animal from raising them upwards or opening the hand beyond a certain position. This structure is exactly the reverse of what we observe in the common cat, which has the phalanxes of the toes formed in such a manner as to keep the claws habitually retracted or drawn up, so that it requires a considerable degree of muscular force to extend or depress them. In the Sloths, on the contrary, they are naturally depressed in the position represented in the figure of the skeleton, and the muscular force is exerted to expand or open them. The claws themselves are of a size altogether enormous, surpassing the entire foot in length. They are so sharp and crooked that they readily seize upon the smallest inequalities in the bark of the trees and branches among which the animals habitually reside; and, united to the great muscular strength and rigid formation of the extremities, furnish the most powerful weapons of defence. Nor are the form and articulation of the posterior extremities less singular than those of the anterior. The formation of the pelvis alone is of such a nature as to render it impossible for the Sloths to walk after the manner of ordinary quadrupeds; and the mode in which the hind legs are articulated with the pelvis, to use the expression of Baron Cuvier, seems almost expressly arranged for the purpose of depriving the animal of the use of its legs altogether. "If," says M. Cuvier, "we consider the Sloths in the relation which they bear to other animals, the general laws of organisation at present existing apply so little to their structure, the different parts of their body seem so completely contradictory of those laws of co-existence which we have found established in the rest of the animal kingdom, that we might be almost tempted to consider them as the remains of a former order of things, the living relics of that precedent nature of which we are obliged to seek the other ruins beneath the surface of the earth, and that they escaped by some miracle the catastrophe which destroyed their contemporary species."



Skeleton of the Sloth (*B. tridactylus*).

Formation of the Pelvis.

If placed upon a plain surface, the Sloth moves with difficulty and only by seizing upon the little asperities which he finds in his way, and by that means dragging his body slowly forwards, just as we may observe a bat to do under similar circumstances. But this is a situation equally foreign to the habits and economy both of the Sloth and of the bat; and we are no more justified in judging of the nature of the one under these circumstances, than we should be in reasoning upon the habits of the other. The Sloth is eminently an arboreal quadruped: it is produced, it lives, and it dies in the trees; it very rarely voluntarily descends to the surface of the earth, and those therefore who observe it in that situation, have not a favourable opportunity of judging of its nature and functions.

We are indebted to the valuable observations of Mr. Waterton, during his 'Wanderings' in South America, for a final and satisfactory explanation of the apparent difficulties and inconsistencies in the structure and habits of the Sloth. "The sloth," says this traveller, "in its wild state, spends its whole life in the trees, and never leaves them but through force or accident; and what is more extraordinary, not upon the branches like the squirrel and monkey, but under them. He moves suspended from the branch, he rests suspended from the branch, and he sleeps suspended from the branch. Hence his seemingly bungled composition is at once accounted for; and in lieu of the sloth leading a painful life and entailing a melancholy existence upon its progeny, it is but fair to conclude that it just enjoys life as much as any other animal, and that its extraordinary formation and singular habits are but further proofs to engage us to admire the wonderful works of Omnipotence." Nor are the motions of this animal so slow while suspended in this strange position, nor his habitat so circumscribed as naturalists have hitherto imagined. "The Indians," continues Mr. Waterton, "have a saying that when the wind blows the sloths begin to travel. In fact during calm weather they remain tranquil, probably not liking to cling to the brittle extremities of the branches, lest they should break whilst the animals are passing from one tree to another; but as soon as the wind rises the branches of the neighbouring trees become interwoven, and then the sloth seizes hold of them and pursues his journey in safety. He travels at a good round pace, and were you to see him, as I have done, passing from tree to tree, you would never think of calling him a sloth." Stedman, in his 'History of Surinam,' has an engraving of a Sloth in this position, which we have copied, as illustrating its singular mode of progression. A specimen of *Cholœpus didactylus*, the Two-Toed Sloth, is now living in the Gardens of the Zoological Society, Regent's Park.

Mode of progression.

The conformation of the extremities is not the only part of its anatomy in which the Sloth differs from ordinary mammals. The number and form of the bones which compose the trunk, the nature of its teeth, and the conformation of its stomach and intestines, are all peculiar. The stomach is divided by transverse ligatures into four separate compartments, which bear a distant resemblance to the four stomachs of ruminating animals: they do not however exercise the functions of these organs, nor do the Sloths regurgitate their food, or subject it to a second process of mastication like the ox and the sheep. The intestines also are unusually short for an animal which lives entirely upon vegetable substances, scarcely equalling twice the length of the body, whilst those of ruminants frequently exceed ten times those dimensions. Their simplicity and diminutive size in the Sloths appear to be compensated by the superior and unusual complication of the stomach,—which, retaining the food for a longer period than in ordinary non-ruminating animals, allows it to be more perfectly macerated, and prepared for the action of the absorbent vessels which imbibe its nutritious particles in its passage through the intestines. The number of vertebræ in the necks of mammals is generally seven, so that the whales and dolphins, which have scarcely any neck at all, as well as the giraffe and camel, which have it developed in a most unusual degree, are all found to agree in this particular, however widely they differ in other respects: the *B. tridactylus* alone forms an exception to this otherwise universal rule, in having nine cervical vertebræ. What renders this circumstance still more surprising is, that the neck of the Sloth (*B. tridactylus*), notwithstanding its two supernumerary vertebræ, is far from long—being on the contrary much too short for its long fore legs if it were compelled to seek its food on the ground like other animals. But this defect is compensated, as well by the nature of the situation which it habitually occupies, suspended from the horizontal branches of the trees, as by its power of using the fore paw as a hand in conveying the food to its mouth, which, notwithstanding the rigidity of its members, it does with great address with one paw, whilst it clings firmly to the branches by means of the other three.

The dental system of the Sloths is the most simple that can well be conceived. They have no incisor teeth, but canines and molars only; and in the *B. tridactylus* the canines are diminutive, and in all respects very similar to the other teeth. The molar teeth are universally eight in the upper jaw and six in the lower, four and three on either side respectively. Their construction is most simple, consisting merely of a cylinder of bone, enveloped in enamel, and hollow at both ends,—at the upper by continual detrition, and at the under by default of ossification. They have no lamina of enamel penetrating the body of the tooth, as in other herbivorous animals, which renders them such effective instruments in grinding and masticating vegetable substances. Hence it results, that the mastication of the Sloth must be extremely imperfect, though the defect of dentition is probably compensated in some degree by the superior complication of the stomach.

The genera *Bradypus* and *Cholœpus*, together with the extinct fossil animals which have been called *Megatherium* and *Megalonyx*, and which, with the form and organisation of a sloth, nearly equalled the elephant in size, constitute the Cuvierian family *Tardigrada*. Besides the difference of the canine teeth, which are completely developed in *Cholœpus* and in *Bradypus*, of the same form and subject to the same detrition as the molars, these two genera are distinguished from one another by the number of toes on the fore feet, which are three in the *Bradypus* and only two in the *Cholœpus*; by the comparative length of the fore-arms, which are much longer in the former than in the latter; by the number of cervical vertebræ in the *Bradypus*, as already mentioned; by the equally unusual number of ribs in *Cholœpus*, which amount to no fewer than forty-six, the greatest number hitherto found in any mammal, the species of *Bradypus* having but thirty-two; and by numerous other modifications which it is unnecessary to enumerate.

The Sloths are known to bring forth and suckle their young like ordinary quadrupeds. For this purpose they have two mammæ, which are situated on the breast; and the young Sloth, from the moment of its birth, adheres to the body of its parent till it acquires sufficient size and strength to shift for itself. The head of the Sloth or Ai (*B. tridactylus*) is short, the face small and round like that of the American monkeys, the ears concealed in the long hair which surrounds them, the eyes small and deeply sunk in the head, and the tail a mere rudiment. This species is found only in the most gloomy and retired tropical forests of South America. The Indians like its flesh, and are in continual pursuit of it.

In the list of specimens of *Mammalia* in the British Museum three species of *Bradypus* and one of *Cholœpus* are given. Several varieties have been described.

B. tridactylus, the Sloth or Ai. It has a short round head, furnished with coarse shaggy hair, disposed on the crown in verging rays, like that of the human species; the face is of a yellowish colour, covered with very short hair, whilst that of the body and extremities is universally long and shaggy; the eyes are encircled by a brown ring; the hair of the body varied with irregular patches of dark and light brown, or silvery white; between the shoulders there is an oval patch of short orange-coloured hair, of a finer quality than that found on other parts of the body, and divided in the centre by a longitudinal black stripe; the throat and breast are frequently of a light straw-colour. The texture of the hair is altogether peculiar, and more nearly resembles dry hay, or grass shrivelled and withered by the sun, than the hair of ordinary quadrupeds. It is coarse and flattened at the extremity, but as small at the root as the finest spider's web; and its dry and withered appearance forms the Ai's principal security against its pursuers, as it renders it extremely difficult to detect it whilst at rest among the branches covered with bark and moss of the same colour. It is only when in motion that it can be readily distinguished from the trunk beneath which it hangs suspended. In other respects different individuals of this species differ considerably from one another in the shades and disposition of their colours, and in the intensity of the mark between the shoulders; some even want this latter mark altogether, others are of a uniform ash-colour over the whole body, and there are others still which have the hair of the head parted in the centre, and hanging down on each side; but whether these constitute distinct species, or mere varieties of the common Ai, is a point hitherto undetermined: the cabinets of Europe do not afford sufficient materials for an extensive comparison, and no naturalist has ever examined the Ais with this view in their native regions.

B. torquatus, the Gipakeiou, is a very distinct species, even in the bony structure of its cranium. Its face is naked, and of a black colour; the hair of its body less flattened and withered-looking than in the common species; the forehead, temples, chin, throat, and breast covered with reddish or rust-coloured hair, slightly frizzled; on the crown of the head it is long and yellow, and on the rest of the body pale orange; but the most distinguishing mark of the species is a large black collar which completely surrounds the neck. Beneath this outer coat there is an inner one of very fine fur, which is of a dark brown colour on the collar, but gradually diminishes in intensity towards the croup, where it is entirely white.

Both these species feed upon the leaves of trees, and bring forth but a single young one at a birth. When in motion in the forests they emit a feeble plaintive cry, resembling the word 'Ai,' and which is the origin of the name they bear among the Europeans settled in America. They are extremely retentive of life, and have been seen to move their legs and exhibit other symptoms of vitality a full half-hour after being deprived of the heart and other viscera.

B. gularis, the Yellow-Faced Sloth, is supposed by some to be a variety of *B. tridactylus*.

BRAGANTIA, a genus of plants belonging to the natural order *Aristolochiaceæ*. One of the species, *B. tomentosa*, is said by Dr. Horsfield to be intensely bitter, and to be used as a medicine in Java.

BRAIN, a soft and pulpy organ, which in man occupies the cavity of the cranium, and forms one of the central masses of the nervous system. [NERVOUS SYSTEM.] In man and all the higher animals the nervous system consists of four distinct parts—the white threads called Nerves, knots or masses of nervous matter situated along the course of the nerves called Ganglions, a long cord of nervous matter filling the cavity of the vertebral or spinal column called the Spinal Cord, and a large mass of nervous matter now generally considered as a continuation and expansion of the spinal cord called the Brain. The Spinal Cord and Brain constitute the two central masses of the nervous system, that is, the immediate seat of the functions peculiar to this system.

The general mass of nervous matter designated under the common term Brain, together with its membranes, vessels, and nerves, completely fills the cavity of the skull. This mass is divided into three parts, the Cerebrum, or brain proper, which occupies the whole of the superior part of the cavity of the cranium; the Cerebellum, much smaller than the cerebrum, whence its name, Little Brain, which occupies the lower and back part of the cavity of the cranium; and the Medulla Oblongata, by much the smallest portion of the mass, situated at the basis of the cavity beneath the cerebrum and cerebellum. The medulla oblongata passes out of the cavity of the cranium into that of the vertebral canal by the foramen magnum of the occipital bone, being continuous with and forming the commencement of the spinal cord.

This general nervous mass is closely enveloped in three distinct membranous coverings, two of which have been called 'matres,' from the fanciful notion that they give rise to all the other membranes of the body. The external covering termed Dura Mater, from its being of a firmer texture than the other two membranes, incloses the brain with all its appendages, and lines the whole internal surface of the bones of the cranium. It is of a fibrous texture, the component fibres interlacing each other in every possible direction, and forming by their firmness and density the thickest and strongest membrane of the whole body. By its external surface the dura mater adheres everywhere to the inner surface of the cranium, just as the periosteum adheres to other bones. When torn from the cranium this surface appears somewhat rough and irregularly spotted with bloody points, which are the lacerated orifices of vessels that pass between the membrane and the surrounding bones. These vessels are much more numerous in the young than in the adult, and are most abundant at the sutures or junctions of the bones that compose the skull. The inner surface of the dura mater, which is shining and smooth, is lubricated and kept in a state of moisture by a fluid secreted by its own vessels. This membrane performs a twofold office; it supplies the place of the periosteum to the inner surface of the bones of the cranium, sustaining their nutrient vessels; and it serves as a defence to the brain, and a support to the different masses into which it is divided.

The dura mater gives off several elongations or productions called processes, which descend between certain portions of the brain; the most remarkable of which is termed the superior longitudinal process, which extends from the fore to the back part of the skull between the lateral halves of the cerebrum. Narrow in front, it becomes gradually broader as it passes backwards, bearing, as has been conceived, some resemblance in shape to a sickle or scythe, whence the common name of it, falx cerebri.

Where the falx cerebri terminates behind, there proceeds a large lateral expansion of the same membrane, extending across the back part of the skull beneath the posterior parts of the cerebrum, and forming a complete floor or vault over the cerebellum. This membranous expansion is called tentorium, the obvious use of which is to prevent the cerebrum from pressing upon the cerebellum; while from the middle of the tentorium proceeds another membranous expansion, which descends between the lobes of the cerebellum, and terminates insensibly at the edge of the foramen magnum, performing for the cerebellum the same office as the falx performs for the cerebrum: hence it is called falx cerebelli.

Moreover the component fibres of the dura mater in certain parts of its course separate into layers, which are so disposed as to leave spaces between them, for the most part of a triangular form. These triangular spaces, which are commonly termed sinuses, are lined by a smooth membrane perfectly analogous to that which lines the veins in the other parts of the body, and these sinuses perform the office of veins, returning the blood from all the parts of the brain to the neck. Nothing analogous to this structure occurs in any other part of the venous system. In almost every other part of the body the pressure of surrounding parts is a most important aid to these vessels in enabling them to carry on the circulation of the blood; but in the brain the venous tubes are guarded from pressure, the dense dura mater being for this purpose stretched so tensely over them that the weight of the surrounding parts is completely taken off them.

The smooth surface of the brain which is exposed on the reflection of the dura mater, is formed by its second investing membrane which is named the Tunica Arachnoidea, from the extreme tenderness and delicacy of its tissue, which gives it a resemblance to a spider's web. This thin colourless and transparent membrane is spread uniformly over the surface of the brain, covering all the eminences termed convolutions (*fig.* i. 2, 2), but not insinuating itself between any of the depressions between the convolutions. (*Fig.* iv. 7.) On account of its extreme tenuity and its close adhesion to the membrane beneath it, it cannot be easily separated from the latter; but there are situations at the basis where the arachnoid membrane, as it passes between opposite parts of the brain, can be seen distinct from the subjacent tunic.

The third investing membrane, the Pia Mater, derives its name like the former from the tenderness and delicacy of its tissue; but unlike the tunica arachnoidea, in which not a single blood-vessel has hitherto been described, the pia mater is exceedingly vascular. The blood-vessels with which every part of this delicate membrane is covered are the nutrient arteries of the brain; before they penetrate the brain these vessels divide; subdivide, and ramify to an extreme degree of minuteness upon the external surface of this membrane, so that the blood does not enter the tender cerebral substance with too great force. When a portion of the pia mater is gently raised from the brain, these blood-vessels appear as exceedingly fine delicate threads, which on account of the elasticity with which they are endowed are capable of elongation as they are drawn out of the cerebral substance. As the pia mater contains and supports the nutrient vessels of the brain, this membrane is not only spread as a general envelope over its entire surface, but it penetrates between all its convolutions, and lines every cavity which is formed in it.

It has been stated that the large portion of the cerebral mass, termed the cerebrum, occupies the whole of the upper part of the cavity of the cranium. The cerebrum is divided into two equal lateral halves termed hemispheres (*fig.* i. 2, 2), which have an ovoid figure somewhat resembling an egg cut longitudinally into two equal parts. The hemispheres are separated from each other by the membrane already described, the falx cerebri (*fig.* i. 3); and their inner sides in apposition with the falx are flattened, while their upper and outer surfaces are convex, being accurately adapted to the concavity formed by the inner surface of the bones of the cranium.

Each hemisphere is subdivided into an anterior, a middle, and a posterior lobe, but it is only on the under surface of the brain that these lobes are accurately defined. (*Fig.* ii. 1, 2, 3.) The anterior and middle lobes are separated from each other by a deep fissure named the fissura sylvia (*fig.* ii. 4), which extends obliquely backwards from the basis to a considerable depth between the convolutions; but the middle is distinguished from the posterior lobe, not by a fissure but by a superficial excavation on the under surface of the posterior lobe. (*Fig.* ii. 5.) The anterior lobes rest upon the orbital plates of the frontal bone; the middle lobes are lodged in the temporal fossæ formed by the sphenoid and temporal bones, while the posterior lobes are supported upon the tentorium.

The whole of the external convex surface of the hemispheres is divided into numerous eminences termed convolutions, which run in different directions, and are of different sizes and lengths in different parts of the hemisphere. (*Fig.* i. 2, 2.) The depressions or fissures between the convolutions, termed clefts, or sulci, generally penetrate the consistence of the brain to the depth of about an inch or an inch and a half. (*Fig.* iv. 7.) The greater number of these pursue a

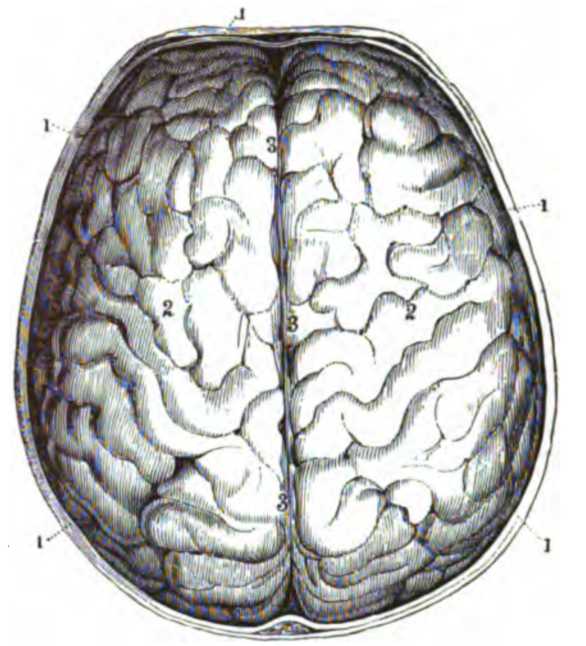


Fig. I.—Upper Surface of the Brain.

1, Cut edge of the bones of the cranium; 2, superior convex surface of the two hemispheres of the cerebrum, with their convolutions; 3, separation between the two hemispheres of the cerebrum, occupied by the falx cerebri.

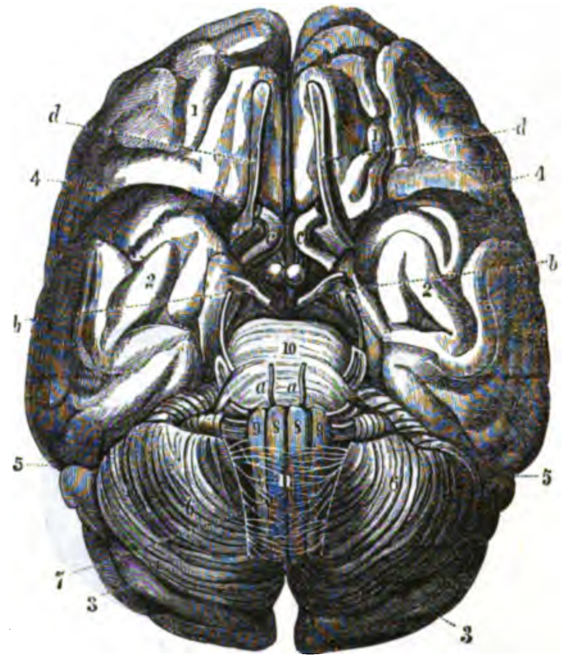


Fig. II.—Base of the Brain.

1, Anterior lobes of the cerebrum; 2, middle lobes of the cerebrum; 3, posterior lobes of the cerebrum; 4, fissure separating the anterior from the middle lobes, named the fissura sylvia; 5, situation of the superficial excavation forming the boundary between the middle and the posterior lobes; 6, the two hemispheres of the cerebellum, composed of flattened laminæ or layers; 7, the medulla oblongata, which, in this position of the brain, rests upon and covers the vermiform process; 8, corpora pyramidalia; 9, corpora olivaria; 10, tuber annulare, or pons varolii; 11, decussation of the corpora pyramidalia; *a, b, c, d*, cerebral nerves.

zigzag course, but some run longitudinally, others obliquely; some communicate with each other, while others terminate separately in the substance of the brain. (*Fig.* iv. 7.)

The nervous matter constituting the cerebrum is composed of two distinct substances, which differ from each other materially both in their colour and consistence. (*Fig.* iv. 7.) The outer substance is sometimes termed cineritious, from its being of a grayish-brown colour; at other times cortical, from its surrounding the inner part of the brain, as the bark the inner parts of the tree; by some it is also called glandular, and by others secretory, from the supposition that its nature is that of a gland, and that it secretes a peculiar fluid. It is of a softer consistence than the inner part, and leaves by desiccation a smaller quantity of solid residuum. It is composed almost entirely of blood-vessels connected and sustained by exceedingly fine cellular membrane. Its structure is uniform throughout, presenting no appearance whatever of a fibrous texture. It gives to the entire surface of the cerebrum an external covering, generally about the tenth of an inch in thickness. (*Fig.* iv. 7.)

The inner substance, termed white or medullary (*fig.* iv. 7), is firmer in consistence and larger in quantity than the gray matter; and when an incision is made into it, its surface is spotted with red points, the cut orifices of its vessels, which vary in number and size according as they may be more or less distended with blood. It is now universally agreed that this part of the brain is composed of fibres. When examined in its recent and most perfect state, especially after it has been artificially hardened and condensed by the action of heat or certain chemical substances, if it be carefully scraped with a blunt instrument these fibres become perfectly distinct and are of considerable magnitude, with furrows between them, which for the most part are placed in such a direction as to converge towards the base of the brain. (*Fig.* iv. 6, 5, 4.) The fibres do not merely unite, forming what are called commissures, but they actually cross each other and pass into the opposite sides of the body. This decussation of the medullary fibres has been demonstrated in the most satisfactory manner by Drs. Gall and Spurzheim.

The cerebellum is situated at the basis of the cerebrum towards its posterior part. (*Fig.* ii. 6, 6.) Its form is elliptical, its largest diameter extending transversely from one side to the other. (*Fig.* ii. 6.) Like the cerebrum it is divided into two lateral halves or hemispheres (*fig.* ii. 6), which are separated by the falx cerebelli. In the centre of its upper surface there is a distinct prominence, termed the vermiform process (*fig.* ii. 7), which may be considered as the fundamental part of the organ, because, in the lower animals, whatever other parts of the cerebellum are absent, this is invariably present, affording thus the nucleus or rudiment of the organ, from which, by the addition of other parts, as the hemispheres or lateral lobes, &c., the more perfect organ of the higher animal is built up.

The external surface of the cerebellum is divided into flattened strata or layers (*fig.* ii. 6), separated by fissures which correspond to the clefts or sulci between the convolutions. The pia mater, bearing the nutrient arteries of the cerebellum, passes between every one of these fissures; while the arachnoid membrane is simply extended over them. If a vertical section be made through either hemisphere of the cerebellum, a thick mass of white substance is seen in the centre, which, as it divides into the several strata, presents an arbor-

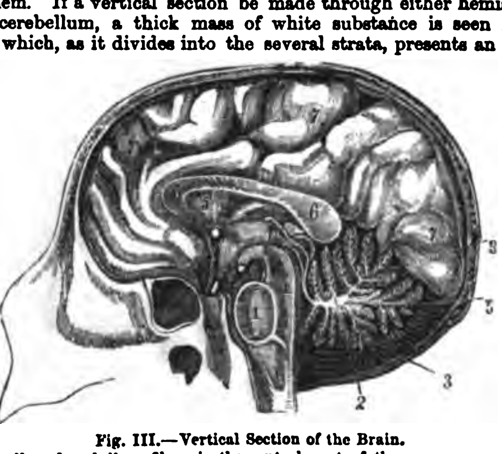


Fig. III.—Vertical Section of the Brain.

1, Bundles of medullary fibres in the central part of the nervous apparatus; 2, white matter forming the centre of the fundamental part of the cerebellum; 3, vertical section of the cerebellum, showing the arborescent arrangement of its component laminæ, and forming the appearance called arbor vitæ; 4, situation of the third ventricle; 5, fibres of white matter, forming the septum lucidum, the medullary layer which separates the two lateral ventricles from each other; 6, fibres of white matter, forming the corpus callosum, immediately beneath which are situated the lateral ventricles; 7, convolutions of the cerebrum.

escent appearance commonly denominated the arbor vitæ. (*Fig.* iii. 3.) These strata diverge towards the circumference of the cerebellum, and are covered externally by gray substance. (*Fig.* iii. 3.)

In front of the cerebellum is placed a large mass of nervous matter, forming a very considerable eminence, commonly termed the tuber annulare, or the pons varolii. (*Fig.* ii. 10.) The external surface of this body is convex, and it is divided into two lateral halves by a middle groove. (*Fig.* ii. 10.) It is joined to the cerebrum by two thick white cords named the crura cerebri, and to the cerebellum by two similar cords named the crura cerebelli. The crura cerebri are continued (from the tuber) outwards and forwards to the under and middle part of each hemisphere of the cerebrum, in which they are lost. In like manner the crura cerebelli are continued outwards and backwards into the hemispheres of the cerebellum, in which they terminate.

The Medulla Oblongata is that portion of the cerebral mass which intervenes between the tuber annulare and the foramen magnum (*fig.* ii. 7): beyond the foramen magnum it takes the name of spinal cord. On the anterior surface of the medulla oblongata there are four eminences contiguous to each other. (*Fig.* ii. 7.) The two internal are named corpora pyramidalia, or the pyramids (*fig.* ii. 8); and the two external the corpora olivaria (*fig.* ii. 9), or the olivary bodies.

If the membranes which invest the medulla oblongata are carefully removed, and its middle groove be gently drawn asunder, there will be discovered four or five bands of white substance ascending obliquely from one side of the medulla to the other. (*Fig.* ii. 11.) These bands on each side decussate, some of them passing above and others below those of the other side, so that they are interwoven like plaited straw. (*Fig.* ii. 11.) These bands are named the decussating bands of the corpora pyramidalia, and their decussation is conceived to explain the phenomenon familiar to the physician and surgeon, that when injury is done to one side of the brain a consequent disturbance of function is manifested on the opposite side of the body.

Taken as a whole, the nervous mass constituting the brain is strictly symmetrical, that is, the different parts of which it is composed are so arranged, that, if the organ be supposed to be divided into two lateral halves by a plane passing perpendicularly through its centre, the parts placed on each side of this plane have a perfect correspondence with each other, and form in fact reduplications of each other. (*Fig.* ii.) The principal parts of the cerebral mass are thus double, but they are all united on the median line with their fellows of the opposite side. This union is effected by medullary bands of various sizes and figures which pass from one to another, called commissures. Thus the double parts of the cerebellum are united by means of the large mass of cerebral matter already spoken of under the name of tuber annulare, or pons varolii. (*Fig.* ii. 10.) The hemispheres of the cerebrum are united chiefly by a broad expansion of medullary matter, which extends transversely across from the bottom of one hemisphere to that of the opposite side, called the corpus callosum, or the great commissure of the brain. (*Fig.* iii. 6, 6.) There are other connecting bands of smaller size by which minor portions of the cerebral mass are placed in communication, into a description of which it is not necessary to enter here.

The cerebral parts are separated from one another at certain places, and the intervals form cavities which are termed ventricles. Of these ventricles there are commonly enumerated four, all of which are in communication with each other. By far the largest of these are the two great cavities called the lateral ventricles, which are situated in the interior of the hemispheres of the cerebrum. Commencing in the fore part of the anterior lobes, these cavities proceed backwards in a direction parallel to each other through the middle into the posterior lobes. Their figure is winding and exceedingly irregular, and they are separated from each other by a tender mass of medullary matter termed the septum lucidum. (*Fig.* iii. 5.) They are lined throughout by a fine transparent membrane, which secretes a fluid that keeps them moist, gives them a bright polished appearance, and prevents them from uniting. This membrane is the pia mater, which is continued from the exterior surface of the brain into these interior cavities; and some anatomists describe the arachnoid membrane as accompanying the pia mater in all its course through the ventricles.

The middle or third ventricle is a vertical fissure between the two large convex eminences called the thalami optici (*fig.* iii. 4), situated in the middle and back part of the lateral ventricles. The fourth ventricle, called also ventricle of the cerebellum, is a cavity of considerable extent situated between the cerebrum, the tuber annulare, and the medulla oblongata.

For a detailed account of the course of the fibres the reader is referred to the work of Drs. Gall and Spurzheim, entitled 'Recherches sur le Système Nerveux en général, et sur celui du Cerveau en particulier,' in which the direction of the cerebral fibres is not only minutely and exactly described, but illustrated by excellent drawings as large as the objects. The course of the fibres that compose the pyramids (*fig.* ii. 8 and *fig.* iv. 1) is as follows:—Immediately before their entrance into the tuber annulare the pyramids are a little contracted. (*Fig.* ii. 8.) As soon as they enter this mass the pyramids are divided into innumerable bundles of fibres (*fig.* iv. 2), which are covered by a thick layer of transverse fibres (*fig.* iv. 2) that come from the cerebellum. (*Fig.* iv. 8.) These fibres of the pyramids, thus increased in number, ascend, and receive at every point of their course fresh accessions, until at their exit (from the tuber) forward and outward they form at least two-thirds of the crura cerebri, as is seen at *fig.* iv. 3. Followed in their course forwards from *fig.* iv. 3, they are manifestly increased at every point by the accession of infinite numbers of fibres. (*Fig.* iv. 4.) At the point (*fig.* iv. 5) the fibres, now exceedingly numerous, manifestly assume a diverging course, proceeding in every direction forwards, upwards, laterally, and backwards. (*Fig.* iv. 5, 6, 7.) At length the radiating fibres, crossing and interlacing each other in all directions, form an expansion or tissue, and, being folded in

Fig. IV.—Course of the fibres of the Brain.

1, Entrance of the anterior pyramids into 2, the tuber annulare, or pons varolii; 3, fibres of the pyramids much increased as they issue from the tuber annulare; 4, 5, continued increase in the fibres of the pyramids as they advance onwards towards the convolutions; 6, divergence of the fibres of the pyramids; 7, convolutions of the cerebrum, showing their depth, their gray matter, and the sulci between them; 8, cerebellum.

various ways and covered with gray matter, constitute the convolutions. (*Fig.* iv. 5, 6, 7, 7.) Thus the pyramids, progressively increased and developed, form a large portion of the anterior and middle lobes of the cerebrum. If the corpora olivaria (*fig.* ii. 9) were traced in like manner, they would be found to form the posterior lobes of the cerebrum; and the origin and source of the fibres constituting the main bulk of the cerebellum can be demonstrated with the same clearness and exactness.

From the preceding account of the structure of the brain, which shows it to be an exceedingly complex organ, it might have been inferred from analogy that it would receive a large supply of blood; but the quantity actually sent to it is far greater than any analogy could have led us to suppose. Haller made a calculation, from which he concluded that one-fifth of all the blood sent out of the left ventricle of the heart is carried to the head, yet the weight of the brain in the human subject is not more than one-fortieth of that of the whole body. Even if this estimate, which is generally thought too large, be reduced to one-tenth, according to the idea of Monro, it will still leave a very great over-proportion. There is no part of the structure of the brain more curious than the various contrivances connected with the circulation through the head, which have for their object the prevention of this prodigious quantity of blood from producing any injurious effects upon the tender cerebral substance, whether by its pressure or by its unequal distribution, in consequence of its stagnating in the vessels, or of its being too violently propelled against them. Many conjectures have been formed respecting the object of furnishing this organ with such an extraordinary quantity of blood, but nothing is really known of the use to which it is applied, though it may be admitted, to give a degree of plausibility to the opinion, that the brain has some analogy to a secreting organ. Without doubt one use both of the ventricles and the convolutions is to afford a more extended surface by which the blood-vessels may enter the cerebral substance at a greater number of points, and consequently in small quantity at any one point, while at the same time they are more firmly supported in their passage by the greater quantity of investing membrane with which they are supplied. [NERVOUS SYSTEM.]

The brain of the vertebrate animals differs considerably from that of man, and more in proportion to their low position in the scale of development. The most obvious distinction between the brain of man and that of the other mammalia is its diminished size in most of the latter. The moment the skull-cap is raised, the difference between the full rounded appearance of the former and the compressed flattened shape of the latter cannot fail to be observed. The convexity of the middle lobes is strangely lessened, and the posterior lobe is in a manner lost in quadrupeds. If the brain is now removed from the cranial cavity, the difference in bulk between that of man and the inferior animals is strikingly displayed. The brain of the ox scarcely weighs a pound: the average weight of the brain of the human being is more than 2½ pounds.

In man the brain is supposed to constitute about 1-35th part of the weight of his body. In the dog, averaging the different breeds, it is 1-120th part; in the horse it is only the 450th part, in the sheep the 750th part, and in the ox the 800th part.

As an illustration of the greater size and development of the nerves of sense in animals, the olfactory one may be selected. In man, who has other means of judging of the qualities of his food, and of surrounding objects, than by the sense of smell, the olfactory nerve is not one-fourth the size of that of the horse; in the ox, which is not so much domesticated as the horse, and oftener sent into the field to shift for itself, it is considerably larger; it is larger still in the swine, which has to search for a portion of its food buried in the earth, or deeply immersed in refuse or filth; and it is largest of all in the dog, whose acuteness of scent renders him so useful a servant to man.

The different development of the medulla oblongata in different animals may be adduced as another proof of the admirable adaptation of each to the situation which it occupies and the functions which it discharges. The medulla oblongata is the prolongation and condensation of the medullary matter of the brain, and it is the origin of that portion of the spinal cord which is devoted to organic life. In the human being, the breadth of it is only a seventh part of that of the brain; in the horse and the ox, it is nearly a third; and in the dog it is more than a half. In every part of the brain of the quadruped the medullary portion preponderates, and the cineritious is deficient.

In the smaller quadrupeds the comparative size of the brain approaches nearer to that of the human being. In the mouse it is a 43rd part of the weight of the animal.

The brain of the larger birds agrees with that of the mammalia in the smallness of its bulk, compared with the development of the same organ in the human being. The brain of the eagle is not more than a 260th part of the weight of the bird. The brain of the goose is not more than a 360th part. If in some of the lesser birds, as in the chaffinch and the redbreast, it approaches to the proportionate size of that of the human being, it is, as in the smaller quadrupeds, on account of the quantity of medullary matter required for the origins of the nerves; and the cineritious matter forms only a very small part of the brain. The brain of the bird has no convolutions on its surface; no corpora striata in the ventricles; no pons varolii between the brain and the spinal cord; and the origins of the optic nerves are separate from the brain, and lie behind and below it.

In fishes the brain is yet more diminished in proportionate size. In some species it does not constitute a 2000th part of the bulk of the fish. It scarcely half fills the cranial cavity, but is surrounded by a cellular tissue containing a transparent semifluid mass. It singularly varies in different species. It consists of at least four or more rounded eminences, placed in pairs opposite to each other and forming two parallel lines; and there is often only a very slight connection between these lines, or the eminences of which either of them is composed. The two principal hemispheres of the brain and the optic thalami are always present. The olfactory nerves often form a third pair of tubercles anterior to these and the cerebellum, and are always found posteriorly on the mesian line. The optic nerves usually cross each other without any intermingling of medullary matter. The cineritious substance is found in an exceedingly small proportion in the brain of fishes.

There is no brain properly speaking in the *Invertebrata*. In the worm, the upper ganglion of the nervous system, which represents the brain, is placed near to, or may be said to be perforated by, the superior portion of the œsophagus, and thence proceed little white threads or cords, which run along the course of the digestive canal. In insects the upper ganglion usually surrounds the œsophagus, and a ganglionic system of nerves can generally be traced proceeding from it. In the larvæ of insects the brain is inclosed in a horny cavity. The spinal cord proceeding from it pursues its course through the whole of the abdomen, presenting evident ganglia at different points, from which nerves are distributed; while from the intermediate spaces are given out other nerves without ganglia, presenting a rude but satisfactory sketch of the combined systems of sensitive and motor nerves discovered by modern physiologists.

(Quain, *Elements of Anatomy;* Grant, *Outlines of Comparative Anatomy;* Carpenter, *Principles of Physiology.*)

BRAIZE, a Fish. [PAGRUS.]

BRAKES. [PTERIS.]

BRAKES ROCK, the vulgar name for the *Allosorus crispus*, a plant belonging to the natural order *Polypodiaceæ*. *Allosorus* is known by its nearly circular sori, which are at length confluent, and are concealed by the reflexed margin of the frond. *A. crispus* has a slender very brittle stem, which attains a height of from 6 to 12 inches. It grows in stony places on mountains throughout Great Britain.

BRA'MA, a genus of Fishes of the order *Acanthopterygii* and family *Squamipennes*. Dorsal, anal, and ventral fins more or less scaly; body much compressed, somewhat ovate when viewed laterally; the head rather obtusely terminated; mouth when shut almost vertical; teeth slender, placed both in the jaws and palatines; branchiostegous rays seven. But one species of this genus is known, *Brama Raii*. M. Cuvier mentions the Mediterranean as the chief locality for this fish, but at the same time he says that it occasionally wanders into the ocean. It appears however that it is not so local as M. Cuvier supposes, numerous specimens having been found on different parts of our own coasts.

Brama Raii measures from about 1 to 2 feet in length; it is of a deep blue colour, becoming silvery towards the belly. The dorsal fin has 34 rays and the anal 30 rays. The tail is large and forked; pectoral fins rather long and narrow; ventral fins small: the scales extend as far as the jaws. The flesh of this fish is said to have an exquisite flavour. (Yarrell, *British Fishes.*)

BRAMBLE, the wild bush that bears blackberries, belonging to the natural order *Rosaceæ*. [RUBUS.]

BRAMBLING. [FRINGILLA.]

BRANCHIO'PODA, the first order of the division *Entomostraca* [ENTOMOSTRACA], of the class *Crustacea*. [CRUSTACEA.] Dr. Baird, in his 'Natural History of the British Entomostraca,' thus characterises it:—Mouth furnished with organs fitted for mastication; branchiæ many, attached to the feet; body sometimes naked, but most frequently having an envelope in form of a buckler, in some inclosing only the head and thorax, in others the whole body; feet vary in number, all branchiferous; antennæ two- or four-jointed and generally ciliated; eyes sometimes two, or even three, but frequently only one, or so closely approximated as to appear single. They are all free and unattached, swimming at large in water. This division of the *Entomostraca* includes some of the commonest forms, such as those known under the name of *Monoculus* and the various species of *Daphnia*, the water-fleas of popular writers. The following is the arrangement of this order by Latreille, which comprehends the *Lophyropoda* of Baird and others:—

Section I.

Lophyropoda.

Feet never more than six, the articulations more or less cylindrical or conical, and never entirely lamelliform or foliaceous. The branchiæ are not numerous; and there is but one eye. Many have the mandibles furnished with a palpus or feeler, and though M. Straus attributes this organisation exclusively to the genera *Cypris* and *Cytherina*, which compose his order of *Ostrapoda*, the elder Jurine and M. Ramdohr have shown that it is also characteristic of *Cyclops*. The antennæ are almost always four in number, and serve for locomotion. Three groups are arranged under this section.

Carcinoida.

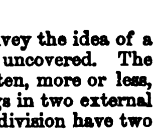
Shell more or less ovoïd, not folded so as to convey the idea of a bivalve, but leaving the lower part of the body uncovered. The antennæ never in the form of ramified arms. Feet ten, more or less, cylindrical or setaceous. Females carrying their eggs in two external bags situated at the base of their tail. Some of this division have two eyes, but the genus *Cyclops* has but one.

a. Two Eyes.

Shell entirely covering the thorax. Eyes large and distinct. Antennæ intermediate, terminated by two bristle-like appendages.

Under this subdivision Latreille places the genera *Zoea*, Bosc; *Nebalia*, Leach; and *Condylura*, Latreille.

In the genus *Zoea* we have an interesting example of the necessity of observing animals not only in one stage but through the whole period of their existence. The *Zoea pelagica* of Bosc, and the other species of the same genus, are now known to be transitionary conditions of the higher forms of *Crustacea*. We are indebted to Mr. V. Thompson of Cork for first having shewn this with regard to *Zoea*. He observed that the members of *Zoea*, from being natatory and cleft, became simple and adapted to crawling only. The animal, when perfected, was found to be a crab. To complete his proof of metamorphosis among the *Crustacea*, he states that he succeeded in hatching the eggs of the common Crab (*Cancer pagurus*), the young of which were found to be similar in form to *Zoea Taurus;* and he thence concluded that the crustaceous decapods generally undergo metamorphosis, being in the first state of their existence essentially natatory; and the greater number of them becoming afterwards in their perfect state incapable of swimming, being then furnished with chelæ (pincers), and with feet almost solely adapted for crawling. Mr. Thompson states that with regard to brachyurous decapods (crabs, &c.) he has ascertained the newly-hatched animal to be a *Zoea* in the following genera: *Cancer, Carcinus, Portunus, Eryphia, Gegarcinus, Thelphusa, Pinnotheres, Inachus*—eight in all; and that in the *Macroura* (lobsters, &c.) he has ascertained that the following seven genera are subject to metamorphosis: *Pagurus, Porcellana, Galathea, Crangon, Palæmon, Homarus, Astacus.* The annexed figure of *Zoea clavata* (Leach), taken by Mr. Cranch in the unfortunate expedition to the Congo under Captain Tuckey in 1816, will give some idea of the general form of *Zoea*.



Zoea clavata.

As an example of this division of Latreille we may give the *Nebalia bipes*, which includes the two species *N. glabra* and *N. ciliata* of Lamarck. This creature has an ovate body of a pale yellow colour, with a darker longitudinal line along each side; antennæ long, the inferior pair as long as the body, and setiferous; beak of carapace sharp-pointed and moveable; four pairs of natatorial feet of moderate length, and setiferous; caudal appendages rather long, and furnished at the extremity with one long slender seta and three or four short setæ, not plumose. This species is a native of the sea, and has been found on the coast of Devonshire, on the coast of Ireland, and the Shetland Isles.

β. One Eye.

Thorax divided into many segments. The anterior, and much the largest segment, presents a single eye only, placed in the middle of the front between the superior antennæ. *Cyclops* (Müller), which has been so well illustrated by the acute observations of the elder Jurine and of Ramdohr, is the only genus of this subdivision.

The body of the species of *Cyclops* is more or less approaching to oval, soft or rather gelatinous, and is divided into two portions, the one anterior, consisting of the head and thorax, the other posterior, forming what is commonly called the tail. The segment immediately preceding the sexual organs, and which in the females carries two supporting appendages in the form of little feet (fulcra, Jurine), may be considered as the first segment of the tail, which is not always very clearly defined or strongly distinguished from the thorax, and consists of six segments or joints, the second of which in the males is provided on its lower side with two articulated appendages of varied form, sometimes simple, sometimes having a small division at the internal edge, and constituting entirely or in part the organs of generation. In the other sex the female organ is placed upon the same joint. The last segment terminates in two points forming a fork, and more or less bordered with delicate beards or penniform fringes. The anterior portion of the body is divided into four segments, of which the first and by far the largest includes the head and a portion of the thorax, which are thus covered by one scale common to both. Here are situated the eye, four antennæ, two mandibles (internal mandibles of Jurine) furnished with a feeler (which is either simple or divided into two articulated branches), two jaws (the external mandibles, or lip with little beards, of Jurine), and four feet, divided each into two cylindrical stems, fringed with hairs or bearded. The anterior pair representing the second pair of jaws differ a little from the succeeding pair, and are compared by Jurine to a kind of hand. Each of the three succeeding segments serves as the point of attachment to a pair of feet. The two superior antennæ are longest, setaceous, simple, and formed of a great number of small articulations. They facilitate by their action the motion of the body, and perform very nearly the office of feet. The lower antennæ (antennules of Jurine) are filiform, consisting most frequently of not more than four joints, and are sometimes simple, sometimes forked. By their rapid motion they produce a small eddy in the water. In the males the upper antennæ, or one of them only, as in *Cyclops Castor*, are contracted in parts, and exhibit a swelling portion which is followed by a hinge joint. By means of these organs, or of one of them, the males seize either the hind feet or the end of the tail of their females during the season of fecundation, and are thus often found attached. On each side of the tail of the females is an oval bag filled with eggs (external ovary of Jurine), adhering by a very fine pedicle to the second segment, near its junction with the third, and where the orifice of the deferent egg-canal may be seen. The pellicle which forms these bags is only a continuation of that of the internal ovary. The number of contained eggs increases with age. They are at first brown or obscure, but afterwards present a reddish tinge and become nearly transparent, without however increasing in size when the young are about to come forth. When isolated or detached, up to a certain period at least, the germ perishes. A single fecundation suffices for successive generations, and the same female can lay eggs ten times in the course of three months, so that the number of births amounts to something enormous. Thus, taking eight ovipositions and allowing forty eggs for each, it has been calculated that one female *Cyclops* may be the progenitress of four thousand five hundred millions. The time the fœtus remains in the ovary varies from two to ten days, the variation depending on the temperature of the seasons and on other circumstances.

The young at their birth have only four feet, and their body is rounded and tailless. In this state they are the genus *Amymone* of Müller. Some time afterwards (in about fifteen days in the months of February or March) they acquire another pair of feet; they are then the genus *Nauplius* of the same author. After their first moult they assume the form and all the parts which characterise the adult state, but with smaller proportions: their antennæ and feet, for example, are comparatively short. At the end of two more moults they are fit for the reproduction of the species. The greater part of these *Entomostraca* swim upon their backs, darting about with vivacity, and possessing the power of moving either backwards or forwards. Their food generally consists of animal matter in preference to vegetable; but in the absence of the former they feed upon substances of the latter description, and it is said that the fluid in which they live never enters their stomachs. The alimentary canal extends from one extremity of the body to the other. The heart (taking *Cyclops Castor* as the subject) is of a shape approaching to oval, and situated immediately under the second and third segment of the body. Each of the extremities of this organ gives off a vessel, the one going to the head, the other to the tail. Immediately below is another analogous organ, giving off also at each end a vessel supposed to represent the branchiocardiac canals observable in the circulation of the Decapodous *Crustacea*.

The genus *Cyclops* is an inhabitant of the fresh waters; and we select the Common Cyclops, *Cyclops vulgaris*, Leach; *Monoculus quadricornis*, Linn.; *Cyclops quadricornis*, Müller; Monocle à Queue Fourchue, Geoffroy, as an example of the species.

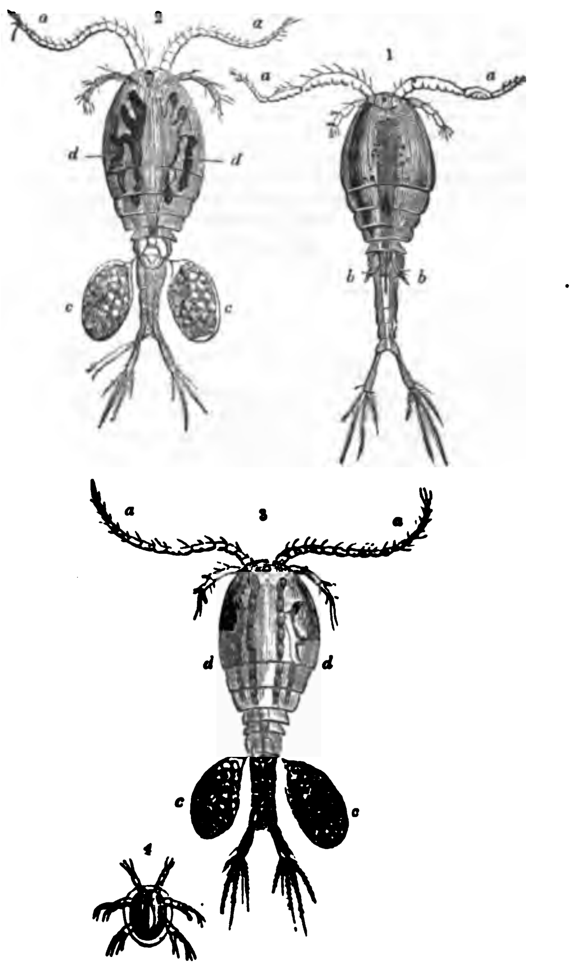
The body of the Common Cyclops has a somewhat swollen appearance, and is formed of four rings, and prolonged to about one-third of its entire length. The tail consists of seven rings. The posterior antennæ (antennules of Jurine) are tolerably large and composed of four joints, the anterior antennæ are thrice the length of the posterior.

There are several varieties.

Var. *a*. Reddish; eggs brown, forming two oblique masses near the sides of the tail. Total length eight-twelfths of a line. This is the *Monoculus quadricornis rubens* of Jurine.

Var. *b*. Whitish or gray, somewhat tinged with brown, rather larger than the preceding. Egg-masses greenish, forming nearly a right angle with the tail. Total length the same as the preceding. This is the *M. q. albidus* of Jurine.

Var. *c*. Greenish. Direction of the two egg-masses intermediate between that of the egg-masses of the two former. Length nine-twelfths of a line. *M. q. viridis* of Jurine.



Cyclops vulgaris, magnified.

1, Male of variety *a*; 2, female of the same; *a a*, antennæ; *b b*, sexual organs of the male; *c c*, external oviparous pouches of the female; *d d*, internal ovaries; 3, a female of variety *c*; 4, a young individual of that variety.

Var. *d*. Smoky red. General form nearly oval. Eggs brown, composing two masses, which cover a great portion of the tail. Length six-twelfths of a line. *M. q. fuscus* of Jurine.

Var. *e*. Of a deeper green than var. *c*. Eggs obscure green, passing a little into rose-colour when hatching is near, forming two masses attached to the tail, and appearing to be incorporate with it. Length the same as the preceding. *M. q. prasinus* of Jurine.

Ostracoda, Latreille; *Ostropoda*, Straus.

The shell of the *Ostracoda* is formed of two pieces or valves representing those of a conchiferous mollusk or bivalve shell, but horny, not testaceous. As in the bivalves, the two pieces are united by a hinge, and when the animal is inactive they close upon and shut in the body and the parts. The feet are ambulatory, six in number, and none are terminated by a digitated swimming organ, nor accompanied by a branchial lamina. The antennæ are simple, filiform, or setaceous. There is but one eye, which is composite and sessile. The mandibles and jaws are furnished with a branchial lamina, and the eggs are situated on the back.

In this division Latreille includes the genera *Cythere*, Müller (*Cytherina*, Lamarck) and *Cypris*. *Cythere* has one eye; three pairs of feet; abdomen short; the inferior or pediform antennæ furnished with one tolerably long curved and jointed filament. The species are inhabitants of the sea. They have not the power of swimming, but are always walking among the leaves or branches of the *Confervæ* and *Fuci*, where they delight to dwell. When shaken out of their hiding places into a tumbler or bottle, they may be seen to fall in gyrations to the bottom, without ever attempting to dart through the fluid, as would be the case with the species of *Cypris*. Upon reaching the bottom they open their shells and creep along the surface of the glass; but when touched or shaken they immediately again withdraw themselves within their shell and remain motionless. Dr. Baird, whose work on the British species contains a fund of information on the habits of the minute family to which these creatures belong, says that the species "are undoubtedly numerous, and the labours of any inquirer after them would assuredly be rewarded with success." He has described fifteen species as inhabitants of the British coasts. Several of the species have been found fossil.

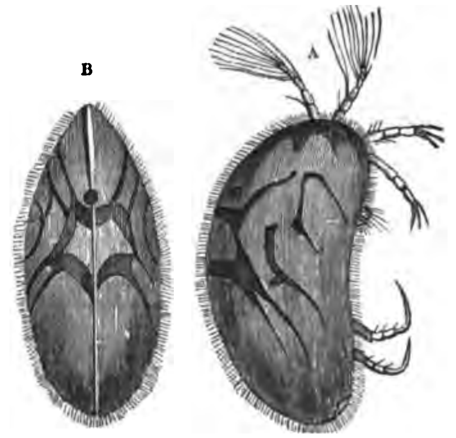
Cypris has two pairs of feet, one pair always inclosed within the shell. The two antennæ are terminated by a pencil of fine hairs. The case or shell is suboval, arched, and protuberant on the back or hinge side, and nearly straight or a little sinuous or kidney-shaped on the opposite edge. A little in advance of the hinge, and upon the mesial line, is the single large blackish round eye. The antennæ, which are inserted immediately below, are shorter than the body, setaceous, composed of from seven to eight joints, of which the last are the shortest, and terminated by a pencil of twelve or fifteen fine hairs, which serve as swimming organs. The mouth is composed of a carinated labrum; of two large toothed mandibles, each furnished with a feeler of three joints, to the first of which a small branchial lamina of five digitations (interior lip of Ramdohr) is attached, and of two pairs of jaws; the two upper, which are much the largest, have on their internal border four moveable and silky appendages, and externally a large branchial lamina pectinated on its anterior edge; the second are formed of two joints, with a short, nearly conical, and jointless feeler, also silky at the end. A sort of compressed sternum performs the office of a lower lip (external lip of Ramdohr). The feet have five joints, the third representing the thigh, and the last the tarsus; the two anterior ones, much stronger than the rest, are inserted below the antennæ, directed forwards with stiff hairs on long hooks collected into a bundle at the extremity of the two last joints: the four following feet are without these appendages. The second pair, situated on the middle of the under side of the body, are directed backwards, curved, and terminated by a long strong hook bent forwards; the two last, never showing themselves beyond the shell, are applied to the sides of the body for the purpose of sustaining the ovaries, and are terminated by two very small hooks. There is no distinct joint observable in the body, which terminates posteriorly in a kind of tail, which is soft and bent upon itself underwards, with two conic or setaceous filaments fringed with three silky hairs or hooks at the end, and directing itself backwards so as to project beyond the shell. The ovaries form two large vessels, simple and conical, situated upon the posterior sides of the body under the shell, and opening, one at the side of the other, at the anterior part of the abdomen, where the canal formed by the tail establishes a communication between them. The eggs are spherical.

These animals swim with more or less rapidity in the still fresh waters or gently-running streams which they inhabit, in proportion as they bring into action the filaments of the antennæ; sometimes they only show one, at others they put them all forth. Latreille thinks that these filaments may also assist in respiration. The two anterior feet are moved with the same rapidity as the antennæ when the animal is swimming; when it creeps over the surface of the water-plants, the progress is slow. The female deposits her eggs in a mass, fixing them by means of a glutinous substance on the water-plants or on the mud. Anchored by her second pair of feet, so as to be safe from the agitation of the water, she is occupied about two hours in this operation, the produce of which, in the largest species, amounts to 24 eggs. Jurine collected some of these at the time of their exclusion, and, after having insulated them, obtained another generation without the intervention of the male. A female which laid her eggs on the 12th of April changed her skin six times between that day and the 18th of May following. On the 27th of the last-named month she laid again, and, two days afterwards, made a second deposit. Jurine concludes that the number of moults in the young state corresponds with the gradual development of the individual. Desmarest considers that they do not undergo a metamorphosis, but that they present on their exclusion from the egg the form which they preserve throughout their life. Their food is said to consist of dead animal substances and of *Confervæ*. In summer, when the heats have dried up the pools, they plunge into the humid mud, and there remain in an apocryphal kind of existence till the rains again restore them to activity.

The recent species are numerous; Jurine described 21. Dr. Baird describes 15 species as British.

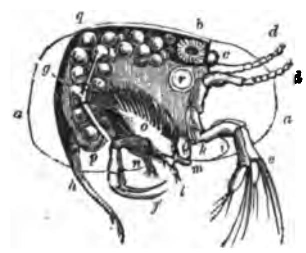
The hard shells of *Cypris* resist decomposition, hence many are fossil.

Cypris Faba, Desmarest, holds a place among the organic remains of the Wealden Rocks of England. Dr. Fitton has recorded it in the Weald Clay of the Isle of Wight, Swanage Bay, &c., and Dr. Mantell in the Hastings Sands. Desmarest notes the species as found in great abundance near the mountain of Gergovie, in the department of the Puy-de-Dôme, and at the Balme-d'Allier, between Vichy-les-Bains and Cussac. Their great fruitfulness and the frequent moults noticed



Cypris ornata (magnified).

Shell yellowish-green, banded with green. A, side view; B, view looking upon the hinge. The bands commence behind the eye.



Cypris fusca (magnified), Straus.

Valves brown, kidney-shaped, covered with fine scattered hairs. Antennæ with fifteen fine bristles. In the view the valves are supposed to be removed, the outline *a a* showing their shape and their relative situation; *b*, origin of the hinge membrane; *c*, eye; *d d*, antennæ deprived of their bristles; *e*, feet of the first pair; *f*, of the second pair; *g*, of the third pair; *h*, tail; *i*, labrum; *k*, mandible; *l*, feeler; *m*, jaw of the first pair; *n*, of the second pair; *o*, branchia or gill; *p q*, posterior portion of the left ovary; *r*, the male organ according to Straus.

above may account in some measure for the quantities of their petrified exuviæ. *Cypris* has also been found in the Fresh-Water Limestone, beneath the Mid-Lothian Coal-Field, at Burdiehouse, near Edinburgh, and in other districts.

Cladocera, Latreille; *Daphnides*, Straus.—These minute creatures have a single eye only, and are protected by a shell doubled as it were, but without any hinge, according to Jurine, and terminated posteriorly in a point. The head, which is covered with a kind of beak-like armour, projects beyond the shell. There are two antennæ, generally large, in the form of arms, divided into two or three branches placed on a peduncle fringed with filaments always projecting, and serving the purpose of oars. The feet, four to six pairs, terminated by a digitated or pectinated swimming organ, and furnished, with the exception of the two first, with a branchial lamina. Their eggs are situated on the back, and their body terminates with a sort of tail with two delicate hairs or filaments at the end. The anterior part of the body is somtimes prolonged into the form of a beak, sometimes into a shape approaching that of a head occupied almost entirely by one large eye.

Latreille gives the following sub-genera: *Polyphemus*, Müller; *Daphnia*, Müller; *Lynceus*, Müller (*Chilodorus*, Leach). This division in Baird's 'Entomostraca' includes the following families and genera.

1. *Daphniadæ*.

Daphnia. *Moina*.
Bosmina. *Macrothrix*.
Sida. *Daphnella*.

2. *Polyphemidæ*.

Polyphemus. *Evadne*.

3. *Lynceidæ*.

Eurycercus. *Chydorus*.
Camptocercus. *Acroperus*.
Alona. *Pleuroxus*.
Peracantha.

Of these *Daphnia* is the most numerous genus; and though the species are so extremely small, the observations of naturalists, and more especially of Schœffer, Ramdohr, Straus and the elder Jurine, have rendered its organisation and habits extremely well known. In the species of *Daphnia* one junction of the sexes fecundates the ova for many successive generations, six at least; their moults are very frequent; they lay at first but one egg, then two or three, and so on progressively as they advance in life till their number amounts to 58 in one species (*Daphnia magna*); and the young of the same deposit are generally of one sex, it being rare to find two or three males in a female batch, and vice versâ. As the winter approaches their moults and oviposits cease, and the frost is supposed to destroy them, leaving however the eggs unharmed, which the genial spring season hatches to fill the pools with myriads of *Daphniæ*. Then those who have microscopes will find ample employment for them. Every ditch, every pool, every garden reservoir, will furnish the observer with Branchiopoda.

The species are numerous. The most common is the Water-Flea, *Daphnia pulex* of Latreille, *Monoculus pulex* of Linnæus, *Pulex aquaticus arborescens* of Swammerdam, Le Perroquet d'Eau of Geoffroy. Despised as this minute creature may be by those who, like the orientalists, consider size as absolutely necessary to produce grand ideas, it has fixed the especial attention of Swammerdam, Needham, Leuwenhoek, Schœffer, De Geer, Straus, and above all, of Jurine, who, in common with other philosophers of great name, have found as much interesting information regarding the development of animal life in the admirable organisation of these animated specks as is afforded by the largest vertebrated animal. [DAPHNIA.]

Section II.

Phyllopoda.

Distinguished by the number of feet, and by the lamella or foliaceous form of the joints, representing, according to Latreille, the *Myriapods* in the class *Insecta*. The eyes are always two in number, formed of a sort of network, and sometimes placed on pedicles; many have besides a single smooth eye.

Ceratophthalma, Latreille, have ten pairs of feet at the least, and the maximum of those organs in this group is said to be 22. There is no vesicular body at their base, and the anterior feet are never so long as the others, nor are they ramified. The body is either inclosed in a shell-case, like a bivalve shell, or naked, the thoracic divisions being each furnished with a pair of feet. The eyes are sometimes sessile, small, and placed very nearly together; sometimes, and indeed most frequently, they are mounted on the extremity of two moveable pedicles. The eggs are either internal or external, and inclosed in a capsule.

α.

Eyes sessile, immoveable; body inclosed in an oval case like a bivalve shell; ovaries always internal.

The sub-genus *Limnadia* of Adolphe Brongniart is an example of this structure. *Limnadia Hermanni* (Adol. Brongn.), *Daphnia gigas* of Hermann, occurs in great numbers in the little pools of the forest of Fontainebleau, and we must refer the reader to Brongniart's Memoir in the 6th vol. of the 'Mémoires du Muséum d'Histoire Naturelle' for its description.

β.

Each eye situated at the extremity of a pedicle on both sides of the head; body naked and annulated throughout its length; no enveloping case or shell; eggs contained in an elongated capsule situated towards the base of the tail, or at the posterior extremity of the body and thorax in those which have no tail.

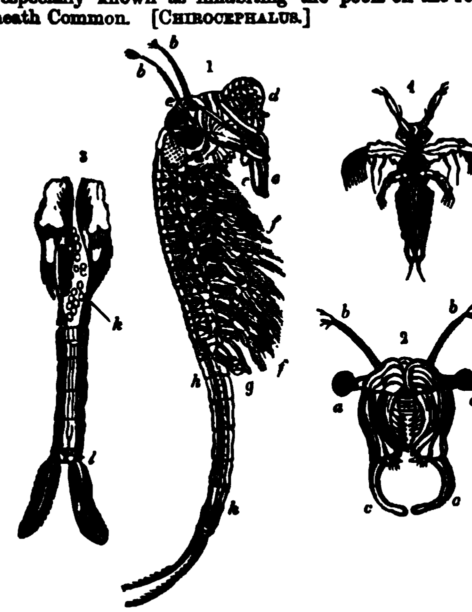
1. With a Tail.

To this subdivision belongs the Brine-Shrimp or Brine-Worm, *Artemia* or *Artemis* of Leach, *Branchipus* of Latreille, and *Chirocephalus* of Benedict Prevost and Jurine. We are now arrived at that development of form in the Branchiopods where the numerous legs or feet become paddles adapted simultaneously to the purposes of locomotion and respiration.

The Brine-Worm or Brine-Shrimp, *Artemia salina* of Leach, *Cancer salinus* of Linnæus, *Gammarus salinus* of Fabricius, *Artemis salinus* of Leach, *Artomisus salinus* of Lamarck, when full-grown, is about half an inch in length and very transparent: it is said to have been first discovered in the salt-pans at Lymington by Dr. Maty. There these animals are found in myriads, in rapid and continual motion in the salterns, which are the open tanks or reservoirs where the brine is deposited previous to boiling. The brine attains the desired strength by evaporation from exposure to the sun and air in about a fortnight. A pint contains about a quarter of a pound of salt, and in this concentrated solution, which, as Mr. Rackett observes, instantly destroys most other marine animals, the Brine-Shrimp revels. It is further said that these Brine-Worms are never found in the sun-pans where the brine is made by the admission of sea-water during the summer, and which are emptied every fortnight, but only in the pits or reservoirs (clearers) where it is deposited after it is taken out of the pans, and where some of the liquor constantly remains. So persuaded are the workmen of their utility in clearing the liquor, that they are accustomed to transport a few of the worms from another saltern if they do not appear at their own, and they increase greatly in a few days. Little however was known of the natural history of this animal till Mr. Thompson published his interesting observations in the 6th number of his 'Zoological Researches' (1834). He has there described and illustrated the gradual development of the embryo, and the metamorphoses which it undergoes from its first production until it arrives at a perfect or adult state. These, he says, will be found to correspond with those of *Branchipus*, *Chirocephalus*, and *Apus*, animals with which its alliance can no longer be doubtful. *Artemia* bears a long journey very well. We have had a glass jar full of them in their native brine sent to London. They lived a considerable time and were in full life and activity, affording very satisfactory opportunities of observing their habits and of confirming the statements of Mr. Thompson. They are constantly gliding with an even motion in the clear circumambient fluid, sometimes on their backs, sometimes on their sides, sometimes on their bellies, and seem to move with equal facility in every direction. Their transparency and the unwearied undulating motions of their respiratory paddles render them very interesting objects, and convey a deep impression of the harmony of adaptation of members to two such apparently anomalous ends as breathing and locomotion at the same moment.

The salt-pans at Lymington and some salt lakes in Siberia appear to be the only localities where these animals have been hitherto detected.

Branchipus stagnalis of Milne-Edwards, *Cancer stagnalis* of Linnæus, *Gammarus stagnalis* of Fabricius and Herbst, *Apus pisciformis* of Schœffer, who found it in a ditch by the road which leads from Ratisbon to the town of St. Nicholas, *Chirocephalus diaphanus* of Prevost, belongs to this division of Latreille. It is a British animal, and is especially known as inhabiting the pools on the road-side of Blackheath Common. [CHIROCEPHALUS.]



Branchipus stagnalis.

1, Male, magnified; *a a*, composite or network eyes; *b b*, antennæ; *c c*, mandibuliform horns; *d*, proboscidiform moveable tentacula, rolled spirally; *e*, simple rudimentary eye; *f f*, leaf-like natatory feet or oars; *g*, male organs; *h h*, tail; *i*, terminating filaments; 2, front view of the head; 3, tail of the female; *k*, egg-pouch; *l*, female organ; 4, a young *Branchipus* after the first moult.

2. Without a Tail.

The genus *Eulimene*, Latreille, belongs to this sub-section. The body is nearly linear, and there are four short antennæ almost filiform, of which the two smallest, which much resemble feelers, are placed at the anterior extremity of the head, which is furnished with two eyes mounted on cylindrical pedicles. The branchial paddles are 11, and immediately behind them is a terminal demi-globose piece in place of a tail, from whence issues a long delicate thread-like process, which may perhaps (according to Latreille) be an oviduct. *Eulimene albida*, whose body is for the most part white, with its posterior extremity black (*Artemia Eulimene*, Leach), the only species described by Latreille, was found in the Mediterranean near Nice.

Aspidophora.

Of this last division of the *Phyllopoda*, Latreille says that they have 60 pairs of feet, all furnished near their base with a large oval vesicle, the two anterior feet, which are much the largest, resembling antennæ. A large shell or crust covers the larger portion of the upper part of the body. This shell is free, shield-shaped, notched posteriorly, and bearing anteriorly on a circumscribed space three simple sessile eyes, of which the two anterior are largest and lunated. There are two bivalve capsules containing the eggs, and annexed to the eleventh pair of feet.

Apus productus [BINOCULUS] is an example. Mr. Thompson figures a species, *Apus Guildingii*, from the West Indies, and observes that there appear to be two European species confounded under the specific name *cancriformis*, namely, Schœffer's and Dr. Leach's, which most resemble *Apus Guildingii*, and that described by Savigny, in which the elongated shield entirely covers the natatory members.

Mr. Thompson observes that there is a considerable approximation between *Artemis* and certain *Trilobites* (*Bucephalithus*, &c.), nor can there be any doubt that the analogies of *Branchipus*, *Serolis*, and *Limulus* all contribute to the illustration of that most ancient race of Crustaceans. [TRILOBITES.] (Burmeister, *On the Trilobites*.)

BRANCHIO'STOMA, the name given by Costa to the most anomalous of all living fishes, and indeed of all the *Vertebrata*.

This extraordinary animal was first discovered on the coasts of Britain, a single specimen having been sent to Pallas from the coast of Cornwall during the latter part of the last century. The great naturalist of Russia described and figured it in his 'Spicilegia Zoologica' under the name of *Limax lanceolatus*, believing it to be a mollusk, though remarking in his description of it on the resemblance of some of its characters to those of a fish. It seems to have been lost sight of for more than half a century, and with the exception of a brief reference in Stewart's 'Elements of Natural History' we find no notice of it in any synopsis of animals. In 1834 it was re-discovered by Costa on the Neapolitan shores, who described it in the 'Annuario Zoologico' under the name of *Branchiostoma lubricum*; and some years after in his 'Fauna of the Kingdom of Naples' gave a fuller account of it. Costa first perceived that it was a fish and not an invertebrate animal, and remarked its affinity to the Cyclostomatous fishes. In 1836 Mr. Yarrell gave an account of it in his 'History of British Fishes' under the name of the Lancelet (*Amphioxus lanceolatus*). He had not then met with Costa's account of it. He figured and described it from a specimen found by Mr. Couch at Polperro in Cornwall, the first taken in that locality since its original discovery there. Mr. Yarrell gave the first correct notice of the chorda dorsalis and vertebral column. About the same time, singularly enough, considering how long it had escaped notice since the days of Pallas, it was taken by several naturalists on the coasts of Sweden. Lundevall and Loven found it in Bohuslan in 1834, but did not give an account of it till 1841. Retzius had it from the same locality, and published a notice of it in the 'Berlin Proceedings for November,' 1839, in which also is a communication on the same subject by Professor J. Müller. Rathke gave an account of its structure in 1841. In the same year Mr. J. Goodsir published an elaborate memoir on its anatomy in the 'Transactions of the Royal Society of Edinburgh' for 1841, being the result of his examination of two examples taken in the Irish Sea by Professor E. Forbes in 1837. In 1842 a most valuable memoir on this animal was read before the Royal Society of Berlin by Professor J. Müller, and this paper beautifully illustrated appeared in the volume of 'Transactions' of that society published in 1844.

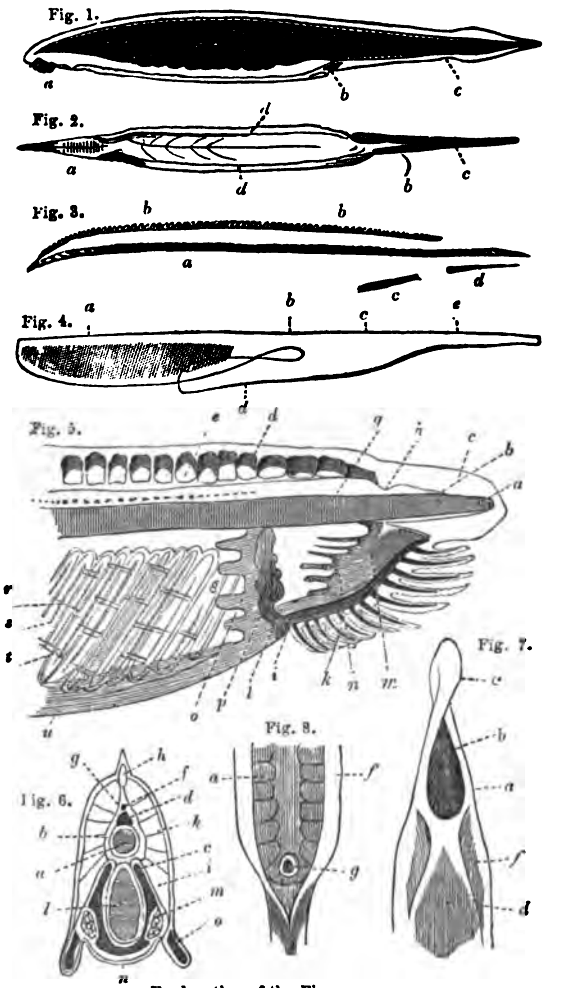
Besides the instances of its capture above mentioned it has been since taken by Mr. MacAndrew on the west coast of Scotland, and by Professor Edward Forbes in the Ægean Sea, and by those gentlemen on the south coast of England in 1846.

The great interest which attaches to this fish depends on the strangeness of its anatomical characters, the unexampled degradation of its organisation among the *Vertebrata*, and the link which it forms between the highest of animals and some of the lowest. A vertebrated animal without a brain, a fish with the respiratory system of a mollusk, and the circulatory system almost of an Annelide, presents a combination of characters which must excite the wonder and interest equally of the physiologist and the systematic naturalist. Scarcely any animal yet discovered is so likely to change received views of classification and relative order of characters as the Lancelet. As yet however it has attracted but little attention among zoologists, though the physiologists and anatomists have fully perceived its value. For these reasons we shall give a full account of what is now known respecting its external character, structure, and habits.

The usual size of the Lancelet is about 2 inches in length; the height to the length being as 1 : 10, and the breadth to the length as $\frac{1}{2}$: 10. It is of a lanceolate form tapering to each extremity, and riband-like. Anteriorly it terminates in a head scarcely distinguishable from the body, apparently pointed, but when examined closely seems to end in a rounded and somewhat spathulate rostrum, beneath which is the mouth, a longitudinal opening, fringed on each side by a row of long filaments which can close in and clasp alternately, so as to protect the oral opening. Along the back runs a continuous fin, which dilates near the sharp posterior extremity on each side so as to form a sort of caudal fin. Near the tail opens the vent, in front of which is a median fin continued to another opening situated a little behind the centre of the body (porus abdominalis), and serving as an outlet for the genital products. Continued from this forwards nearly to the mouth are two strong lateral folds, mistaken by Pallas for the margins of a ventral disk, and hence leading him to consider the animal a Gasteropodous Mollusk. The entire animal is translucent and of a silvery whiteness, its sides being marked by the indications of the lateral ichthyic muscles, which give it the aspect of a small sand-eel.

Organisation. Skeleton.—The osseous system consists of a chorda dorsalis tapering at both ends, and, strange to say, not presenting the slightest vestige of a cranium, and of the germs of superior and inferior inter-spinous bones and fin-rays in the most rudimentary state. The chorda dorsalis is composed of from 60 to 70 vertebræ.

which are also in a rudimentary state, and little more than indicated. "The chorda dorsalis," to quote Mr. Goodsir, "is formed externally of a fibrous sheath, and internally of an immense number of laminæ, each of the size and shape of a section of the column at the place where it is situated. When any portion of the column is removed



Explanation of the Figures:—

Fig. 1. The Lancelet, a little larger than life. *a*, the mouth; *b*, porus abdominalis; *c*, the vent.

Fig. 2. View of the animal from beneath. *a*, the mouth; *b*, porus abdominalis; *c*, vent; *d d*, ventral folds.

Fig. 3. The neuro-skeleton of the Lancelet, consisting of—*a*, the chorda dorsalis; *b b*, the vesicular germs of the dorsal fin-rays; *c*, those of the anterior, and *d*, those of the posterior anal fins (from Goodsir).

Fig. 4. The intestinal system. *a*, the branchial sac; *b*, the œsophagus; *c*, greener and wider part of the intestinal canal; *d*, cæcum; *e*, narrower and posterior part of the intestinal canal.

Fig. 5. Anterior extremity of the body of a young animal (from Müller). The lateral muscles are omitted in order to show more clearly the other parts. *a*, chorda dorsalis; *b*, its sheath; *c*, rounded anterior extremity of the body, terminating in the dorsal fin; *d*, cellular dorsal fin-rays; and *e*, their contents; *g*, spinal marrow; *h*, eye; *i*, labial cartilages; *k*, cirrhi of the mouth; *l*, a muscle of the labial cartilages, arising from the fringed fold between the cavity of the mouth and branchial cavity; *m*, wall of the mouth; *n*, finger-formed figures on the wall of the mouth (ciliated organs); *o*, fringed fold between the oral and branchial cavities; *p*, heart-like arch of the aorta, connecting arch between the branchial heart and aorta; *q*, anterior and superior part of the branchial sac, in which the branchial slits are wanting; *r* and *s*, branchial ribs; *t*, branchial slits; *u*, walls of the belly.

Fig. 6. Transverse section of the body (from Müller). *a*, chorda dorsalis; *b*, its sheath; *c*, membranous layer; *d*, spinal marrow, and *f*, canal above it; *g* and *h*, section of fin-rays; *i*, lateral muscles; *k*, intermuscular ligament; *l*, branchial sac; *m*, ovaria; *n*, wall of belly; *o*, lateral ventral folds, with their canal.

Fig. 7. View of the anterior part of the body from beneath. *a*, mouth; *b*, cirrhi; *c*, snout; *d*, ventral wall; *f*, lateral ventral fold.

Fig. 8. View of the underside of the body in the region of the porus abdominalis. *a*, ovary; *f*, lateral ventral folds; *g*, porus abdominalis.

these plates may be pushed out from the tubular sheath like a pile of coins. They have no great adhesion to one another, are of the consistence of parchment, and appear like flattened bladders, as if formed of two tough fibrous membranes pressed together." Besides the skeleton of the nervous system there is a hyoid apparatus forming the armature of the mouth, and consisting of two sets of 17 articulated pieces, from each of which, except two, a ray proceeds. These rays form the oral cirrhi. Müller takes a different view of this structure, maintaining that it corresponds neither to the jaw-bone nor to the hyoid apparatus in other animals, but is analogous to the cartilaginous ring of the mouth of the lamprey and the Myxinoid fishes, a system peculiar to that family. There is also in the Lancelet a series of fine, transparent, cartilaginous, hair-like ribs, 70 to 80 on each side, forming a cage for the protection of the branchial cavity.

Nervous System.—The spinal cord extends the whole length of the spine, but is not quite so sharp at the fore-end as behind. It presents no trace of a brain. From 55 to 60 nerves pass off from each side of it, which do not arise by double roots. The details of this important part of the animal's anatomy are fully given by Mr. Goodsir. Müller and Rathke have observed the existence of rudimentary eyes, consisting of a small black spot of pigment, but not furnished with any optical apparatus. No traces of organs of smelling or hearing have been met with.

Vascular System.—The observations of Müller having been made on the living animal, he was enabled to pursue this part of its organisation further than the other observers. According to him the vascular system of this animal corresponds in general arrangement with that of fishes, differing however in regard to the heart from that of all other vertebrate animals, and displaying a striking accordance with that in worms; for the hearts in the *Branchiostoma* are not only more divided than in other animals of its class, but present entirely the form and distribution of blood vessels, and extend over wide spaces. The blood is white.

The Respiratory System is constituted by the anterior extremity of the intestinal tube, the walls of which are clothed with vibratile cilia, and protected and adapted to their office by the peculiar cage-like skeleton already mentioned, which is further strengthened by transverse cartilaginous rods, between which are numerous clefts, their openings protected by vibratile cilia. This was first made known by Müller, who described also a curious apparatus of finger-shaped wheel-organs and fringed folds placed at the entrance of the branchial cavity, and marking the commencement of the ciliated portion of the intestinal canal of which the branchial sac forms a part. At the end of the branchial sac is the porus abdominalis, an opening which serves equally respiratory and genital purposes.

The Digestive System consists of an intestinal canal and a cœcum, both of which are ciliated. The latter is considered by Müller to be a liver, but the office of a liver appears to be performed equally by the other parts of the intestines.

The Reproductive System is imperfectly known. As far as it has been observed it appears in the form of certain bean-shaped bodies attached to the inner surface of the lining of the abdomen on the outside of the branchial canals. Müller distinguishes the two sexes, but this part of the history of the Lancelet demands further investigation. It is not impossible that the two membranous folds of the abdomen and their canals may be connected with this system, and serve marsupial purposes. This remark, however, we merely throw out as a suggestion.

The Muscular System is highly symmetrical, and consists of a series of lateral muscular bundles corresponding in number, size, and position to the vertebræ of the chorda dorsalis, and bearing a general resemblance to the lateral muscles of the higher fishes. Müller classes the muscles of the Lancelet under the heads of—1st, lateral muscles; 2nd, abdominal muscles; 3rd, muscles of the oral ring and tentacula; 4th, muscles of the ring between the oral cavity and branchial sac; and, 5th, muscles of the branchial apparatus. The skin is thin, tough, and scaleless.

Habits.—The Lancelet lives in sandy ground at a depth of between 10 and 20 fathoms water. It probably buries itself in the sand. When taken it swims rapidly with a snake-like motion, but after a time settles down, unless disturbed, lying flat on its side. It is very tenacious of life. We have had it for three hours in a watch-glass under the microscope, at the end of which time when disturbed it seemed as lively as at first. It dislikes the light. It bears handling without injury. Its food was found by Müller in the intestinal canal of some of the specimens he examined: it consisted of infusorial animalculæ. The Lancelet does not swallow but simply imbibes its food.

General Remarks.—"*Branchiostoma*," says Müller, "is evidently a vertebrated animal and a fish. It is distinguished from all other *Vertebrata* by its peculiar circulatory system, and by the absence of a distinction between the brain and spinal marrow; from all other fishes by the extraordinary number of branchial ribs, by the union of the branchial and ventral cavities, and by the combination of the respiratory opening with the ventral opening." Müller considers it connected with the Cyclostomatous fishes through the peculiar characters of its chorda dorsalis and the absence of jaws, but as inferior to them in the absence of a distinct brain and in the peculiarities of its respiratory system. "The *Branchiostoma*," he concludes, "ranks next the Cyclostomatous fishes, but not among them, being removed from them by distinctions which are greater than the differences between fishes and naked amphibia."

"Viewed as an entire animal," writes Mr. Goodsir, "the Lancelet is the most aberrant in the vertebrate sub-kingdom. It connects the *Vertebrata* not only to the Annulose animals, but also through the medium of certain symmetrical *Ascidiæ* (the genus *Pelonaia* of Forbes and Goodsir) to the Mollusks. We have only to suppose the Lancelet to have been developed from the dorsal aspect, the seat of its respiration to be transferred from its intestinal tube to a corresponding portion of its skin, and ganglia to be developed at the points of junction of one or more of its anterior spinal nerves, and inferior branch of its second pair, to have a true Annulose animal, with its peculiar circulation, respiration, generative organs, and nervous system, with supra-œsophageal ganglia and dorsal ganglionic recurrent nerve."

Taking all we know of the structure of this truly wonderful animal into consideration, we are inclined to regard it as the relic of some great order of Fishes, which in their organisation brought down the Vertebrated series to a parallel with the lower forms of *Mollusca*, and which became extinct in some former epoch of the world's geological history, and from the unpreservable character of their bodies, and the absence of hard parts, left "not a wreck behind." The more we know of nature the more are we convinced that there are no isolated organisms; that beings apparently anomalous are members of orders either partially known or for the most part extinct. Of all anomalous creatures the *Branchiostoma* is the most so, and it is much more consistent with the principles of scientific zoology to admit it as the type of a distinct order among fishes than to attempt to place it among defined groups. The strange combination of characters which it presents—a vertebrated animal without a brain, having the respiratory apparatus of an Ascidian Mollusk, and a ciliated intestinal cavity—if it does not almost warrant its erection into the type of a class by itself, certainly is sufficient, and more than sufficient, to constitute it the type of an order in the lowest of the vertebrate classes.

BRANCHITE, a mineral belonging to the Resin series, and found with Coal.

BRAND, or BURN, a disease in vegetables by which their leaves and tender bark are partially destroyed as if they had been burnt; hence the name of this disease, which is called Brûlure in French. It has been observed that after the leaves have been wetted by dews or gentle rains so that drops adhere to them, and a bright sunshine has succeeded, every spot to which the water had adhered lost its natural colour, and became of a dark or yellow hue; and on closer examination it was found that the organisation had been partly destroyed, and that these spots no longer possessed the power inherent in healthy leaves of exhaling the water which circulates through them. When this disease is extensive, and attacks the bark as well as the leaves, it frequently causes the death of the plant, and at all events enfeebles its growth and prevents its perfect fructification. The cause of this, like that of most diseases which are common to plants, has been vulgarly ascribed to some unknown atmospheric influence; and various guesses have been made, which for the most part have little or no foundation. That which appeared most plausible was, that the drops of water being apparently globular, collected the light of the sun into a focus, and produced a sufficient degree of concentration of the calorific rays to burn the tender substance of the leaves. A little reflection will soon convince us that this will not bear examination. The drops which adhere to the leaves and the bark are not globes, but at best flattened hemispheres, and consequently cannot collect the rays of the sun into a focus on the surface to which they adhere; besides, the spots are as large as the diameter of the drops, so that all the surface that has been covered with water is injured; whereas the focus of a globe, such as would actually burn the leaf, must be very small in proportion to the lens which concentrated the rays. It is much more probable that the effect of the water on the tender epidermis of the leaf or bark to which it adheres is similar to that which it has on vegetable matter infused in it; it softens and dissolves a portion of it, especially when the temperature is somewhat raised, and destroys the vitality. (De Candolle, 'Physiologie Végétale.)

It is a fact that the principal mischief arises from a sudden change of temperature soon after sunrise, especially when there has been a heavy dew or hoar-frost in the night; and careful gardeners brush off the drops from their delicate plants before sunrise to guard against the Brand. Every drop which falls on the leaves of tender plants from the glass which covers a hotbed in which they grow produces a disease exactly similar to that which we have been describing; and although the vapour of fermenting dung has a pungent ammoniacal smell, it will be found that the water condensed on the glass is nearly pure, and can have no peculiar corroding effect. It acts therefore simply as a dissolvent, and by stopping the evaporation, which is always rapid from the leaves of plants in a hotbed, produces a derangement in their functions, and ultimately disease.

BRANK-URSINE. [ACANTHUS.]

BRANTAIL, the Redstart. [SYLVIADÆ.]

BRA'SSICA, a genus of Cruciferous plants, comprehending among other species the Cabbage, Cauliflower, Broccoli, Borecole, Rape, Turnip, Colza, and the like. It is distinguished from other Cruciferous genera by the following characters:—Its seeds contain an embryo, the radicle of which is embraced in the concavity of the folded cotyledons. Its pod is long, slender, and many-seeded. The seeds are spherical. The calyx is equal at the base, and slightly spreading; the petals are undivided; the stamens entire.

B. oleracea, the Wild Cabbage, is met with in abundance upon the cliffs of many parts of Europe; commonly in the south part of European Turkey (especially about Mount Athos), on the coast of Kent near Dover, and on that of the Isle of Wight, Cornwall, Wales, and Yorkshire. In other places it forms a broad-leaved glaucous plant, with a somewhat woody stem, having but slender likeness to its cultivated progeny; and it is difficult to conceive by what original discovery the species was brought under the influence of domestication so as to have been prepared for the numerous changes and improvements it had to undergo before the races of Cabbages, Savoys, Borecoles, Cauliflowers, and Broccolis could have been produced.

B. campestris, the Wild Navew or Turnip, has its leaves lyrate, dentate, somewhat hispid; upper leaves ovate, acuminate, deeply cordate, amplexicaul, glabrous. It grows by the sides of rivers, by ditches, in marshes, and the borders of fields in many parts of England. It is believed to have been the Γογγυλὶς of Theophrastus. This is looked upon as the original of the Swedish Turnip, whilst a variety, regarded by some botanists as a species, with a caulescent fleshy root, called *B. Rapa*, is supposed to be the origin of the Common Turnip.

B. Napus, the Rape, Colza, or Coleseed, has the lower leaves lyrate, dentate, glabrous; upper leaves oblong, somewhat narrowed below, with a dilated cordate semi-amplexicaul base. It is difficult to find any character by which to distinguish this plant from the preceding. In fact some botanists regard *B. Napus* as nothing more than a variety of *B. campestris*.

B. monensis has the leaves stalked, all deeply pinnatifid; the lobes oblong, unequally toothed, those of the upper leaves linear. The stem of this plant is prostrate, and the flowers yellow. It is found on the western coasts of Great Britain.

BRASSICA'CEÆ, the name given by Dr. Lindley to the natural order *Cruciferæ*. [CRUCIFERÆ.]

BRAUNITE, a native Protoxide of Manganese, containing 79 per cent. of Manganese. It is a dark brownish-black, with a sub-metallic lustre. It has a hardness from 6 to 6·5, and specific gravity 4·8. It is found in Piedmont and Thuringia.

BRAYERA, a genus of plants belonging to the natural order *Rosaceæ*. One of the species, *B. anthelmintica*, yields the anthelmintic remedy known by the name Cusso, Cabotz, or Kousso. Although its anthelmintic virtues have been long known, it has only been recently introduced into Europe. The plant is a native of Abyssinia. [KOUSSO, in ARTS AND SC. DIV.]

BRAZIL-NUTS. [BERTHOLLETIA.]

BRAZIL-WOOD, the wood of *Cæsalpinia Brasiliensis*. [CÆSALPINIA.]

BREAD-FRUIT. [ARTOCARPUS.]

BREAM, a name given more especially to the Carp-Bream, but applied to several other kinds of fish. It is more especially adopted to designate the species of the genus *Abramis*, belonging to the division of Abdominal *Malacopterygii* and the family *Cyprinidæ*. The chief distinguishing characters of this genus consist in the deep and compressed form of the body; the great convexity of the dorsal and abdominal line; the base of the dorsal fin being short, placed behind the line of the ventrals; the long anal fin; and the absence of either strong horny rays or barbules.

A. Brama, the Bream or Carp-Bream, may be known by its yellowish-white colour, which becomes yellowish-brown by age. The irides are of a golden yellow, the cheeks and gill-covers silver-white; fins light-coloured, the pectoral and ventral fins tinged with red; the dorsal, anal, and caudal fins tinged with brown. The Bream is an inhabitant of many of the lakes and rivers of the continent of Europe generally as far north as Norway and Sweden. It thrives best in this country in large pieces of water or in the deep and most quiet parts of rivers that run slowly. It occurs near London in the Mole and the Medway, also in the Regent's Canal. Bloch states that the number of ova in the female is 130,000. The flesh of the Bream is generally considered insipid, although, on account of the sport it affords the angler, it is a good deal sought after.

A. blicca, the White Bream or Bream-Flat, differs from the Carp-Bream of the same size, in having the head larger and the fleshy portion of the tail deeper. The number of the rays in the pectoral and anal fins differs considerably from those of the Carp-Bream. The pectoral fin of the White Bream has three rays and the anal fin five rays less in number than the Carp-Bream. The general colour of the sides is silvery-bluish white, without any of the yellow-golden lustre observable in the last species. The irides silvery-white, tinged with pink. This fish has never been taken of so large size as the Carp-Bream. It has been described by Bloch, who says it is very common on the continent. It is also found in most of the lakes in Sweden. In England it is not generally known. Mr. Jenyns has recorded its presence in the Cam, and Dr. Lankester took it in large numbers in a piece of water at Campsall near Doncaster. Mr. Lubbock has also taken it near Norwich. It varies very much in its characters, but is undoubtedly a distinct species.

A. Buggenhagii, the Pomeranian Bream. This species of Bream is at once distinguished from the preceding by the greater thickness of its body, by the scales being larger in proportion to its size, the anal fin being shorter, and having a smaller number of rays. Bloch records it as being common in Swedish Pomerania. It is even more rare in England than the last species. (Yarrell, *British Fishes.*)

BREATHING-PORES, microscopic apertures in the cuticle of plants. [STOMATES.]

BRE'CCIA, an Italian word literally signifying "an opening or breaking in any substance," is employed in geology to designate a rock composed of angular fragments of a pre-existing rock, or of several pre-existing rocks, united by a cement of mineral matter that may vary from compact to friable. Thus, as in the annexed diagram, the fragments (which are shaded) may be composed either of angular portions of quartz rock, or any other single rock, united by a cement (which is dotted) formed of the hard siliceous substance named chert, or any other hard mineral substance; or the fragments may be angular portions of many rocks, such as a mixture of pieces of slate, porphyries, limestones, granites, or others, united by a friable sandstone or any other soft mineral substance.

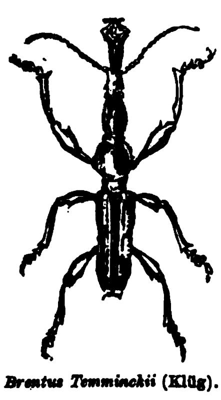
The term Breccia has been adopted from the well-known Breccia marble, which has the appearance of being composed of fragments joined together by carbonate of lime, infiltrated among such fragments after the latter were produced by some disrupting force.

Breccias inform the geologist that the pre-existing portions of rocks included in them have not been exposed to considerable friction, which would have rounded off the angular parts; as has happened in the case of pre-existing pieces of rocks included in conglomerates. [CONGLOMERATE.] Hence the geologist may expect to find the rocks, whence the angular fragments of a breccia are derived, not far distant from the breccia itself, while the rounded pebbles contained in a Conglomerate may have been transplanted from considerable distances.

BREISLAKITE, a mineral which occurs crystallised in delicate capillary crystals of a reddish-brown or chestnut-brown colour, bent and grouped like wool. Its fibres are flexible. It has a metallic lustre. It is found at Vesuvius and Capo di Bove, near Rome, forming woolly coatings in the cavities of lavas. It contains silica, alumina, and oxide of iron.

BRENTI'DES, a family of Coleopterous Insects, belonging to the section *Rhynchophora* and sub-section *Recticornes.* Distinguishing characters:—Body much elongated; tarsi with the penultimate joints bilobed; antennæ filiform, or in some with the terminal joint formed into a club; proboscis projecting horizontally, generally long; in the male longer than in the female; palpi minute.

The insects constituting this family are among the most remarkable of the Beetle Tribe, and are almost entirely confined to tropical climates; only one species has yet been discovered in Europe. But little is known of their habits, except that they are generally found crawling on trees, or under the bark, and sometimes on flowers. The most common colouring of the species is black, or brown, with red spots and markings.



Brentus Temminckii (Klüg).

The four principal genera of the *Brentides* are as follows:— *Brentus, Arrhenodes, Ulocerus,* and *Cyclas.* The genus *Brentus* is chiefly distinguished by having the antennæ 11-jointed, either filiform or sometimes slightly enlarged towards the apex, and the body linear.

Brentus Temminckii (Klüg), one of the most remarkable species of the tribe, will give an idea of their general form. It is found in Java, and is of a blackish colour varied with red markings, and has deeply-striated elytra.

In the genus *Arrhenodes* the rostrum is short, and terminated by two distinct mandibles, which are straight and project considerably in the males. The species inhabit North America, and one is found in Europe, *A. Italica.*

Ulocerus has the antennæ 9-jointed; the last of which forms a club.

Cyclas has the antennæ 10-jointed; the terminal joint forms an oval club; the thorax is indented in the middle, and the abdomen is of an oval form.

BRETT. [RHOMBUS.]

BREUNNERITE is a native Carbonate of Magnesia and Iron. It occurs crystallised. Its primary form is an obtuse rhomboid. The cleavage perfect, parallel to the primary planes. Colour yellow of different shades, and black; streak white; fracture flat conchoidal; hardness 4·0 to 4·5; its lustre is vitreous, sometimes inclining to pearly; it is transparent and translucent. Specific gravity 3·0 to 3·2. Found at Zillerthal in Salzburg and other places in the Tyrol. It has been analysed by Stromeyer and contains

Carbonate of Magnesia	86·05
Carbonate of Iron	13·82
Carbonate of Manganese	0·69

BREXIA'CEÆ, *Brexiads,* the Brexia Tribe, a natural order of plants belonging to the polycarpous group of Monopetalous Exogens. This order was constituted by Lindley in the first edition of his 'Natural System of Plants.' The following is his description of the order:—Calyx inferior, small, persistent, 5-parted, æstivation imbricated; petals 5, hypogynous, imbricated in æstivation; stamens 5, hypogynous, alternate with the petals, arising from a narrow cup, which is toothed between each stamen; anthers oval, innate, 2-celled, bursting longitudinally, fleshy at the apex; pollen triangular, cohering by means of fine threads; ovary superior, 5-celled, with numerous ovules attached in two rows to placentæ in the axis; style 1, continuous; stigma simple; fruit drupaceous, 5-celled, many seeded; seeds indefinite, attached to the axis with a double integument, the inner of which is membranous; no albumen; cotyledons ovate, obtuse; radicle cylindrical, centripetal. The species are trees with nearly single trunks; the leaves are coriaceous, alternate, simple, not dotted, with deciduous minute stipules; the flowers are green, in axillary umbels, surrounded by bracts on the outside.

Dr. Lindley remarks that the habit of *Brexia* is that of some *Myrsinaceæ,* especially of *Theophrasta,* from which it differs in being polypetalous, and the stamens being alternate with the petals. Its relations are also strong with *Rhamnaceæ* and *Celastraceæ,* but its stamens are hypogynous, and its seeds indefinite. Some resemblance to *Anacardiaceæ* may be seen in the resinous appearance of the young shoots, and in its habit. It agrees with *Pittosporaceæ* in its hypogynous definite stamens, its polyspermous fruit, and alternate undivided leaves. There are three species of *Brexia,* all of them elegant trees with a fine foliage. They grow well in a mixture of turfy loam and peat; and cuttings with their leaves not shortened strike readily in sand under a hand-glass in heat, or a leaf with a bud attached will grow. The leaves are covered with a resinous matter which causes rain to run off them immediately, and thus induced Du Petit Thouars to give these plants the name of Brexia, from Βρέξις, which signifies 'a wetting.' In gardens they are commonly called Theophrastas, but they differ considerably from that genus. All the species of *Brexia* are natives of Madagascar. The other genera of this order are *Ixerba, Argophyllum,* and *Roussea.* There are but six species in all.

(Loudon, *Encyclopædia of Plants;* Lindley, *Vegetable Kingdom;* Don, *Gardener's Dictionary.*)

BRILL. [PLEURONECTIDÆ.]

BRIMSTONE. [SULPHUR.]

BRINE-SHRIMP. [BRANCHIOPODA; CHIROCEPHALUS.]

BRITTLEWORTS. [DIATOMACEÆ.]

BRIZA, a genus of Grasses belonging to the tribe *Festucineæ.* It has nearly equal broad 3-ribbed glumes; 3-8 flowers, densely imbricated in a short distichous spikelet; the outer palea navicular, heart-shaped, obtuse, rounded on the back, unarmed; the glumes and paleæ membranous with a scarious margin; terminal styles. Two species of this grass are natives of Great Britain, the *B. minor* and *B. major.* They are known by the common names of Quaking-Grass and Maiden's-Hair. Their dense clusters of flowers are hung upon the ends of a very delicate filamentous peduncle, forming an elegant panicle which shakes with the slightest breath of air, hence the name Quaking-Grass. Both the species grow in pastures, but do not yield much nutriment for animals which feed upon them. (Babington, *Manual of Botany.*)

BROADBILL. [DUCKS.]

BROCCOLI. [BRASSICA.]

BROCHANTITE, a native hydrous Sulphate of Copper. It occurs crystallised, and has for its primary form a right rhombic prism. The cleavage is obtained with difficulty in the direction of the lateral faces of the primary form. The colour is emerald-green; fracture uneven; hardness 3·5 to 4·0; lustre vitreous; translucent, transparent. Specific gravity 3·78 to 3·87. It is found in Siberia. The following analysis is by Magnus:—

Sulphuric Acid	17·43
Oxide of Copper	66·93
Oxide of Tin	3·14
Oxide of Lead	1·04
Water	11·91

BROME-GRASS. [BROMUS.]

BROMELIA'CEÆ, or BROMELIÆ, *Bromelworts,* the Pine-Apple Tribe, a natural order of Endogenous plants, taking its name from the genus to which the pine-apple was once incorrectly referred [ANANASSA], and consisting of herbaceous plants, remarkable for the hardness and dryness of their gray foliage. They occur in great abundance in the tropical parts of the New World, or in such extra-tropical countries as, owing to local circumstances, have a climate of a tropical nature. Sometimes they are found growing on the earth in forests, but more commonly they spring up from the branches of trees, round which they coil their simple succulent roots, vegetating upon the decayed matter they may find there, and absorbing their food in a great measure from the atmosphere. Their leaves are always packed together so very closely at the base as to form a kind of cup, in which water collects; so that the traveller who ascends the trees on which they grow, if he upset one of these plants, as he easily may, is unexpectedly deluged by a shower, the source of which he would not have suspected. The flowers of most are pretty, and of some of them remarkably handsome and sweet-scented; but the fruit is in no case of any value except in the genus *Ananassa*. *Bromeliaceæ* may be shortly described as scurfy-leaved hexandrous endogens, with distinct calyx and corolla, an inferior ovary, and seeds whose embryo lies in mealy albumen. They are known from *Amaryllidaceæ* by the last circumstance, by their hard scurfy leaves, and epiphytal habit; from *Burmanniaceæ*, by their leaves not being equitant, nor their fruit winged; and from *Taccaceæ* by all their habit, and their fruit being 3-celled, with central placentæ.

The green fruit of the wild Pine-Apple, as well as *Bromelia Pinguin* and others, are used as anthelmintics and diuretics in the West Indies. The leaves of *Tillandsia usneoides* are used for stuffing mattresses. A gum flows from the spike of *Puya lanuginosa*. A dye is extracted from the root of *Billbergia tinctoria*. Muslin has been manufactured from the fibres of the common Pine-Apple. Many species are cultivated in the hot-houses of this country, the most beautiful of which belong to the genera *Bromelia* and *Billbergia*. They all grow readily in decayed tan. No species has been yet seen wild in any part of the Old World. The order contains 23 genera, and 170 species.

BROMUS, a genus of plants belonging to the natural order *Graminaceæ*, and the tribe *Festuceæ*. It has unequal many-flowered herbaceous glumes, the lower being 1-nerved, the upper 3- to 5-nerved. The flowers are lanceolate, compressed. The outer palea short, (usually) founded on three nerves from below the tip. The styles below the summit of the fruit lateral. The sheaths of the leaves divided half way down.

The species are generally known under the name of Brome-Grass. Four of the species are common in Great Britain.

B. erectus has an erect stem two or three feet high, and grows on dry sandy and chalky soils. It is known from the other species by the outer palea being indistinctly 7-nerved and one-third longer than the smaller glume.

B. asper has its outer palea hairy and 5- to 7-ribbed, with the leaves broad and hairy. The stem reaches a height of four or five feet. It grows in damp woods and thickets.

B sterilis is a common plant in waste places, and is known by its outer palea having 7 distinct equidistant ribs. It has large flat broad pubescent leaves, and a stem from one to two feet high. It grows in waste places.

B. diandrus is remarkable for its erect panicle. It is a rare plant.

Some of the species, as *B. purgans* and *B. catharticus*, are purgative, whilst *B. mollis* is said to possess poisonous properties.

(Babington, *Manual of British Botany;* Lindley, *Vegetable Kingdom.*)

BRONGNIARTIN. [GLAUBERITE.]

BRONZITE, a native Silicate of Magnesia. It occurs in massive aggregations of columnar crystals. The cleavage is parallel to the lateral planes and both diagonals of a rhombic prism. Colour brown, ash-gray, or dark-green, streak lighter; fracture uneven; hardness between 4·0 and 5·0. The lustre is vitreous, pseudo-metallic on the cleavage-planes; translucent in thin laminæ; opaque in mass. Specific gravity 3·3. It is found in Upper Styria, the Harz, in Bayreuth, the Tyrol, and the Lizard district of Cornwall.

BROOK-BEAN. [MENYANTHES.]

BROOKITE, a native Oxide of Titanium. It is met with in thin hair-brown crystals attached by one edge. Its hardness is 5·5 to 6. Its crystals are secondaries to a rhombic prism. It is found in Dauphiny, and on Snowdon in Wales. It is also said to occur in the United States of America.

BROOM. [CYTISUS.]

BROOM-RAPE. [OROBANCHE.]

BRORA COAL. Beds of very poor Coal, lying in the midst of the Oolitic deposits in the district of Brora in North Scotland, and near Scarborough in Yorkshire, are thus termed. This Coal has been conjectured to be composed principally of *Equiseta*.

BRO'SCUS, a genus of Coleopterous Insects, belonging to the section of the *Carabidæ*, called *Simplicimani* by Latreille. In Latreille's work, however, this genus retains the name of *Cephalotes* (given to it by Bonelli, from the circumstance of the species possessing an unusually large head), which has been expunged by many naturalists owing to its having been previously used to designate a genus in some other branch of Natural History.

The insects of this genus are remarkable for the almost total absence of the indented striæ on the elytra generally observed in the insects of the tribe to which they belong, and for the large and strong mandibles, the elongate form of the body, and the somewhat heart-shaped thorax, which is much attenuated posteriorly.

It has the following characters:—Palpi with all their joints of nearly equal thickness, the terminal joint of the maxillary palpi rather short and truncated; the antennæ, if extended backwards, reaching to the base of the thorax; mandibles unidentate internally; labrum entire; anterior tarsi of the males with the three basal joints dilated.

The species are generally found under stones, and often accompanied by fragments of numerous other insects devoured by them. When taken in the hand they will often pretend to be dead, extending their limbs stiffly, and it is then with difficulty they can be made to move.

Only one species of this curious genus is a native of this country, *Broscus cephalotes*. It is of a dull-black colour, and varies from three-quarters to an inch in length: its form is elongate; the head is nearly equal to the thorax in bulk; the elytra are nearly smooth, the longitudinal striæ being scarcely discernible. It seems to be confined to the sea-coast, where it is frequently found under stones or rubbish.

In Stephens's arrangement of British Insects this genus is classed among the *Harpalidæ*. About six or seven exotic species have been discovered.

BRO'SIMUM, a genus of *Urticaceæ*, one species of which is believed to be the Cow-Tree, or Palo de Vacca of South America. [COW-TREE.]

BRO'SMIUS, a genus of Fishes belonging to the section Subbrachial *Malacopterygii*, and family *Gadidæ*. Generic characters:—Body elongate, and furnished with a single dorsal fin which extends from near the head to the tail; the anal fin is also of considerable length, and extends from the vent to the tail; ventral fins small and fleshy; chin furnished with but one barbule. This genus was established by Cuvier; it is the genus *Gadus* of Pennant ('British Zoology'), and *Brosmius* of Fleming ('British Animals').

But one species of *Brosmius* has been found on our coast, and that appears to be confined to the northern parts; it is the *B. vulgaris* of Cuvier, commonly called the Torsk, and in the Shetlands the Tusk and the Brismak; in this latter locality it is abundant, and forms when barreled or dried a considerable article of commerce. In Yarrell's 'History of British Fishes' we are informed that this species also occurs plentifully in "Norway, as far as Finmark of the Faroe Islands, and the W. and S. coast of Iceland," and other parts.

The Torsk (*Brosmius vulgaris*).

The following is Pennant's description of this fish:—"Length twenty inches, and depth four and a half; head small; upper jaw a little longer than the lower; both jaws furnished with a multitude of small teeth; on the chin was a small single beard; from the head to the dorsal fin was a deep furrow; the dorsal fin began within six inches of the tip of the nose, and extended almost to the tail; pectoral fins small and rounded; ventral short, thick, and fleshy, ending in four cirrhi; the belly from the throat grows very prominent; anal fin long, and reached almost close to the tail, which is small and circular; colour of the head dusky; sides and back yellow, belly white; edges of the dorsal, anal, and caudal fins white, the other parts dusky; pectoral fins brown." When eaten fresh it is rather tough; hence it is preferred dried, and is prepared in the same manner as ling and cod. Faber says, "It is thrown up dead in incredible numbers on the coasts of the Faroe Islands, and the south coast of Iceland, after a storm." (Yarrell, *British Fishes*.)

BROSSÆA, a genus of plants belonging to the natural order *Ericaceæ*. The fruit of *B. coccinea*, like that of *Gaultheria procumbens* and *Arctostaphylos alpina*, is succulent and grateful to the taste, and sometimes used as food.

BRO'TULA, a genus of Fishes, of the order Subbrachial *Malacopterygii* and family *Gadidæ*, chiefly distinguished by the dorsal and anal fins being united with the caudal and forming one fin, which terminates in a point. The only species known (*B. barbatus* of Cuvier) is from the Antilles. The genus is closely allied to *Brosmius*.

BROUSSONE'TIA, a genus of plants belonging to the natural order *Urticaceæ* and sub-order *Moreæ*. There is but one species, *B. papyrifera*. It is from the inner bark of this plant that the Japanese and the Chinese manufacture a kind of paper, and the South Sea Islanders the principal part of their clothing. It forms a small tree with soft brittle woolly branches, and large hairy rough leaves, either heart-shaped and undivided, or cut into deep irregular lobes. Some of the individuals are sterile, others fruitful. The flowers of the sterile trees grow in catkins, which fall soon after their anthers have all shed their pollen; these catkins are composed of little greenish-purple membranous calyxes, each seated in the axil of a hairy bract and containing four elastic stamens. The flowers of the fruitful trees are collected into round green heads, and consist of a calyx like that of the sterile tree, with a small simple pistil occupying its centre, and having a long downy stigma. The heads gradually push forth little oblong greenish bodies; these are the ripening fruits, which at maturity have a bright scarlet colour, and are of a pulpy consistence, with a sweetish insipid taste.

B. papyrifera, the Paper Mulberry, is not uncommon in the shrubberies of this country, where it proves perfectly hardy; but it is liable to be broken by winds, and soon becomes an unsightly object. Its wood, like that of many other arborescent *Urticaceæ*, is soft, spongy, and of no value. In the tenacity of the woody tissue of its liber, or inner bark, it also corresponds with the general character of that order. It is from that part that the preparations above alluded to have been obtained. Sir James Smith gives the following abridgment of Kæmpfer's account of the preparation of paper from its bark by the Japanese:—"For this purpose the branches of the present year, after the leaves are fallen, in December, are chosen, and being cut into pieces about a yard long are boiled till the bark shrinks and is easily separable from the wood, which is then thrown away. The bark being dried is preserved till it is wanted. In order to make paper it is soaked for three or four hours in water, after which the external skin and the green internal coat are scraped off; at the same time the stronger and firmer pieces are selected, the produce of the youngest shoots being of an inferior quality. If any very old portions present themselves they are, on the other hand, rejected as too coarse. All knotty parts and everything which might impair the beauty of the paper are also removed. The chosen bark is boiled in a lixivium till its downy fibres can be separated by a touch of the finger. The pulp so produced is then agitated in water till it resembles tufts of tow. If not sufficiently boiled the paper will be coarse though strong; if too much, it will be white indeed, but deficient in strength and solidity. Upon the various degrees and modes of washing the pulp much also depends as to the quality and beauty of the paper. Mucilage obtained from boiling rice, or from a root called *Oreni* (Kæmpf., 474), one of the mallow tribe, is afterwards added to the pulp. The paper is finished much after the European mode, except that stalks of rushes are used instead of brass wires."

BRU'CEA, a genus of plants, named in honour of James Bruce the celebrated traveller in Abyssinia, belonging to the natural order *Rutaceæ*. It has the following characters:—Flowers monœcious; calyx 4-parted; petals 4, hardly equal the length of the calyx; stamens 4, inserted round about a 4-lobed gland-like central body; the pistiliferous flowers with four abortive stamens; ovaries 4, seated on a 4-lobed receptacle, each terminated by a single, acute, reflexed stigma; fruit a drupe, 1-seeded. The species are shrubs, with unequally pinnated leaves, 6 pairs of opposite, entire, or serrated leaflets, without dots.

B. antidysenterica (*Brucea ferruginea* of L'Heritier), Woodginoos, has entire leaflets covered with rusty villi on the nerves beneath; racemes simple, spike-like. This plant is a native of Abyssinia, and is said to be a tonic and astringent, and to act favourably in dysentery. By some mistake it was at one time supposed to be the plant which yielded the false Angostura Bark of the shops. By the substitution of the False Angostura for the true Angostura Bark [GALIPÆA] fatal effects have been known to follow. At the time that the false Angostura Bark was supposed to be the produce of *Brucia ferruginea* an alkaloid was discovered in it which had been called on that account *Brucia*. It appears now however that there can be little doubt that the false Angostura Bark of the shops is a species of *Strychnos*. On this subject Dr. Christison, in the last edition of his 'Dispensatory,' has the following remarks:—"The Angostura Bark (*Galipæa Cusparia*) of this country is seldom adulterated; but on the continent a most serious fraud has been often practised by the substitution of a highly poisonous bark long erroneously conceived to be that of the *Brucea ferruginea* or *antidysenterica*. This bark, commonly called False Angostura, presents externally a dirty grayish-yellow ground with numerous irregular spots or tubercles of a lighter gray tint, which appearances are in the larger pieces displaced in patches, or entirely, by a uniform, loose, bright, rusty-coloured efflorescence. The speckled gray pieces alone bear some resemblance to the smaller pieces of true Angostura, but are easily distinguished by their greater thickness, their far more intense bitterness, without either aroma or pungency, and also, as the Edinburgh College has indicated, by the transverse fracture becoming bright red when touched with nitric acid. Another excellent character mentioned by the college, but applicable only where rusty specks exist, is, that such spots become deep bluish-green with the same acid; which, on the other hand, scarcely affects the true bark. Nitric acid does not similarly alter the spurious bark where it is quite free of rusty efflorescence. Fatal accidents from the substitution of the spurious for the true bark were at one time not uncommon on the Continent, and in Austria they were so frequent that upon one occasion the government ordered the whole Angostura Bark in the empire to be destroyed. This adulteration has never been publicly noticed in Britain, and experienced wholesale and retail dealers whom I have consulted both here and in London were unaware of its existence. A few weeks ago however Dr. Moore Neligan of Dublin informed me, that on inquiring for Angostura Bark at an extensive and respectable drug warehouse in that city he got the spurious bark, which proved to have been part of a considerable stock kept in the establishment since at least the beginning of this century, but never previously displaced. From specimens I owe to the kindness of Dr. Neligan there can be no doubt of the accuracy of his observation, so that druggists ought to be aware of the possible risk even in this country of so serious an error."

B. Sumatrana has serrated leaflets villous beneath, the racemes usually compound, the petals longer than the calyx. This plant is a native of Sumatra, the Moluccas, China, and Cochin-China. The leaves are intensely bitter, and possess the same medicinal properties as the former. (Christison, *Dispensatory*; Don, *Gardener's Dictionary*.)

BRU'CHUS, a genus of Coleopterous Insects of the section *Tetramera* and family *Rhynchophora*. It has the following characters:—Head slightly produced, and forming a short and broad rostrum; labrum distinct: antennæ 11-jointed, either filiform, serrated, or pectinated; eyes emarginated; thorax narrower before than behind, anteriorly rounded, posteriorly furnished with a lobe near the scutellum; elytra somewhat oblong, not reaching to the apex of the abdomen; femora of the hinder legs thick and generally dentated.

The female *Bruchi* deposit their eggs in the yet tender germ of various leguminous plants; the seed becoming matured is devoured by the larva, which lives entirely within the seed, where it undergoes its metamorphosis. The holes so often observed in peas and other seeds of a similar nature are those formed by the perfect insect to effect its escape; after which it is generally found in flowers.

From the habits of these insects as above related it may easily be conceived that when numerous they become exceedingly destructive. In Kirby and Spence's 'Introduction to British Entomology' we are told that in North America a species—*Bruchus Pisi*—is most alarmingly destructive to peas, "its ravages being at one time so universal as to put an end in some places to the cultivation of that favourite pulse." This insect is less than a quarter of an inch in length, of a blackish colour, and has a gray spot at the base of the thorax in the middle, and several spots of the same colour on the elytra, which are striated. The four basal joints of the antennæ and the anterior tibiæ and tarsi are red. The thorax has a little tooth on each side, and the femora are also dentate.

B. Pisi is a native of our own country (having most probably been introduced in the seeds of the pea), but fortunately it is not sufficiently abundant to do much mischief.

Two other species of *Bruchus* also infest the pea, *B. granarius* and *B. pectinicornis*: the latter is common in China and Barbary; the former is a native of this country, and is found among beans, vetches, and other seeds, the lobes of which it devours. It very much resembles *B. Pisi*, but is rather less.

The true *Bruchi* are generally of small size.

BRUCITE. [MAGNESIA.]

BRUGMA'NSIA. Two very different plants have been called by this name, one a Rhizanth belonging to the order *Rafflesiaceæ*, the other a plant belonging to the natural order *Solanaceæ*. The species of the latter are now referred to *Datura*. *D. arborea* is the Bovochevo of the Columbians, and is known in our gardens under the name of *Brugmansia*. Like the rest of the natural order *Solanaceæ* it is narcotic in a high degree. "This remarkable plant is a native of elevated and cold situations in the provinces of Tarma, Xauxa, Huarochei, Canta, and Humalies, where it grows among rubbish; it is also found near the village of La Cruz and on the banks of the river Mayo, between Almaquer and Pasto in New Granada, where it was found by Humboldt and Bonpland at nearly 7000 feet above the sea. It begins to flower in June and ceases in November. By the Peruvians it is called Floripondio Encarnado and Campanillas Encarnadas; by the Columbians Bovochevo. Its stature varies from 10 to 12 feet, the stem being generally undivided and terminated by a roundish leafy head. The flowers are either a bright yellowish-orange colour or a deep orange-red: we believe they change from the former to the latter. They are succeeded by an oblong, smooth, yellow, pendulous capsule, which is as much as 8 inches long. The seeds, like those of the common *Stramonium*, are narcotic in a high degree. In the Temple of the Sun in the city of Sogamoza there is a famous oracle, the priests of which inspire themselves with the intoxicating seeds of this plant, just as the Pythoness at Delphi is said to have received the influence of her god by chewing laurel leaves and inhaling a gaseous vapour. From the fruit itself the Columbians prepare a drink called 'Tonga,' which when weak is merely soporific, but drank in stronger doses produces frenzy, which can only be removed by administering immediate draughts of cold water." ('Botanical Register.')

In cultivation it is hardy during the summer, but requires the protection of a greenhouse in winter.

BRUNI'ACEÆ, *Bruniads*, the Brunia Tribe, a small natural order of Exogens belonging to the albuminous group, and, notwithstanding the different habit, nearly allied to the currant tribe, *Grossulariaceæ*. The species are small heath-like shrubs, with minute closely-imbricated leaves, and small flowers collected in little compact heads. They have a superior 5-cleft calyx, 5 petals, 5 perigynous stamens, and a dicoccous or indehiscent 2- or 1-celled fruit, crowned by the persistent calyx. The seeds are solitary or in pairs, and have a short aril. All the species except one from Madagascar are natives of the Cape of Good Hope. They are of no known use.

Bruniaceæ differ from *Grossulariaceæ* in their dry fruit and central placenta; from *Escalloniaceæ* in the very small number of their seeds; from *Rhamnaceæ* in their minute embryo; and from both *Umbelliferæ* and *Araliaceæ* in their flowers not being in umbels. Their relations are with *Hamamelidaceæ*, *Myrtaceæ*, *Santalaceæ*, and *Umbelliferæ*. The order contains 15 genera and 65 species.

BRUNONIA'CEÆ, *Brunoniads*, the Brunonia Tribe, a natural order of plants belonging to the Monopetalous Exogens. This order was defined by Robert Brown, and has for its type a genus which was named after him. He placed it as a section of the natural order *Goodenoviæ*, but it is raised to the rank of an independent order by

Professor Lindley. It has an inferior calyx in 5 divisions, with four bracts at the base; a monopetalous corolla, almost regular 5-parted inferior withering; definite hypogynous stamens, alternate with the segments of the corolla; the anthers collateral, slightly cohering; a 1-celled ovary, with a single erect ovule; a single stigma inclosed in a 2-valved cup; a membranous fruit (a utricle) inclosed within the indurated tube of the calyx; a solitary erect seed without albumen; the embryo with plano-convex fleshy cotyledons, and a minute inferior radicle.

This order has but one genus, of which there are two species. They are herbs, natives of Australia, having flowers of an azure blue, which are on scapes, collected in heads, and surrounded by enlarged bracts. Although placed by Brown in *Goodenoviæ*, Lindley thinks it differs essentially from that order "in the superior 1-celled ovary and capitate flowers, thus approaching some species of *Dipsaceæ*, but differing in the want of an involucel, the erect ovule, superior ovary, and peculiar stigma." It agrees with *Compositæ* in inflorescence, in the æstivation of the corolla, in the remarkable joint or change of texture in the apex of its filaments, and in the structure of the ovarium and seed. Brown remarks, that "in the opposite parietes of the ovarium of *Brunonia* two nerves or vascular cords are observable, which are continued into the style, where they become approximated and parallel. This structure, so nearly resembling that of *Compositæ*, seems to strengthen the analogical argument in favour of the hypothesis advanced in the present paper of the compound nature of the pistillum in that order, and of its type in phænogamous plants generally; *Brunonia* having an obvious and near affinity to *Goodenoviæ*, in the greater part of whose genera the ovarium has actually two cells, with one or an indefinite number of ovula in each; while in a few genera of the same order, as *Dampiera*, *Diaspasis*, and certain species of *Scævola*, it is equally reduced to one cell and a single ovulum." There is but the genus, *Brunonia*, with two species, in this order. (R. Brown, *Linn. Trans.*, xii. 132; Lindley, *Vegetable Kingdom*, 266.)

BRYA'CEÆ, a name given to a section of the natural order of Mosses. [MUSCI.]

BRYA'XIS, a genus of Coleopterous Insects belonging to the family *Pselaphidæ*, which by some authors is arranged with the *Brachelytra*, but according to Latreille forms the third family of the section *Trimera*. Technical Characters:—Antennæ long, from the third to the terminal joint gradually increasing in size, the three terminal joints forming a large knob; the last joint much larger than the rest, and somewhat conical in shape; the two basal joints large; maxillary palpi distinct; the apical joints robust; head rather large; thorax rounded at the sides; elytra very broad, and covering only the basal half of the abdomen.

The species of this and allied genera, though minute, are perhaps among the most remarkable of the *Coleoptera*. In the short wing-cases they appear to evince an affinity to the *Brachelytra*, but in the number of joints in the tarsi, a character generally considered of importance, they differ; they likewise differ from that tribe in having the terminal joints of the antennæ immensely large, and in many other characters. They are generally found during the winter and early part of the spring in moss. Nine or ten species have been recorded as British.

BRYO'NIA. The Wild Bryony or Red Bryony of our hedges, *Bryonia dioica*, is a plant formerly much employed in rural pharmacy, but now disused. It is a perennial with large fusiform succulent roots, which have a repulsive nauseous odour. From these there annually springs a slender pale-green hairy branching stem, which climbs among bushes by means of its tendrils, in the manner of a cucumber, to which it is botanically allied, both belonging to the natural order *Cucurbitaceæ*. The leaves are palmate, and rough on both sides, with callous points. The stamens and pistils are on different flowers on different plants. The flowers in which the stamens are situated are larger than those which contain the pistils. They are whitish with pale-green veins, and the pistiliferous flowers are succeeded by little red berries containing a very few seeds. Its principal use was on account of the powerful drastic properties of its root, which the French call from that circumstance Navet du Diable, or Devil's Turnip. It is excessively bitter, and when dried purges in doses of 30 or 40 grains. Over-doses are extremely dangerous, and even sometimes fatal. Its properties are apparently owing to the presence of a principle called bryonine, analogous to cathartine, which exists in about the proportion of 2 per cent. of the root. It should be gathered in the autumn, after the stem has turned yellow; it is cut into slices, which are strung upon a thread, and hung in the air to dry.

BRYONY, BLACK. [TAMUS.]

BRYONY, RED. [BRYONIA.]

BRYOPHY'LLUM, a genus of succulent plants belonging to the natural order *Crassulaceæ*, and remarkable for the singular property possessed by its leaves of budding from their margin. These leaves are of a succulent texture, and sometimes pinnated; they or their leaflets are of an oblong figure, with a deeply-crenelled border; when placed in a damp and shady warm place they sprout from the crenels and form young plants—a property unknown in the same degree in any other vegetable production. Physiologists however consider that traces of a similar power, exercised in another way, exist in all plants in their carpellary leaves, from whose edges, forming placentæ, ovules, which are theoretically young buds, are constantly produced.

The only species is *Bryophyllum calycinum*, a shrub found in the Moluccas, with panicles of large pendulous greenish-yellow flowers. In this country it is a green-house plant; but is apt to be eaten by mice.

BRYOZOA, a name proposed by Ehrenberg for those Zoophytes in which a higher organisation is indicated by the presence of separate orifices for the mouth and anus. The same naturalist has applied the term *Anthozoa* to those Polypes in which the mouth and vent have but one orifice. The distinction between these two great families seems to have been observed by Mr. J. V. Thompson previously to the publication of Ehrenberg's name, hence his designation for this family, *Polyzoa*, is more generally received. Other names have been given to this interesting family of Zoophytes. Professor Owen calls them Molluscan Zoophytes, on account of their structure being supposed to ally them to the *Mollusca*. For the same reason they have also been called Ascidioid Polypes (*P. Ascidioida*). Milne-Edwards has also called them Tunicated Polypes (*Polypes tuniciens*). Dr. Farre in a paper in the 'Philosophical Transactions,' 1837, proposes to call them *Ciliobrachiata*, in reference to the ciliated character of their tentacula. Mr. Busk in his Catalogue of the Zoophytes in the collection of the British Museum, adopts Mr. Thompson's designation of *Polyzoa* as prior to that of any others. [POLYZOA.]

BRYUM, a genus of plants belonging to the natural order of Mosses. It has a terminal footstalk; double peristome, outer one of 16 teeth, inner one of a membrane cut into 16 equal segments with filiform processes often placed between them; the calyptra dimidiate. The species of this genus are exceedingly numerous. They are found in great abundance in Great Britain. They are all very small, produce a large number of capsules, and are found growing in wet places. They resemble forests of larger plants in miniature. In *B. palustre* are found terminal capitular bodies which resemble what are called the anthers of *B. Androgynum*; but in *B. palustre* they are considered gemmæ, and arise not only from the main stems, but also from the innovations. A large number of the species is British. [MUSCI.]

(Loudon, *Encyclopædia of Plants*.)

BUBO, a genus of Birds belonging to the family *Strigidæ*, separated by Cuvier, and characterised by a small concha, or ear aperture, and a facial disk, less perfect than in the sub-genus *Syrnium* (Chats-Huans of the French). Two tufts or feathered horns of considerable size adorn the head, and the legs are feathered down to the toes.

B. maximus, the Great Owl or Eagle-Owl; *Strix Bubo* of Linnæus; Le Hibou Grand Duc of the French; Gufo, Gufo Grande, and Gufo Reale of the Italians; Uhu, Grosse Ohreule of the Germans; Uff of the 'Fauna Suecica;' Buhu of the Lower Austrians.

Great Owl (*Bubo maximus*).

This, the largest of the nocturnal birds, is, there can be little doubt, the Βύας of Aristotle ('Hist. Anim.' viii. c. 3), and the *Bubo funebris* mentioned by Pliny in his chapter 'De Inauspicatis Avibus' (lib. x. c. 12 and 13), on account of whose advent Rome twice underwent lustration. Upon one of these occasions the bird of ill omen penetrated into the very cella of the Capitol.

Temminck says that it inhabits great forests, and that it is very common in Hungary, Russia, Germany, and Switzerland, less common in France and England, and never seen in Holland. He adds, that it is found at the Cape of Good Hope. Willughby observes that about Bologna, and elsewhere in Italy, it is frequent. Bonaparte notes it as rare in the neighbourhood of Rome, and says that it is only seen in mountainous situations. It is said to extend eastward as far as Kamtchatka.

Pennant states that it has been shot in Scotland, and in Yorkshire, from which county it was sent to Willughby. Latham adds Kent and Sussex as localities where it has been found. It is said to have been seen in the Orkneys; and four are stated to have occurred on the northern coast of Donegal in Ireland. The Eagle-Owl then can be only considered as a rare visitant to our islands.

The following is Temminck's description:—Upper part of the body variegated and undulated with black and ochreous; lower parts ochreous, with longitudinal black dashes; throat white; feet covered to the nails with plumes of a reddish-yellow; iris bright orange. Length two feet. The female is larger than the male; but the tints of her plumage are less bright, and she is without the white on the throat. It sometimes varies in having the colours less lively and in being of inferior dimensions.

Its food consists of young roes and fawns, hares, moles, rats, mice, winged game, frogs, lizards, and beetles.

It builds its nest in the hollows of rocks, in old castles and other ruins, where the female lays two or three, but rarely four, round white eggs. Latham says two, "the size of those of a hen."

M. Cronstedt, who resided on a farm in Sudermania, near a mountain, had an opportunity of witnessing the devotion of these birds to their young, and their care in supplying them with food, even under extraordinary circumstances. Two Eagle-Owls had built their nest on the mountain, and a young one which had wandered away was taken by the servants and confined in a hen-coop. The next morning there was a dead partridge lying close to the door of the coop. Food was brought to the same place for fourteen successive nights; this generally consisted of young partridges newly killed, but sometimes a little tainted. Once a moor-fowl was brought still warm under the wings, and at another time a piece of lamb in a putrid state. M. Cronstedt sat up with his servant many nights in order to observe the deposit of the supply if possible, but in vain. It was evident however to M. Cronstedt that the parents were the caterers, and on the look-out, for on the very night when M. Cronstedt and his servant ceased to watch, the usual food was left near the coop. The supply continued from the time when the young owl was taken—in July—to the usual time, in the month of August, when these birds leave their young to their own exertions.

Belon gives an account of the use which falconers made of this bird to entrap the kite. They tied the tail of a fox to the Eagle-Owl, and let him fly. This spectacle soon excited the attention of the kite, if he were near, and he continued to fly near the owl, not endeavouring to hurt him, but apparently intent on observing his odd figure. While so employed the falconer surprised and took the kite.

There are specimens in the Gardens of the Zoological Society in the Regent's Park.

Bubo Virginianus, the Virginian Horned-Owl (*Strix Virginiana* of Vieillot; Duc de Virginie of Buffon; Netowky-Omeesew of the Cree Indians, according to Mr. Hutchins; Otowuck-Oho of the Crees of the plains of the Saskatchewan, according to Sir John Richardson).

Pennant, in his 'Arctic Zoology,' says that this seems to be a variety of the eagle-owl, although he notices the inferiority in size: but it is a very distinct species.

It is not improbable, as Sir John Richardson observes, that this night-bird, peculiar to America, inhabits that continent from end to end. Cuvier gives his opinion that the *Strix Magellanica* of the 'Planches Enluminées' differs merely in having browner tints of colour; and Sir John Richardson mentions the result of Mr. Swainson's comparison of the northern specimens with those of the table-land of Mexico, as confirmatory of the identity of the species; the only difference being a more general rufous and vivid tint of plumage in the Mexican specimens. Almost every part of the United States possesses this bird, and it is found, according to Richardson, in all the Fur Countries where the timber is of large size.

We have seen how the civilised Romans regarded the European bird; and it is curious to observe how, in a comparatively savage state, the same superstitious feelings were connected with the American species. "The savages," says Pennant, quoting Colden's 'Six Indian Nations,' "have their birds of ill-omen as well as the Romans. They have a most superstitious terror of the owl, which they carry so far as to be highly displeased at any one who mimics its hootings." Lawson, evidently speaking of these birds, says—"They make a fearful hallooing in the night-time, like a man, whereby they often make strangers lose their way in the woods." Wilson thus describes the haunts and habits of the Virginian Horned-Owl:—"His favourite residence is in the dark solitudes of deep swamps, covered with a growth of gigantic timber; and here, as soon as the evening draws on, and mankind retire to rest, he sends forth such sounds as seem scarcely to belong to this world. . . . . Along the mountain shores of the Ohio, and amidst the deep forests of Indiana, alone, and reposing in the woods, this ghostly watchman has frequently warned me of the approach of morning, and amused me with his singular exclamations, sometimes sweeping down and around my fire, uttering a loud and sudden 'Waugh O! Waugh O!' sufficient to have alarmed a whole garrison. He has other nocturnal solos, one of which very strikingly resembles the half-suppressed screams of a person suffocating or throttled." Wilson treats this visitation like a philosopher, but, after reading his description and that of Nuttall ('Ornithology of the United States'), we shall cease to wonder at the well-told tale in the 'Fauna Boreali-Americana,' of the winter night of agony endured by a party of Scottish Highlanders, who, according to Sir John Richardson, had made their bivouac in the recesses of a North American forest, and inadvertently fed their fire with a part of an Indian tomb which had been placed in the secluded spot. The startling notes of the Virginian Horned-Owl broke upon their ear, and they at once concluded that so unearthly a voice must be the moaning of the spirit of the departed, whose repose they supposed they had disturbed.

Virginian Horned-Owl (*Bubo Virginianus*).

The following is Sir John Richardson's description of the plumage of a specimen, 26 inches in length from the tip of the bill to the end of the tail, killed at Fort Chepewyan:—

"Bill and claws pale bluish-black. Irides bright yellow. Facial circle of a deep black immediately round the orbit, composed of white mixed with black bristly feathers at the base of the bill, and posteriorly of yellowish brown wiry feathers, tipped with black, and having black shafts. The black tips form a conspicuous border to the facial circle posteriorly; but the small feathers behind the auditory opening differ little in colour and appearance from the adjoining plumage of the neck. Egrets composed of ten or twelve dark brown feathers, spotted at the base of their outer webs, and along their whole inner ones, with yellowish brown. Forehead and crown dark blackish-brown, finely mottled with grayish-white, and partially exhibiting the yellowish-brown base of the plumage. The whole dorsal plumage is yellowish-brown for more than half the length of each feather from its base, and dark liver-brown upwards, finely barred and indented with undulated white lines. More of the yellowish-brown is visible on the neck and between the shoulders than elsewhere. The primaries present six or seven bars of dark umber or liver-brown, alternating with six bars, which on the outer webs are brownish-white, finely speckled with dark-brown, and on the inner webs are of a bright buff-colour, sparingly speckled with the dark-brown near the shafts. The tips of the feathers have the same mottled appearance with the paler bars of the outer webs. The secondaries and tail-feathers are similarly marked to the primaries, but show more white on their outer webs. There are six liver-brown bars on the tail, the last of which is nearly an inch from its end. Under-surface:—Chin white, succeeded by a belt extending from ear to ear of liver-brown feathers, having pale yellowish-brown margins. Behind the belt there is a gorget-shaped mark of pure white. The rest of the lower surface of the body is crossed by very regular transverse bars of white, alternating with bars of equal breadth (three lines) of liver-brown, shaded with chocolate-brown. The yellowish-brown base of the plumage is likewise partially visible: there is a white mesial line on the breast, and when the long feathers covering the abdomen are turned aside, a good deal of white appears about the vent. The outside thigh-feathers are yellowish-brown, with distant cross bars of liver-brown; and the legs and feet are brownish-white with brown spots. The linings of the wings are white, with bars of liver-brown, margined by yellowish-brown. The insides of the primaries are bright buff, crossed by broad bars of clove-brown. On the under surface of the secondaries the clove-brown bars are much narrower. The under tail-coverts are whitish, with distant bars of liver-brown. The under surface of the tail has a slight tinge of buff-colour, and is crossed by mottled bars of clove-brown."

The bird preys, according to Richardson, on the American hare, Hudson's Bay squirrel, mice, wood-grouse, &c., and builds its nest of sticks on the top of a lofty tree, hatching in March. The young, two or three in number, are generally fully fledged in June. The eggs are white.

Wilson observes that it has been known to prowl about the farm-house and carry off chickens from roost. "A very large one," says that author, "wing-broken, while on a foraging excursion of this kind, was kept about the house for several days, and at length disappeared, no one knew how. Almost every day after this, hens and chickens also disappeared, one by one, in an unaccountable manner, till in eight or ten days very few were left remaining. The fox, the minx, and weasel were alternately the reputed authors of this mischief, until one morning the old lady herself rising before day to bake, in passing towards the oven surprised her late prisoner regaling himself on the body of a newly-killed hen! The thief instantly made for his hole under the house, from which the enraged matron soon dislodged him with the brush-handle, and without mercy dispatched him. In this snug retreat were found the greater part of the feathers, and many large fragments of her whole family of chickens."

There are specimens in the Gardens of the Zoological Society in the Regent's Park.

BUBON. [GALBANUM.]

BUCCINUM, the name of a genus of Molluscous animals, to which the common Whelk belongs. Forbes and Hanley place it amongst the Prosobranchiate *Gasteropoda*, and the tribe *Muricidæ*. The following are its characters:—Shell ovate, more or less ventricose, turreted; surface smooth or spirally striated, spirally grooved or longitudinally plicated, invested with an epidermis. Aperture ovate, emarginate, or very shortly canaliculated below; canal wide, truncated dorsally, more or less tumid; columella smooth, inner lip expanded, outer lip usually thin and smooth within. Operculum corneous, oblong, its nucleus lateral. Animal bulky; head broad, depressed, bearing two somewhat flattened tentacula set well apart, their tips subulate, their bases thickened for half their lengths by the connate sustentacula, which bear the rather small eyes; proboscis ample; tongue armed with teeth, ranged three in a row, the axil one broad and quadrate, with many crenations, the laterals scythe-shaped, with denticulated bases. Male organ very large, sickle-shaped.

Messrs. Forbes and Hanley say—"We retain the old name *Buccinum* originally applied to whelks in general, for that group of shells of which the common *Buccinum undatum* may be regarded as the type. They constitute a very natural assemblage, though one of no great extent, and are mainly inhabitants of the boreal and arctic regions of both northern and southern hemispheres. The relation of the distribution of this form of mollusk to climate is strikingly shown when we compare such a shell as the *Buccinum cyaneum* of Greenland with the *Buccinum antarcticum* of the Falkland Islands, one of the most striking instances that can be cited of the representation of species by similar species in regions far apart, but subject to similar physical conditions.

"Several zoologists have of late united the *Buccinum undatum* and its allies with *Fusus antiquus* and similar shells, under the old generic name of *Tritonium*, originally proposed by Otho Frederic Müller. Independent of the very serious objection which applied to this name on account of its having become obsolete, whilst the too similar word *Triton* and even *Tritonium* itself were used in the meantime for a very different assemblage of *Muricidæ*, and one presenting good natural marks of distinction, we are inclined still, provisionally at least, to keep up the distinction between the *Fusi* of the north and *Buccinum*, since shell, animal, and operculum present marks of distinction, which, though in the end they may prove to be of no more than sectional value, yet in the present state of our knowledge deserve to be considered of importance. Unfortunately, the name *Buccinum* has even of very late years been applied to such a heterogeneous assemblage of shells, that it is difficult to disentangle those to which we restrict the names from a number of very different forms having no true generic affinity with them.

"These Mollusks appear to have commenced their existence during the later Tertiary epoch. At present they have the power of enduring very variable conditions of depth and locality, though the geographic range of the group is limited, however widely may extend the areas of some species."

B. undatum (Linnæus), the common Whelk. It has more or less coarse spiral striæ, and usually with broad longitudinal folds; the beak short. Forbes and Hanley, amongst other synonyms for this very widely distributed species, give the following:—*B. striatum*, Pennant; *B. canaliculatum vulgare*, Da Costa; *B. Borinanum*, Chemnitz; *B. carinatum*, Turton; *B. acuminatum*, Broderip; *B. Anglicanum*, Fleming; *B. Labradorense*, Reeve; *B. imperiale*, Reeve; *B. pyramidale*, Reeve; *B. tenerum* (fossil), Sowerby; *Tritonum undatum*, Müller; *T. Humphreysianum*, Loven; *Murex undatus*, Clark. As would be supposed from these synonyms, the Whelk is one of the most variable of shells. It is also one of the most widely distributed. It is found on almost every British shore, varying greatly however in its characters according to its locality. In most parts of the country it is used as an article of diet. Great numbers are to be seen exposed for sale in London. The process of cooking consists in simply boiling, and they are eaten with vinegar and pepper. They are not however very digestible. Dr. Johnston mentions that at the enthronisation feast of William Warham, archbishop of Canterbury, in 1504, no fewer than 8000 Whelks were supplied at five shillings for a thousand.

"This species," say the authors of the 'British Mollusca,' "first appeared in the British seas during the age of the coralline crag, and persisted through all succeeding epochs, becoming more and more abundant. It is found from low-water mark to as deep as one hundred fathoms. It has a wide latitudinal range, now extending throughout the Celtic, Boreal, and Icy Seas, and along the coast of Boreal America from Cape Cod to Greenland. According to Middendorff it finds its way through the Siberian seas into the Sea of Ochotsk. This great range in time and space accords with its capacity for variation and adaptation to circumstances. During the Pleistocene epoch it had found its way into the Mediterranean, and occurs fossil in the Sicilian newer Pliocene beds, but is now extinct in that region."

B. Dalei (Sowerby) has a polished white shell without folds; the body half as long as the spine. It is the *Halia Flemingiana* of Macgillivray, the *Tritonium ovum* of Middendorff. The animal belonging to this shell is unknown. Messrs. Forbes and Hanley regard this shell as British, though exceedingly rare. It is an inhabitant of the Icy Seas, and ranges from Greenland to Behring's Strait.

B. Humphreysianum (Bennett). This species is faintly variegated, almost smooth, without folds, the body longer than the spine. The animal is unknown, and the shell is rare. It has been found on the British coasts, but like the last it appears to be an arctic species lingering in our Fauna.

B. fusiforme (Broderip) has an oblong subfusiform shape, is of a pure white, decussated by narrow longitudinal ribs and spiral costellæ; the beak rather long, recurved. It has been found in Ireland in the neighbourhood of Cork and off the coast of Wexford. It is a very rare shell.

BUCCO. [BARBETS.]

BUCEROS. [HORNBILL.]

BUCHOLZITE, a mineral closely allied to Sillimanite. According to Thomson it is composed of—

Silica	46·4
Alumina	52·9

A specimen from Chester, Pennsylvania, gave Erdmann—

Silica	40·1
Alumina	58·9
Protoxide of Manganese	(a trace)

It is found at Fassa, in the Tyrol, and in several districts in the United States.

BUCIDA, a genus of plants belonging to the natural order *Combretaceæ*. One of the species, *B. Buceras*, yields a bark which is used in tanning.

BUCK. [CERVIDÆ.]

BUCK-BEAN. [MENYANTHES.]

BUCK'S-HORN. [RHUS.]

BUCK-THORN. [RHAMNUS.]

BUCK-WHEAT. [FAGOPYRUM.]

BUCKLANDIA, a fossil plant from the Stonesfield Oolite, supposed to belong to the natural order *Liliaceæ*.

BUCKLANDITE, a mineral containing silica, alumina, lime, protoxide of iron, protoxide of manganese, and water. It is a variety of Epidote, with iron. [EPIDOTE.]

BUCKU. [DIOSMA.]

BUD, or LEAF-BUD, in Vegetable Physiology, is the organised rudiment of a branch. Whatever becomes a branch is, when first organised, a bud; but it does not therefore follow that all buds become branches; on the contrary, owing to many disturbing causes, buds are subject to transformations and deformities which mask their real nature.

A Leaf-Bud is constructed thus:—In its centre it consists of a minute conical portion of delicate cellular tissue, and over the surface of this are arranged rudimentary leaves, in the form of scales. These scales are closely applied to each other; those on the outside are the largest and thickest, and the most interior are the smallest and most delicate. In cold countries the external scales are often covered with hair, or a resinous varnish, or some other contrivance, which enables them to prevent the access of frost to the young and tender centre which they protect; but in warm countries, where such a provision is not required, they are green and smooth and much less numerous. The cellular centre of a bud is the seat of its vital activity; the scales that cover it are the parts towards the development of which its vital energies are first directed.

A Leaf-Bud usually originates in the axil of a leaf; indeed there are no leaves in the axil of which one or more buds are not found either in a rudimentary or a perfect state. Its cellular centre communicates with that of the woody centre of the stem, and its scales are in connection with the bark of the latter. When stems have the structure of Exogens, the bud terminates one of the medullary processes; in Endogens it is simply in communication with the cellular matter that lies between the bundles of woody tissue in such stems. It is moreover important to observe that this is true not only of what are called normal buds, that is to say, of buds which originate in the axil of the leafy organs, but also of adventitious buds, or such as are occasionally developed in unusual situations. It would seem as if, under favourable circumstances, buds may be formed wherever the cellular tissue is present; for they occur not only at the end of the medullary processes of the root and stem of Exogens, but on the margins of leaves, as in *Bryophyllum*, *Malaxis paludosa*, and many others; and occasionally on the surface of leaves, as in the case of an *Ornithogalum* published by Turpin, and not very uncommonly in ferns.

A Leaf-Bud has three special properties, those of growth, attraction, and propagation. In warm damp weather, under the influence of light, it has the power of increasing in size, of developing new parts, and so of growing into whatever body it may be eventually destined for. In effecting this it lengthens by the addition of new matter to its cellular extremity, and it increases in diameter partly by a lateral addition to the same kind of tissue, and partly by the deposit of woody matter emanating from the bases of the scales or leaves which clothe it. As soon as growth commences the sap which a bud contains is either expended in forming new tissue or lost by evaporation. In order to provide for such loss the bud attracts the sap from that part of the stem with which it is in communication; that part so acted upon attracts sap in its turn from the tissue next it, and so a general movement towards the buds is established as far as the roots, by which fresh sap is absorbed from the soil. Thus is caused the phenomenon of the flow of the sap. Every leaf-bud is in itself a complete body, consisting of a vital centre covered by nutritive organs or hairs. Although it is usually called into life while attached to its parent plant, yet it is capable of growing as a separate portion, and of producing a new individual in all respects the same as that from which it was divided; hence it is a propagating organ as much as a seed, although not of the same kind; and advantage has been taken of this for horticultural purposes. [BUDDING, in ARTS AND SC. DIV.]

In general a bud is developed into a branch, but that power is interfered with or destroyed by several causes. This must be evident from the following consideration independently of all others. Every one knows that leaves are arranged with great symmetry upon young branches; as buds are axillary to leaves, the branches they produce ought therefore to be as symmetrically arranged as leaves; and this we see does not happen. We may account for this in two or three ways: accidental injuries will doubtless destroy some; from want of light others will never be called into action; and of those which are originally excited to growth a part is always destroyed by the superior vigour of neighbouring buds, which attract away their food and starve them. There is moreover in many plants a special tendency to produce their leaf-buds in a stunted or altered state. In fir-trees the side-buds push forth only two or a small number of leaves, and never lengthen at all; in the Cedar of Lebanon they lengthen a little, bear a cluster of leaves at their points, and resemble short spurs; in the sloe, the whitethorn, and many other plants, they lengthen more, produce no leaves except at their very base, and grow into hard sharp-pointed spines. The knobs seen on beech and other trees, which have been called by Dutrochet embryo-buds and by Dr. Lankester abortive branches, take their origin in buds which are not normally developed. The bulbilli which are found in the axils of many Liliaceous plants originate in the bud. Bulbs are nothing but leaf-buds with unusually fleshy scales, and with the power of separating spontaneously from the mother-plant; and flower-buds are theoretically little more than leaf-buds without the power of lengthening, but with the organs that cover them in a special state. Hence flowers are modified branches. [FLOWER.] Schleiden regards the ovule as a changed bud; hence in his 'Principles of Scientific Botany' he calls this organ the seed-bud. [OVULE.]

BUDDLEA, a genus of plants named after Adam Buddle, a botanist of the time of Ray, who contributed to Ray's 'Synopsis,' and whose Herbarium is now in the British Museum. *Buddlea* belongs to the natural order *Scrophulariaceæ*. It has a campanulate 5-toothed calyx; tubular corolla with the limb 4-5-cleft, equal, spreading; 4-5 stamens nearly equal, inclosed, the anthers composed of two parallel distinct cells the stigma clavate, 2-lobed; the capsule crustaceous with a dissepiment formed from the inflexed edges of the valves, inserted in the thick spongy placenta; the seeds angular; testa loose, membranous; albumen fleshy. The species are shrubs, with mostly quadrangular branches, opposite leaves; terminal, capitate, spicate or panicled, usually orange-coloured flowers.

B. globosa has branches clothed with hairy tomentum as well as the under sides of the leaves; the leaves lanceolate, acuminate, petiolate, crenate; the heads terminal, globose, pedunculate. This plant, now so common in our gardens, is a native of Chili.

B. Americana has branchlets clothed with hairy tomentum; leaves ovate, acuminate, narrow at the base, crenate, rather pilose above, but clothed with a yellowish tomentum beneath; spike panicled; flowers glomerate. It is a native of the mountains of Peru and also of the West Indies. Browne says that it is used in Jamaica as an emollient. Its properties however are not active.

There are about 60 species of *Buddlea*, all of which are worth cultivating on account of their showy blossoms. *B. Neemda*, a native of the peninsula of India, is said to be one of the most beautiful plants of that country. *B. globosa* will bear, with a little care, our winters as well as the *B. salvifolia*. All the flowers are sweet-scented. They grow best in a light rich soil. Cuttings will strike readily in mould under a hand-glass. Those of the stove species require heat.

(Loudon, *Encyclopædia of Plants*; G. Don, *Gardener's Dictionary*.)

BUFFALO. [BOVIDÆ.]

BUFFALO, AMERICAN. [BISON.]

BUFFO'NIA, a genus of plants named in honour of Buffon, the celebrated French writer on natural history. This genus belongs to the natural order *Caryophyllaceæ* and the sub-order *Alsineæ*. The calyx has 4 sepals; the petals are 4, entire; stamens 4; styles 2; capsules compressed, 1-celled, 2-valved, 2-seeded. The species are insignificant slender herbs, resembling the species of *Arenaria*. *B. annua* is a native of the south of France, and is said to have been found in England on the sea-coast of Lincolnshire.

BUFO, a genus of Reptiles belonging to the family *Bufonidæ*, and to which the Common Toad belongs. The genus is thus characterised:—Body inflated; skin warty; parotids porous; hind feet of moderate length, toes not webbed; jaws without teeth; nose rounded. About 20 species of this genus have been enumerated by naturalists. Two of them are found in the British Islands.

B. vulgaris, the Common Toad, is the *Rana Bufo* of Linnæus, the Crapaud Commun of the French. Its body is of a lurid brownish-gray colour, spotted over with reddish-brown tubercles: the body is much inflated. The Toad is very generally distributed over the British Islands, and from its dark colour, slow movements, and unprepossessing form, has acquired very general dislike. It is however perfectly harmless, and seems to possess an amount of intelligence that renders it capable of recognising those who treat it kindly. Mr. Bell in his 'British Reptiles' says:—"That toads may be rendered very tame, and be made to distinguish those who feed and are kind to them, there are abundant facts to testify. I have possessed a very large one which would sit on one of my hands and eat from the other; and the story of Mr. Arscott's toad in Devonshire, related in Pennant's 'British Zoology,' is too well known to need repetition." That they may be handled with impunity, and are incapable of producing any injurious influence, we know from having repeatedly seen them made the domestic pets of the children of a naturalist.

B. calamita, Natter-Jack, Walking Toad, Running Toad; *Bufo Rubeta* of Fleming, *Bufo mephitica* of Shaw, *Rana Rubeta* of Turton. It is known by its light yellowish-brown colour clouded with dull olive, but more especially by a bright yellow line along the middle of the back. It has acquired its name of Walking Toad or Running Toad in certain parts, from its never hopping, as is the case with the common toad and frog. Its colour varies very much according to circumstances, becoming lighter or darker in the course of a few minutes.

Pennant was the first to record this animal as British, and although very locally distributed it occurs in great numbers in some parts of Great Britain. Mr. Bell says it is common on Blackheath and at Deptford. It has also been found on Putney Common, at Gamlingay in Cambridgeshire, at Selbourne in Hampshire, and Bawdsey in Suffolk. It has also been found in Scotland. The form and appearance of this animal is less repulsive than the Common Toad. It is more social, and is generally found in communities. At Bawdsey they are found on the Red Crag cliffs overlooking the sea, and when alarmed hide themselves in holes in the sand which they make apparently for the purpose of concealment. The Natter-Jack appears to be an inhabitant of Ireland. Mr. Patterson in his 'Zoology for Schools' says:—"The Common Toad is there unknown, its absence being accounted for, according to popular tradition and song, by the malediction of St. Patrick. The smaller species, the Natter-Jack, does not appear however to have been banished with the rest of 'the varmint,' as it is found in three or four localities in the County Kerry and at Ross Bay, County Cork."

For an account of the general structure, habits, and classification of the family of Toads, see AMPHIBIA.

BUFONITES, the term commonly applied, previously to the investigations of M. Agassiz, to the roundish teeth of fishes frequent in the Oolitic Strata. They belong to the genera *Sphærodus*, *Gyrodus*, *Pycnodus*, &c.

BUG, one of a numerous tribe of Insects which constitute the order *Hemiptera*, belonging to the family *Cimicidæ* (Leach), and genus *Cimex*. The most common species is the *C. lectuarius*, the Bed-Bug.

It has been said that the Bed-Bug was not known in England previous to the great fire of London in 1666, and that it was first imported from America in the timber brought over to rebuild that city. Of the accuracy of this statement however there is considerable doubt. It appears to have been well known in various parts of Europe long before that time. Its shape, colour, and the offensive smell which it emits when touched, together with the circumstance of its deriving its nutriment from blood sucked through a long pointed proboscis, which when not in use lies parallel with the underside of the body, are circumstances too well known to need particular description. The female Bug deposits her eggs in the beginning of summer; they are of a tolerable size compared with that of the insect, of a whitish colour, and each fixed to a small hair-like stalk, which when the egg is first deposited is apparently of a glutinous nature, and readily adheres to anything which it touches. The places generally chosen in which to deposit the eggs are the crevices of bedsteads and other furniture, or the walls of a room. In about three weeks it is said these eggs hatch, and the young bug comes forth—an active larva, very closely resembling the parent insect except in size. The larva then undergoes the usual transformation, and becomes a perfect insect in about three months.

What was the natural habitat of this insect, which differs from most of its tribe in having no wings, is difficult to say. The species of bugs which come nearest to it in affinity are generally found under the bark of trees, a habitat which the flat form of our insect is well adapted for. Pigeons, swallows, &c., are attacked by bugs as well as man. Various means have been proposed for destroying these insects, but cleanliness is the best. [CIMICIDÆ.]

BUGLOSS. [ANCHUSA.]

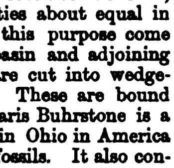
BUGLOSS, VIPER'S. [ECHIUM.]

BUHRSTONE is a quartz rock containing cellules. It is as hard and as firm as a quartz crystal, and owes its peculiar value to this quality, and the cellules, which give it a very rough surface. Stones for grinding wheat and other kinds of grain are formed of this rock, and those which are most valued have the cavities about equal in space to the solid part. The best stones for this purpose come from France, and are obtained from the Paris basin and adjoining districts. When used for grinding, the stones are cut into wedge-shaped parallelopipeds, which are called panes. These are bound together by iron-hoops into millstones. The Paris Buhrstone is a Tertiary Formation. A Buhrstone is obtained in Ohio in America which is in part a true sandstone, and contains fossils. It also contains lime, and Mr. Dana suggests that the removal of the lime by solution may have given it its cellular character. It overlies the Coal Formation, and has an open cellular structure where quarried for millstones. The quartz rock of Washington in the United States is in some parts cellular, and makes good millstones. Buhrstone also occurs in Georgia near the Carolina line, and in Arkansas near the Cove of Wichitta. (Dana, *Manual of Mineralogy*.)

BUKKUM-WOOD. [CÆSALPINIA.]

BULB, a bud, usually formed under ground, having very fleshy scales, and capable of separating from its parent plant. Occasionally it is produced upon the stem, as in some lilies, when it is called a bulbillus. [BUD.] Sometimes the scales are thick and narrow, and arranged separately in rows; the bulb is then called scaly, as in the lily. In the onion and leek the scales are broad and membranous, and inclose each other in a concentric manner; the bulb is then said to be tunicated.

BULI'MULUS, Leach's name for a genus of terrestrial *Mollusca*, which he thus defines:—Shell univalve, free, conically acuminated; spire elevated, regular; the last whorl very large; mouth entire, long; pillar smooth, simple; external lip thin; internal lip inflected towards the middle, with a hollow beneath. To this generic character the Rev. Lansdown Guilding observes that there should be the following addition: "Tentacula 4, the two upper ones long, with terminal eyes: no operculum." The last-named author observes that it differs from *Bulimus* in the delicacy of its outer lip. It is indeed a *Bulimus* of Lamarck. The shell varies much in colour. [BULIMUS.]

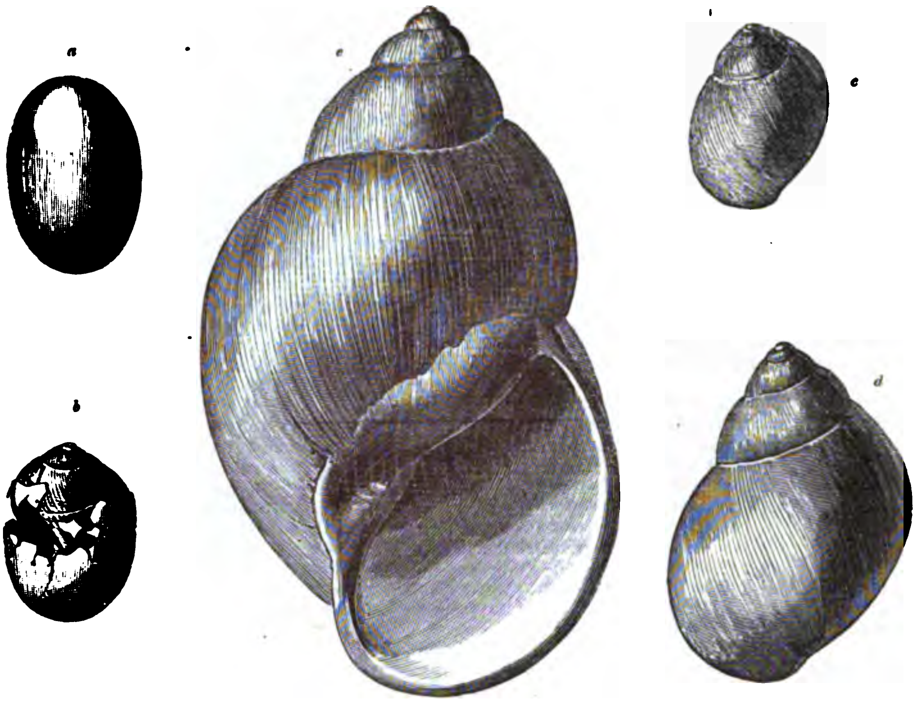

Bulimulus trifasciatus.

Leach observes that *Bulimulus trifasciatus* (*Bulimus Guadalupensis*, Brug.), a very common existing West Indian species, occurs imbedded in the same limestone which incloses the fossil human skeleton from the Grande Terre of Guadaloupe, now in the British Museum.

BULI'MUS, the name of a very extensive genus of terrestrial Pulmoniferous *Mollusca*. Lamarck arranges it under his Colimacés, a family of Phytophagous or Plant-Eating Trachelipods, respiring air by means of lungs, and protected by a spiral shell which is more or less elongated, oval, oblong, or turriculated, with an entire aperture longer than it is wide, and with a very unequal border, which is reflected in the adult. The columella is smooth, without any notch or truncation at the base, but with an inflexion in the middle at its point of junction with that part of the peristome which it contributes to form. De Blainville places it under the *Limacinea*, his third family of *Pulmobranchiata*, whose organs of respiration are retiform, and line the cavity situated obliquely from left to right upon the origin of the back of the animal, communicating with the ambient air by means of a small rounded orifice in the right side of the border of the mantle. Some of the species were placed by Linnæus under his genera *Bulla* and *Helix*. Scopoli and Bruguières began the reform, and Lamarck carried it still further. But before we proceed, it may be necessary to say a word as to the origin of the term used to designate the genus. "We constantly hear," says Broderip, in the 4th volume of the 'Zoological Journal,' "among conchologists the question, 'what is the meaning of Bulimus?' The author of the article entitled 'Lamarck's Genera of Shells,' in the 15th volume of the 'Journal of Science,' thus derives the word 'βούλιμος—insatiable hunger: what title this genus has to so strange a name we know not.' It may not then be unacceptable to give a plain statement of the origin of the word. Swainson observes ('Zool. Illust.,' vol. i., '*Bulimus Melastomus*') that "the genus *Bulimus* was long ago formed by Scopoli, out of the heterogeneous mixture of shells thrown together in the Linnæan genus *Helix*." Let us now turn to Scopoli's account of the source whence he derived the name. "Proprium," says Scopoli, "itaque ex his constituo, et duce celeberrimo Adansonio Bulimos voco, ut eo facilius adgnoscantur. Solam testam nec animal inhabitans vidi, quod diversum esse à Limace affirmat Adansonius." ('Deliciæ,' &c., p. 67.) Now Adanson has no such genus as Bulimus, but he has such a genus as Bulinus. At plate 1, fig. G 2, in his 'Natural History of Senegal,' will be found 'Le Bulin, Bulinus,' but the letters 'n' and 'u' are so confusedly engraven, that at first sight the word looks like Bulimus. In the text (p. 5), the word is printed Bulinus very plainly; but neither Scopoli nor any of his successors appear to have noticed it. Till the time of Lamarck, who confined the genus (still calling it Bulimus, after Scopoli and Bruguières) to the land-shells with a reflected lip, which now range under it, many land and fresh-water shells which have not a reflected lip, such as *Achatinæ*, *Physæ*, *Limnææ*, and *Succineæ*, were also congregated under the name of Bulimus. The *Bulinus* of Adanson was a fresh-water shell, apparently a *Physa* or *Limnæa*."

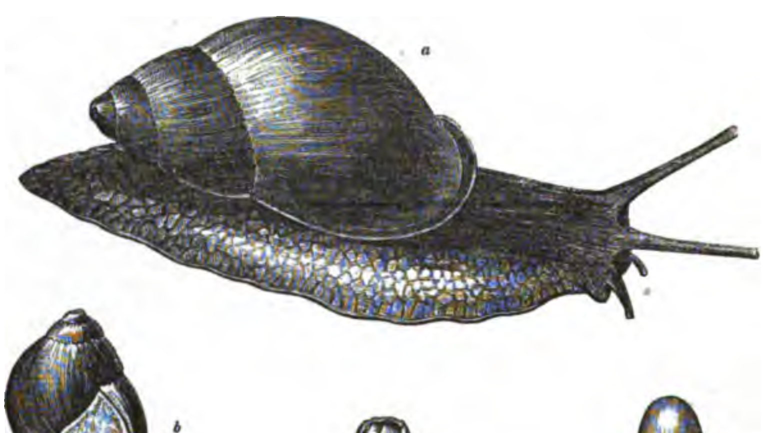
The shell is never orbicular, as in the *Helices*, but of the shape noticed at the commencement of the article. The last whorl is always larger than the penultimate, and indeed as a general rule may be stated to be larger than all the others put together. The mouth or opening is an oval oblong, and the border is disunited. The adult reflected lip or border on the right side is generally very thick, but this reflection is sometimes absent. The animal is very like that of *Helix*; De Blainville says entirely so—"toute-à-fait semblable." The head is furnished with four tentacula or horns, the two largest of which are terminated by the so-called eyes. There is no true operculum. The geographical distribution of the genus is very general, and there is scarcely a part of the world where the form does not occur. The great development of it takes place in the warmer climates, where some of the species are very large.

The species are multitudinous. Mr. Cuming has added largely to our knowledge of those of South America, and we are indebted to that gentleman for the following account of the habits of *Bulimus rosaceus*. In the dry season he always found the animals adhering to the under side of stones, generally among bushes, and close at the edge of the sea-shore, within reach of the spray at times. On the hills, about 1000 feet above the sea, they were observed adhering between the lower leaves of an aloe-like plant, on the honey of whose flowers the Giant Humming-Bird (*Trochilus gigas*) feeds. The natives burn down clumps of these plants for the sake of the rings at the bottom of the footstalks of the leaves, which they use for buoys for their fishing-nets and for baking the coarse earthenware which they make on the hills, because this part of the plant when ignited throws out a great heat. Between these leaves the *Bulimi* lie in the dry season in a torpid state. In the spring (the months of September and October) they burrow in the shady places at the roots of this plant, and among the bushes on the sea-shore. At this period (the spring) they lay their eggs in the earth, about two inches below the surface. Mr. Cuming never saw them crawling about. In the dry season they were evidently hybernating, for their parchment-like secretion, which operates in place of an operculum to seal up the animal, was strongly formed, and they stuck to the stones so tenaciously that Mr. Cuming broke many of them in endeavouring to pull them off. Chili and the neighbouring coasts of South America generally were the localities where the species was taken. Captain Phillip Parker King, R.N., has the following notice of the power of the animal to exist in a dormant state:—"Soon after the return of the expedition (his Majesty's ships Adventure and Beagle—'Survey,' 1826-30), my friend Mr. Broderip, to whose inspection Lieutenant Graves had submitted his collection, observing symptoms of life in some of the shells of this species, took means for reviving the inhabitants from their dormant state, and succeeded. After they had protruded their bodies, they were placed upon some green leaves (cabbage), which they fastened upon and ate greedily. These animals had been in this state for seventeen or eighteen months; and five months subsequently another was found alive in my collection, so that the last has been nearly two years dormant. These shells were sent to Mr. Loddige's nursery, where they lived for eight months in the palm-house, when they unfortunately died within a few days of each other. Soon after the shells were first deposited at Mr. Loddige's, one got away and escaped detection for several months, until it was at last discovered in a state of hybernation: it was removed to the place where the others were kept, when it died also. The upper surface of the animal, when in health, is variegated with ruddy spots and streaks on an ash-coloured ground." The only process used for revivifying these animals was placing them on a plate near a



Bulimus hæmastoma, natural size.

a, The egg; *b*, the egg-shell broken, showing the young animal with its shell in situ; *c*, the shell of a young one just after exclusion from the egg; *d*, the shell at a more advanced age, but before the lip is reflected; *e*, the adult shells. The specimens figured were brought from Trinidad. It is found in the brakes of St. Vincent's and of the Antilles generally. The young shell is semitransparent, but becomes opaque as it advances in age. The adult shell is brown, strongly striated or wrinkled longitudinally, with a rose-coloured mouth. Epidermis brown.



Bulimus rosaceus, natural size.

a, an adult, with the animal as it is seen when in motion; *b*, a young shell before the lip is reflected. The mouth is represented as sealed with the parchment-like secretion, which serves as an operculum when the animal is hybernating; *c*, egg-shell broken, discovering the infant shell; *d*, egg, unbroken. Figure *a* was taken from one of the specimens mentioned above when living in this country. Adult shell roughish; apex and upper whorls of a rose colour in fine specimens; the other whorls brownish, mottled longitudinally in fine specimens with dirty white. Suture crenulated; lip white; throat brownish; epidermis greenish.

moderate fire, and sprinkling them with tepid water. Upon their restoration they eat a considerable part of the parchment-like seal or operculum. They lived some time with Mr. Broderip before they were sent to Messrs. Loddiges. These animals had been packed up in a box and enveloped in cotton from the time of their capture to the period mentioned, when they were unpacked by Mr. Broderip.

The British species of this genus are of small size and ordinary aspect. The following are enumerated by Forbes and Hanley in the 'British Mollusca.'

B. acutus is a small species, turreted, conical, white or clear brown, often with dark markings; body whorl comparatively short. It is most abundant near the sea, and is found in the Channel Islands, Dorsetshire, Devon, Cornwall, the Isle of Man, Scotland, and Ireland.

B. Lackhamensis is a rare shell in Great Britain. It is abundant in many districts of Germany, France, and Switzerland.

B. obscurus is of a yellowish-brown colour, with a smooth surface and mouth with white lips. The animal is of a dark colour. It is found under stones, on old walls and ruins, and on trees in woods, and is very widely distributed in the British Islands. Forbes and Hanley regard the following species as spurious in the British Fauna: — *B. Guadaloupensis*, *B. Goodalli*, *B. decollatus*, *B. pupa*, *B. Guildingii*, *B. ventricosus*. The distribution of the *Bulimi* has been treated in detail by Mr. L. Reeve.

Fossil Bulimi.

Deshayes, in his tables (Lyell's 'Principles of Geology,' 2nd edition) enumerates three fossil species of *Bulimi* in the Tertiary Formation, one of which is known to him from the sub-Apennine beds, and another from Paris; but he does not give the locality of the third, nor does he identify any of the fossils with recent species. De la Beche, in his 'Geological Manual,' under the head of 'Fossil Shells,' contained in the Supra-Cretaceous rocks of Bordeaux and Dax, enumerated by M. de Basterot, has the following notice: "*Bulimus* (?) *terebellatus*, Lam., analogous to the existing species, Grignon, Placentine, Dax." Lamarck ('Animaux sans Vertèbres,' vol. vii. p. 534) describes the shell of *Bulimus terebellatus*, a Grignon fossil, as two centimeters in length, and observes on the singularity of its mouth or opening, but he makes no allusion to its resemblance to any existing species. In the 'Annales du Muséum,' he places it among the *Bulimi*, with doubt, observing that it may from its conformation be probably marine, but keeping that generic name for it, because it approaches nearer to the *Bulimi* than to any other known genus. In the seventh volume of his 'Animaux sans Vertèbres,' published eighteen years afterwards, he still arranges it among the *Bulimi*, and not under the head of 'doubtful Species.' The fifteen species described by Lamarck in this volume are all stated to be fossil, and only the last five are separated as 'Espèces douteuses.' Of the not-doubtful species, *Bulimus sextonus*, found fossil at Villiers and Grignon, bears a great resemblance, according to the author, to *Bulimus lubricus*; but he observes that the

Bulimus lubricus.

a, natural size; *b*, magnified. Inhabits Northern Europe, and is common in the neighbourhood of Paris. Shell smooth, shining, of a horn colour, inclining to fulvous; transparent.

opening or mouth of the fossil shell is much shorter than that of the recent, and that the summit of its spire is less obtuse. It may be doubted whether even the first ten fossil species enumerated by Lamarck are all true *Bulimi*.

De Blainville quotes Defrance for thirty-seven fossil species. [HELICIDÆ.]

BULL. [BOVIDÆ.]

BULLA. [BULLIDÆ.]

BULLACE, the English name of a kind of Plum, the *Prunus insititia* of botanists. It is probably a mere variety of the Sloe. [PRUNUS.]

BULLÆA. [BULLIDÆ.]

BULLFINCH, or BULFINCH, Latin *Pyrrhula*, French Bouvreuil, the name of a genus of Birds separated by Brisson from the Grosbeaks, afterwards again incorporated with them, and since by Temminck and others again arranged under Brisson's name *Pyrrhula*.

The following is Temminck's generic character:—

Beak short, hard, conico-convex, thick, swollen (bombé) on the sides, compressed at the point and towards the edge (arête) which advances upon the forehead; upper mandible always curved; lower mandible more or less so. Nostrils basal, lateral, rounded, most frequently hidden by the plumage of the forehead. Feet with the tarsus shorter than the middle toe; the front toes entirely divided. Wings short, the three first quills graduated (étagées), the fourth longest. Tail rather long, slightly rounded or squared.

The place generally assigned by ornithologists to the Bullfinches, between the Grosbeaks and the Crossbills, appears to be their proper position. Their food consists principally of seeds and kernels; and though the smaller species confine themselves for the most part to grain or seeds, which they open, rejecting the husk, some of the foreign species, as Temminck observes, have the bill excessively large and strong, and capable of fracturing the most ligneous seed-cases. Cold and temperate climates, adds the author last quoted, appear to produce the greatest number of species. They are found in Europe and America. The north of Asia appears to be equally their cradle, but they have never yet been observed in Australia, and but few have been noticed in Africa, while South America produces many. All the known species are subject to a double moult. The males and females differ, and can be easily distinguished in all stages of life. The young of the year differ but little from the old birds, and only till their autumnal moult.

Of the European species the Common Bullfinch may be taken as an example. It is Le Bouvreuil and Bouvreuil Commun of the French, according to Belon; Fringuello Marino, Ciufolotto, Suffuleno, and Monachino, of the Italians; Dom-Pape of the Danes and Norwegians; Dom-Herre of the 'Fauna Suecica;' Blutfinck, Rothbrustiger, and Der Gimpel of the Germans; De Goudvink of the Netherlanders; *Loxia Pyrrhula* of Linnæus, and *Pyrrhula vulgaris* of Brisson. The provincial names are Norsk-Pipe, Coalhood, Hoop, Tony Hoop, Alp, and Hope.

Male.—Length about 6¾ inches, two inches and three-quarters being taken up by the tail, which is rather forked, and of a lustrous black, shot as it were with iron blue. Bill six lines in length, short, thick, and black. Shanks eight lines high, and black. Irides of a chestnut

Bullfinch (*Pyrrhula vulgaris*), male.

colour. Crown of the head, circle round the bill, and upper part of the throat, of the same hue with the tail. Nape, back, and shoulders deep gray, or rather bluish-gray. Cheeks, neck, breast, belly (to the centre of it), and flanks, red. Rump and vent white. Greater wing-coverts tipped and margined with a French or pinkish white, forming a transverse bar across the wing.

Female.—Somewhat less than the male, and of a reddish-gray where he is red; back brownish-gray; feet brownish-black. The colours generally less bright than in the male.

The young of the year are at first ash-colour, with wings and tail of blackish-brown; afterwards more like the female till the autumnal moult; but the young males may always be known by the greater tinge of red about the breast.

There are several varieties:—

1. Black.—This variety may be produced artificially by feeding the bird entirely on hemp-seed, in which case a change of diet will often produce the true colours. Bechstein says it will arise from being kept when young in a totally dark place; and that females, either from age or from the diet above mentioned, are most subject to it.

2. White.—This is merely an albino of an ashy or dusky white, or cream-colour: the parts which are generally black are more shaded than the rest. There is a specimen from Middlesex in the British Museum.

3. Speckled or Variegated.—Spotted with black and white, or white and ash-colour, besides the natural hues. Selby says that Captain Mitford killed one, of which both the wings were white.

4. Bechstein mentions varieties under the name of the Large Bullfinch, about the size of a thrush, and the Middling or Common Bullfinch. He treats the dwarf variety, which is said to be not so large as a chaffinch, as a bird-catcher's story; for he observes that this difference of size occurs in all kinds of birds, and says he has had opportunities every year of seeing hundreds both wild and tame, and adds, that he has even found in the same nest some as small as redbreasts, and others as large as a crossbill.

The Bullfinch will produce hybrid young with the Canary.

The native song of this common but pretty bird is very soft and simple, but so low that it is almost inaudible. Its call is a plaintive whistle, and when feeding it utters a low short twitter. It has however acquired great celebrity from the facility with which it learns to whistle musical airs, and from its retentive memory, when well educated and carefully attended to. "Those which are to be taught," says Bechstein, "must be taken from the nest when the feathers of the tail begin to grow, and must be fed only on rape-seed soaked in water and mixed with white bread; eggs would kill them or make them blind. Their plumage is then of a dark ash-colour, with the wings and tail blackish-brown. The males may be known at first by their reddish breast; so that when these only are wished to be reared they may be chosen in the nest, for the females are not so beautiful, nor so easily taught, though they answer the purpose of call-birds as well as the male." Mrs. Charlotte Smith however says ('Nat. Hist. of Birds') that she had a nest of bullfinches given her, of which only one was reared: it was a hen, which she kept only because she had reared it, but the bird hung in the same room with a very fine Virginian nightingale, whose song she soon acquired, and went through the same notes in a lower and softer tone. "Although the young," continues Bechstein, "do not warble before they can feed themselves, one need not wait for this to begin their instruction, for it will succeed better, if one may say so, when infused with their food; since experience proves that they learn those airs more quickly and remember them better which they have been taught just after eating. It has been observed several times that these birds, like the parrots, are never more attentive than during digestion. Nine months of regular and continued instruction are necessary before the bird acquires what amateurs call firmness; for if one ceases before this time, they murder the air by suppressing or displacing the different parts, and they often forget it entirely at their first moulting. In general it is a good thing to separate them from the other birds, even after they are perfect, because, owing to their great quickness in learning, they would spoil the air entirely by introducing wrong passages; they must be helped to continue the song when they stop, and the lesson must always be repeated whilst they are moulting, otherwise they will become mere chatterers, which would be doubly vexatious after having had much trouble in teaching them."

A single air with a short prelude is generally as much as the bird can learn and remember; but Bechstein, who asserts this, allows that there are some of them which can whistle distinctly three different airs, without spoiling or confusing them in the least. In truth, as the same author observes, there are different degrees of capacity among the bullfinches as well as in other animals. One young bullfinch learns with ease and quickness, another with difficulty and slowly; the former will repeat without hesitation several parts of a song; the latter will hardly be able to whistle one after nine months' uninterrupted teaching. Those birds which learn with most difficulty are said to remember the songs, when once learnt, better and longer, and rarely forget them even when moulting. To these attractive qualities of the Bullfinch must be added its obedience and capability of strong attachment, which it shows by a variety of little endearing actions; and it has been known even to repeat words with an accent and tone indicative of sensibility, if, as Bechstein observes, one could believe that it understood them. Of its attachment the following are instances:—Buffon asserts that tame bullfinches have been known to escape from the aviary, and live at liberty in the woods for a whole year, and then to recollect the beloved voice of the person who had reared them, returning never more to leave her. Others, when forced to leave their master, are said to have died of grief. Buffon's story of the return of the escaped bullfinch is corroborated by the amiable qualities ascribed to it by Bechstein, for he says that, among other feats, it may be accustomed to go and return, provided the house is not too near a wood.

In a state of nature the Bullfinch feeds on pine and fir seeds, corn, linseed, millet, rape, and nettle seed, all sorts of berries, and the buds of most trees, among which those of the oak, beech, pear, plum, cherry, and gooseberry are favourites. Bewick says that in the spring it frequents gardens, where it is usefully busy in destroying the worms which are lodged in the buds. Busy it is; but we are compelled to add that its utility, to the horticulturist at least, is no longer questionable. In its devastation it may now and then, and no doubt does find a worm in a bud; but its object is the bud, not the worm. "They feed most willingly upon those buds of trees which break forth before, indeed are pregnant with, the leaves and flowers, especially those of the apple-tree, pear-tree, peach-tree, and other garden trees; and by that means bring no small detriment to the gardeners, who therefore hate and destroy them as a great pest of their gardens, intercepting their hopes of fruit." Such is Willughby's verdict. "I have known," says Selby, "a pair of these birds to strip a considerable-sized plum-tree of every bud in the space of two days. These buds are not swallowed whole, but first minutely divided by the tomia of the powerful bill." "Its delight," observes Mr. Knapp in his interesting and lively 'Journal of a Naturalist,' "is in the embryo blossoms wrapped up at this season (spring) in the bud of a tree; and it is very dainty and curious in its choice of this food, seldom feeding upon two kinds at the same time. It generally commences with the germs of our larger and most early gooseberry; and the bright red breasts of four or five cock birds, quietly feeding on the leafless bush, are a very pretty sight; but the consequences are ruinous to the crop. When the cherry buds begin to come forward, they quit the gooseberry, and make tremendous havoc with these. I have an early wall cherry, a may-duke by reputation, that has for years been a great favourite with the bullfinch family, and its celebrity seems to be communicated to each successive generation. It buds profusely, but is annually so stripped of its promise by these feathered rogues, that its kind might almost be doubted. The Orleans and green-gage plums next form a treat, and draw their attention from what remains of the cherry. Having banqueted here a while, they leave our gardens entirely, resorting to the fields and hedges, where the sloe-bush in April furnishes them with food."

Bewick says it builds its nest in bushes, and that it is composed chiefly of moss,—Bechstein, in the most retired part of a wood, or in a solitary quickset hedge, adding that it is constructed, with little skill, of twigs, which are covered with moss. Graves says that it is mostly found in the thickest part of a black- or white-thorn bush, and that it is composed of small twigs and moss, and is lined with soft dry fibres. Yarrell says the nest is formed of small twigs, and lined with fibrous roots, the materials not very compactly entwined together, and usually placed four or five feet above the ground on the branch of a fir-tree, or in a thick bush. The eggs are generally four or five; Temminck says from three to six, but in this country the number is usually four, of a bluish white, speckled and streaked with purplish or pale orange-brown at the large end, and rather obtuse. The young are generally hatched in May or the beginning of June, and there are frequently two broods in a year. The time of incubation is fifteen days.

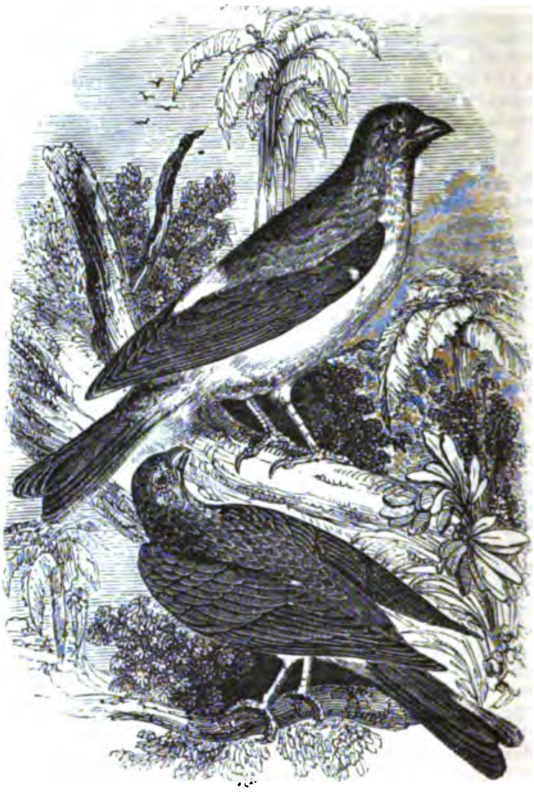
The species is widely spread. They are common in most parts of Northern Europe, extending into Russia and Siberia: in the south of Europe they occur only as birds of passage. They are said to winter in Italy. Gesner says that about the Alps the bird is called Franguel Invernengk—that is, 'Winter Finch.' Bonaparte notes it as "raro d' inverno avventizio" near Rome. Thunberg long ago said that the common Bullfinch was found in Japan, and this is corroborated by Dr. von Siebold, for it was one of the European species which he found in that country. The bird is particularly common in the mountainous forests of Germany: and it is from Cologne and other spots,

"Where Rhenus strays his vines among,"

that the market for Piping-Bullfinches is principally supplied. Bechstein mentions that there are schools for these little musicians in Hesse and Fulda, and at Waltershausen near Gotha. With us the bullfinch is a constant resident.

P. Synoica, the Asiatic Bullfinch. The adult male is ornamented round the base of the bill with a circle of rich red, going off in spots upon the cheeks. The front is covered with small lustrous white feathers, of a silvery white, lightly shaded upon the borders with red; all the lower parts of the body, the inferior coverts of the tail, and the rump, are of a brilliant rose-colour, or clear carmine; the upper parts are ash-coloured, lightly tinged with rose: wings and tail brown, with ash-coloured borders.

The female is brown, of a light brown or earth-colour above, with longitudinal lines of deeper brown upon each feather. The lower parts are of a very clear brown or Isabella-colour, with longitudinal striæ of a somewhat deeper brown upon the middle of the feathers. The tail is slightly notched at the end, and the bill and feet in both sexes are of a clear brown. Length about 5 inches and 5-8ths. M. Hemprich found this species near Mount Sinai, in Arabia; and there are specimens in the museums of the Netherlands and of Berlin. Temminck, from whose work the figures and description are taken, thinks it possible that the 'social bullfinch' may be found some day in the islands of the Grecian Archipelago, and that it may easily pass in its migrations the arm of the sea between Asia and those isles.



Asiatic Bullfinch (*Pyrrhula Synoica*). Upper figure, male; lower figure, female.

Pyrrhula Gigathinea. Lower figure, male.

Temminck received his specimen from Professor Lichtenstein; and it was one of the discoveries of the travellers sent some years ago by the King of Prussia into Egypt with a view of obtaining objects of natural history.

A species from the Himalaya Mountains, *Pyrrhula erythrocephala*, figured in Mr. Gould's beautiful work, comes near to the common Bullfinch of Europe except in the form of the tail, which is decidedly forked, while in the European it is nearly even. There is a specimen of *Pyrrhula erythrocephala* in the British Museum, and another in that of the Zoological Society.

P. Gigathinea. This species is characterised by a very thick bill, and a slightly notched tail. The colours of the sexes do not vary greatly. In the male a grayish colour tinted with bright-rose covers all the lower parts of the body, the throat, and the circle round the bill; this tint is palest on the throat. The crown of the head is pure ash-colour, and an ashy brown is spread over the nape, the back, and the wing-coverts. A faint rose-colour tinges the plumage of the rump and the edges of the quills and tail-feathers, all of which are bordered towards the end with whitish upon a black ground. The two middle quills are the shortest. The wings reach to the extremity of the tail-feathers; the bill is of a fine red. Length 4 inches 6 lines.

The female has no rosy tint except on the edges of the quills and tail-feathers, and on the rump, where it is very faint. The upper parts are of an Isabella-brown, and the wings edged with a brighter tint of the same. The circle round the bill and the throat are ash-coloured; the lower parts of a pure Isabella-colour; and the middle of the belly white. Bill same as in the male.

This bird is figured in the great French work on Egypt (plate 5, fig. 8), and was sent home some years ago by the German travellers to the north of Africa. It inhabits Egypt and Nubia. There are specimens in the Berlin museum, and in those of the Netherlands and of Frankfort.

P. cinereola. Head, cheeks, back, and scapulars, ashy-bluish; wings and tail darker, but all the feathers of those parts are bordered with ash-colour. There is a small white spot on the wing, formed by the white towards the base of the quills, beginning with the fourth; the first three have no white. All the lower parts are white, with the exception of the flanks, which are clouded with ash-colour. Bill coral-red, very strong, large, and as it were swollen (bombé). Feet ash-coloured. Length 4½ inches. Inhabits Brazil, where it is said to be common.

Pyrrhula cinereola.

BULLHEAD. [COTTUS.]

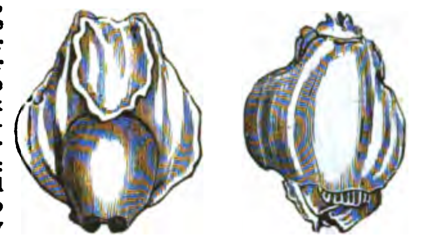
BULLHEAD, ARMED. [ASPIDOPHORUS.]

BU'LLIDÆ, a family of Marine *Mollusca*, which Lamarck arranges among his Gasteropods, between the Calyptracians on one side and the Aplysians on the other, making the family to consist of the three following genera, *Acera* or *Akera*, *Bullæa*, and *Bulla*. Cuvier finds a situation for it in his fourth order of Gasteropods, the Tecti-branchians (Monopleurobranchians of De Blainville), which includes both *Aplysia* and *Umbrella*. De Blainville places it next but one to his Aplysians (his family *Patelloidea* intervening) under the family *Akera*, the fourth of his third order *Monopleurobranchiata*, of his second sub-class *Paracephalophora Monoica*, of his second class *Paracephalophora*.

Forbes and Hanley make it the first family of the *Gasteropoda opisthobranchiata*. They observe that "this tribe may be considered intermediate between the two great sections of *Gasteropoda*. The shells of its mollusks are always convolute and more or less enveloped by the animal; sometimes entirely invested, more rarely absent. Except in the case of *Tornatella* there is no operculum. The head of the animal is in the form of a single or lobed disk, and its lateral lobes are often greatly developed, so as in many species to serve as swimming organs. The foot is in some extremely small, in others a crawling disk of considerable dimensions. There are more than 150 species of this family known. They inhabit all parts of the world, and some of them are very widely diffused." The best account of the family that has yet appeared is by Mr. Arthur Adams in the 'Thesaurus Conchyliorum' of Mr. G. B. Sowerby, Jun.

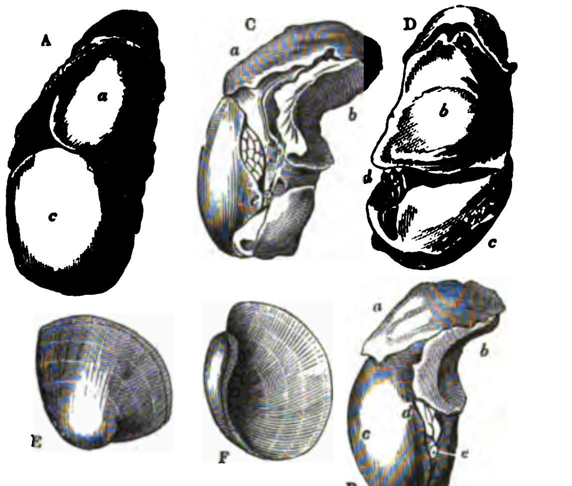
The following are illustrations of some of the genera:—

Acera, Lamarck, *Lobaria*, De Blainville, has its body oval-oblong, sub-globular, appearing to be divided into four parts: one anterior for the head and thorax, one on each side for the natatory appendages or fins, and one posterior for the viscera. The anterior fleshy disk terminates in an approach to a point near the middle of the body: the branchiæ covered by the mantle are so posterior that they seem to be almost at the extremity of the body, and below them would be the analogous situation for the shell, of which there is not even a rudimentary trace.



Lobaria carnosa, Cuv.

Bullæa. Lamarck assigned this name to those of the family which have the shell entirely hidden in the substance of the mantle. This shell is very open and delicate, and can hardly be said to have more than the first rudiment of the rolled-up form which is in *Bulla* carried to greater perfection. *Bullæa aperta*, Lam. (*Bullæa Planciana*, Lam., in the early edition of the 'Syst. des Anim. sans Vert.'); *Amygdala marina* (Amande de Mer), Planc.; *Bulla aperta*, Lin.; *Bulla aperta* and



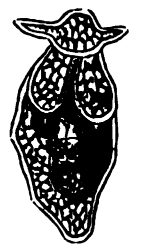
Bullæa (*Bulla*) *aperta*.

A, view of the back; B, side view, the right; C, the same, but the ventral fleshy plate separated from the dorsal to show the parts between; D, view of the under side; *a*, the fleshy plate which covers the anterior part of the body; *b*, the fleshy plate that acts as a foot; *c*, the part which contains the shell; *d*, a part of the branchiæ; *e*, the vent; *f*, the common orifice of the testicle and oviduct; E, shell in its natural position; F, view of the under or concave side.

Lobaria quadriloba, Gmelin, which is found in almost all seas, and is very common on the shores of Great Britain, will serve for an example. The animal is whitish, more than an inch in length, and, as Cuvier observes, the fleshy shield formed by the vestiges of the tentacula, the lateral borders of the foot, and the mantle occupied by the shell, seem to divide it into four portions, whence Gmelin's term *quadriloba*. The shell is delicate, white, semitransparent, and consists almost entirely of aperture. The stomach or gizzard is armed with three very thick rhomboidal bones or rather shelly pieces.

Bullæa has been found at a depth ranging from near the surface to 12 fathoms. Mr. W. Clark found three English species, two of them (*Bullæa catena* and *B. punctata*) at Exmouth and Torquay, in pools at the time of the lowest spring-tides; and a third (*Bullæa pruinosa*) by dredging off Budleigh Salterton. The depth is not mentioned, but it is probable that it was considerable, for the author says that it is rare, and only occasionally to be procured by deep dredging seven or eight miles from the shore. The first of Mr. Clark's species, which is *Bulla catena* of Montagu, had a testaceous gizzard, but the gizzards of the other two were unfurnished with shelly appendages. (See Mr. Clarke's description, 'Zool. Journ.' vol. iii. p. 337). G. Sowerby, when speaking of the use of the shelly species and their powerful adductor muscles, states that the animal of *Bullæa aperta* is sometimes distorted by having swallowed entire a *Corbula nucleus*, which is a very thick and strong shell, nearly equal in size to itself.

De Blainville says of this genus that he characterises it somewhat differently from Lamarck, who establishes it, and who only places under it the *Acerata*, whose shell is internal; but as De Blainville considers the animal to be of the first consequence, he distinguishes under the name of *Bullæa* those species which, whether their shell be external or internal, have the foot thickest and not dilated into natatory appendages, having, in fact, habits different from the *Bullæ*, according to his acceptation of the term, which swim very well and creep very badly. He divides *Bullæa* into—



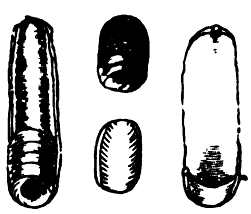
Ferussac's *Bullæa*.

1st. Those species which have an internal shell very incompletely rolled up without spire or columella, and selects as his example *Bullæa aperta*, the species figured in the preceding page.

2nd. Those species whose shell is internal and very incompletely rolled up, with a columella and alveolar spire (spire rentrée), and gives as an example *Bulla ampulla*.

3rd. Species whose shell is internal, the lateral lobes cirrhous and more developed, and gives as an example Ferussac's *Bullæa* (Quoy et Gaimard), here figured from the 'Atlas Zoologique' of the voyage of the Uranie.

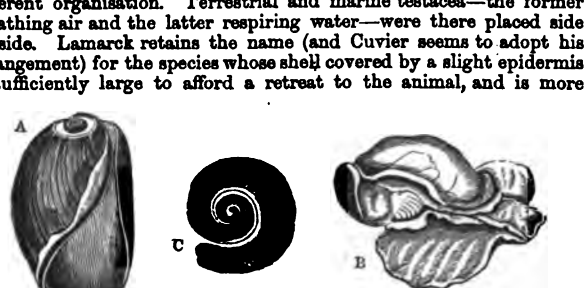
In the 'Additions and Corrections' to his 'Malacologie,' De Blainville says, that, in studying more attentively the species of these two genera, it seems to him that the greater part would be better placed under *Bulla* than under *Bullæa*, where he would leave only the species which serves for the type, and another which was brought from the seas of Australia by Quoy and Gaimard. He then proposes an entirely new arrangement into seven groups represented by the following genera:—1. *Bullina* (Bulline) of Ferussac, with a projecting spire (example *Bulla Lajonkairiana*, Bast.) 2. *Aplustre* (Schum.) 3. *Bulla*. 4. *Atys* (Montf.) 5. The form represented by *Bulla fragilis*. 6. *Scaphander* (Montf.), which is *Bulla lignaria*. 7. *Bullæa* (Lam.).



Sormetus Adansonii.

Sormetus. Cuvier observes that this form approaches very closely to that of his *Bullææ*, but he adds that he does not find sufficient certainty in the imperfect materials afforded by Adanson to enable him to found either a genus or even a species on them. De Blainville places it as a genus next to *Lobaria*; but his description and figure are taken from Adanson, and he is obliged to add that it is established upon an animal "assez incomplètement connu."

Bulla. Besides the true *Bullidæ*, the heterogeneous *Bulla* of Linnæus comprised some of the *Physæ* and *Achatinæ*, and of the *Ovula*, *Terebella*, *Pyrulæ*, &c.: in short, the genus comprised animals of entirely different organisation. Terrestrial and marine testacea—the former breathing air and the latter respiring water—were there placed side by side. Lamarck retains the name (and Cuvier seems to adopt his arrangement) for the species whose shell covered by a slight epidermis is sufficiently large to afford a retreat to the animal, and is more



Bulla fragilis.

A, the shell showing the aperture; C, a view of the spiral end, showing the way in which the shell is rolled up; B, the animal.

perfectly rolled up than the shell of *Bullæa*. Lamarck describes the shell of his *Bulla* as completely rolled up (enroulée), showing itself constantly uncovered. It is, generally speaking, only partially enveloped by the animal, which can retreat into it almost entirely; has no distinct columella nor any true spire, unless indeed that term be applicable to the apex of *Bulla fragilis*, which we now proceed to describe. Its shell is ovate-oblong, very thin and fragile, of a horn colour, with very small transverse striæ, and the apex rises into the rudiment of a projecting spire.

It is the *Akera bullata* of O. F. Müller, and is not uncommon on the British coasts. We now proceed to give an example of those species which, while they have a little more solidity than *Bulla fragilis*, are still very delicate and fragile in their texture.

B. Velum. The shell is very delicate, of a very light horn-colour when in fine condition, with a snow-white band about the middle, bordered on each side with a broad dark-brown one; the apex and base are white, both bordered with dark brown bands.

Bulla Velum.

B. ampulla. The shell is ovate and subglobose, beautifully mottled with white, plum-colour, and reddish. Instead of a spire there is an umbilical alveolus. Lamarck gives as a locality both the Indian and American oceans; Deshayes, the European ocean and the Indies.

Bulla ampulla.

B. lignaria (*Scaphander lignarius*) is a common species on our coasts. It has a testaceous stomach or gizzard, so well known as the vehicle of Gioëni's half error, half fraud. He found these testaceous gizzards and elevated them immediately to the rank of shells 'sui generis' literally, for he gave the genus his own name, and imposed upon many: he went so far as to describe the habits of his pretended testaceous animal. Draparnaud first exposed this piece of charlatanry.

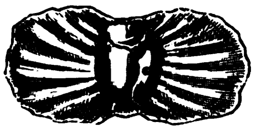
B. Hydates, Linnæus, and *B. Cranchii*, Leach, are found in the British seas. *B. media*, Philippi, *B. columna*, Chiaje, are recorded as British, but may be regarded as doubtful.

The following genera of *Bullidæ* are found in Great Britain:—*Cylichna*, eight species [CYLICHNA]; *Amphisphyra hyalina*; *Tornatella fasciata*; *Akera bullata*; *Bulla*, two species; *Scaphander lignarius*; *Philine*, six species.

Fossil Bullidæ.

Lamarck enumerates four fossil species, all of them from Grignon; G. Sowerby says that such are only to be distinguished in the Tertiary Beds and in the Greensand. Deshayes in his tables, speaking of tertiary fossils only, gives two fossil species of *Bullæa*, one from the sub-Apennine Beds, and one from Paris. Of *Bulla* he enumerates twenty-three fossil in the Tertiary Beds; and of these, two are both living and fossil, namely, *B. lignaria* and *B. ampulla*. The first he places in Sicily, in the sub-Apennine Beds (Italy), and the English Crag at Bordeaux and Dax, in Touraine, at Turin, Angers, Paris, and Valognes; in short, in the beds of the Pliocene, Miocene, and Eocene periods of Lyell. The second, Deshayes quotes as occurring in beds of the Pliocene period only, namely, those of Sicily and the sub-Apennine Beds (Italy). In his edition of Lamarck (vol. vii., 1836,) he takes no notice of *B. ampulla* as a fossil, but notices *B. striata* (which he observes has been confounded with *B. ampulla*) as a fossil species. He also remarks on the confusion between *B. solida* and *B. cylindrica*, and proposes that *B. solida* should take the name of *B. cylindrica*; that the *B. cylindrica* of Bruguières, living in the Mediterranean and European seas, should be called *B. cylindracea* (Pennant's name); and that the fossil *Bulla* from the environs of Paris, confounded with the latter, should be named *B. Bruguièrei*.

De Blainville places under his family of *Acerata*, the genus *Gasteroptera*, whose body is divided into two parts, the posterior being globular and joined by a peduncle to the anterior portion, which is small, but enlarged on each side into a considerable muscular expansion transversely oval, and cut or hollowed out in the middle, both above and below, rendering the expansion bilobated, as it were, and an organ for swimming, in place of a foot for creeping. The lateral gill is uncovered; there is no shell. Example, *G. Meckeli*, from the Sicilian seas.



Gasteroptera Meckeli.

BULLRUSH the English name of *Typha latifolia* and *T. angustifolia*, two wild marsh plants bearing long black cylindrical masses of flowers. The name is also sometimes applied to *Scirpus lacustris*, a tall rushy-looking plant from which the bottoms of chairs, mats, &c., are often manufactured. [Typha; Scirpus.]

BULLRUSHWORTS. [Typhaceæ.]

BULL-TROUT. [Salmo.]

BULLY or BULLET-TREE. [Mimusops.]

BUMASTES, a genus of *Trilobites* thus named by Sir R. Murchison, includes the *B. Barriensis*, or Barr Trilobite, which occurs in the Upper Silurian Strata.

BUMELIA, a genus of plants belonging to the natural order *Sapotaceæ*. Many of the species are used in medicine. *B. nigra* has a bitter and astringent bark, which is used in fevers. The wood is very hard. *B. retusa* has a milky fruit. The fruit of *B. lycioides* is austere, with some sweetness, and is said to be useful in diarrhœa. The flowers of *B. graveolens* have a heavy unpleasant odour. (Lindley, *Vegetable Kingdom*.)

BU'NIUM, a genus of plants belonging to the natural order *Umbelliferæ*, the sub-order *Orthospermeæ*, and the tribe *Ammineæ*. It has an obsolete calyx; obcordate petals, with a broad obtuse inflexed point; an oblong fruit, the carpels with 5 filiform equal ridges; the interstices with 1 or 3 vittæ; the stylopodium conical. The species are perennial herbs with usually tuberose and globose roots, square stems, compound leaves, and white flowers.

B. flexuosum, the Pig-Nut, has a general involucre of 1-3 leaves, partial more numerous; fruit oval, narrowing upwards, crowned with the elongated stylopodium and erect styles, interstices with 3 vittæ. This species is the *B. denudatum* of De Candolle: it is a native of the west and south of Europe, and plentiful in Great Britain. It has a nearly globular root, of a black or chestnut colour on the outside and white inside. It has an aromatic sweet taste, and is frequently dug up and eaten by children. It is called in this country by many names, as Earth-Nut, Ar-Nut, Kipper-Nut, Hawk-Nut, Jur-Nut, Earth Chestnut, and Ground-Nut. The synonyms are almost as numerous in the French and German languages. Pigs are very fond of this nut, and get fat when they are allowed to feed on them. When boiled they are a pleasant and nutritious food. Roasted, they are preferred by some people to chestnuts, and are often in this country and on the Continent added to soup or broth.

B. Bulbocastanum of Linnæus is a different species from the latter, though often confounded with it. Its general and partial involucres are composed of numerous leaves, the fruit oblong, crowned with the short stylopodium and reflexed styles, the interstices with single vittæ. This plant has been discovered in chalky fields in Cambridgeshire and Herts, and is probably more generally diffused. George Don enumerates in the 'Gardener's Dictionary' sixteen species of *Bunium*. (Babington, *Manual of Brit. Bot.*)

BUNTER SANDSTEIN, the lowest arenaceous member of the Triassic system of strata, as understood in Germany (the lowest part of our Mesozoic Series). The three parts are—

Keuper above, marly.
Muschelkalk in middle, calcareous.
Bunter Sandstein below, arenaceous.

This classification is applicable to England by retrenching the middle term. Sir R. Murchison is of opinion that part of the Bunter Sandstein (Grès Bigarré of France) belongs to the Palæozoic Series, but no proof of this is yet published.

BUNTING is the common name applied to a number of small Birds belonging to the order *Insessores* and the family *Emberizidæ*. The Common Bunting, the Yellow Bunting, the Cirl Bunting, and the Ortolan Bunting, all British birds, are species of the genus *Emberiza* [Emberiza]; whilst the Snow Bunting and the Lapland Bunting, also British, are referred by Yarrell to the genus *Plectrophanes*. [Emberizidæ.]

BU'PALUS, a genus of Insects belonging to the order *Lepidoptera* and the family *Geometridæ*. It has the following characters:—Palpi very short; antennæ in the males pectinated on each side to the apex, in the females simple; wings erect during repose; the anterior wings in the males having a protuberance at the base; larva smooth, and furnished with ten legs.

B. piniarius, the Bordered White Moth, is a beautiful moth, which when the wings are expanded measures rather more than an inch in width. Its wings on the upper side are of a dusky brown colour, and adorned with numerous pale yellow spots; and beneath clouded with the same dusky colour and having two brown stripes. The caterpillar is green, with a white longitudinal stripe down the middle of the back, and four other stripes of a yellowish colour placed two on each side of this. It feeds upon the *Pinus sylvestris* and *P. abies*, in the neighbourhood of which species of firs the moth is not uncommonly seen flying during the day-time.

(Stephens, *Illustrations of British Entomology*.)

BU'PHAGA (*Buphagus*, Brisson), a genus of Birds, whose form in some points resembles that of the *Merulidæ* (Blackbirds), while its habits approach those of the *Sturnidæ* (Starlings); but the form notwithstanding presents such strong points of difference that most ornithologists agree in viewing it as the type of a family, *Buphagidæ*, of which at present it is the only genus. The following is Temminck's generic character:—Bill strong, large, obtuse, nearly quadrangular; lower mandible stronger than the upper; both swollen towards the point. Nostrils basal, oval, half closed by a vaulted membrane. Feet moderate; shank (tarsus) longer than the middle toe; three toes before, one behind, the lateral toes equal, the external toe conjoined at the base, the internal one divided; claws hooked, compressed. Wings moderate; the first quill very short, the second nearly the length of the third, which is the longest.

The species live principally upon those parasitic insects the larvæ (maggots) of which are hatched under the skin of some of the larger ruminants and birds, a mode of life which is followed by some of the Crows (*Corvidæ*) and the Pastors. The quadrupeds on whom the *Buphaga* waits are principally those of the ox-family, the antelopes, and the camels, and generally the other ruminants both wild and tame. Fixed on the backs of these by his cramp-irons of claws the Beef-Eater, as he has been called by the English, and Pique-Bœuf by the French, digs and squeezes out with his forceps of a beak the larva that lies festering under the tough hide of the quadruped.

Le Vaillant gives the following account of the habits of *Buphaga Africana*, which is distributed through Southern Africa, and found also at Senegal:—The bill of the Pique-Bœuf is fashioned as a pair of solid pincers to facilitate the raising up out of the hides of quadrupeds the larvæ of the gadflies, which are there deposited and nourished: the species therefore anxiously seeks out the herds of oxen, of buffaloes, of antelopes—of all the quadrupeds, in short, upon which these gadflies deposit their eggs. It is while steadied by a strong gripe of the claws in the tough and hairy hide of these animals that with strong blows of the bill and powerful squeezes of the skin at the place where the bird perceives an elevation which indicates the presence of a maggot, he extracts it with effort. The animals accustomed to the treatment bear with the birds complacently, and apparently perceive the service which they render to them in freeing them from these true parasites, which live at the expense of their proper substance. The Pique-Bœufs however are not the only birds that perch upon the backs of quadrupeds and large birds, for many other omnivorous species have the same habit; but these last content themselves with

Beef-Eater (*Buphaga erythrorhyncha*), male.

only taking away the parasites which are attached to the skin of those animals, not having in their bills the necessary strength for extirpating the larvæ which are lodged beneath it; an office which the *Corvus albicollis* (Le Corbivau) executes as well as the Pique-Bœufs.

The Pique-Bœufs are generally seen in company, but they never fly in large flocks. Le Vaillant rarely saw more than six or eight in the same herd of buffaloes or antelopes; and M. Rüppell never observed them except in bands consisting but of few individuals about the camels of his caravan. They are very wild and difficult of approach, so that there is no chance of obtaining either the one or the other species, except by hiding behind an ox or a camel and driving it gently in the manner of a stalking horse towards those beasts on whose backs the birds are perched. When sufficiently near the fowler shows himself, and brings them down while on the wing. Besides the larvæ of the gadfly, these birds eat the ticks when they are full of blood, and all sorts of insects generally.

B. erythrorhyncha was received by Temminck some years since from the Cape of Good Hope, whither it had been brought with a number of other birds from Madagascar. Temminck says it is distinguished from its congener by a smaller and less powerful bill, by the red colour of that organ (whence it is called in French Pique-Bœuf, Bec-Corail—Beef-Eater, Coral-Bill)—by the more sombre tints of its upper plumage, and, finally, by its smaller proportions. The upper parts, head, and throat in the adult are ash-brown, glazed as it were with bluish; the lower parts are yellowish-rust or dark Isabella-colour. The total length is 7 inches, about one-third less than *B. Africana*, whose bill is yellow, and whose geographical distribution seems to lie in the southern districts and on the western coasts—parts of the country to which Temminck expresses his belief that *B. erythrorhyncha* does not penetrate. Temminck, from whose work our figure and description are taken, says that no particulars as to the structure of the nest, its position, or the period of incubation, are yet known.

BUPLEURUM (from βοῦς, ox, and πλευρον, side), a genus of plants belonging to the natural order *Umbelliferæ*, the sub-order *Orthospermeæ*, the tribe *Ammineæ*. It has an obsolete calyx; entire roundish petals, with a closely involute broad retuse point; the fruit subdidymous; carpels with equal winged or filiform and sharp or obsolete ridges; interstices with or without vittæ; stylopodium depressed. The species are quite smooth, herbs or shrubs. The leaves are rarely cut, in most instances being quite entire. This arises from their possessing no lamina; they are composed entirely of the petioles, and are in fact phyllodia. The flowers are yellow.

There are about fifty species of *Bupleurum*. They are natives of temperate climates in most parts of the world, and are known by the common name of Hare's-Ear. When eaten by cattle they are supposed to injure them and cause distension of the abdomen; hence the generic name. *B. rotundifolium* is the Thorow-Wax of the herbalists. It has a branched stem, with oval perfoliate leaves, and the fruit with striate interstices. It was supposed to possess especial virtues as a vulnerary, but there is no question now that wounds are better without any such applications. There are three other British species, *B. tenuissimum*, *B. aristatum*, and *B. falcatum*. The species are sometimes cultivated in gardens. The annual species only require to be sown in the open ground early in the spring. The perennial may be increased by dividing their roots; the shrubby by cuttings.

(Don. *Gard. Dict.*; Babington, *Man. of Brit. Bot.*)

BUPRE'STIDÆ, a family of Coleopterous Insects of the section *Pentamera* and sub-section *Sternoxi* (Latreille). The section *Sternoxi* is composed of two great groups or families, *Buprestidæ* and *Elateridæ*: the species of the former group are distinguished from the latter principally in having the tarsi dilated (the penultimate joints of which are bilobed) and furnished beneath with velvet-like pellets; the thorax nearly straight behind, and the mandibles entire, that is, without any notches internally near the apex; and likewise in having the terminal joints of the palpi cylindrical, or nearly so.

The form of the body in the *Buprestidæ* is somewhat ovate, the apex of the elytra being more or less pointed, and the base of the thorax of nearly equal width with that of the elytra; the head is placed almost vertically, and is deeply inserted into the thorax, so that the eyes nearly come in contact with that part.

In splendour of colouring this family of insects surpasses all others among the Beetle Tribe, the *Cetoniadæ* perhaps excepted. Green appears to be the most frequent colour, but shades of blue, red, golden or copper-like hue are not uncommon, and these colours are in most cases brilliant, or as it were burnished.

The *Buprestidæ* are found on the trunks and leaves of trees, and likewise on flowers (on the latter more particularly the smaller species), and when touched, or frequently even when approached, they apply their legs and antennæ close to the body, and allow themselves to fall to the ground, a means of escape frequently practised by insects; they crawl slowly, but in hot sunny weather are frequently on the wing, and fly rapidly.

About 500 species have been discovered belonging to this tribe, which are for the most part from the tropics. In this country about 20 species have been found at large, of these however several have most probably been imported with timber in which their larvæ feed.

The genus *Buprestis*, which is now only restricted to a few of the species of this family, is distinguished principally by the following characters:—Antennæ serrated from the third or fourth joint to the apex; labrum attenuated and slightly emarginated anteriorly; scutellum distinct; body nearly ovate.

The elytra of this genus have been found fossil at Stonesfield.

BUPRESTIS. [BUPRESTIDÆ.]

BURATITE, a mineral consisting of a Carbonate of Copper, Zinc, and Lime, with water. It occurs in bluish radiating needles. It has a specific gravity of 3·2. It is found at Chessy in France, in the Altaï Mountains, and Tuscany.

BURDOCK, the common name for the species of *Arctium*, a genus of plants belonging to the natural order *Compositæ*. This genus is distinguished by its globose involucre, the bracts terminating in hooked points, and imbricated, the flat receptacle with rigid subulate scales; the fruit compressed, oblong; the pappus short, pilose, and distinct. Two species of this genus are common in Great Britain. *A. majus*, the Greater Burdock, is characterised by its large subcorymbose heads and its cordate ovate leaves, the lowermost of which attain a very large size. *A. minus*, the Lesser Burdock, has small heads, which are racemose. The leaves are smaller than in the last species. They were both described as *Arctium Lappa* by Sir J. E. Smith.

BURGEON, or BOURGEON, an obsolete English and modern French name of a Leaf-Bud. [BUD.]

BURMANNIA'CEÆ, *Burmanniads*, the Burmannia Tribe, a natural order of plants belonging to Lindley's group of Epigynous Endogens. It was first constituted by Sprengel as a separate order, and is sometimes made a section of *Amaryllidaceæ*. The species of plants belonging to this order are herbaceous, with tufted radicle, acute leaves, or none at all, with terminal flowers, which are sessile upon a 2- or 3-branched rachis, or solitary. The flowers are hermaphrodite; the perianth tubular, superior, coloured, membranous, with 6 teeth, the 3 inner ones minute, the outer larger, with a wing or keel at the back; the stamens 3, inserted in the tube opposite the petals, with sessile 2-celled anthers opening tran versely with a fleshy connective, and sometimes 3 sterile stamens alternate with them; the ovary inferior or 3-celled, many-seeded, with the dissepiments alternate with the wings of the perianth; the style single; the stigma 3-lobed, petaloid; the capsules covered by the withered perianth, or 3-celled, bursting irregularly; the seeds being numerous, minute, striated with an aril, fleshy albumen, and minute embryo.

The genus *Burmannia*, on which this order has been founded, is variously assigned by different botanists. Jussieu placed it in *Bromeliaceæ*, Brown in *Juncaceæ*, Von Martius in *Hydrocharaceæ*, Blume places it between *Juncaceæ* and *Iridaceæ*, Lindley between *Apostasiaceæ* and *Orchidaceæ*, and there can be little doubt of the propriety of constituting it a distinct order. The species are natives of Asia, Africa, and America. The genera referred to this order are *Burmannia*, *Gonyanthes*, *Gymnosiphon*, *Apteria*, *Dictyostega*, *Cymbocarpa*, and *Stenoptera*. There are about 30 species. They have not very conspicuous properties; the *Apteria setacea* is said by Nuttall to possess tonic and astringent properties. *Burmannia cærulea* is also said to have a flavour very similar to that of green tea.

(Lindley, *Natural System*; Burnett, *Outlines of Botany*.)

BURNET. [SANGUISORBA; POTERIUM.]

BUR-REED. [SPARGANIUM.]

BURSA'RIA, the name of a genus of Polygastric animals, with a membranous body, short, and a little bent upon itself, so as to be concave below and convex above.

Lamarck places *Bursaria* among his *Infusoria*, observing that their body is delicate and membranous, and remarkable by its concave form on one side, which sometimes puts on the appearance of a boat, sometimes of a purse. Their movements are not lively, and it is said that they are irregular, so that when they describe a spiral line from right to left and raise themselves in the water they move with tolerable swiftness; but when they return or descend they only proceed slowly, a difference of velocity attributable to their form. They are abundant in fresh and stagnant waters, and sea-water. There are many species; the most common is *Bursaria truncatella*. It is so large as to be visible to the naked eye, and is found in ditch-water.

According to Ehrenberg, the *Bursariæ*, as well as the *Loxodes*, the *Trachelia*, &c., have an intestinal tube furnished with cæcal appendages which open anteriorly at the inferior surface of the body, and posteriorly at its extremity. The mouth is without cilia or hooks, and there is no ciliary circle on the front. The *Bursariæ* differ besides from the other two genera by the form of the upper lip, which is compressed, subcarinated, or swollen, and not contracted. The body of the *Bursariæ* is for the most part covered with cilia.

Some of the species are found parasitical in other animals. *B. entozoon* and *B. intestinalis*, and others, are found in the rectum of the frog.

BURSATELLA, a genus of Marine *Mollusca* without any traces of a shell, placed by De Blainville under his second family *Aplysiacea* of his third order, *Monopleurobranchiata*, of his *Paracephalophora monoica*. The following is De Blainville's definition of the genus, which, in his arrangement, comes between *Dolabella* and *Notarchus*. Rang thinks it ought to belong to the genus *Aplysia*:—

Body subglobular; below, an oval space circumscribed by thick lips, indicating the foot; above, a symmetrical oval opening with thick lips, formed by the complete junction of the natatory appendages of the mantle, and communicating with a cavity in which are found one very large free gill and the vent. The tentacula are four, divided and ramified, besides two buccal appendages.

Example, *Bursatella Leachii*, which De Blainville says is the only species of the genus. It is large, and a native of the East Indian seas.

Bursatella Leachii.

BURSERA. [BURSERACEÆ.] *Bursera paniculata* yields the *Bois de Colophane.*

BURSERA'CEÆ, a natural order of Exogenous plants, consisting of balsamic, resinous, or gummy plants with pinnated leaves and small hermaphrodite or unisexual polypetalous flowers, with a superior ovary seated in a large circular disk. The fruit is a 2-5-celled drupe, with its rind sometimes splitting into valves. It was formerly included, among other orders, in the *Terebintaceæ* of Jussieu, but it differs from *Amyridaceæ* and *Anacardiaceæ* in its compound fruit. Myrrh, frankincense, olibanum, balsam of Acouchi, gum elemi, balm of Gilead, and opobalsamum, or balsam of Mecca, are all products of different species of the order. In his 'Vegetable Kingdom,' Lindley includes this order under *Amyridaceæ.* [AMYRIDACEÆ.] It forms a section of that order called *Burseridæ.*

BUSH-BUCK. [ANTILOPEÆ.]

BUSTAMITE, a Mexican Mineral consisting of Silica, Manganese, and Lime. It occurs in spherical and reniform masses. It has a hardness of 6 to 6·5, and a specific gravity of 3·2.

BUSTARD, the English name of a Bird belonging to the genus *Otis.* The species are land-birds whose proper position in the ornithological system has caused some embarrassment to zoologists. Temminck places the genus *Otis* under his twelfth order, *Cursores* (Runners), observing that the genera *Struthio, Rhea*, and *Cassuarius* ought to stand at the head of that order. Cuvier arranges the Bustards under the *Pressirostres*, his second family of his fifth order (Échassiers,—*Grallæ*, Linn.) of birds, between the Cassowaries on one side and *Œdicnemus* (Thick-Kneed Bustard or Stone Curlew) on the other. Temminck makes *Cursorius* immediately succeed it, and observes that among the species of that genus the passage between *Otis* and *Cursorius* may be possibly found. It appears that the Bustards partake of the organisation of the Struthious, Gallinaceous, and Wading Birds (Échassiers,—*Grallatores*). *Rhea*, without alluding to the *Dodo* on the Struthious side, *Œdicnemus* on that of the Plovers, and the Turkey on the side of the Gallinaceous birds, make near approaches to the genus under consideration; while the Çariama of Brisson (*Microdactylus* of Geoffrey, *Dicholophus* of Illiger), a South American form, seems to be one of its nearest representatives on the new continent. [ÇARIAMA.] Vigors places the genus in his family *Struthionidæ* (order *Rasores*), which occupies a position between the *Cracidæ* and the *Tetraonidæ*, while it approximates to the *Gruidæ* and *Charadriadæ* in the order *Grallatores;* and, taking all the circumstances into consideration, this seems to be the best arrangement hitherto proposed.

The Bustards live generally in open countries, preferring plains or wide-spreading extensive downs dotted with low bushes and underwood—localities which give them an opportunity of descrying their enemy from afar. They are said to fly but rarely, running from danger with exceeding swiftness, and using their wings like the ostriches to accelerate their course. When they do take wing their flight is low, and they skim along the ground with a sufficiently rapid and sustained flight. Their food consists of vegetables, insects, worms, grain, and seeds. They are polygamous, one male living with many females, which, after fecundation, live solitary. Temminck says that it would seem that they moult twice a year, and that the males in the greatest number of species differ from the females in having extraordinary ornaments, and in possessing a more variegated plumage. He further observes that the young males wear the garb of the female during the first and second year, and adds his suspicion that the males in winter have the same plumage as the females. Cuvier notices their massy port and the slightly arched and vaulted upper mandible of their beak, which, with the little webs or palmations between the bases of their toes, recal the form of the Gallinaceous birds; but he adds that the nudity of the lower part of their legs, all their anatomy, and even the flavour of their flesh, place them among the *Grallatores*, and that, as they have no hind toe, their smallest species approach nearly to the Plovers.

The following is the character of the genus:—

Bill of the length of the head or shorter, straight, conical, compressed, or lightly depressed at the base; point of the upper mandible a little arched (voutée.)

Nostrils oval, open, approximated, distant from the base.

Feet long, naked above the knee; three front toes short, united at their base, bordered by membranes.

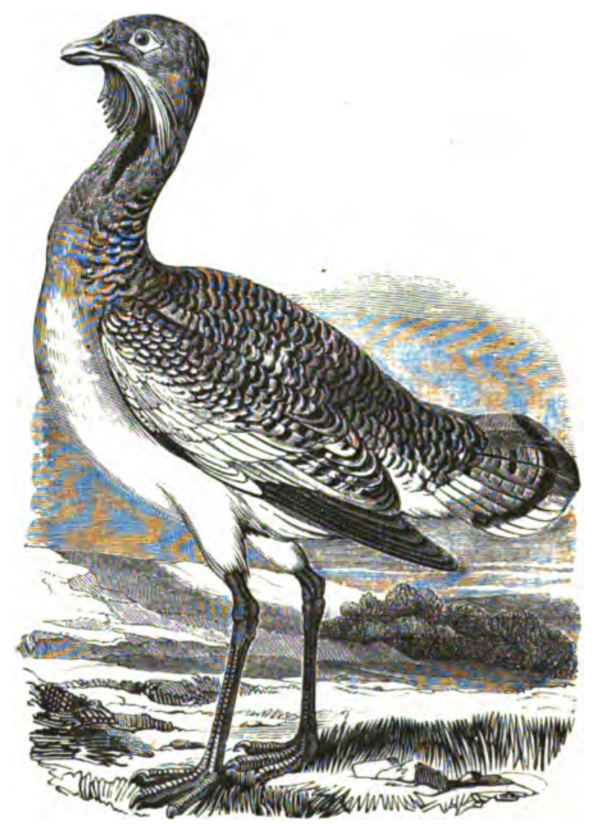
Wings moderate, the third quill longest in each wing.

They are found in Europe, Asia, and Africa; but not in America.

O. tarda, the Great Bustard, is the *Otis* and *Avis tarda* of Bélon and others; Ostarde, Houtarde, Outarde, Bistarde of the French; Starda and Starda Commune of the Italians; Der Grosse Trappe, Trapp, Trappgans, and Ackentrapp of the Germans; Abutarda (*Avis tarda*) of the Spaniards; and Gustard of the old Scotch.

From passages in the 'History of Animals' (ii. 17, vi. 6), there can be scarcely a doubt that our Great Bustard is Aristotle's 'Ωτίς. Indeed the doubts originated in a misunderstood passage in the thirty-third chapter of his ninth book; and it is clear from several authorities that the bird and the quality of its flesh were well known to the Greeks. Pliny evidently alludes to these birds as those "quas Hispania aves tardas appellat, Græcia otidas" ('Nat. Hist.' x. 22); though he blunders about the flesh, telling an absurd story of its effects, which arises from his confounding the ὠτίς with Aristotle's ὠτός, an owl.

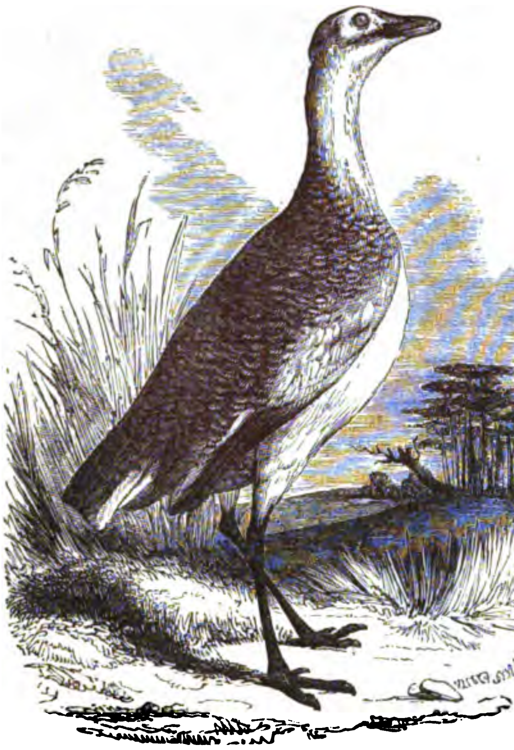
The following is the description of this bird given by Mr. Selby:—The male has the bill strong, grayish-white; the under mandible palest. Head, nape of the neck, and ear-coverts, bluish-gray. A streak of black passes along the crown of the head, reaching to the occiput. Chin-feathers and moustaches composed of long wiry feathers, with



Great Bustard (*Otis tarda*), male.

the barbs disunited and short. Fore part of the neck clothed with a naked bluish-black skin, extending upwards toward the ear-coverts, and covering the gular pouch. Sides of the neck white, tinged with gray; lower part of the neck fine reddish-orange. At the setting on of the neck, or between the shoulders, is a space destitute of feathers, but covered with a soft gray down. Scapulars buff-orange, barred and spotted with black. Back, rump, and tail-coverts, reddish-orange, barred and variegated with black. Greater coverts and some of the secondaries bluish-gray, passing towards the tips into grayish-white. Quills brownish-black, with their shafts white. Tail-feathers white at their bases, passing towards the middle into brownish-orange, with one or two black bars; the tips often white, and, when the feathers are spread laterally, forming a segment of a circle. Upper part of the breast reddish-orange; lower part, belly, and vent, white. Legs black, covered with round scales. Irides reddish-brown. The possession of a gular pouch by these birds, which was first recorded by Dr. Douglass, seems to be a mistake, as Mr. Yarrell in dissecting a male bustard has failed to detect this organ. The average length of a male is 3 feet 3 inches.

The female has the head and forepart of the neck of a deeper gray, and without the moustaches. Back of the lower part of the neck reddish-orange. The other parts of the plumage similar to that of the other sex. Size seldom more than one-third of that of the male.



Great Bustard (*Otis tarda*), female.

The young at a month old are covered with a buff-coloured down, barred upon the back, wings, and sides with black.

With regard to its distribution, Selby says, "It is found in some provinces of France and in parts of Germany and Italy. It is common in Russia and on the extensive plains of Tartary." Temminck states that it inhabits some departments of France, of Italy, and Germany: that it is less abundant towards the north than in the south; and that it is very rarely and accidentally found in Holland. Graves relates that the species is dispersed over the southern parts of Europe, and the more temperate parts of Africa, and is very abundant in some parts of Spain and Portugal. In our own islands the increase of population and civilisation, followed by greater demands on the land, and consequently by an extension of cultivated surface, have so reduced the Bustards, that unless care be taken to preserve the few which remain, they will soon be numbered among the other extinct species of our Fauna. The following are notices of the old British localities of these noble birds. "They are called," says Willughby, "by the Scots *Gustardæ*, as Hector Boëthius witnesseth in these words:—In March, a province of Scotland, are birds bred, called in the vulgar dialect *Gustardes*, the colour of whose feathers and their flesh is not unlike the partridges, but the bulk of their body exceeds the swans." The editor of the last edition of Pennant states that in Sir Robert Sibbald's time, they were found in the Mers, but that he believes that they are now extinct in Scotland. Willughby also says (1678), "On Newmarket and Royston Heaths, in Cambridgeshire and Suffolk, and elsewhere, in wastes and plains they are found with us." Ray (1713) thus writes:—"In campis spatiosis circa Novum Mercatum (Newmarket) et Royston, oppida in agro Cantabrigiensi, inque planitie, ut audio, Salisburiensi, et alibi in vastis et apertis locis, invenitur." In Brookes's 'Ornithology' (1761) the following passage occurs:—"This bird (the bustard) is bred in several parts of Europe, and particularly in England, especially on Salisbury Plain, Newmarket and Royston Heaths, in Cambridgeshire and Suffolk; for it delights in large open places. The flesh is in high esteem, and perhaps the more so because it is not very easy to come at." Pennant says, "These birds inhabit most of the open countries of the south and east parts of this island from Dorsetshire as far as the Wolds in Yorkshire."

The editor of the last edition (1812) observes that "the breed is now nearly extirpated, except on the Downs of Wiltshire, where it is also very scarce." The figure of the male bird given by Graves is said to have been drawn from one taken alive on Salisbury Plain in 1797. Montagu in his 'Dictionary' (1802) says that in this locality it had become very rare from the great price given for the eggs and young to hatch and rear in confinement. In his 'Supplement' (1813) he states that not one had been seen there for two or three years previous. Graves says that, in the spring of 1814, he saw five birds on the extensive plains between Thetford and Brandon, in Norfolk, from which neighbourhood in 1819 he received a single egg, which had been found in a large warren. In the autumn of 1819, he adds, a large male bird which had been surprised by a dog on Newmarket Heath, was sold in Leadenhall Market for five guineas; and in the same year, he continues, a female was captured under similar circumstances on one of the moors in Yorkshire. When the mania for real British specimens of birds was prevalent, the bustards suffered not a little. We know a collector who, about the year 1816, had nine dead bustards before him together: they came from Norfolk. In 1830 a young male was shot on Shelford Common, in Cambridgeshire, and in 1832 a specimen was killed at Caxton in the same county. In 1843 one was shot in Cornwall on an open plain between Helston and the Lizard Point. It is very certain, from these notices, that this bird is becoming every day more rare in England, and will probably soon be wholly absent from its Fauna.

With regard to its food Willughby says that the Bustard feeds upon corn, seeds of herbs, colewort, dandelion leaves, &c. In the stomach of one which he dissected he found a great quantity of hemlock-seed, with three or four grains of barley, and that in harvest time. Brookes states that they feed upon frogs, mice, small birds, and different kinds of insects. Pennant makes their food to consist of corn and other vegetables, and those large earth-worms that appear on the Downs before sun-rising in the summer. Montagu states it to be green corn, the tops of turnips, and various other vegetables, as well as worms; but adds, that they have been known to eat frogs, mice, and young birds of the smaller kind, which they can swallow whole. Turnip-tops are certainly a favourite article of diet with these birds; and we believe that the nine bustards above mentioned owed their fate to their fondness for this vegetable—being laid in wait for at their feeding-time. Temminck says that their nourishment consists very much of insects and worms, and also of grain and seeds.

The eggs of the Bustard, two in number generally, sometimes three, are laid upon the bare ground, which is often a little hollowed out by the female (occasionally, says Selby, among clover, but more frequently in corn-fields), early in the spring. They rather exceed those of a turkey in size, and their colour is a yellowish-brown, inclining to oil-green, with slight darker variations. Time of incubation four weeks. The young as soon as hatched follow the parent, but are incapable of flight for a long time.

The extreme rapidity of their running, and the unwillingness to rise on the wing exhibited by these birds, have been the theme of most ornithologists. We have also many accounts of their being coursed with dogs. The following is from Brookes:—"There are also bustards in France which frequent large open plains, particularly near Chalons, where in the winter time there are great numbers of them seen together. There is always one placed as a sentinel, at some distance from the flock, which gives notice to the rest of any danger. They raise themselves from the ground with great difficulty; for they run sometimes a good way, beating their wings before they fly. They take them with a hook baited with an apple or flesh. Sometimes fowlers shoot them as they lie concealed behind some eminence, or on a load of straw; others take them with greyhounds, which often catch them before they are able to rise." Selby, who has evidently had good opportunities of observation, thus writes in his 'Illustrations':—"Although, in a state of confinement, the bustard becomes tolerably tame to those who are in the habit of attending it, yet it displays at all times considerable ferocity towards strangers; and all attempts to continue the breed in that state have been without success. With respect to its habits in the wild state, it is so shy as seldom to be approached within gun-shot; invariably selecting the centre of the largest inclosure, where it walks slowly about, or stands with the head reposing backwards upon the bare part of its neck, and frequently with one leg drawn up. Upon being disturbed, so far from running in preference to flight (as has been often described), it rises upon the wing with great facility, and flies with much strength and swiftness, usually to another haunt, which will sometimes be at the distance of six or seven miles. It has also been said that in former days when the species was of common occurrence, it was a practice to run the young birds (before they were able to fly) with greyhounds. So far from this possibility existing with the present remnant of the breed, the young birds upon being alarmed constantly squat close to the ground, in the same manner as the young of the lapwing, golden plover, &c., and in that position are frequently taken by hand; indeed this is even the habit of the female during incubation." Selby's remarks on its powers of flying are corroborated by the 'Booke of Falconrie or Hawking' (1611), where, under the head of 'Other flights to the fielde called great flights,' at p. 83, we find it thus written:—"There is yet another kind of flight to the fielde, called the great flight, as to the cranes, wild geese, bustard, bird of paradise, bittors, shovelars, hearons, and many other such like, and these you may flee from the fist, which is properly tearmed the source. Neverthelesse, in this kind of hawking, which is called the Great Flight, the falcons or other hawkes cannot well accomplish their flight at the cranes, bustard, or such like, unlesse they have the helpe of some spaniell, or such dogge, wel inured and taught for that purpose with your hawke. Forasmuch as great flights require pleasant ayde and assistance, yea and that with great diligence." As an article of food the flesh of the bustard is held in great estimation. It is dark in colour, short in fibre, but sweet and well-flavoured.

O. tetrax, the Little Bustard, is only an accidental winter visitor in Great Britain. Specimens have been killed in various parts of our coast. It is frequent in the southern and south-western parts of Russia. It is common in France, and also found in Spain, Provence, Sardinia, Italy, and Sicily. It is also an inhabitant of North Africa, Turkey, and Greece.

O. nigriceps is a native of Asia. The specimen from which the figure in Mr. Gould's magnificent work ('Century of Birds from the Himalaya Mountains') was taken was brought from the highlands of the Himalaya, but it is by no means confined to that locality. Colonel Sykes observed it in the wide and open country of the Mahrattas, where it lives in large flocks, and where it is considered one of the greatest delicacies as an article of food. It is indeed so abundant in the Deccan, that Colonel Sykes records, in the 'Proceedings of the Zoological Society,' that one gentleman shot nearly a thousand.

The male has the body above pale bay, lightly undulated with rufous-brown; neck, a few spots on the wings, and belly, white; the head, which is crested, the outer wing-coverts, the quills, and the large mark on the breast, black; irides deep-brown; bill and feet yellowish. Length, inclusive of tail, 56½ inches; tail, 13½ inches.

Otis nigriceps, male.

The female resembles the male in plumage, but is only 41½ inches including the tail, which is 10½ inches.

The eggs, of which Colonel Sykes found only one in a hole in the earth on the open plain and that considerably advanced in the process of incubation, were in shape a perfect oval, and in colour a brown-olive, with obscure blotches of darker brown-olive. Length 3$\frac{1}{10}$ inches, diameter 2$\frac{1}{10}$ inches.

O. cærulescens is an inhabitant of Africa. The summit of the head is marked with black and reddish zig-zags, straight and nearly approximated. Above the eyes extends a large whitish band, punctured as it were with brown; plumes near the ear-opening of a clear ruddy colour. Under the neck a demi-circular band of pure white; and below another twice as large, of deep black. Front of the neck, breast, and all the other lower parts of a lead-colour. All the upper parts of the body of a reddish or yellowish brown, marked with black zig-zags and dots very nearly together. Lower coverts of the wings and tail-feathers unspotted, ruddy. End of the tail black, tinged with brown. Quills black. Feet yellowish-green. Bill brown, yellow at the base. Length 20 inches; height, when erect, 17 inches 6 lines.

Le Vaillant discovered this species in the interior of South Africa, inhabiting the Kaffir country and some parts of the colony of the Cape of Good Hope. Temminck, from whom the description and figure are taken, says that he is ignorant whether the female differs in plumage from the male, of which latter sex were the two individuals he had seen. There are specimens in the museums of Paris and of the Netherlands.

Otis cærulescens, male.

O. Denhami, the African Bustard met with by Major Denham near the larger towns, did not occur in any great abundance. It frequented moist places where the herbage was pure and fresh, and where it was taken in snares by the natives for food. It was almost invariably seen singly, Major Denham never having observed a pair together more than once. It was always found in company with gazelles: whenever a bustard was observed it was certain that the gazelles were not far distant. Major Denham praises its large and brilliant eye. The Arabs are accustomed to compare the eyes of their most beautiful women to those of the Oubara, which seems to be a general name for the bustards in Africa. Gmelin has given the title as a specific distinction to an African bustard smaller than Major Denham's, which is 3 feet 9 inches in length. But this is small in comparison with the Kori Bustard (*Otis Kori*) discovered by Mr. Burchell in South Africa, for that stood upwards of 5 feet high, and may be considered the most gigantic development of the form hitherto observed.

Burchell, in his Travels in the interior of Southern Africa, gives the following account of his becoming possessed of this noble Bustard on the banks of the Orange River:—"We shot a large bird of the bustard kind, which was called Wilde Paauw (Wild Peacock). This name is here very wrongly applied, as the bird to which it properly belongs differs from this in every respect. There are indeed three, or perhaps four, birds to which in different districts this appellation is given. The present species, which is called Kori in the Sichuana language, measured in extent of wing not less than 7 feet, and in bulk and weight was almost greater than some of the people could manage. The under part of the body was white, but the upper part was covered with fine lines of black on a light chestnut-coloured ground. The tail and quill-feathers partook of the general colouring of the back; the shoulders were marked with large blotches of black and white, and the top of the head was black; the feathers of the occiput were elongated into a crest; those of the neck were also elongated, loose, narrow, and pointed, and were of a whitish colour marked with numerous transverse lines of black. The irides were of a beautiful,

Head of Kori Bustard (*Otis Kori*).

pellucid, changeable, silvery, ferrugineous colour. A representation of the head of the Kori Bustard is given at the end of the chapter. Its body was so thickly protected by feathers that our largest sized shot made no impression, and taught by experience the hunters never fire at it but with a bullet. It is reckoned the best of the winged game in the country, not only on account of its size but because it is always found to abound in fat. The meat of it is not unlike that of a turkey, but is certainly superior as possessing the flavour of game."

BUTCHER-BIRD. [LANIADÆ.]

BUTCHER'S-BROOM. [RUSCUS.]

BU'TEA, a genus of plants belonging to the natural order *Leguminosæ*, named after John, Earl of Bute, a great patron of botanists. It has a campanulate calyx, 5-toothed, the two superior teeth approximate and almost connected; the corolla with a lanceolate spreading vexillum; keel incurved, equal in length to wings and vexillum; the stamens diadelphous; the legume stipitate, compressed, flat, membranous, indehiscent, 1-seeded at the apex; the seed large, compressed. The species are natives of the East Indies. They are unarmed trees, with pinnately trifoliate leaves, with racemes of deep scarlet flowers.

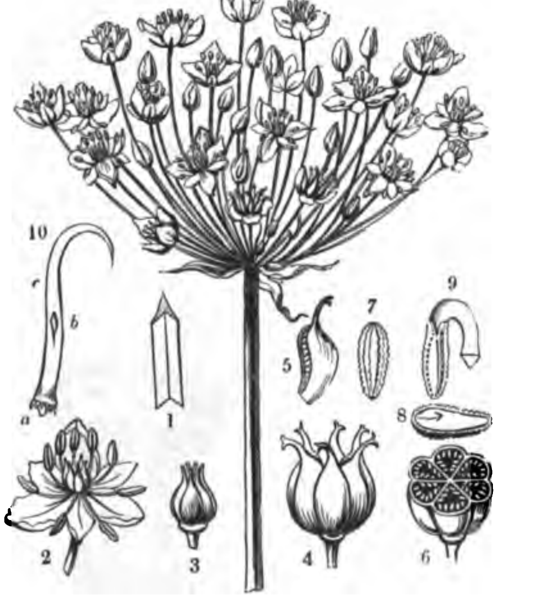
B. frondosa has pubescent branches; roundish obtuse or emarginate leaflets, velvety beneath; the corolla four times the length of the calyx; the calycine teeth rather acute. It is a native of mountainous districts in Hindustan. A red juice flows from this tree, which when evaporated is found to consist principally of tannin, and is brought into the market under the name of East Indian Kino. The juice of the common flowers, which in this species are two inches long, gives to water a bright yellow colour similar to gamboge. This property is also possessed by the dried petals. "The lac insects are frequently found upon the smaller branches of the tree, but whether the natural juices of its bark contribute to improve their red colouring matter has not been determined." (G. Don.)

B. superba has glabrous branches; roundish ovate obtuse leaflets, velvety beneath; the corolla four times the length of the calyx; calyx-teeth acute. It grows on the mountains of Coromandel. It resembles the last species, but is larger in all its parts. It yields the same kind of juice. There are two other species described.

(G. Don, *Gardener's Dictionary;* Lindley, *Vegetable Kingdom.*)

BUTEO, a genus of Birds belonging to the order *Raptores* and the family *Falconidæ*. It includes, according to Yarrell, two British species, *B. vulgaris*, the Common Buzzard, and *B. lagopus*, the Rough-Legged Buzzard. [FALCONIDÆ.] Various other species of the *Falconidæ* have been included under this generic name. (Yarrell, *British Birds.*)

BUTOMA'CEÆ, *Butomads*, the Butomus Tribe, a natural order of Endogens, the type of which is the *Butomus umbellatus*, a common



Flowering Rush (*Butomus umbellatus*).

1, A section of a portion of a leaf; 2, an entire flower; 3, the carpels; 4, the ripe fruit; 5, a separate carpel; 6, a transverse section, showing how the whole lining of the ripe carpels is covered with seeds; 7, a seed much magnified; 8, a longitudinal section of the same; 9, a seed germinating; 10, the same in a more advanced state; *c*, the cotyledon; *b*, the plumule sprouting; *a*, the radicle just bursting through its integuments. (N.B. This offers an illustration of the endorhizal mode of germination.)

water-plant of this country. It is vulgarly called the Flowering Rush, and is accounted the handsomest herbaceous plant of the British Flora. *Butomaceæ* are briefly characterised by being Tripetaloideous Endogens (that is, with three sepals distinct in size and colour from the three petals), with several carpels, the whole lining of which is covered with seeds. This simple circumstance cuts them off from *Alismaceæ*, with which they were once associated, and also distinguishes them from all other monocotyledonous orders. The order is a very small one, not containing more than three known genera, and about half a dozen species, natives of equinoctial America, exclusive of the *Butomus umbellatus* of England, and another species of the same genus occurring in Nepal.

Butomus umbellatus is a rush-like plant with three-cornered sword-shaped leaves, and umbels of handsome rose-coloured flowers, containing nine stamens, a peculiarity by which it is immediately recognised among other wild flowers. The roots of it are regarded in Russia as a specific in hydrophobia; but experiments made with them in this country have not confirmed the accounts of their influence in this utterly incurable disease recorded by the Russian physicians.

BUTT, a name for the Flounder. [PLEURONECTIDÆ.]

BUTTER-BUR. [PETASITES.]

BUTTER-FISH. [MURÆNOIDES.]

BUTTERFLY. [LEPIDOPTERA.]

BUTTERFLY-FISH. [BLENNIUS.]

BUTTERFLY-ORCHIS. [PLATANTHERA; HABENARIA.]

BUTTERFLY-PLANT. [ONCIDIUM.]

BUTTERFLY-WEED, a name given in the United States to the *Asclepias tuberosa*. [ASCLEPIAS.]

BUTTERS, VEGETABLE, the name given to the concrete oil of certain vegetables, from its resemblance to the butter obtained from the milk of animals, and from being employed for similar purposes. The term is also occasionally, but improperly, applied to some vegetable products which are entirely of a waxy nature, such as the wax of the *Myrica cerifera*. The name is likewise bestowed in Siberia on certain algæ, species of the genus *Nostoc*, such as *N. pruniforme*. The most important Vegetable Butters are produced by the *Bassia butyracea* and other species of that genus (*Bassia*) and certain palms, such as the *Cocos butyracea* and the *Elais Guineensis;* the former of which is of great utility to the inhabitants of Brazil, where it grows naturally, and to the negroes of St. Domingo, where it is cultivated; while the latter is very serviceable to the natives of Guinea.

(*Library of Entertaining Knowledge—Vegetable Substances, Materials of Manufacture*, p. 221.)

BUTTER-TREE. [BASSIA.]

BUTTERWORT. [PINGUICULA.]

BUXBAUMIA, a genus of plants belonging to the natural order of Mosses. It was named in honour of J. C. Buxbaum, a German botanist, and author of a catalogue of plants of the environs of Halle, and who first detected this moss in Russia. *Buxbaumia* has an oblique gibbous capsule; a double peristome, the outer consisting of numerous filiform erect jointless teeth, the inner a plaited membranous cone; a minute mitriform calyptra. There is but one species of this singular genus, the *B. aphylla*. This plant is destitute of apparent leaves, and looks more like a fungus than a moss. The ascending axis of the plant is in fact reduced to a little conical bulb, which is clothed with minute scales, and these Mr. Robert Brown pointed out as its leaves. From the bulb arises a red tuberculated seta bearing the reproductive organs, which is about an inch high. It is a very rare plant. It was first discovered in Great Britain at Sproughton near Norwich. It has also been found in three or four localities in Scotland. (Smith's *English Flora*, vol. v.)

BUXUS, the genus of plants whose species afford the valuable hard wood called Box. It is remarkable botanically as being the most northern arborescent plant of the natural order *Euphorbiaceæ*, all the other trees of which are confined to mild or tropical climates. Its essential character is to have both the male and female flowers upon the same individual; a 3- or 4-parted calyx; in the males a 2-lobed scale and 4 stamens placed round the rudiment of an ovary; in the females 3 small scales, 3 styles, 3 blunt stigmas, and a 3-horned 3-celled 6-seeded capsular fruit.

The only two certain species are *B. sempervirens* and *B. Balearica*. The former, or common Box, forms a large evergreen bush or small tree, common all over the south of Europe, from Spain to Constantinople, and reaching even so far as the north of Persia. In this country it is only found on warm chalky hills. Many varieties are known in gardens, the most remarkable of which is the Dwarf-Box, so much used for the edgings of walks. Between this and the arborescent form the difference is so great, that one wonders how they can be both the same species, and Miller and others have even considered them distinct. But De Candolle states that the wild plant in France is very variable in size, rising in some places to the height of 15 or 20 feet, and in rocky localities not exceeding 3 feet. It is from the arborescent *Buxus sempervirens* that box-wood is obtained. For the turner, for mathematical instruments, and especially for the uses of the wood engraver, it is invaluable. The French employ it for coat-buttons &c. "The value of the box-wood sent from Spain to Paris is reported to amount to about 10,000 francs a year. In 1815, the box-trees cut down on Box-Hill, near Dorking in Surrey, produced upwards of 10,000*l.*" (Macculloch, 'Dictionary of Commerce.') Great quantities are imported from Turkey, and of fine quality. The leaves have been employed, medicinally, as a tonic, a substitute for Peruvian bark.

Buxus Balearica, the Majorca Box, is a handsomer plant than the other, with broader leaves, and a more rapid growth; but it is much more impatient of cold. Plants of it however live in the neighbourhood of London without protection. It is found wild in the neighbourhood of Lluch in Majorca, on the hills, at the height of 1500 feet; and it also occurs abundantly on Mount Galatzo, where it is mingled with the palmetto, but not in great masses. We find nothing in books concerning the quality of its wood; but there is reason to suppose that a part at least of the Spanish and Turkey box-wood is furnished by this species.

BUZZARD. [FALCONIDÆ.]

BYRRHUS, a genus of Coleopterous Insects, instituted by Linnæus, belonging to the family of *Byrrhidæ* as defined by Leach. The Beetles composing it are more or less globose, very convex, and sericeous; the club of their antennæ is 5-jointed, and is gradually thickened to the extremity. The elytra cover the body, and the animal can so contract its legs as to pack them in cavities adapted for their reception on the under side of the body. This it does when alarmed, simulating death. The larva of the common species, the *Byrrhus pilula*, popularly known as the Pill-Beetle, is of an elongate form, narrow, with a large head, the dorsal plate of the first segment large, and the two terminal segments larger than the others. Seven British species of *Byrrhus* are enumerated by Mr. Stephens in his 'Systematic Catalogue of British Insects.' (Westwood, *Introduction to Entomology*.)

BYRSONIMA, a genus of plants belonging to the natural order *Malpighiaceæ*. The bark of the species is astringent, and is used extensively for tanning in the Brazils. The wood of some of the species, especially *B. verbascifolia*, is of a bright red. The bark of *B. crassifolia* is used in fevers. *B. crassifolia* is one of the thousand remedies for rattlesnake bites. It is called Chapera Manteca. The Alcornoco Bark is the produce of *B. laurifolia*, *B. rhopalæfolia*, and *B. coccolobæfolia*. The acid and astringent berries of *B. spicata* are said to be good in dysentery. (Lindley, *Vegetable Kingdom*.)

BYSSA'CEÆ, a tribe of Cryptogamic Plants, raised by some botanists to the importance of a distinct order, whilst others refer it either to the Lichens or the *Fungi*, or distribute its genera amongst the various orders of *Cryptogamia*. Fries places this group of plants in the natural order of Lichens, with the following definition:—"Aerial, perennial, constantly growing, with a filamentous texture, consisting of solid fibres (either few, or several glued together, with a common bark), unchanged and permanent. Fructification homogeneous, growing externally and naked." Many of the species of plants referred to this order are of a very doubtful nature, and particular states of decaying vegetable and animal matter have undoubtedly been described as plants, and placed amongst them. These forms of matter, whatever they may be, are not less interesting to the naturalist than if they came under his definition of a plant.

The genus *Rhizomorpha* [RHIZOMORPHA] is referred by most botanists to *Byssaceæ*. Some authors have doubted their specific vegetable character. The various forms are found on decaying wood, and in mines, pits, and dark places. In the coal-mines of Dresden they form objects of great interest on account of their phosphorescence. Mr. Erdmann, quoted by Burnett in his 'Outlines of Botany,' gives the following account of this phenomenon in one of the Dresden mines:—"I saw," he says, "the luminous plants here in wonderful beauty; the impression produced by the spectacle I shall never forget. It appeared, on descending into the mine, as if we were entering an enchanted castle. The abundance of these plants was so great that the roof and walls and the pillars were entirely covered with them, and the beautiful light they cast around almost dazzled the eye. The light they give out is like faint moonshine, so that two persons near each other could readily distinguish their bodies. The lights appear to be most considerable when the temperature of the mines is comparatively high." One of the species, *Rhizomorpha cinchonarum*, is found on the cinchona barks of commerce, and is a sure indication of their worthless state. Another species of *Byssaceæ*, *Himantia cinchonarum* of Fée, is an evidence of the subputrescent state of the barks on which it is found. *Racodium* is a genus referred by Fries to this group of plants. The *R. cellare* is a common plant in wine-cellars, where it forms a kind of tapestry on the walls and roofs, investing the casks and bottles with a tunic resembling in colour and appearance the skin of a mouse. *Hypochnus* is a genus found on the decaying bark of trees. When found on barks used for medicinal purposes, they should be rejected as unfit for use, as this plant indicates incipient decay.

The genera *Monilia* and *Aspergillus* are sometimes referred to *Byssaceæ*. The species of these genera, with many others, form what is known by the name of Mould on various substances. [MOULDINESS.] *Monilia penicillata* is commonly found on plants in herbaria. The various forms of *Aspergillus* are found on all kinds of decaying substances. *A. glaucus* is the blue-mould which forms on cheese, lard, bread, &c. It gives a value to cheese, and its colour is often imitated by fraudulent dealers by sticking brass pins into the cheese, the verdigris formed from the pins giving it the colour of mould.

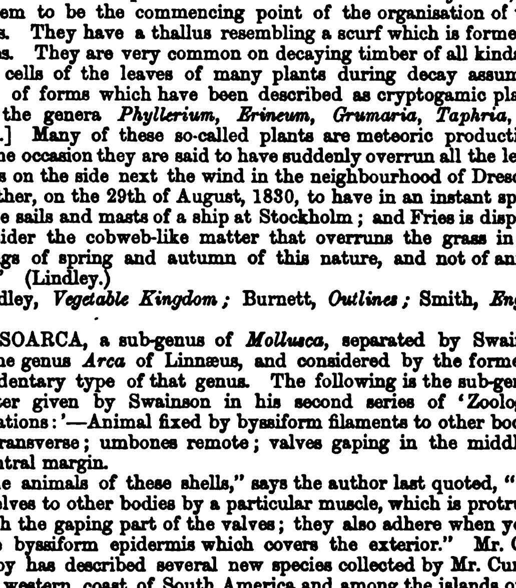
Most of the species of the old genus *Byssus* are distributed amongst other genera. *B. Iolithus*, the Violet-Scented Byssus, is found of a deep red colour on boarded buildings, old pales, and trunks of trees, on rocks in mountainous countries, and on walls. It is now called *Lepraria Iolithus*. It is not less remarkable for its violet scent than its red colour. [SNOW, RED.] There is another plant, *Chroolepus Iolithus*, which was included under the *Byssus Iolithus* of older writers. *Byssus Cryptarum* forms the genus *Tophora* of recent writers. Several species of *Tophora* have been named. They do not however produce spores, and by some they are supposed to arise from the germination of the spores of ferns and mosses arrested in the rudimental state. The *Leprariæ* are sometimes referred to *Byssaceæ*, but they seem to be the commencing point of the organisation of true Lichens. They have a thallus resembling a scurf which is formed of sporules. They are very common on decaying timber of all kinds.

The cells of the leaves of many plants during decay assume a variety of forms which have been described as cryptogamic plants, under the genera *Phyllerium*, *Erineum*, *Grumaria*, *Taphria*, &c. [FUNGI.] Many of these so-called plants are meteoric productions. "On one occasion they are said to have suddenly overrun all the leaves of pines on the side next the wind in the neighbourhood of Dresden; on another, on the 29th of August, 1830, to have in an instant spread over the sails and masts of a ship at Stockholm; and Fries is disposed to consider the cobweb-like matter that overruns the grass in the mornings of spring and autumn of this nature, and not of animal origin." (Lindley.)

(Lindley, *Vegetable Kingdom*; Burnett, *Outlines*; Smith, *English Flora*.)

BYSSOARCA, a sub-genus of *Mollusca*, separated by Swainson from the genus *Arca* of Linnæus, and considered by the former as the sedentary type of that genus. The following is the sub-generic character given by Swainson in his second series of 'Zoological Illustrations:'—Animal fixed by byssiform filaments to other bodies; shell transverse; umbones remote; valves gaping in the middle of the ventral margin.

"The animals of these shells," says the author last quoted, "affix themselves to other bodies by a particular muscle, which is protruded through the gaping part of the valves; they also adhere when young by the byssiform epidermis which covers the exterior." Mr. G. B. Sowerby has described several new species collected by Mr. Cuming on the western coast of South America and among the islands of the South Pacific Ocean, in the 'Proceedings of the Zoological Society of London' for 1853. *Byssoarca* has been found moored to stones and shells at depths varying from the surface to 75 fathoms.



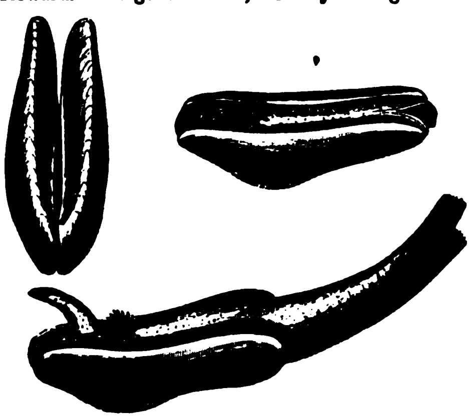
Byssoarca Noæ.

1, Valves closed; 2, valves closed, view of the hinge area; 3, a single valve, showing the hinge teeth and the interior of the valve; *a*, umbones; *b*, part of the ventral margin where the valves gape, to give room for the extrusion of the tendinous foot.

BYSSOMYA, a genus of Conchiferous Mollusks, separated by Cuvier and placed by him under his Acephalous *Testacea*, between *Pandora* and *Hiatella*. De Blainville, who approves of Cuvier's separation, observing that, though the shell differs little from *Saxicava*, the animal is very distinct, arranges it in his family of *Pyloridea*, between *Saxicava* and *Rhomboides*.

Generic Character.—Animal more or less elongated, subcylindrical, elongated behind by a long tube, which is bifurcated at its extremity only. A hole at the lower and anterior part of the mantle for the passage of a small conical canaliculated foot, and of a byssus situated at its posterior base. Two strong adductor muscles.

Shell often irregular, covered with a strong epidermis, oblong, strongly striated longitudinally, equivalve, very inequilateral, obtuse and wider before, and attenuated or rostrated as it were behind. Umbones but little developed, though distinct and a little curved forward. Hinge toothless, or only having a rudiment of teeth under the corselet. External ligament rather long. Two strong, distant, and rounded muscular impressions.



Byssomya pholadis.

Example, *Byssomya pholadis*, *Saxicava pholadis* of Lamarck. The species inhabits the northern seas, living in the fissures of rocks in company with *Mytili* (Mussels), and attached by its byssus; but sometimes it buries itself in the sand or lodges in small stones, the roots of *Fuci*, and even in the polymorphous *Millepora*: in the latter cases, according to O. Fabricius, it is without byssus.

Forbes and Hanley, in the 'History of British Mollusca,' refer *B. pholadis* of Bowdich and the *S. pholadis* of Lamarck as synonymous to *Saxicava rugosa*. [SAXICAVA.]

BYSSUS, the name of a long, delicate, lustrous, and silky fasciculus of filaments, by which some of the conchiferous mollusks (the *Mytilacea*, Mussels, and *Malleacea*, Hammer Oysters, for example) are moored to submarine rocks, &c. This is not, as some authors have stated, a secretion spun by the animal, but, according to De Blainville, an assemblage of muscular fibres dried up in one part of their extent, still contractile and in a living state at their origin, a condition which they enjoyed throughout their whole length at the period of their attachment. The tendinous foot of *Byssoarca* and *Tridacna* seems to be a step towards the organisation of a true byssus. In the great *Pinna* of the Mediterranean this substance is well and largely developed, and its situation is in a fleshy sac or sheath at the base of the foot, which is attached towards the middle of the abdominal mass of the animal. In Italy the byssus is manufactured into various articles; and there are few museums without a glove or a stocking woven out of this substance. In the Great Exhibition of 1851 a large number of articles were exhibited manufactured from this substance, as well as specimens of the silk for making up.

BYTTNERIA'CEÆ, *Byttneriads*, the Byttneria Tribe, a group of plants by some botanists considered a distinct natural order, by others reduced to a section of *Sterculiaceæ*. They belong to Lindley's Malval alliance of Exogens, and are readily known by their petals being bagged at the base, their stamens partly sterile and petaloid, and their fruit covered with hooked spiny hairs. From *Sterculiaceæ* proper they differ by the presence of petals, and their stamens not being united into a column; from *Malvaceæ* by their 2-celled anthers and bagged petals; and from *Lasiopetaleæ* by their calyx not being coloured like a corolla, and their petals not rudimentary. The species are chiefly inhabitants of tropical countries. They partake of the mucilaginous inert properties of *Malvaceæ*. Their bark often yields a tough fibre fit for manufacture into cordage; and one species, *Theobroma Cacao* [THEOBROMA], produces the seeds from which the buttery and somewhat bitter substance called cocoa is obtained, and which forms the basis of chocolate.

Byttneria inodora.

1, A complete flower seen from above; the outer pentagon is the calyx, the auricled bodies are petals, and the five-rayed centre represents the five sterile stamens; 2, the calyx cut open, with the stamens attached to it; 3, a longitudinal section of a flower, showing the origin of the petals; 4, a petal; 5, a calyx seen from above, with the young fruit cut transversely, and the hocked hairs with which it is covered projecting from its sides; 6, a stamen; 7, the ovary.

The fruit of *Guazuma ulmifolia* is eaten by the Brazilians. Many of the species yield fibres which might be manufactured into cordage, as *Microlæna spectabilis* and *Abroma augustum*. [ABROMA.] In Madagascar the bark of *Dombeya spectabilis* is made into ropes. [DOMBEYA.]

BYTTNERIADS. [BYTTNERIACEÆ.]

C

CABBAGE. [BRASSICA.]

CABBAGE, BRAZIL. [CALADIUM.]

CABBAGE PALM. [ARECA.]

CABOTZ, a name for the Cusso or Kousso. [BRAYERA.]

CACHALOT. [CETACEA.]

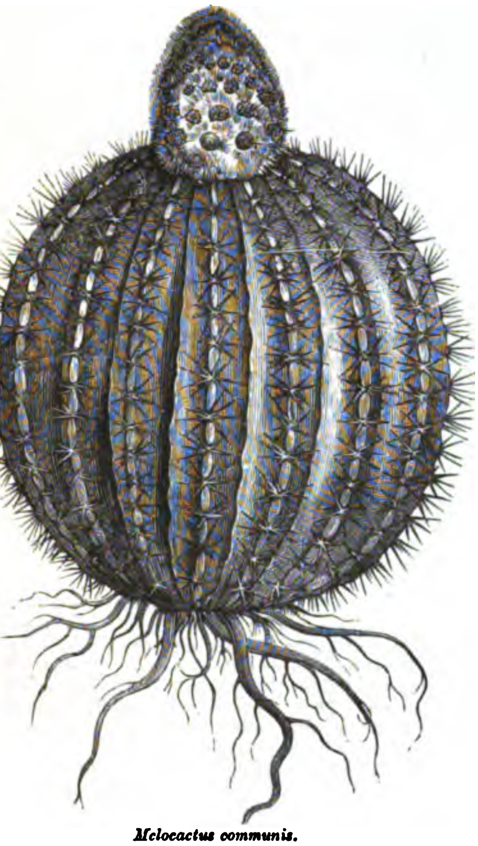
CACHOLONG. [OPAL.]

CACTACEÆ, or CACTEÆ, Indian Figs, the Cactus Tribe, a natural order of Exogenous plants.

The fructification of these plants consists of a calyx adhering to the ovary, with a border divided into an uncertain number of segments, which are arranged in several rows, the one overlapping the other, and the innermost gradually ceasing to be green and leafy, but acquiring the delicacy and colour of petals. The latter usually pass into sepals by insensible gradations, are very numerous, and often brilliantly coloured. The stamens originate in the orifice of the tube formed by the combination of the petals and sepals, are very numerous, and consist of delicate thread-shaped filaments terminated by small roundish anthers. The ovary, which, in consequence of its adhesion to the sepals, seems to occupy the place of the stalk of the flower, consists of a single cell lined with parietal placentæ covered over with minute ovules; its style is slender; the stigma is star-shaped and divided into as many narrow lobes as the ovary contains placentæ. The fruit is a succulent berry, marked at the end by a broad scar formed by the separation of the limb of the calyx: it contains a great quantity of seeds, which consist of nothing but a skin containing a succulent embryo slightly two-lobed at the upper end.

In natural affinity these plants have been considered allied to the Gooseberry Tribe (*Grossulaceæ*) on account of the great similarity in the structure of their fruit, and in the general production of spines upon their branches. Their relationship is probably far greater with *Mesembryaceæ* and the other epigynous orders of polypetalous dicotyledons.

The habit of *Cactaceæ* is remarkable. They have a very succulent stem in which the woody system is developed in but a small proportion compared to the whole mass. Usually the stem is angular or deeply channeled, occasionally it is destitute of both angles and channels, but in that case is mostly either much compressed as in *Opuntia*, or leafy as in *Epiphyllum*. Sometimes it is continuous from the base to the apex, but in many instances it is divided off into regular joints, each of which has a similar form varying with the species: in these instances however it is worthy of remark that as the stems advance in age the angles fill up, or the articulations disappear in consequence of the slow growth of the woody axis and the gradual development of the cellular substance; so that "at the end of a number of years, which vary according to the species, all the branches of *Cactaceæ*, however angular or compressed they originally may have been, become trunks that are either perfectly cylindrical or which have scarcely any visible angles. This metamorphosis is one of the causes which render it so difficult to identify species that have been described in their native localities from full-grown specimens with such as are cultivated in the gardens of Europe." The greater part of the species have stems which are more or less elongated, but in some they are spherical, as in the whole genera *Melocactus* and *Echinocactus*. Whatever may be the form of the stem, they usually bear upon their surface little tubercles which at an early age lose the leaves. Those organs however rapidly fall away, and are succeeded by tufts of hairs or spines hooked backward at the ends, and then the species have the appearance of being perfectly leafless.



Melocactus communis.

All the species are believed to be natives of America, whence however some of the Opuntias have been so long introduced to the Old World that they have here and there taken possession of the soil, and appear like aboriginal inhabitants. Such is the case on the volcanic soil of Ætna, and in various places on the shores of the Mediterranean; and this has led to the erroneous idea entertained by Sprengel and others, that the *Opuntia* of Theophrastus was the *Opuntia vulgaris* of modern botanists. The *Cactaceæ* are chiefly found in the tropical parts of America, a few species only escaping from those countries; as, for example, to the southern states of North America and to the highlands of Chili and Mendoza. They principally occur on hot dry rocks or plains where the commoner forms of vegetation could not exist, and may be considered one of the means which nature has provided for the support of man in regions where neither food nor water can be procured. Their stems are filled with an abundant insipid wholesome fluid, and their fruit is succulent and in many cases superior to that of European gooseberries. In the fevers of their native countries they are freely administered as a cooling drink, and being bruised they are esteemed a valuable means of curing ulcers. For the sake of such their uses, because of their rapid growth, and especially on account of the numerous spines with which they are armed, the Opuntias or Tunas, as the Spanish Americans call them, are much planted round houses as fences, which neither man nor animals can easily break through. They are not unfrequent in the dry forest-lands of Brazil, but are said never to occur in the damper parts of the country. In stature they vary greatly, many of them having small creeping stems, which seem to crawl upon the ground among the dead branches of the surrounding trees, with whose gray colour their deep green shoots form a singular contrast. Others rise like candelabra with many angular ascending arms, while a few elevate their tall and deeply-channeled leafless trunks far above the stunted vegetation of the sterile regions they inhabit, reaching sometimes the height of 30 or 40 feet.

To enable them to endure the excessive drought to which they are naturally exposed they are furnished with an unusually tough skin, the evaporating pores or stomates of which are few in number and very often to all appearance merely rudimentary. This contrivance prevents their losing the scanty moisture which they collect from the burning soil, and enables them to sustain the full ardour of the brightest equinoctial sun without inconvenience; in this respect resembling the succulent fruits of Europe, such as the plum, the grape, the peach, &c., which by the absence of stomates from their tough skin are equally enabled to bear the powerful action of the bright sun that is necessary for their maturation.

These facts teach us what the points are that it is most necessary to attend to in the cultivation of the numerous species which now abound in our gardens. Their skin is so formed that perspiration takes place very slowly through it, unless under the influence of powerful stimulants and when in a young state. It is therefore obvious that they should be sparingly watered or not watered at all during a considerable period of the year. Dry as the places usually are in which *Cacti* naturally grow, they are periodically visited by heavy rains, which, combined with a bright light and a high temperature, force into activity even the sluggish vital powers of such plants as those under consideration. At such a time the annual growth of a *Cactus* takes place, secretions which enable the species subsequently to form its flowers are deposited, and a general impulse is given to all the torpid energies of its constitution. But by degrees the rains moderate and finally cease; the young cuticle which at its first formation perspired freely becomes thicker and tougher, and impermeable to moisture; what food has been obtained during the short period of growth is securely inclosed within the recesses of the stem; and when the air and earth become dry the plant is provided with the means of enduring another long period of fasting and inactivity. With the fall of rain the heat moderates, but the light to which the *Cacti* are exposed is but little if at all diminished; so that the assimilation and alteration of the food contained within the stem keeps continually going on, however slowly. It is by following this natural course of events that gardeners have succeeded in bringing their *Cacti* to that extraordinary state of beauty for which they are now conspicuous; it is by attending practically to such points in the habits of the species that we obtain the myriads of large, brilliant, red, or blush or snow-white blossoms that form the glory of our green-houses in the spring. A *Cactus* is placed in a damp stove, exposed to all the light that can be collected without being concentrated, and it begins to grow: it is then watered, at first gently, afterwards copiously with water holding a quantity of organisable matter (manure) in solution; this practice is continued for three months, when the quantity of moisture is diminished and the temperature is lowered, but exposure to light is still attended to, till at last the plant sinks to rest. In this state it is kept till the season for again forcing it into growth shall have returned, when it is subjected to a repetition of the same treatment as before.

If the *Cactaceæ* are to be propagated, their branches or joints, if they have any, are cut off, a little dried, and then placed in a hot and damp place, when they strike root immediately. Among the practical consequences, De Candolle observes, that result from the facility with which they are thus multiplied, is one which deserves to be noticed on account of its importance, namely, the manner in which the *Opuntia* is employed to fertilise the old lavas at the foot of Ætna. As soon as a fissure is perceived, a branch or joint of an *Opuntia* is stuck in: the latter pushes out roots, which are nourished by the rain that collects round them, or by whatever dust or remains of organic matter may have collected into a little soil: these roots, once developed, insinuate themselves into the most minute crevices, expand, and finally break up the lava into mere fragments. *Opuntias* treated in this manner produce a great deal of fruit, which is sold as a refreshing food throughout all the towns of Sicily.

Where however the species have neither branches nor joints, as is the case with some of the species of *Melocactus* and *Echinocactus*, a different mode of propagation is had recourse to: it is then necessary to compel them to branch by artificial means. Each of the numerous tufts of spines that occupy the ridges of their stems is a bud, and is capable of being forced into a branch, if by any means the general tendency to grow at the upper extremity only is checked. This is effected either by burning the apex of the plant with a broad flat iron, or by cutting the plant across below the top, in either of which cases several of the spiny buds will gradually swell and develop themselves as little branches, which being broken off will strike root and become new plants.

It is on species of the *Cactaceæ* that the cochineal insect feeds. Of these the most common are the three following:—*Opuntia Tuna*, which seems the most employed in Peru; *O. Hernandezii*, which is the most celebrated in Mexico; and *O. cochenillifera*, the native province of which is somewhat doubtful.

CACTUS, a genus of plants, the type of the natural order *Cactaceæ*, The species are numerous, and have the general characters of the order. [CACTACEÆ.]

CADDICE, CADDIS-WORM, or CAD-BAIT, the common name for the larvæ of the species of *Phryganea*, which reside in the water, in cases which they form of various substances, such as bits of stick, grains of sand, small stones, shells, &c., which are held together by a silken thread secreted in their bodies in the same manner as in the silk-worm. The case acts as a protection to the larva, and it is capable of drawing in its head or putting it out, according to circumstances.

CADMIUM. [GREENOCKITE.]

CÆSALPINIA, a genus of plants belonging to the tribe *Cassieæ*, of the natural order *Leguminosæ*, and especially distinguished by the lowermost of its sepals being arched, the uppermost of its stalked petals being the shortest, its stamens all perfect with shaggy bases, and the fruit a compressed bivalved pod. The species are trees or shrubs, found in both the East and West Indies, with showy yellow flowers, abruptly pinnated leaves, and stems which are usually more or less prickly. The Brazil-Wood of commerce is said to be furnished by two of its species.

One of these, *C. Brasiliensis*, is a West Indian rather than a Brazilian tree, without prickles, downy flower-stalks, panicled flowers, smooth obtuse oblong leaflets. The other, *C. echinata*, which is really a Brazilian plant, is a prickly tree, with yellow and red blossoms, smelling deliciously like lilies of the valley, prickly pods, and oval blunt leaflets. Both these species undoubtedly yield a red wood, but it is by no means clear that they exclusively furnish the Brazil-Wood of commerce, as is commonly stated. According to Dr. Bancroft, this article is obtained from a tree with a large crooked knotty stem, the bark of which is so thick that a tree as large as a man's body with the bark, will not be so thick as the leg when peeled; and he calls this species *C. Brasiletto*, a name unknown to botanists: he however states that it is called by the natives Ibiripitanga. Now, that is the name given by Marcgraaf to the *C. echinata*, but this author says nothing about the peculiarity in the bark. One authority however ascribes a particularly thick alburnum to *C. echinata*, but says nothing of the bark. Malte-Brun says there are three kinds of Mirim, or Brazil-Wood found in Brazil; but he includes with them the *C. Brasiliensis*, which there is no good authority for considering a native of that country. Fée again refers the sappan wood of the East Indies (*Cæsalpinia Sappan*) to one of the Brazil-Woods of the merchants. Upon the whole it appears that we have no good testimony as to what the tree is that yields it; but it is probable that it is the produce of many species, and possibly of more than one genus, for De Candolle and Sprengel doubt whether the *Cæsalpinia echinata* is not rather a *Guilandina*. The best Brazil-Wood is said to come from Pernambuco, where it is called Páo da Rainha, or Queen's Wood, on account of its being a royal monopoly. The Bukkum or Sappan Wood of commerce is yielded by *C. Sappan*. A substance known in the markets under the name of Dividivi or Libidibi has lately become important on account of the tannin it contains. It is the fruit or pods of *C. coriaria*. They are not used in medicine, but in dyeing and tanning.

CAFFER-BREAD. [ENCEPHALARTOS.]

CAKILE, a genus of plants belonging to the natural order *Cruciferæ*, to the sub-order *Lomentaceæ*, and the tribe *Cakilineæ*. In addition to the accumbent cotyledons of the tribe, it has an angular pouch composed of two 1-seeded indehiscent joints, the upper joint deciduous, with an erect seed, the lower one persistent, seedless, or with a pendent seed. The species are annual branched herbs, smooth, fleshy, glaucous, with pinnatifid or toothed leaves; racemes of flowers opposite the leaves, and terminal with filiform bractless pedicles.

C. maritima, Purple Sea-Rocket, has the joints of the pouch 2-edged, the upper one with two teeth at the base, the leaves fleshy, pinnatifid, somewhat toothed. The flowers are of a purplish colour. It is a native of Europe, along the sea-coast from Sweden and Lapland to Gibraltar; it is also found on both sides of the Mediterranean. It is a native of Great Britain, on the sea-coast. This plant had at one time a reputation as a cathartic, but it is not employed at the present day. There are three other species of *Cakile*, named—*C. Ægyptiaca*, *C. Americana*, *C. equalis*. They are all pretty annuals, and may be easily cultivated. The seeds may be sown in spring or autumn, and they should be treated as other hardy annuals.

(Babington, *Manual*; Don, *Gardener's Dictionary*.)

CALABASH, a name given in the West Indies to the fruit of the tree called *Crescentia Cujete* by botanists. [CRESCENTIA.]

CALA'DIUM, a genus of plants belonging to the natural order *Aroideæ*, and to the tribe *Caladieæ*. The flowers are monœcious, and the calyx and corolla are absent; the male flowers have many-celled peltate anthers, disposed in a spike at the end of the spadix; the female flowers have the ovaries inserted at the base of the spadix, no style; the fruit is a 1-celled berry with many seeds. A great number of species of this genus have been described. They are frequently cultivated in this country for the sake of their spotted stems and neat green leaves, which are rarely disfigured by any of the accidents which affect other stove-plants. They have the same general appearance as the species of *Arum*, and also resemble them in physical and chemical properties.

C. Seguinum, Dumb-Cane, is a caulescent suberect plant with oblong cuspidate leaves, and the spadix shorter than the oblong spathe. This plant is a native of South America and the West Indies. It grows to a height of five or six feet. It secretes an acrid poison, so that when any part of the plant is chewed the tongue swells and the power of speech is lost. It is on this account called 'Dumb-Cane.' Sir William Hooker, in his 'Exotic Flora,' relates the case of a gardener who incautiously bit a piece of Dumb-Cane: "His tongue swelled to such a degree that he could not move it; he became utterly incapable of speaking, and was confined to the house for some days in the most excruciating torments." The juice is stated to impart an indelible stain to linen. Notwithstanding its poisonous nature, P. Browne says that, in common with the *Arum ovatum*, its stalk is used to bring sugar to a good grain when it is too viscid, and cannot be made to granulate with lime alone. In the districts where it grows the natives use a decoction of the stem as a bath and fomentation in dropsy, and the rootstock is used in obstinate constipation and in long-standing gout. The negroes use it as an anti-aphrodisiac.

C. sagittifolium, Brazil Cabbage, is stemless, with sagittate acuminate leaves, the spadix shorter than the spathe, which is ovate-cucullate. This plant is a native of the West Indies, and is called by the French Chou-de-Bresil, and by the Germans Essbar Arum. In appearance it resembles *Arum colocaria*, and is used for the same purposes. Both the leaves and rootstock of this plant are eaten. The leaves are boiled and eaten as coleworts; the rootstock is not considered so great a delicacy as the leaves. Of all the eatable *Aroideæ*, this appears to be the most extensively cultivated. It is found in the East and West Indies, in China, Japan, New Zealand, and the South Sea Islands. When raw the rootstock contains a certain amount of the poisonous secretion of the family, and like the potato has an acrid unpleasant flavour, which entirely disappears in cooking. The leaves are very soft and glaucous, from being covered with a fine silky hair, and in many places are used instead of plates and dishes.

C. esculentum resembles the last: its leaves are peltate-cordate, and its spathe ovate-lanceolate. It is also a native of South America, and is cultivated on account of the starch contained in its rootstock. It possesses properties similar to the last.

C. arborescens is a poisonous species, though not so virulent as the Dumb-Cane. Merat says that it was formerly used for wetting the mouths of negroes as a punishment for slight misdemeanours.

(Loudon, *Cyclopædia of Plants*; Lindley, *Natural System*; Burnett, *Outlines of Botany*; Bischoff, *Medicinisch-Pharmaceutische Botanik*.)

CALAMINE. [ZINC.]

CALAMINT. [CALAMINTHA.]

CALAMINTHA, a genus of plants belonging to the natural order *Lamiaceæ*, and the tribe *Satureiineæ*. It has the apices of the stamens connivent under the upper lip of the corolla; the anther-cells at length divergent, connective, subtriangular; the upper lip of the corolla straight, nearly flat, the lower patent trifid; the calyx 2-lipped and 10-13-nerved, throat hairy; the flowers whorled, axillary or spiked. This genus was constituted by Moench, and contains several species which were placed under *Thymus* and *Clinopodium* by Smith, in *Melissa* by Bentham, and one in *Acinos* by Hooker. Koch in his 'Flora Germanica' follows Moench, and also Babington in his 'Manual of British Botany.' There are four species of this genus, common and well-known plants in Great Britain.

C. Nepeta, Lesser Calamint, Cat-Mint, Balm or Field-Balm, has leaves ovate, obtuse, serrated, pale beneath, shortly stalked; calyx subcampanulate, obscurely 2-lipped, teeth all nearly the same shape, the upper ones slightly shorter; nuts roundish, almost smooth; cymes dichotomous, many-flowered. This is not a common plant, and is found on dry banks. It has a strong aromatic smell not unlike that of penny-royal, and a pungent taste. Cats are said to be fond of the smell, and hence its name cat-mint. An infusion of the leaves is recommended as a tonic and stimulant in flatulence and colic. This and the other species possess the volatile oil which is found in the whole order, and hence they all have a more or less powerful medicinal action.

C. officinalis (*Thymus Calamintha*, Smith; *Melissa Calamintha*, Bentham), Mountain-Balm, Common Calamint, has broadly ovate, rather acute, slightly serrated leaves, green on both sides, seated on longish stalks; the calyx tubular, ventricose in front, distinctly 2-lipped, teeth of the upper lip triangular, of the lower twice as long, and subulate; nuts roundish, covered with impressed dots; cymes scarcely dichotomous, few-flowered.

C. Acinos (*Acinos vulgaris*, Persoon; *Acinos thymoides*, Moench), Basil-Balm, or Basil-Thyme, has ovate subserrate acute leaves with revolute margins; tubular gibbous calyx distinctly 2-lipped, the upper lip with short triangular teeth, the lower one with subulate teeth, all converging in fruit. It is found in dry gravelly places, and in corn-fields throughout Europe.

C. Clinopodium (*Clinopodium vulgare*, Smith), Wild Basil, Bed-Foot, has ovate obtuse leaves, rounded below, slightly crenate; whorls equal, many-flowered; bracts setaceous, as long as the calyx. Common in dry bushy places, in Europe; it is also found in America, but has probably been introduced there.

(Babington, *Manual*; Bentham, *Labiatarum Genera et Species*.)

CALAMITES, one of the most frequent and characteristic genera of fossil plants. It is found abundantly, but not exclusively, in the Carboniferous system of strata, and generally in the sandstones and shales which alternate with coal. *Calamites Suckovii* occurs in most European and American Coal-Fields. *Calamites arenaceus* occurs in the Bunter Sandstein. We have found traces of a *Calamites* in the Red Marl series of Worcestershire. [COAL PLANTS.]

CALAMOPHILUS, a genus of Birds belonging to the family *Paridæ* and the tribe *Insessores*, sub-tribe *Dentirostres*. *C. biarmicus* of Yarrell is the *Parus biarmicus* of Pennant and other writers. This bird is common in Great Britain, and is known by the name of the Bearded Tit. [PARIDÆ.] (Yarrell, *British Birds*.)

CALAMO'PORA, the generic title applied by Goldfuss to many Palæozoic Corals, for some of which Lamarck employed the name of *Favosites*.

CA'LAMUS, a genus of Palms the different species of which yield the Rattan Canes of commerce. Although a genuine palm, yet from the slender stems and general habit, it has more the look of some tall grass, and has been considered as one of the links in the chain of organisation which connect the Grasses with the Palms. Blume gives the following account of the flowers and fruit:—Polygamous-diœcious, or diœcious; spathes several, incomplete; flowers sessile, in spikes; calyx 3-toothed or trifid; petals 3, united at the base; stamens 6; filaments subulate, connected at the base into a cup; anthers arrow-shaped, fixed by the back. The rudiment of an ovary:—female: ovary 3-celled, surrounded by a staminiferous cup, which is usually sterile; style scarcely any; stigmas 3, distinct or combined; berry protected by scales overlapping each other downwards, 1-seeded; seed surrounded by a succulent flesh; albumen uneven in the circumference, even in the inside, or near even in the circumference and ruminated internally; embryo at the base; leaves pinnated.

The species are principally found in the hotter parts of the East Indies, where they grow in the forests, climbing over trees and bushes to a greater extent than any other known plants. The stem of *Calamus verus* is described as being 100 feet long, that of *C. oblongus* 300 to 400 feet, of *C. rudentum* upwards of 500 feet, and of *C. extensus* as much as 600 feet; Rumphius even states that one kind attains the extraordinary length of 1200 feet (vol. v. 100). It is closely covered over by the tubular bases of the leaves, through which it is drawn by the cane-gatherers when green; afterwards it is dried in the sun, and then is ready for market. These canes are extensively used for the sake of the hard flinty coating of their stems, which are readily split into strips, from which the bottoms of chairs and similar articles are manufactured. It is not possible to say from what particular species the canes of the shops are obtained, it being probable that many are gathered indiscriminately; *C. Rotang* has however been said to furnish the stouter, and *C. Scipionum* the slenderer sorts. The flesh that surrounds the seeds of this genus is a delicate article of food; limpid water flows from the stems when cut through; and finally the young shoots of some of them, while still tender, are roasted or boiled, chopped small, and being fried with pepper and gravy, are said to furnish a very delicate dish.

It is not a little remarkable that notwithstanding the polished surface of the stem, almost all the other parts except the fruit should be furnished with stiff hairs and even prickles. The prickles are usually hooked backwards to enable the plants to raise themselves upon the trees among which they grow in their native forests; and to assist them in this operation the terminal pinnæ of the pinnated leaves are shortened, hardened, and also hooked backwards. Several species are copiously described in Rumphius's 'Herbarium Amboinense,' (vol. v.) under the name of Palmijuncus. Dragon's Blood or Djurnang, is the produce of a species of *Calamus*. Those which chiefly yield it are the *C. petræus* (Lour.), *C. rudentum* (Lour.), *C. verus* (Lour.), and *C. Draco* (Willd.), of which the last three were by Linnæus reckoned mere varieties of the *C. Rotang* (Linn.). They are natives only of Hindustan, Cochin China, and the Moluccas. The ripe fruits are covered with a reddish-brown dry resinous substance, which is the Dragon's Blood. In this state they are collected, and allowed to remain in rice-mills till the resin drops off. The resin is afterwards melted, either by the natural warmth of the air or by artificial heat, and then moulded into the different forms in which it occurs in commerce. Another mode of obtaining it is as follows:—The ripe fruits are shaken in bags, and the resin so obtained is formed into pieces about the size of a bean, which are then wrapped up in leaves; this kind is much prized in the East Indies. A second sort is procured by throwing together the fruits after they have been treated in the foregoing manner, melting them in the sun or with a slow fire, and collecting what exudes, which is then formed into small four-cornered cakes. A third sort is obtained from what remains after the two foregoing processes, being run out and formed into round cakes, which contain hard portions of the fruit. According to other accounts, the finest sort is procured by exposing the fruits to the vapour of boiling water, and scraping off the soft resin as it exudes.

CALA'NDRA, a genus of Coleopterous Insects belonging to the section *Rhynchophora*, and family *Curculionidæ*. It has the following characters:—Antennæ eight-jointed, geniculated, and inserted behind the middle of the rostrum (that is, towards the base); the six joints following the basal one are short, the apical joint forms a large knob, generally somewhat hatchet-shaped, having the apex soft and spongy; rostrum long, and slightly bent downwards; thorax rather long and depressed, narrower in front than behind; body somewhat depressed and pointed at the apex; elytra shorter than the abdomen; legs short, tibiæ armed with a spine; tarsi four-jointed, the penultimate joint bilobed.

The well-known Corn-Weevil (*C. granaria*), which commits so much havock in our granaries, belongs to this genus: it is about one-sixth of an inch long, or rather less; of a pitchy-red colour; the thorax is coarsely punctured, and the wing-cases are deeply striated; the striæ are minutely punctured; the legs and antennæ are red.

This little insect bores a hole into the grain with its proboscis, in which an egg is deposited; the egg turns to a little grub or larva, which devours the whole of the inside of the grain, leaving the husk entire. This quantity of food is just sufficient to mature the grub: it then turns to the pupa, and afterwards to the weevil, which easily breaks through the husk, and is then at liberty to proceed as its parent did. When wheat is suspected to contain these little weevils or their grubs, that which is affected may be easily discovered by throwing the whole into water; that which is good will sink, while the rest will float.

Another species of *Calandra* (*C. Oryzæ*, Linn.) closely resembling the corn-weevil, from which however it may be distinguished by its having four red spots on its elytra, attacks the rice grain in the same way as the one above mentioned does that of the wheat.

C. Palmarum, a large species, being about an inch and a half in length, lives during its larva state on the pith of the palms of South America. It is of a dull, velvet-like black, and has the proboscis furnished with a brush of black hairs on the upper part near the apex.

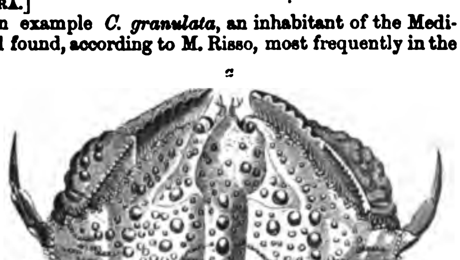
The larva of this species, which is called by the natives the Ver Palmiste, is considered by them a great dainty.

CALAPPA, a genus of Brachyurous Decapod *Crustacea*, separated by Fabricius, and formerly embracing the genus *Hepatus* of Latreille, though now restricted to the following form.

Generic Character:—External and internal antennæ similar to those of the Crab (*Cancer*) properly so called, third articulation of the pedipalpi (pieds-mâchoires extérieurs) terminated somewhat like a pointed hook; chelæ equal, very large, compressed, with their upper edge, which is notched or crested, very much elevated, and fitting exactly to the external border of the shell or carapace, so as to cover the entire region of the mouth; the rest of the feet short and simple; carapace short, convex, wider posteriorly than anteriorly, and forming behind a vaulted shield, under which the posterior legs are hidden when the animal is in a state of repose; eyes mounted on short pedicles, and at a short distance from each other.

The genus is well marked by the peculiarities of the shell and chelæ, with which last, as with a shield, the *Calappæ* cover the mouth and anterior parts, at the same time contracting up their feet beneath the posterior vaults of the shell, under whose hard protection their vulnerable parts are comparatively secured from the attacks of their enemies. They are called by the French, Migranes, and also Coqs de Mer, from their crested chelæ, as well as Crabes Honteux, from their appearing to hide their heads and smaller limbs behind their large chelæ. Their geographical distribution is wide. The species are recorded as inhabiting the seas of the Indian Archipelago, and of Australia, the Pacific and Atlantic oceans, the seas of South America, &c. The proximate form is found in the genus *Æthra* of Leach. [ÆTHRA.]

We select as an example *C. granulata*, an inhabitant of the Mediterranean Sea, and found, according to M. Risso, most frequently in the fissures of rocks near Nice, where these crabs reach to the depth of 90 feet. The same zoologist says, that the females deposit their eggs in summer; and that there is a variety whose shell is six-toothed posteriorly, and whose general colour is pale rose, with whitish feet and brown nails.



Calappa granulata.

a, The Crab with the limbs exserted; *b*, the right chela.

The following is Desmarest's description of *C. granulata*:—Carapace verrucose, marked with four longitudinal sutures, and having on each side before it begins to dilate seven teeth, three short and obtuse, and four more strong and pointed upon the borders of the enlarged part, with two other smaller ones entirely behind;

front bidentated; colour, that of flesh sprinkled with spots of carmine red; length 2¼ inches; breadth 3 inches, 6 lines, French.

CALATHI'DIUM, a modern name for the flower-head of the plants called *Compositæ*, the common Calyx of Linnæus. It consists of a flattish or conical cellular disk, called the Receptacle, upon which a number of small flowers are very compactly arranged; and its surface is either naked and even, except so far as the scars left by the attachment of the flowers render it otherwise, or covered with hairs, bristles, or scales, named Paleæ. Its margin is uniformly furnished with one or more rows of small leaves or scales which inclose the flowers as within a cup. The form, number, texture, and proportions of these scales often afford good generic characters. In reality, a Calathidium is a short spike of inflorescence, the receptacle being the depressed axis, its paleæ bracts, and the external scales being other bracts in a more perfect state. The Daisy, the Dandelion, and the Sunflower, offer illustrations of this form of inflorescence.

CA'LATHUS, a genus of Coleopterous Insects belonging to the section *Geodephaga* and family *Harpalidæ*. It has the following characters:—Body elongate, somewhat ovate, slightly pointed posteriorly; thorax wider behind than before; anterior tarsi with the three basal joints dilated in the males; claws dentate beneath; palpi with the terminal joint almost cylindrical, and truncated; labrum transverse, and slightly emarginated anteriorly.

Upwards of twenty species of this genus have been discovered, almost all of which are European. Their general colouring is black or brown; one or two metallic-coloured species however are known. In England eight species have been enumerated, most of which are common. Four species may be found under stones and rubbish in the neighbourhood of London; of these *C. cisteloides* is exceedingly common, frequently being met with in pathways, &c.; it is about half an inch long, and of a black colour; the antennæ are pitchy black, with the basal joint red; the legs are black, and in some specimens red. The wood-cut here given of *C. latus* will enable the reader to form an idea of their general appearance; it is a very rare species in this country, and differs chiefly from the one above mentioned in its greater width, and the thorax having the lateral margins of a reddish hue.

Calathus latus.

CALCAIRE GROSSIER, the coarse calcareous building-stone of Paris, which, geologically speaking, is coeval with the blue clay of the basin of London, and contains many identical shells. These constitute the types of the Eocene Tertiary series of Mr. Lyell.

CA'LCAR, a genus of Coleopterous Insects belonging to the section *Heteromera* and family *Tenebrionidæ*. This genus is distinguished from the allied genera (*Hypophlæus*, *Apis*, &c.) by having the body linear, the head emarginated anteriorly, and the three or four terminal joints of the antennæ nearly globular; the thorax is longer than broad, truncated anteriorly and posteriorly, and of nearly equal width throughout.

CALCAR, or Spur, in flowers, is a hollow projection from the base of a petal, and has usually a conical figure. It was called Nectary by Linnæus, but it rarely secretes honey. Its use is unknown. The spurs of some of the *Orchidaceæ* are several inches long, and many times longer than the flowers to which they belong, hanging down like vegetable tails.

CALCAREOUS SPAR. Under this term it is usual to include only those varieties of Carbonate of Lime which occur in distinct individual crystals of the rhombohedral system, the name never being used to denote Arragonite, or any crystals of carbonate of lime belonging to the prismatic system; nor is it usual to apply it to those more or less crystalline limestones of which marble is the purest variety, where each crystal is so embedded in the mass as to have lost all individuality. In a word, these rocks are of such importance and interest that they do not admit of our treating them as a mineralogical variety, but as masses formed by the aggregation of numerous crystals of it. These are noticed therefore under the heads LIMESTONE and MARBLE, while we shall here confine ourselves to the individual crystals of which the others are composed.

This substance presents us with one of the most interesting objects which can engage the attention of the mineralogist, not only on account of the important part it plays in the geological structure of the earth, being frequently almost the sole ingredient of beds of rock of great thickness and extent, produced at every geological epoch, but also from the beauty and diversity of its crystalline forms, and from the peculiarity of several of its physical properties. The study and a correct knowledge of this mineral species have also become of still greater importance since the discovery of the principles of isomorphism, by which it is shown that it is the most perfectly developed individual of a very large class of the mineral salts of carbonic acid, of which it may consequently be considered the type.

If any crystal of calcspar, whatever its form, be carefully examined, an appearance indicating a tendency in its substance to break or split in the direction of three planes symmetrically related to the form may be perceived, and by a gentle blow the whole is readily reduced to fragments, each of which may with a little care be brought to the form of the rhombohedron represented in *fig.* 2, the faces of which are parallel to the three planes of cleavage above mentioned. This, in the language of Haüy, is the primitive form of calcspar, and represents, according to his theory, the shape of the ultimate molecules or atoms of carbonate of lime, by the aggregation of which, according to certain laws, its various crystals are produced. Although this rhombohedron occurs rarely or never as an unbroken crystal of pure carbonate of lime, it is nevertheless the most convenient ground-form, to the axis of which the faces of all other crystals of this substance may be referred, and it is therefore selected for that purpose. These forms, although far exceeding in number those observed in any other mineral species, are however (omitting the

Fig. 1.

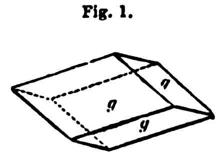


Fig. 2.

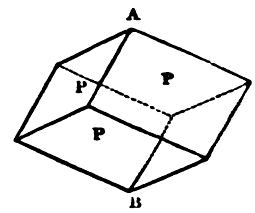
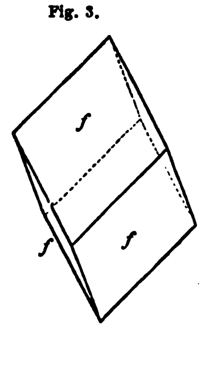


Fig. 3.



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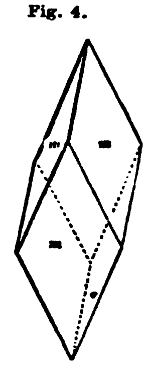


Fig. 5.

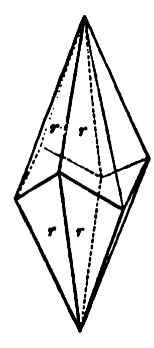


Fig. 6.

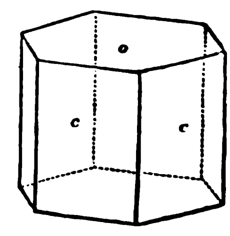


Fig. 7.

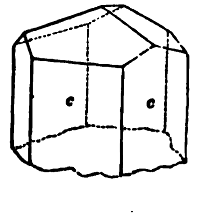
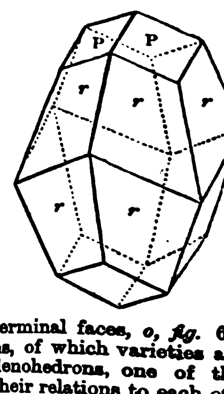


Fig. 8.



regular hexagonal prism, *c*, and its terminal faces, *o*, *fig.* 6) but of two kinds, being either rhombohedrons, of which varieties are represented in *figs.* 1, 2, 3, and 4, or scalenohedrons, one of the most common of which is seen in *fig.* 5. Their relations to each other and their combinations have been developed principally by Haüy, Bournon, and Monteiro, by whom no less than 30 different rhombohedrons and 50 scalenohedrons have been distinguished. As might naturally be expected, the combinations resulting from so large a number of simple forms are exceedingly great, and Bournou, who has written a treatise of three thick volumes on this mineral and Arragonite, has distinguished no less than 700 varieties of form. Of these 154 are described in the large work by Haüy, accompanied by very accurate drawings of each.

A general knowledge of the crystalline form of this mineral may however be easily obtained by acquiring a knowledge of the relation of the faces of the five simple forms and the hexagonal prism referred to above; as in almost all the more ordinary combinations the general feature of the crystal is produced by one of these. The *fig.* 2, which, as has been already stated, is considered as the ground-form, is a rhombohedron, the faces of which are inclined to each other in the terminal edges at 105° 5′. This form, though exceedingly rare in pure calcspar, is however the prevailing crystal in the nearly allied species produced by the combinations of the carbonates of lime and magnesia, as will be seen by referring to the article DOLOMITE. In determining the relations of any form, the position of the planes of this rhombohedron in reference to the other parts must first be fixed, and this is readily accomplished in every case, owing to cleavage-planes running parallel to its faces. This being determined, all other rhombohedrons are at once divided into rhombohedrons of the first order, such as *fig.* 4, which have their faces situated as the faces of the ground-form, or into rhombohedrons of the second order, the faces of which are situated as the edges of the ground-form, as is the case with *figs.* 1 and 3.

The rhombohedron *fig.* 1, which may thus be seen to belong to the second order, is readily recognised by having its faces *g* making the same angle with the vertical axis A B (*fig.* 2) as the terminal edges of the ground-form, so that in a combination the terminal edge of the ground-form is truncated by the plane *g*. This rhombohedron, which is called the first obtuser, has the angles at the terminal edges 135° 57′, and has with the same breadth its vertical axis one-half that of the ground-form. It is one of the most common of the rhombohedrons, and is frequently found alone, but still more frequently in combination with the hexagonal prism, producing the form seen in *fig* 7. It occurs frequently at Andreasberg, in the Harz, and in the mines of Derbyshire.

The rhombohedron *fig.* 3 is also of the second order, and is called the first obtuser: its terminal edges correspond with the long diagonals of the faces of the ground-form, and therefore, with the same breadth, its vertical axis is double that of the other: the inclination of the faces at the terminal edges is 78° 51′. In combination with the ground-form, if the faces *f* predominate the form P appears as truncations of the terminal edges; if P predominates, the faces of *f* produce truncations of the six lateral angles, the edges of intersection being parallel to the inclined diagonals of P for two faces, and with the horizontal one for the third.

The rhombohedron *fig.* 4 bears to *fig.* 3 the same relation as this does to the ground-form, the terminal edges of the first corresponding with the inclined diagonal of the second: the inclination of the planes to each other in the terminal edges is 65° 50′.

Fig. 5 is one of the most common scalenohedrons, and is commonly known as the Dog's-Tooth Calcspar, and is found frequently in Derbyshire and other localities. It bears a close connection with the rhombohedrons P and *m*, having the lateral edges of the first and terminal edges of the latter, so that in combination with the first the form *fig.* 8 is produced, and with the second it forms a bevelment of the terminal edges: the inclinations of the faces in the terminal edges are respectively 104° 38′ and 144° 24′. This form frequently occurs as twins, formed by two crystals growing on each other, their principal or vertical axes being in the same right line, and the two crystals so situated that the obtuser terminal edges of the one abut on those of the other, and the acuter on the acuter.

This mineral may be recognised by its perfect cleavage parallel to the faces P: the specific gravity of the purest crystals is 2·721; and the hardness is in the scale of Mohs 3, being situated between gyps and fluor-spar. It is of itself colourless, but frequently occurs of various tints of yellow, green, red, brown, and even black, from the admixture of impurities. Its glance is vitreous, with the exception of the terminal face *o*, which generally presents a mother-of-pearl lustre. It is usually more or less translucent, and when transparent produces in a remarkable degree the double refraction of light: this property is best seen in the varieties obtained from Iceland, and hence known as Iceland-Spar, and occurs as the ground-form, being in fact merely broken fragments of other larger crystals.

The following are the names of the more common varieties of Calcareous Spar:—Iceland Spar, Satin Spar, Chalk, Rock Milk, Calcareous Tufa, Stalactites, Stalagmite, Limestone, Oolite, Pisolite, Argentine, Fontainebleau Limestone, White and Clouded Marbles, Statuary Marble, Compact Limestone, Stinkstone, Anthraconite, Plumbo-Calcite, Mineral Agaric, &c.

CALCEDONY. [AGATE.]

CA'LCEOLA, an extinct genus of *Brachiopoda*, which occurs in the Palæozoic Strata, and especially in the middle group. *Calceola sandalina* occurs in this position in the Eifel, and in South Devon.

CALCEOLA'RIA, a genus of very ornamental herbaceous or shrubby plants, belonging to the natural order *Scrophulariaceæ*. Its distinctive characters are principally, the flowers being diandrous, with a two-lipped corolla, the lower lip of which is much larger than the upper, and inflated so as to resemble a bag. All the species are South American, and are confined either to the western side of the Cordilleras, or to the southern extremity of the continent and its adjacent islands: in Chili and the mountainous parts of Peru they are so common as to give a peculiar appearance to the vegetation. Some of them are lowlanders; others inhabit the highest parts of the Andes in the districts just below the regions of lichens and mosses; and thus, if both their wide geographical distribution and the various elevations at which they occur are taken into account, they are exposed to every kind of climate between those of England and Barbary.

The greater part of the genus has yellow flowers, a few have purple ones, and here and there in nature species occur with the two colours intermixed, by the addition of spots of purple to the yellow ground-colour, the latter changing the former to a deep rich brown. By intermixing artificially the two colours natural to the genus a production of hybrid varieties has resulted, and some crosses of extraordinary beauty have been obtained, especially from *C. integrifolia, corymbosa, arachnoidea, Chiloensis, crenatiflora, viscosissima*, &c.

CALCITE. [CALCAREOUS SPAR.]

CALEDONITE. [LEAD.]

CALENDULA. [ALAUDA.]

CALE'NDULA, a genus of plants belonging to the natural order *Compositæ*, the sub-order *Corymbiferæ*, the tribe *Cynaveæ*, the subtribe *Calendulaceæ*, the division *Calenduleæ*. It has an involucre of two rows with equal scales; the flowers of the ray ligulate, pistilliferous, fertile; the style divided at top into two stigmata; the flowers of the disk hermaphrodite, barren, the style undivided; the achenia unequal, curved, toothed, or muricated.

C. arvensis, Field-Marigold, has the achenia cymbiform, muricated, incurved, the outer ones lanceolate, subulate, muricated on the back. This plant is common on the continent of Europe, and is found in immense numbers in some of the vineyards of the Rhine.

C. officinalis, Common Marigold, has cymbiform achenia, all of them incurved, and muricated. This is the Souci du Jardin of the French, Gold-Blume of the Germans, and Furrancio of the Italians. Although common enough now in the gardens of Great Britain, and frequently found wild, it is not a native of these islands, and has been introduced from the south of Europe. This plant is a great favourite in gardens, and continues to blossom till the approach of winter. It is often grown in churchyards in this country, and in cemeteries on the Continent, but this practice does not appear to be connected with any superstition. There are several varieties of this plant found in gardens, as the orange-coloured, the lemon-coloured, and the double. It had formerly numerous virtues attributed to it, but independent of the bitterness of the tribe to which it belongs, and a rather more powerful volatile oil than is found in other species of the order, it possesses no active properties. The flowers are used in some parts of the country to give a yellow colour to cheese. In the Clock of Flora of Linnæus, it is said to open its flowers at nine in the morning and to close them at three in the afternoon. *C. pluvialis* has been named from its flowers closing at the approach of rain. The petals of these plants are sometimes employed to adulterate saffron.

(Loudon, *Encyclopædia of Plants*; Koch, *Flora Germanica*.)

CALIDRIS, a genus of Birds belonging to the order *Grallatores* and the family *Charadriadæ*. It has the following characters:—Beak as long as the head, straight, slender, flexible, compressed at the base, with the point dilated and smooth; nostrils basal, lateral, narrow, longitudinally cleft in the basal furrow, which extends to the smooth point of the beak; wings of moderate length, pointed, the first quill-feather the longest; legs of mean length, naked above the tarsal joint; feet with three toes, all directed forwards, with a very small connecting membrane at their base. Gould, in his 'Birds of Europe,' regards the Knot (*Tringa canutus*) as a species of *Calidris*. With this exception the only British bird which is a species of this genus is *C. arenaria*, the Sanderling. It is an inhabitant of most of the shores of Great Britain and Ireland. It obtains its food by probing the moist sands of the sea-shores, from which it obtains minute *Mollusca*, shrimps, annelides, &c. It visits the shores of Sweden, and is stated to breed still farther north. Sir John Richardson says it breeds on the coasts of Hudson's Bay. It does not appear to breed in the British Islands. (Yarrell, *British Birds*.)

CALI'GUS, a genus of Entomostracous *Crustacea*, separated by Müller, in which Latreille and Lamarck include the genus *Pandarus* of Leach, but which Desmarest places under the fourth sub-division or race of *Pæcilopoda*: namely, those which have fourteen feet, of which the six anterior are unguiculated, the fifth pair being bifid with the last joints fringed with fine hairs in the form of cilia.

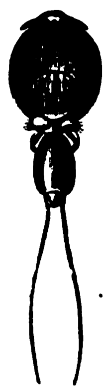
It has the body depressed, having its anterior portion covered by a membranous shell in the form of a shield, narrowed posteriorly. Abdomen narrower, of an elongated oval or nearly square shape, and terminated by two elongated antennæ-like processes, cylindrical and simple. There are two small conical antennæ situated on the anterior border of the head, and directed laterally, and at the internal base of these are placed the two distant eyes. Beneath the head there is an obtuse beak.

Caligus, together with *Argulus*, and other of its congeners of the family *Siphonostomata*, are commonly known among the fishermen as Fish-Lice. But *Caligus* is without the cupping-glass-like suckers, by which *Argulus* adheres to its slippery supporters; and the hooks of the anterior pair of feet are the principal organs by which the former holds on to the fish. [ARGULUS.]

Argulus and *Caligus* are now usually regarded as types of distinct families *Argulidæ* and *Caligidæ*. *Argulus* is the only genus in the family *Argulidæ*. With *Caligidæ* are included the following British genera, *Lepeopthirus*, *Chalimus*, *Trebius*.

Dr. Baird, in his 'History of the British Entomostracous Crustacea,' describes four species of *Caligus* as natives of Great Britain.

C. Mülleri is found parasitic upon the Cod (*Morrhua vulgaris*) the Brill or Brett (*Rhombus vulgaris*) and upon several other fishes. The following description is from Baird :—



Caligus Mülleri.
View of back.

Female.—Carapace oval, rather longer than broad, narrower at upper extremity; frontal plates of considerable size, notched in the centre; lemules well developed; antennæ of considerable size; basal joint large. Thorax shorter than the carapace, about half the size; penultimate joint very small, of an elongate diamond shape; last joint nearly quadrilateral, and lobed at the posterior extremity. On each lobe there are two very small tubercles, each of which gives off two short setæ. Abdomen very short and rounded, broader than long; caudal plates terminated by three tolerably-long plumose setæ; internal fork with simple short obtuse branches; second pair of foot-jaws very long, the last joint being narrow, long, and terminated by two curved claws, one longer than the other; fourth pair of legs stout, the first joint broad and thick, the last ending in one long stout curved claw, which is serrated on its inner edge, and two short ones; oviferous tubes of considerable length.

Male.—In the male the last joint of thorax is considerably smaller than in the female and more rounded; the lobes much sharper, and terminated by the same tubercles, but of a larger size. Abdomen about two-thirds the size of the last joint of thorax; second pair of foot-jaws large.

C. diaphanus is found on the turbot, the gurnard, the mackerel, the plaice, the holibut, and other fish.

C. rapax has been taken on the gurnard, Lough Neagh trout, brill, whiting, dory, and common dab.

C. centrodonti, has been found on the fins and tail of the common Sea-Bream (*Pagellus centrodontus*) alone.

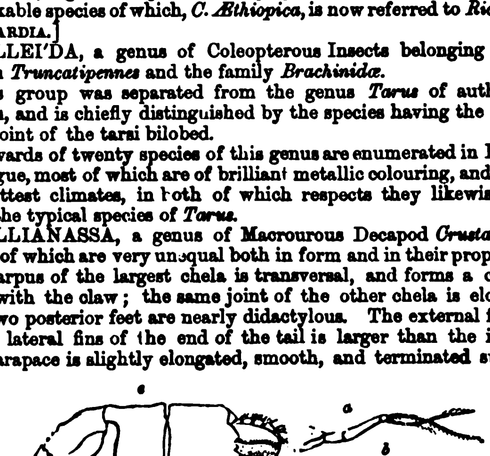
CALLA, a genus of plants belonging to the Arum Tribe, the most remarkable species of which, *C. Æthiopica*, is now referred to *Richardia*. [RICHARDIA.]

CALLEI'DA, a genus of Coleopterous Insects belonging to the section *Truncatipennes* and the family *Brachinidæ*.

This group was separated from the genus *Tarus* of authors, by Dejean, and is chiefly distinguished by the species having the penultimate joint of the tarsi bilobed.

Upwards of twenty species of this genus are enumerated in Dejean's catalogue, most of which are of brilliant metallic colouring, and inhabit the hottest climates, in both of which respects they likewise differ from the typical species of *Tarus*.

CALLIANASSA, a genus of Macrourous Decapod *Crustacea*, the chelæ of which are very unequal both in form and in their proportions. The carpus of the largest chela is transversal, and forms a common body with the claw; the same joint of the other chela is elongated. The two posterior feet are nearly didactylous. The external foliation of the lateral fins of the end of the tail is larger than the internal. The carapace is slightly elongated, smooth, and terminated suddenly



Callianassa subterranea.
a, Intermediate antenna; *b*, external antenna; *c*, right chela.

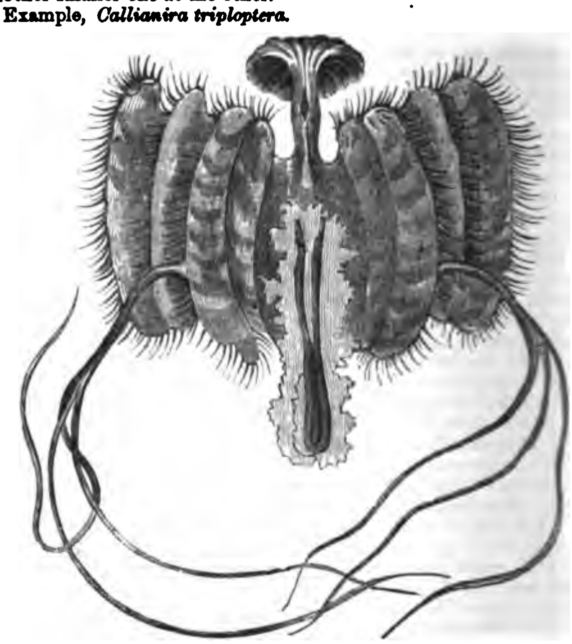
by a small beak. The abdomen is of considerable size, and nearly membranous. The other general characters are those of *Thalassina*. [THALASSINA.] The only species known is *Callianassa subterranea*, which is found on the sands of the sea-shore washed by the tides on the French and English coasts.

CALLIANIRA, or CALLIANYRA, a genus of Ciliograde *Acalephæ*, established on no very sure foundations by Péron and Lesueur, in their 'Memoir on the *Pteropoda*,' and considered by them to belong to the type of the *Malacozoaria*. It seems however from its structure that in its general character it is not far removed from *Beroë*. Lamarck, who perceived this relation, states that it was first established by Péron, in manuscript, under the name of *Sophia*; and the species described by him had, according to his account, a membranous gelatinous wing, divided into two large folioles provided with cilia on their margins.

De Blainville, who observes that *Callianira* is only known by figures and descriptions not very complete in their details, states that Slabber's figure copied by Bruguières was drawn after an animal from the coasts of Holland, and that the description was taken from another belonging to the waters of Madagascar; information which De Blainville acknowledges that he owes to Professor Vanderhoeven. De Blainville adds that M. Eschscholtz refers them to two different species.

The following is the generic character given by De Blainville.—Body regular, gelatinous, hyaline, cylindrical, elongated, tubular, obtuse at the two extremities, and provided with two pair of wing-shaped appendages, which develop themselves in large foliations, and are fringed with a double row of vibratory cilia upon their edges. A pair of tentaculiform appendages, branched, and not ciliferous. A large transverse opening at one of the extremities, and probably another smaller one at the other.

Example, *Callianira triploptera*.



Callianira triploptera.

CALLI'CERA, a genus of Insects of the order *Diptera* and family *Syrphidæ*, section *Athericera*. This genus is allied to *Ceria* of Fabricius, and differs principally in having the body shorter and wider in proportion and silky. The second joint of the antennæ is shorter than the last, and forms with it an elongated, compressed, slightly-curved club.

CALLICHRO'MA, a genus of Coleopterous Insects of the section *Longicornes* and family *Cerambycidæ*, distinguished from the allied genera (*Cerambyx*, *Phœnicocerus*, &c.) by having the maxillary palpi smaller than the labial, and shorter than the terminal lobe of the maxillæ. The posterior tibiæ are generally much compressed.

As in the genus *Cerambyx*, the species of this genus emit a very agreeable odour.

CALLI'CHTHYS (Linnæus), a genus of Fishes belonging to the section Abdominal *Malacopterygii* and family *Siluridæ*. They are distinguished by the species having the body almost entirely protected by four ranges of large hard scaly plates: the head is also protected with plates of the same texture; the snout and under surface of the body are the only naked parts. The mouth is not deeply cleft, and is furnished with four long cirri, two from each corner; the teeth are very small; eyes small, and situated on the side of the head.

The species of this genus generally frequent rivers and streams. Like eels they can live for a considerable time out of water, and as they are natives of hot climates the streams which they inhabit not unfrequently dry up: when such is the case they are said to perform long journeys over land, directing their course to some other stream. In some instances they bury themselves in the mud. Their structure appears to fit them for these habits.

The genus *Callichthys* appears to be included in the genus *Cataphractus* of Willughby and Ray and some others among the older authors.

CALLI'DIUM, a genus of Coleopterous Insects belonging to the section *Longicornes* and family *Cerambycidæ*. It has the following characters:—Body depressed, thorax wider than the head, rounded at the sides; antennæ generally shorter than the body; palpi rather short, the terminal joint thicker than the rest, and truncated at the apex. Legs short; femora suddenly thickened towards the apex, especially in the males; tibiæ simple.

Callidium Bajulus is not an uncommon insect in this country. It lives during the larva state in fir-timber, and when it occurs plentifully is exceedingly destructive. The perfect insect is about three-quarters of an inch long, of a flattened elongate form, and dull black or pitch colour; the thorax is pubescent and has two smooth glossy tubercles on the disc; the elytra are furnished with a fascia (more or less distinct) of silvery-white hairs.

Instances have been recorded of these insects attacking the fir-rafters of houses, to which they are of course exceedingly injurious, and we have known instances when the perfect insects, in order to effect their escape, have perforated the lead with which the house-top was covered.

In many of the deal palings in the neighbourhood of London, and elsewhere, numerous oval-shaped holes (about a quarter of an inch in diameter) may be observed; these are formed by the perfect insect of this species of *Callidium* to effect their escape, having passed through the larva and pupa states within the wood.

Mr. Stephens in his 'Catalogue of British Insects,' enumerates thirteen species of this genus, but of these many have undoubtedly been imported in foreign timber.

CALLIGONUM, a genus of plants belonging to the natural order *Polygonaceæ*, of which one species, *C. Pallasia*, yields in its roots an amylaceous gummy matter, on which the Calmucks feed in times of scarcity. The fruits and branches are acid, and are chewed by the same people to allay their thirst. This plant is destitute of leaves, and grows in great abundance on the sandy steppes of Siberia. (Lindley, *Vegetable Kingdom*).

CALLIMO'RPHA (Latreille), a genus of Insects belonging to the order *Lepidoptera*, section *Nocturna*, and family *Lithosidæ* (Stephens). It has the following characters:—Antennæ slightly ciliated in the males; palpi small, three-jointed; legs moderate, the hinder tibiæ each with two pairs of spurs; body slender, especially in the males; wings large, somewhat triangular, with the hinder margins rounded.

Callimorpha Jacobææ, the Pink Underwing, is a very beautiful and common moth. When the wings are expanded it measures about an inch and a half in width. The upper wings are of a greenish-black colour, with two round pink spots at the apex, and an oblong dash of the same colour, extending nearly the whole length of and parallel to the outer margin. The under wings are entirely pink, with the exception of the margins, which are of the same tint as the ground-colour of the upper wings. The head, thorax, abdomen, and legs are entirely black.

The caterpillar of this moth is not uncommon in the neighbourhood of London. In some situations it is found in the greatest abundance in the month of June, feeding upon the flowers of the Ragwort (*Senecio Jacobæa*) and often upon Groundsel (*Senecio vulgaris*). It is of a bright yellow colour, with numerous slender black bands, and is sparingly covered with hair. The moth appears in the month of May.

CA'LLIODON, a genus of Fishes of the section *Acanthopterygii* and family *Labridæ*. This genus was separated from that of *Scarus* (Linn.) by Cuvier, and differs in the species having the lateral teeth of the upper jaw divided and pointed; the upper jaw is also furnished with an inner range of small teeth. *Scarus spinidens* of Quoy and Gaimard is given as an example of this genus. [SCARUS.]

CALLIO'NYMUS, a genus of Fishes belonging to the Abdominal *Acanthopterygii* and family *Gobiadæ*.

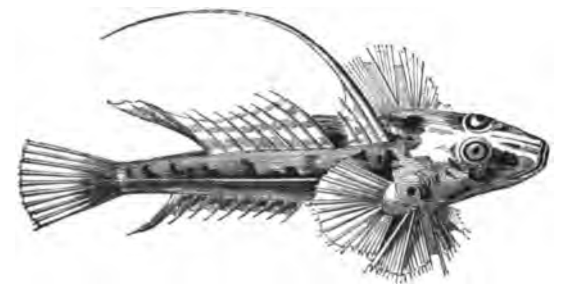
The species of this genus are known in England by the name of Dragonets. Their branchiæ have but a single small opening placed near the nape of the neck; their ventral fins are widely separated, larger than the pectorals, and situated under the throat; the head is oblong and depressed; the eyes are placed on the top of the head and rather close together; body smooth and without scales; intermaxillaries very protractile; teeth small, numerous, and placed on the jaws only; the anterior dorsal fin has the first ray elongated.

Two species of this curious genus (remarkable for the peculiarities in the branchiæ and ventral fins above noticed) are found on our own coasts. *C. Dracunculus*, the Sordid Dragonet, the Fox of the Kentish coast and the Skulpin of Cornwall, is the better known, being frequently met with at the mouth of the Thames. It is about 10 inches long and of a reddish-brown colour above; the under parts, the head, pectoral and ventral fins uniformly white; the dorsal fins are of an immaculate pale-brown.

C. lyra, the Gemmeous Dragonet, Yellow Skulpin of Cornwall and Gowdie of Scotland, very closely resembles the one above described, and indeed has by some been considered as the same species. There appears however to be very good grounds for separating them, independent of the difference of colour. The prevailing hue of this species is yellow of various shades, with sapphirine stripes and spots on the head and sides of the body. The ventrals and caudal fins are bluish-black.

In the Sordid Dragonet the head bears the proportion of one to five of the whole length of the fish, and is of the form of an equilateral triangle: the distance between the eyes and the nostrils is only equal to one diameter of the former.

In the Gemmeous Dragonet the head is of an oblong-ovate form, and its length compared with that of the fish is as one to four: this species may also be distinguished from the former by its less depressed form.



Gemmeous Dragonet (*Callionymus lyra*).

The latter species has been found on various parts of our own coast as well as that of Ireland. It also occurs in the Mediterranean and on the coast of Norway.

The Dragonets live at the bottom of the water, as might be supposed from the disposition of the eyes. Their food consists of small shell-fish and worms. They are sometimes caught by the shrimpers whilst fishing.

CALLI'STUS (Bonelli), a genus of Coleopterous Insects belonging to the family *Harpalidæ* (M'Leay). The following are its characters:—Three basal joints of the anterior tarsi dilated in the males. Palpi with the terminal joint elongated, rather ovate, and terminated almost in a point. Antennæ filiform and slightly compressed. Labrum transverse, emarginated anteriorly. Head somewhat triangular. Thorax nearly heart-shaped. Body rather short and depressed.

Only one species of this genus has hitherto been discovered, but it is found almost all over Europe: it is not uncommon in France, and is found beneath stones. In England it is rather scarce.

This species, *Callistus lunatus*, is conspicuous in the cabinets of British insects for its beauty. It is about a quarter of an inch long; the head and under parts of the abdomen are of a greenish-black colour, the thorax is reddish-yellow, and the wing-cases are yellow with six black spots, placed, two at the base, one on the disc of each elytron which extends to the outer margin, and two at the apex; these spots are large, and occupy about one-half of the whole surface of the elytra. The antennæ are black, with the two basal joints yellow. The legs are black, with the base of the femora and tibiæ yellow. The head and thorax are very thickly punctured; the elytra are punctate-striated. The upper parts, with the exception of the head, are devoid of glossiness.

CALLITHAMNION. [ALGÆ.]

CALLITRICHA'CEÆ, *Starworts*, the Callitriche Tribe, a small natural order of Achlamydeous Dicotyledonous Plants, consisting of a few obscure floating species, all of which belong to the genus *Callitriche*. The distinctive character resides in the presence of several one-seeded carpels combined into a single pistil with two styles, and altogether destitute of any floral covering. Brown and many others consider the order related to *Halorageæ*. Lindley, who formerly placed it near *Podostemaceæ*, now agrees with Endlicher that its proper position is near *Euphorbiaceæ*, of which it may be regarded as an aquatic form. In the genus *Callitriche* the flowers are without calyx or corolla, with 2 bracts at their base; 1 stamen; 2 ovaries, each 2-lobed and imperfectly 2-celled; the styles 2, subulate; the fruit dry, separating into 4 indehiscent carpels. Kützing has figured a deciduous calyx belonging to this genus. Five species have been described. Four of these are natives of Great Britain. They are water-plants with smooth leaves, and are known by the name of Water-Starworts. *C. verna* is common in stagnant waters and slow streams. *C. platycarpa* is found on mud or in shallow water; seldom, and then apparently by accident, in deep water. *C. pedunculata* is found in marshes; and Babington has described a variety, *C. p. sessilis*, which is found in lakes. *C. autumnalis* is found in streams, but is rare. The surface of *C. verna*, and probably of the other species, is covered with rosette-formed epidermal appendages. The same bodies are found on *Hippuris*. (Lankester, *British Association Transactions*; Babington, *Manual of Botany*.)

CALLI'TRICHE. [CALLITRICHACEÆ.]

CALLITRIS, a genus of plants belonging to the natural order *Coniferæ*. Dr. Lindley states, on the authority of Brongniart and Schousboe, that Sandarach is yielded by a species of this genus, the

C. quadrivalvis, and not from *Juniperus communis*, as is frequently supposed. He also adds that he has seen "a plank two feet wide of this Sandarach-Tree, which is called the Arar-Tree in Barbary. The wood is considered by the Turks indestructible, and they use it for the ceilings and floors of their mosques." (Lindley, *Vegetable Kingdom*.)

CALLU'NA (from καλλύνω, to make beautiful), a genus of plants belonging to the natural order *Ericaceæ*. It has a 4-parted membranous coloured calyx, longer than the 4-cleft campanulate corolla, surrounded by four green bracts; 8 stamens, with dilated filaments; the capsule 4-celled, the dissepiments adhering to the axis; the valves opening at the dissepiments, and separate from them. There is only one species of this genus, the Common Heath (*C. vulgaris*). It is a low tufted shrub with small sessile closely-imbricated keeled leaves, arranged in four rows, each leaf having two small spurs at the base, and nearly or quite smooth. The colour of the flowers varies from a deep red to a white, and numerous varieties have been named. This plant is common on every heath in Great Britain. The varieties are ornamental when planted in the garden. They should be grown in a peat soil, and may be propagated by layers or cuttings under a bell-glass. (Babington, *Manual of British Botany*.)

CALOCHO'RTUS, a beautiful genus of Bulbous Plants belonging to the natural order *Liliaceæ*, and nearly allied botanically to the fritillary and tulip, from both of which it is immediately known by the sepals being of a different form, colour, and texture from the petals. Several species have been introduced into England from California, where or near which country they are exclusively found wild. Their exact localities, and the precise conditions of climate under which they occur, are however nearly unknown. It would appear that they inhabit a mild climate, subject to rains, and a moderately high temperature during their season of growth, but dry and cool subsequently. Accordingly it is found that in this country they do not succeed very well unless they are cultivated in pits where they are protected from frost and from water stagnating about their roots, and can be exposed freely to light and air when growing. They are so exceedingly impatient of wet near their bulbs when not in a growing state, that prudent gardeners take the precaution to dig them up and keep them dry from the time when the leaves are withered to the recommencement of their vegetation. When they are replanted they will scarcely bear any water until the young leaves begin to appear above the soil.

CALOPHYLLUM (from καλός, beautiful, and φύλλον, leaf), a genus of plants belonging to the natural order *Guttiferæ*. It has a bractless calyx, consisting of from 2-4 unequal coloured sepals; 4 petals (sometimes 2) opposite the sepals; indefinite stamens, free or connected at the base; filaments short; anthers inserted by their base, 2-celled, bursting longitudinally; the style twisted, crowned by a large capitate stigma, which is usually lobed; fruit drupaceous, globose or egg-shaped, 1-celled, 1-seeded; the seeds large. The species are trees, the leaves of which have numerous transverse parallel veins, which give them a very beautiful appearance.

C. Inophyllum has oblong or obovate obtuse leaves, usually emarginate; round branches; loosely racemose flowers; racemes axillary, 1-flowered; usually opposite peduncles. This tree is a native of the East Indies, and often attains a height of 90 or 100 feet. It has large handsome leaves like those of a water-lily, snow-white fragrant flowers, and a fruit about the size of a walnut. When the trunk is wounded it exudes a yellow viscid juice, which frequently hardens to the consistence of a gum. It is a common plant in Malabar, where it yields fruit twice a year—in March and September—and frequently attains the age of 300 years. The nuts afford a fixed oil, which is expressed, and used for burning in lamps, for making ointment, &c. This tree is cultivated in Java for the sake of its shade and the fragrance of its flowers. The bark and the exudation are used for medicinal purposes.

C. Calaba, Calaba-Tree, has obovate or oblong, obtuse or emarginate leaves; hermaphrodite or male flowers; lateral very short racemes. This plant is a tree 60 feet in height, and is a native of the Caribbee Islands. It has white sweet-scented flowers, and a green fruit something like the cornelian cherry, which contains a white solid kernel. An oil is expressed from the seed for domestic uses and for burning in lamps. The timber is used for various purposes, especially for staves and cask-headings. Lindley says that "the true East Indian Tacamahaca is produced by *Calophyllum Calaba*." There are however several gums brought into the market under the name of Tacamahaca, of which formerly more was used than at the present day. The 'Tacamahaca seu Resina Tacamahaca' of the old Pharmacopœias appears to have been the produce of the *Elaphrium tomentosum* and *E. excelsum*, plants belonging to the natural order *Amyrideæ*. It is described as a resin of a brownish yellow colour, spotted with white, easily broken into pieces, which have a shining fracture, easily melting in the fire, and having a pleasant scent. Cullen says that it was not employed in his day "as an internal medicine; and as an external I cannot perceive its virtues." It was used for making plasters as a counter-irritant, for which there are forms in the continental Pharmacopœias at the present day. There is however another form of Tacamahaca brought to Europe called 'Tacamahaca-in-Shells.' It has got this name from being collected in little gourd-shells. This is the true East Indian Tacamahaca, which is collected from *C. Inophyllum* in the East Indian Islands and from *C. Tacamahaca* in Madagascar and the Mauritius. *C. Brasiliense* yields an acrid aromatic lemon-scented resin. *C. angustifolium* is the Piney-Tree of Penang, and yields a hard timber.

(Bischoff, *Medicinisch-Pharmaceutische Botanik*; Loudon, *Encyclopædia*; Don, *Gard. Dict.*; Lindley, *Vegetable Kingdom*.)

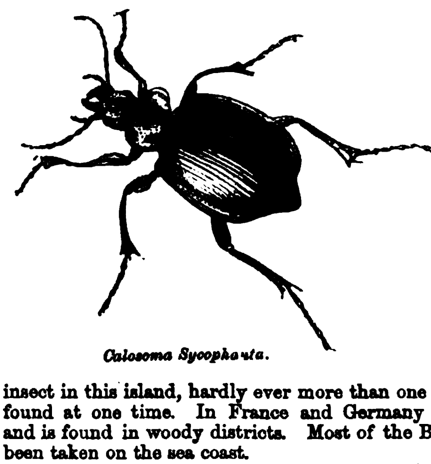
CA'LOPUS, a genus of Coleopterous Insects belonging to the section *Stenelytra* and family *Œdemeridæ*. The species are distinguished by having the femora of the posterior legs of the same size in both sexes, or nearly so; the antennæ with the second joint much shorter than the third, more or less serrated, and inserted into an emargination of the eyes. [ŒDEMERA.]

CALOSO'MA, a genus of Coleopterous Insects belonging to the section *Geodephaga* (M'Leay), and family *Carabidæ*. It is known by the following characters:—Three basal joints of the anterior tarsi, in the males, much dilated, the fourth joint slightly so; antennæ with the third joint longer than the rest; labrum bilobed; mandibles simple, slightly bent, and transversely striated; thorax short; elytra generally rather broad and short.

This genus is very closely allied to the true *Carabi*; indeed so much so, that it is difficult to point out any very tangible distinguishing characters; and yet the entomologist is seldom puzzled in separating them, even without close examination.

There is a considerable difference in the general appearance of the species of the two genera, and we think this in a great measure arises from the comparative proportions of the head and thorax. In *Calosoma* these parts are always smaller and considerably shorter in proportion to the body (which is generally broad) than in *Carabus*. The eyes are generally more projecting; and M. Dejean mentions the larger-sized jaws, and their being always transversely striated, as a good distinction.

To the genus *Calosoma* belongs our largest and most beautiful British Carabideous insect, the *C. Sycophanta*. It is about an inch long; the head, thorax, and under parts of the body are of a beautiful blue colour, and the elytra are green, with red reflections more or less conspicuous in different examples; the legs and antennæ are black.



Calosoma Sycophanta.

Most of the best British collections contain this insect, and some even several specimens: it must nevertheless be considered a rare insect in this island, hardly ever more than one specimen having been found at one time. In France and Germany it is not uncommon, and is found in woody districts. Most of the British specimens have been taken on the sea coast.

C. Inquisitor is the only other species of this genus found in this country. It is about three-quarters of an inch in length, and of a bronze or brassy-green above, and black beneath. This species, though by no means common, is far more abundant than the last. It has been frequently met with crawling up the trunks of oak-trees in the spring of the year, about the time that that tree begins to put forth its leaves. Most probably it feeds upon the young caterpillars, which are then abundant.

Unlike most genera of insects, this appears to be confined to no particular quarter of the globe, species having been met with in almost all countries. About thirty species are known; their prevailing colours are various shades of green, generally of a brassy hue, and sometimes black.

CALOTHRIX. [ALGÆ.]

CALOTRAGUS. [ANTILOPEÆ.]

CALOTROPIS, a genus of plants belonging to the natural order *Asclepiadaceæ*. One species, *C. gigantea* (*Asclepias gigantea*, Linnæus), is the Mudar-Plant, Akund or Yercum of the Hindoos. It yields a milky juice, which is extensively used in India as a medicinal agent, as are also the root and bark. [MUDAR, in ARTS AND SC. DIV.]

CALPE. [ACALEPHÆ.]

CALTHA, a genus of plants belonging to the natural order *Ranunculaceæ*. Two species are met with in this country; one, *C. palustris*, the Water-Caltrops or Marsh-Marigold, commonly in meadows and by the side of wet ditches. It is very much like a *Ranunculus*, from which genus *Caltha* chiefly differs in having a calyx and corolla mixed together, no scale at the base of the petals, and many seeds in each carpel. The other species is *C. radicans*, which is very local. The species partake of the acridity of *Ranunculus* itself.

CALUMBO-ROOT, the bitter tonic root of an African plant called *Cocculus palmatus*. [COCCULUS.]

CALYCANTHA'CEÆ, *Calycanths*, the Calycanthus Tribe, a natural order of hardy Dicotyledonous Plants, well known in gardens for the delicious fragrance of their blossoms. They are in some respects allied to the *Magnolia*, or Star-Anise Plant (*Illicium*), in consequence of their chocolate-coloured flowers with the segments overlying each other in several rows, and because also of their peculiar fragrance; their true affinity is however with *Rosaceæ*, as the mass of their characters sufficiently proves; especially the unusual circumstance of the cotyledons of the embryo being rolled up both in this order and in the genus *Chamæmeles* in *Rosaceæ*.

Calycanthaceæ consist of but two genera, *Calycanthus* and *Chimonanthus*, which agree in having—1st, an imbricated calyx and corolla that pass insensibly into each other, and combine at their bases into a thick fleshy tube; 2nd, a small number of perigynous stamens, whose anthers are adnate and are tipped by a projection of the connective; 3rd, several one-seeded nuts inclosed in the tube of the calyx; and 4th, a convolute embryo, destitute of albumen. Their wood is remarkable for the glandular nature of the woody tubes; and for having, in addition to the usual structure of exogens, four imperfect axes with concentric circles, lying at equal distances in the bark near the circumference, on which they produce externally four elevated lines or wheals.

The two genera are thus distinguished:—*Calycanthus*, or the Carolina Allspice, has 48 stamens arranged in four rows, the innermost being rudimentary; and a great many nuts inclosed in a calyx, which is naked at its apex. It consists of small shrubs, natives of North America, with fragrant chocolate-coloured flowers, appearing along with the leaves in May or June.

Chimonanthus, or the Japan Allspice, has 10 stamens, all perfect and inserted in a double row; only one or two nuts to each calyx-tube, which is crowned and closed up by the permanent recurved stamens. The only species is found wild in Japan, and has fragrant lemon-coloured blossoms, appearing in the winter after the fall of the leaves. Botanists call it *Chimonanthus fragrans*, and distinguish three varieties:—1st, the pale kind, which has long been in gardens, and has flowers the colour of which is very slightly yellow; 2nd, the large-flowered, with bright yellow flowers twice as large as those of the last; and 3rd, the small-flowered, which is in all respects the same as the first, except that its blossoms are less than half the size. These plants are multiplied with some difficulty by layering. (Lindley's *Vegetable Kingdom*.)

CALYCANTHUS. [CALYCANTHACEÆ.]

CALYCERA'CEÆ, *Calycera*, a small natural order of Monopetalous Dicotyledons, differing from *Compositæ* in nothing but their seeds having albumen, and being pendulous, and in their anthers being only half syngenesious. It has five genera and ten species. They are natives of South America, but more especially of South Chile.

CALYCIFLO'RÆ, an artificial division of Polypetalous Dicotyledonous Plants, proposed by Jussieu and adopted by De Candolle. It is characterised by the stamens adhering more or less to the side of the calyx; or, in the language of the French school of botanists, being perigynous.

CALYCOPHYLLUM (from κάλυξ, calyx, and φύλλον, leaf), a genus of plants belonging to the natural order *Cinchonaceæ*. It has the limb of the calyx truncate or bluntly 5-toothed, one of the teeth expanded into a petiolate coloured membranous leaf; the corolla campanulate or funnel-shaped with a 5-plaited limb; 5 stamens, the filaments rising from the throat free, the length of the corolla; the anthers oval, exserted; the style ending in 2 reflexed stigmas; the capsule dehiscing at the apex, oblong, 2-celled, many-seeded; the seeds fixed to the linear placenta, imbricate, oblong, girded by a very narrow membranous wing. The species are small smooth trees, with opposite glabrous leaves, short stipules, and flowers disposed in axillary and terminal dichotomous corymbs.

One of the most remarkable species of this genus has been described by Sir Robert Schomburgk as a native of British Guyana. There are several genera closely allied to *Calycophyllum*, as *Mussænda Pinkneya*, &c., in which one of the teeth of the calyx expands into a petioled and coloured leaf of a membranaceous texture. In the species discovered in Guyana the bract-like expansion of the calyx has a rose colour, and as the flowers are very numerous the whole tree assumes the colour of the rose. In describing the discovery of this plant, Sir Robert says, "Let imagination convey you to the great garden of nature in Guyana, clothed in tropical exuberance; and, among those productions of a congenial sun and fertile soil, figure to yourself trees from 40 to 50 feet high, presenting a mass of leaves the colour of our favourite flower, from a deep pink to the lightest rose, and perhaps your fancy will assist you to form some idea of the picture I beheld at one of the valleys of the river Rapunnuni, where a high mountain on the river's left bank turns its bed boldly to the east. The banks of the stream and the steep side of the hill were alike covered with trees clothed with rose-coloured leaves; and only on a near approach could the shining green leaves and the spikes of flowers of a velvety blue be discovered."

This plant is called by its discoverer, in honour of the present Lord Derby, *Calycophyllum Stanleyanum*. The wood of the tree is very hard. It is very bitter to the taste, and like the rest of the order is probably febrifugal.

(Hooker, *London Journal of Botany*, 1844.)

CALY'MENE, the generic title, in Brongniart's classification of *Trilobites*, for the species of *Crustacea* allied to the well-known Dudley fossil, *Calymene Blumenbachii*. [TRILOBITES.]

CALYMMA, a genus of Ciliograde *Acalephæ*, thus characterised by Eschscholtz:—Body but little elevated, compressed, widened, as it were, and provided on each side with a considerable appendage, taking its rise from four other smaller appendages, free at their extremity, near the mouth, and furnished with the series of cilia. The species on which this genus was established was taken in the South Seas near the equator.

CALY'PTRA, in Botany, a name given to a hood-like body connected in some plants with the organs of fructification. In the genus *Pileanthus* it covers over the flower, and is formed of united bracts; in *Eucalyptus* and *Eudesmia* it is simply a lid or operculum to the stamens, and is produced in the former by the consolidated sepals, in the latter by the petals in the same state: in mosses it is seated upon the end of the fruit-stalk, inclosing the spore-vessel, and is a leaf rolled round the latter and torn away from its base. In *Jungermannia* it exists in the form of a cup or wrapper at the base of the fruit-stalk, which, instead of carrying it up upon its point, pierces through its apex and leaves it behind.

CALYPTRÆ'IDÆ, a family of Gasteropodous *Mollusca*, formerly arranged under the genus *Patella* of Linnæus, and known by collectors as Chambered Limpets, comprising the genera *Calyptræa* and *Crepidula* of Lamarck, with the sub-genera into which they have been divided by Lesson.

"When," says M. Deshayes, in his edition of Lamarck, "collections contained but a small number of *Calyptræ* and *Crepidulæ*, and when the animals of these two genera were unknown, it was natural and proper to preserve them both; but now the resemblance of the animals of these two genera is proved, not only by what M. Cuvier formerly stated in the 'Annales du Muséum,' but also by the more recent works of M. Lesson, of Messrs. Quoy and Gaimard, and of Mr. Owen. Already we had perceived, in publishing our work upon the environs of Paris, as well as in our articles '*Calyptræa*' and '*Crepidula*' in the 'Encyclopédie,' that there existed a great resemblance between the shells of these two genera. One sees in effect, in certain *Crepidulæ*, the summit taking a spiral shape upon the side of the shell, and raising itself insensibly in a succession of species so as to show an incontestable passage between the *Crepidulæ* and spiral *Calyptræa*, which we would particularly designate by the name of Trochiform *Calyptræa*. As in the *Calyptræ*, properly so called, there exist a certain number of particular forms which may serve to group them in sections, it was necessary to see whether the species having in their interior a lamina or plate of a funnel shape afforded proof of a passage to the *Crepidulæ*, like those which are trochiform. This passage does exist; so that from the entire facts we may come to the conclusion that the two genera, *Calyptræa* and *Crepidula*, ought to be united for the future in the system. This conclusion, which we had in some sort foreseen, has been rigorously drawn and proved by incontestable evidence in the work lately published by Mr. Broderip, in the first volume of the 'Transactions of the Zoological Society of London.' M. Lesson, in the conchological part of the great work published on the return of the expedition in the corvette La Coquille, had attempted to establish in the united genera *Calyptræa* and *Crepidula* many sub-genera, of which some have been adopted by Mr. Broderip as sections of the entire genus *Calyptræa*. These sections, of which some persons think that they can make genera, are connected one with another by the strongest affinities, and cannot be separated into genera on account of the resemblance of the animals."

Deshayes then proposes the following sections of the great genus *Calyptræa*:

1. Those which have in their interior, and fixed to the summit, a shelly plate, hollowed out into a sort of gutter, which may be compared to a hollow cone of paper cut longitudinally in two, and of which one portion has been removed. (*Calyptræa equestris*.)

2. Those which have a delicate plate or lamella in the form of a funnel, fixed either to the side or the summit: a well-defined section, representing nevertheless a passage towards some of the *Crepidulæ*.

3. Uniting all the species from those which begin to have a very short lamella attached to the internal side (*Calyptræa extinctorium*) to those whose lamella forms spiral turns (*Calyptræa trochiformis*), the gradations being very insensible. To this section M. Deshayes thinks that many of Lamarck's *Crepidulæ* should be referred.

4. *Crepidula*, properly so called. This section he says might be subdivided, taking for a basis of the subdivision characters of less value than those relied on for forming the four principal sections.

Some idea of the variety of shape to which these shells are subject may be obtained from the following passage in Mr. Broderip's paper:—"I have before me specimens taken from under the same stone, evidently of the same species, varying in shape from a regular high cone to an almost flat surface, with nearly every intervening irregularity of circumference that can be imagined."

The species of *Calyptræidæ* are numerous and widely diffused; but the great development of the form is to be found in warm climates, where many of the species attain considerable size, and are remarkable for their form and the richness of their colour. They are found sticking on rocks, on and under stones, on other living and dead shells and submarine substances at depths varying from the surface to 40 fathoms, on sea-coasts, in æstuaries, and in tidal rivers.

Two genera of this family have representatives in the British seas—*Pileopsis* and *Calyptræa*. Each genus has one species. *Pileopsis Hungaricus* is a common Limpet on our shores, and is known by the name of the Bonnet or Large Foolscap Limpet. *Calyptra Sinensis* is essentially a southern British shell. It does not range north of Britain, but extends southward to the Mediterranean. Both these species are found fossil, and date back as far as the Coralline Crag.

CALYSTE'GIA (from καλὺξ, calyx, and στέγω, to cover), a genus of plants composed of species formerly included under *Convolvulus*, and separated by Robert Brown. It is distinguished by two large bracts which inclose the flower. It has a 5-parted calyx, a campanulate 5-plicate corolla, one style, a 2-lobed stigma, globose or terete lobes, a 2-celled ovarium with 2 ovules; the capsule only 1-celled from the shortness of the dissepiment. The species are lactescent, glabrous, twining or prostrate herbs, with solitary 1-flowered peduncles.

C. Sepium, Great Bindweed, has sagittate or cordate very acute leaves; lobes truncate, entire, cordate, keeled; acute bracts, longer than the calyx, but one-half shorter than the corolla; the peduncles square; sepals acute. This is the *Convolvulus Sepium* of older botanists. The genus *Calystegia* is not adopted by Koch, Babington, and other botanists. It is a native of Europe, in hedges, and is found in Great Britain very common. It possesses apparently the properties of the genus *Convolvulus*. Haller and Withering state that the expressed juice of the root may be used as a substitute for scammony. It is sometimes called German Scammony. In doses of 20 or 30 grains it has been recommended as a hydragogue cathartic in dropsies, by Mason Good.

C. Soldanella, Sea Bindweed, has trailing glabrous rather fleshy leaves, reniform, entire, or a little angular; peduncles angular, angles winged; bracts large, ovate, blunt, mucronate, generally shorter than the calyx. It is a native of many parts of Europe on the sea-coast, and also some parts of Asia. It is common on the coasts of Great Britain. The young stalks are sometimes eaten pickled. The juice of the mature plant is however a cathartic.

Several other species of this genus are described. Like the *Convolvuli* they are elegant plants in blossom, and are of the most easy culture. They may be propagated by pieces of the root or by seeds. The *C. Soldanella* should now and then be watered with salt-water.

(Don, *Gardener's Dictionary.*)

CALYX, the external wrapper of a flower within the bracts. Usually it is green and leaf-like, sometimes however it is coloured like a corolla, from which it is only known by its being the outermost of the rows of floral envelopes. It consists of leaves called sepals, which are sometimes separate, when the calyx is polysepalous, and sometimes united into a sort of cup by the edges, or monosepalous. Occasionally it is converted into feathery or short divisions, when it is named pappus; or it is altogether reduced to a small rim, so as to be hardly visible. In some plants it grows to the sides of the ovary, and is technically called superior, while it is named inferior if it is quite separate from that part. Its segments are usually of the same number as those of the corolla, and alternate with them. The office of the calyx appears to be, in its ordinary green state, merely that of protecting the tender parts that are formed within it; but when it is coloured and similar to a corolla, we can scarcely doubt that in such cases it also performs the part of a corolla. [COROLLA.] In some instances, as in that of pappus, it seems merely intended as a means of transporting seeds to a distance by enabling them to catch the wind by the wings which it at that time resembles. This is especially seen in many of the fruits of *Compositæ*. The foliar nature of the sepals is well seen in the cases of *Calycophyllum*, *Mussænda*, &c., where the sepals naturally grow into leaves.

CAMASSIA, a genus of Bulbous Plants belonging to the natural order *Liliaceæ*. The bulbs of one of the species (*C. esculenta*) are eaten by the North American Indians under the name of Quamash.

CAMBING OUTAN. [ANTILOPEÆ.]

CAM'BIUM, a viscid substance that appears in the spring between the wood and bark of exogenous trees. It is in this substance that the young cells are formed which become the wood of the following year. This substance disappears every spring after the complete formation of the wood, which then adheres firmly to the bark; but it re-appears whenever the plant is again called into growth, as at midsummer in those species which shoot twice a year, like roses, peaches, &c.

CAMBOGE. The produce of several species of plants belonging to the natural order *Guttiferæ* is known by this name. It is a gum-resin, and has purgative properties. On account of its bright yellow colour it is also used as a pigment. [STALAGMITES; GARCINIA; CLUSIACEÆ.]

CAMBRIAN ROCKS. Science is indebted to Professor Sedgwick for having established in North Wales, beyond a doubt, the important fact, that beneath the slates and flags of Denbighshire, which belong to the Upper Silurian Strata, occur in the Berwyn Mountains and in the vicinity of Bala other strata containing Lower Silurian fossils, to the extent of several thousand feet in thickness. In South Wales the progress of the Geological Survey, under Sir H. De la Beche, has established the fact of very considerable thicknesses of partially fossiliferous rocks beneath the Llandeilo (or Lowest Silurian) Strata of Murchison. By these labours we perceive that the Palæozoic forms of organisation descend, in Wales, many thousand feet below the lowest recognised Silurian strata, and the subjoined view of the nomenclatures, separately proposed by Sedgwick and Murchison, will give an idea of the relations of these rocks.

Lower Palæozoic Strata.		Upper Silurian. (Murch.)	Ludlow Rocks. Wenlock Rocks.
	Cambrian Strata. (Sedgw.)	Lower Silurian. (Murch.)	Caradoc Rocks. Llandeilo Rocks.
		Groups yet to be named.	——— ———

Hypozoic Strata of Cumberland and Scotland.

Thus it appears that the Cambrian Strata are not exactly equivalents of the Lower Silurians, but include a great range of other strata below those originally defined by Sir Roderic Murchison. Viewed, however, without reference to nomenclature, the Cambrian and Lower Silurian Rocks form one type, and may perhaps deserve to be ranked as one great Protozoic System. [*See* SUPPLEMENT.]

CAMEL. [CAMELUS.]

CAMELI'NA, a genus of plants belonging to the natural order *Cruciferæ*, to the sub-order *Latiseptæ*, and the tribe *Camelineæ*. It has a subovate pouch, the valves ventricose, with a linear prolongation at the end, which is confluent with the persistent style.

C. sativa, Gold of Pleasure, has pear-shaped pouches, intermediate stem, leaves lanceolate, sagittate at the base, entire or denticulate. It has small yellow flowers. Its name is a burlesque on the humble appearance of the plant. Babington admits it into his British Flora, but it is undoubtedly a foreign plant, which has been introduced with the seed of flax. It is found abundantly in the corn and flax fields of the Continent, from whence the seed is brought to this country.

C. dentata is another species frequently found in Great Britain, in company with the last, and introduced in the same way.

CAME'LLIA, a genus of plants belonging to the natural order *Ternstromiaceæ*, and nearly related to the plants which yield the tea of the shops. All the species are natives of China and Japan, or of corresponding climates in the north of India, whence they have been introduced to Europe. *C. Japonica*, a species with broad shining leaves, and red flowers, is the origin of the numerous beautiful varieties now so common in our gardens. The principal part of these have been raised by the skill of the Chinese or Japanese, and are remarkable not only for their gay colours, but for the great symmetry with which their petals are arranged, the flowers when seen in perfection resembling nothing so much as beautiful shell-work. The sorts that have been raised in this country are in most instances inferior to the Chinese in symmetry, but they occasionally surpass them in richness of colour. They are multiplied by cuttings, grafts, and buds, and also by seeds, which the Waratah and some single sorts produce in plenty.

The other species of *Camellia* in our gardens which deserve notice are, the *C. maliflora*, the Apple-Blossomed Camellia, which is probably a mere variety of the last; *C. oleifera*, whose seeds yield a valuable oil in China; and *C. reticulata*, which is by far the handsomest of all. The leaves of this species are very remarkably netted, and the semi-double flowers, which are sometimes as much as six inches across, are of a deep rich rose-colour. For the culture of these plants see CAMELLIA, in ARTS AND SC. DIV.

CAMELOPARD. [GIRAFFA.]

CAMEL'S-THORN a name given to a species of *Alhagi*, the *A. Camelorum*. [ALHAGI.]

CAMELUS a genus of Ruminant Animals without horns; Gamal of the Hebrews, Djemal of the Arabs, Κάμηλος of the Greeks, Camelus of the Romans, Cammello of the Italians, Camello of the Spaniards, Kameel of the Germans, Chameau of the French, and Camel of the English. It includes two species, *C. Bactrianus*, the Camel, and *C. Arabicus*, the Dromedary.

The Camels have 34 teeth: 16 in the upper jaw; namely, two incisors—for the camels and the llamas have these, and form the exceptions, the other ruminants being without any incisors in the upper jaw—two canines, twelve molars: 18 in the lower jaw; namely, six incisors, two canines, ten molars. The incisors of the upper jaw bear a close resemblance to canine teeth, for they are conical, compressed at the sides, pointed, and somewhat curved or hooked. There is another difference between the Camels and the other Ruminants: the former have the scaphoïd and cuboïd bones of the tarsus separated. Instead of the great horny case or shoe, which envelopes all the lower part of each toe and determines the figure of the ordinary cloven hoof, the camels have only a small one, or rather the rudiment of one, adhering only to the last joint of the toe, and symmetrical in form, like the hoofs of the *Pachydermata*. These and other peculiarities of form lead to the opinion that the Camels and the Llamas form the link between the *Ruminantia* and *Pachydermata*.

The characters of the genus may be thus summed up:—Lower incisors in the form of cutting wedges; upper incisors sub-lateral; canines conical, sub-erect, strong; false molars situated in the inter-dentary space on either side; head long; upper lip cleft; nostrils slit obliquely; eyes prominent; ears small. Neck elongated. Back with fleshy bosses or hunches; tail moderate. Toes united below. Teats ventral, four in number. Hair inclining to woolly. Callosities on the breast, and flexible points of the extremities. The upper lip of the Camel swollen and divided, the projecting orbits of its eyes, the lengthened and certainly not graceful neck, the back bossed with a hump or humps, and croup comparatively weak, supported upon the long and awkward-looking legs terminating in apparently disproportioned feet, are not materials for producing elegance of form: and indeed the air of the animal is altogether grotesque; but this uncouth shape is, as we shall presently see, one of those admirable examples of contrivance which must strike the most casual observer.

The two species of Camel were well known to Aristotle, who, in his 'Natural History' (ii. 1), mentions both the Arabian and the Bactrian, remarking that the latter has two humps, whereas the former has but one.

The organisation of the Camels is wonderfully adapted to their habits and uses to man. The pads or sole-cushions of the spreading feet are divided into two toes without being externally separated, which buoy up as it were the whole bulk with their expansive elasticity from sinking in the sand, on which it advances with silent step—the nostrils so formed that the animal can close them at will to exclude the drift sand of the parching simoom—the powerful upper incisor teeth for assisting in the division of the tough prickly shrubs and dry stunted herbage of the desert—and, above all, the cellular structure of the stomach, which is capable of being converted into an assemblage of water tanks, bear ample testimony to the care manifested in the structure of this extraordinary quadruped.

The stomach of the Camel has been well described by Sir Everard Home.

"The camel's stomach," he says, "anteriorly forms one large bag, but when laid open this is found to be divided into two compartments, on its posterior part, by a strong ridge, which passes down from the right side of the orifice of the œsophagus, in a longitudinal direction. This ridge forms one side of a groove that leads to the orifice of the second cavity, and is continued on beyond that part, becoming one boundary to the cellular structure met with in that situation. From this ridge eight strong muscular bands go off at right angles, and afterwards form curved lines, till they are insensibly lost in the coats of the stomach. These are at equal distances from each other, and, being intersected in a regular way by transverse muscular septa, form the cells. This cellular structure is in the left compartment of the first cavity, and there is another of a more superficial kind on the right, placed in exactly the opposite direction, made up of twenty-one rows of smaller cells, but entirely unconnected with the great ridge. On the left side of the termination of the œsophagus a broad muscular band has its origin from the coats of the first cavity, and passes down in the form of a fold parallel to the great ridge, till it enters the orifice of the second, where it takes another direction. It is continued along the upper edge of that cavity, and terminates within the orifice of a small bag, which may be termed the third cavity. This band on one side and the great ridge on the other form a canal, which leads from the œsophagus down to the cellular structure in the lower part of the first cavity. The orifice of the second cavity, when this muscle is not in action, is nearly shut; it is at right angles to the side of the first. The second cavity forms a pendulous bag, in which there are twelve rows of cells, formed by as many strong muscular bands, passing in a transverse direction, and intersected by weaker muscular bands, so as to form the orifices of the cells. Above these cells, between them and the muscle which passes along the upper part of this cavity, is a smooth surface, extending from the orifice of this cavity to the termination in the third.

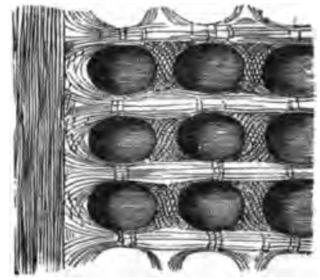
"From this account it is evident that the second cavity neither receives the solid food in the first instance, as in the bullock, nor does the food afterwards pass into the cavity or cellular structure. The food first passes into the first compartment of the first cavity, and that portion of it which lies in the recess, immediately below the entrance of the œsophagus, under which the cells are situated, is kept moist, and is readily returned into the mouth along the groove formed for that purpose, by the action of the strong muscle which surrounds this part of the stomach, so that the cellular portion of the first cavity in the camel performs the same office as the second in the ruminants with horns. While the camel is drinking, the action of the muscular band opens the orifice of the second cavity at the same time that it directs the water into it; and when the cells of that cavity are full, the rest runs off into the cellular structure of the first cavity immediately below, and afterwards into the general cavity. It would appear that camels, when accustomed to go journeys, in which they are kept for an unusual number of days without water, acquire the power of dilating the cells so as to make them contain a more than ordinary quantity as a supply for their journey; at least, such is the account given by those who have been in Egypt. When the cud has been chewed, it has to pass along the upper part of the second cavity before it can reach the third. How this is effected without its falling into the cellular portion, could not, from any inspection of dried specimens, be ascertained; but when the recent stomach is accurately examined the mode in which this is managed becomes very obvious. At the time that the cud has to pass from the mouth the muscular band contracts with so much force that it not only opens the orifice of the second cavity, but acting on the mouth of the third brings it forward into the second, by which means the muscular ridges that separate the rows of cells are brought close together, so as to exclude these cavities from the canal through which the cud passes."

Sir Everard Home having stated that John Hunter did not give credit to the assertion that the Camel can retain a quantity of water in its stomach unmixed with the food, and capable of being recovered after the animal has been killed, the following note by Dr. Patrick Russell, in the Appendix to his brother's 'History of Aleppo,' is of some interest:—"That water, in cases of emergency, is taken from the stomach of camels, is a fact neither doubted in Syria nor thought strange. I never was myself in a caravan reduced to such an expedient; but I had the less reason to distrust the report of others, particularly of the Arabs, seeing that even the love of the marvellous could in such a case be no inducement to invention. It may perhaps be superfluous to produce the authority of an Arab historian (Beidawi), who, in his account of the Prophet's Expedition to Tabuc against the Greeks, relates, among other distresses of the army, that they were reduced to the necessity of killing their camels for the sake of the water contained in their stomachs. (Sale, 'Koran,' p. 164; Gibbon, 'Decline and Fall of the Roman Empire,' v. p. 245.)

"On my return from the East Indies, in 1789, hearing accidentally that my friend Mr. John Hunter had dissected a camel, and was supposed to have expressed an opinion that the animal's power of preserving water in its stomach was rather improbable, I took an opportunity of conversing with him on the subject, when (to the best of my recollection) he told me that 'he by no means drew any such absolute inference from his dissection; that he saw no reason for assigning more than four stomachs to the camel, though he could conceive that water might be found in the paunch little impregnated by the dry provender of the desert, and readily separating or draining from it.'

"In hopes that other particulars might be found among the papers of my lately-deceased friend, I applied to his brother-in-law, Mr. Home, who informed me that he had examined them, but without discovering any observations on the subject." (Vol. ii. p. 425.)

"From these remarks, then, it appears that the small cavity regarded by Daubenton as analogous to a reticulum, was not considered by Mr. Hunter as of sufficient importance to be ranked as a distinct stomach; and the water-bag must therefore, in his opinion, have held the place of the honey-comb-bag in the horned ruminants. And when we compare the relation of the reticulum to the rumen in that tribe, with the corresponding free communication which subsists between the water-bag and rumen in the camel tribe; and when also we observe in both the precise correspondence in the mode of communication of these two cavities with the œsophagus and with the muscular apparatus destined to convey the re-masticated food beyond their apertures into the third cavity, and at the same time find an approach to the peculiar disposition of the cells of the water-bag in the reticulum of some of the horned ruminants, it becomes evident that the two cavities are analogous, the reticulum of the camels being modified for its destined functions by the greater development of the secondary cells, by the absence of a cuticular lining, and by the production of the inner layer of the muscular tunic, which forms the apparatus for closing the orifice of the primary cells. The third cavity, therefore, which could not have been recognised as a distinct compartment in the llama, and which undoubtedly receives the re-masticated food in the camel, ought rather to be regarded as a peculiar structure, to which nothing analogous is to be found in the stomachs of the horned ruminants."



Cells of Camel's Stomach, one-ninth of natural size.

Here is represented the muscular arrangement provided for closing the orifices of the cells so as to prevent the food from falling into them. The cells themselves are exposed, bringing into view their bottoms, the muscular conformation of which enables the animal to give out their contents.

The seven callosities on the flexures of the limbs and chest, and the hump on the back, seem perhaps to bear more relation to the necessities of the animal, considered as the slave of man. These callosities are the points whereon the animal rests when it kneels down to receive its burden. The hump, which is a fatty secretion, is known to be absorbed into the system when the animal is pinched for food, thus forming a provision against the casualties of a life ordained to be spent in the desert.

The Camel furnishes the Arab with flesh and milk; of its hair he weaves clothing and even tents; his belt and his sandals are the produce of its hide; and the dung affords him fuel. The soot of this fuel, after having undergone the process of sublimation in closed vessels, produced the sal-ammoniac, or hydrochlorate of ammonia, which was formerly imported from Egypt into this country, where the alkali is now however manufactured in a variety of ways. In the East the hair of the camel is made into cloth. The raiment of John the Baptist was of camel's hair. (Matthew, iii. 4; Mark, i. 6.) It is principally imported into these islands for the manufacture of pencils for the painter. The hair which is the product of Persia is held in the greatest estimation. There are three qualities—black, red, and gray; the black brings the best price, the red comes next in value, and the gray is only valued at half the price of the red. But these uses are mere trifles when compared with the paramount importance of these animals as commercial vehicles, 'ships of the desert,' as they have been poetically termed; for they are the living machines by means of which communication is kept up across the most desolate and frightful deserts, which without some such aid would be entirely impassable by man. These toilsome journies over the most dreary and inhospitable regions, the organisation of the camel and its extreme temperance enable it to perform with comparative ease.

The load of a heavy or slow-going camel in one of the caravans is, according to Major Rennell, from 500 to 600 lbs. weight. The latter is the amount given by Sandys as the ordinary load; "yet," he adds, "will he carry a 1000 lbs. weight." At Pisa the burden of a full-grown camel is stated to be sometimes 400 kilogrammes (above 850 lbs.). The mode of training the beast to bear these loads seems to vary. Brue, speaking of an African mode (Senegal) towards the end of the 17th century, says:—"Soon after a camel is born the Moors tie his feet under his belly, and having thrown a large cloth over his back, put heavy stones at each corner of the cloth, which rests on the ground. They in this manner accustom him to receive the heaviest loads." Santi describes the method adopted at Pisa. At the age of four years a camel which is intended for labour is broken in. The trainers first double up one of his fore legs, which they tie fast with a cord; they then pull the cord, and thus usually compel the animal to fall upon his bent knee. If this does not succeed they tie up both legs, and he falls upon both knees, and upon the callosity which is upon his breast. They often accompany this operation with a particular cry and with a slight blow of a whip. At this cry and blow, with the addition of a sudden jerk downwards of his halter, the camel gradually learns to lie down upon his belly, with his legs doubled under him, at the command of his driver. The trainers then accustom him to a pack-saddle, and place on it a load at first light, but increased by degrees as the animal advances in docility, till at last, when he readily lies down at the voice of his driver and as readily rises up with his load, his education is so far complete. The camels at Pisa, it appears, do not complain if too heavily laden; but in Egypt, according to Denon, they remonstrated loudly on such occasions, crying out when they were laden too heavily or unequally.

In travelling with a caravan the acute sense of smelling possessed by the Camel is strikingly displayed. When apparently completely worn out, and when all have been on the point of perishing with thirst, he has been known to break his halter and run with unerring certainty to a spring which had escaped the observation of the other quadrupeds of the caravan, and of man himself.

Arabia, Persia, the south of Tartary, some parts of India, and Africa, from Egypt to Mauritania, and from the Mediterranean to the river Senegal, appear to be the countries over which the Arabian Camel is principally distributed. It is also numerous in the Canary Islands. That it was a native of Asia from the earliest times, and the great oriental commercial vehicle of ancient as it is of modern days, cannot be doubted. We trace it repeatedly in the Scriptures. Thus when Joseph's brethren had cast him into the pit, and after the commission of their crime had sat down to eat bread, "they lifted up their eyes and looked, and, behold, a company of Ishmaelites came from Gilead, with their camels bearing spicery and balm and myrrh, going to carry it down to Egypt." (Genesis xxxvii. 25.) Again, in Judges, viii. 21, we read that "Gideon arose and slew Zebah and Zalmunnah, and took away the ornaments that were on their camels' necks." In Genesis xxxii. 7, we find that Jacob "divided the people that was with him, and the flocks, and herds, and the camels, into two bands;" and the domestic state of the animal at this early period is further proved by verse 15 of the same chapter, where we see, as part of the present sent by Jacob to propitiate Esau, "thirty milch camels with their colts." In Leviticus, xi. 4, the camel is enumerated among the forbidden animals, "because he cheweth the cud, but divideth not the hoof: he is unclean unto you." Part of Job's "substance (Job i. 3.) consisted of three thousand camels;" and the third messenger of evil informs him (i. 17) that "the Chaldæans made out three bands, and fell upon the camels, and have carried them away." When, after his afflictions, the Lord blessed the latter end of Job more than his beginning (xlii. 12) "six thousand camels" formed a portion of the blessing. And here we may observe that though the inquiry has been the subject of much research, there is no satisfactory evidence of the existence of the Camel in an originally wild state at any period whatever. Diodorus and Strabo indeed mention its existence in such a state in Arabia; and Desmoulins, who has written most valuably on the subject, asserts that it so existed in the time of Hadrian; the natives too of Central Africa maintain, it is said, that the animal is to be found wild in the mountains where Europeans have never penetrated. But it is far from improbable that these wild camels might, like the wild horses of the American prairies, have owed their parentage to camels which had escaped from the control of man. Cuvier, in relating the report of Pallas upon the evidence of the Bucharians and Tartars that there are wild camels in the deserts of the middle of Asia, well remarks that it must not be forgotten that the Calmucks give liberty to all sorts of animals from a religious principle.

In Europe, Pisa seems to be the only locality where the Camel is now bred. At San Rossora, the arid plains and stunted bushes bear some distant resemblance to the Asiatic and African desert; but most authors who understand the subject agree in considering that the race is fast degenerating. The time of their introduction into Tuscany is not accurately known.

The Arabian Camel was introduced into Spain by the Moors; and the southern districts possessed many of these animals for a considerable period after the conquest of Granada; but they are now no longer to be found as a species in the Spanish territory. After the conquest of Spanish America an attempt was made to introduce them into that country by Juan de Reinega, a Biscayan; and Acosta saw them towards the end of the 16th century at the foot of the Andes. But the introduction of these animals was looked upon with no favourable eye by the ruling Spaniards, and they gradually dwindled away. They have however been lately imported with greater success from the Canary Islands. Humboldt mentions them, and particularly some that he saw feeding under a palm-tree near New Valencia.

Camelus Bactrianus (Linn.), the Mecheri, or Camel. It is the *C. Ditophus* of Walther, *C. Turcicus* of Alpinus, the Bactrian Camel of Pennant, Le Chameau of Buffon, the Trampelthier of Knorr. It has two humps on the back. Length about 10 feet. Hair shaggy, particularly under the throat. Colour generally dark-brown. Localities, Persia, Turkey, &c.

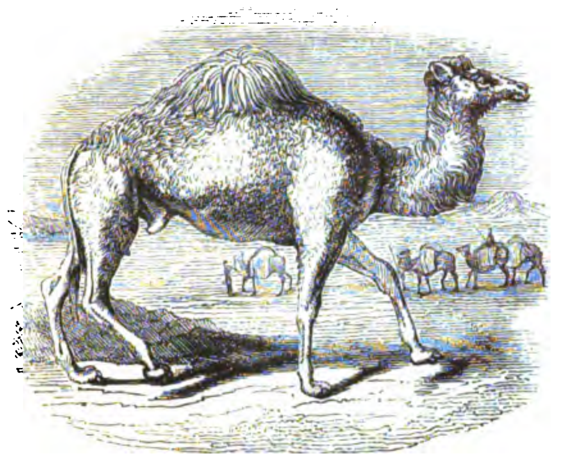
Bactrian Camel (*Camelus Bactrianus*).

This species is comparatively rare; but in the middle zone of Asia, north of the Taurus and the Himalaya Mountains, it is found in comparative abundance. Not that it is not to be seen occasionally in other countries—in Arabia, for instance; but such instances are said to be uncommon. The Bactrian Camel is stouter and more muscular than the Arabian species, and his strength is in proportion. "It varies from brown to white, and also greatly in size, strength, and quickness, according to the breed and climate." (Gray.)

C. Dromedarius (Linn.), the Sghimel, or Dromedary. It is the *C. Luk* of Eversmann, *C. vulgaris* of Forskal, *C. monotophus* of Walther, *C. Dromas* of Gesner, *C. minimus* of Klein, *C. vetus* of Frisch, the Arabian Camel of Pennant, and Le Dromedaire of Buffon.

It has one hump, situated on the middle of the back. Length about 8 feet. Hair pale brown. Localities, Arabia, Africa, &c.

Purchas (book vi., c. 1, s. 9) says that of Camels there are three kinds; the first called Huguin, of tall stature and able to carry a thousand pounds weight; the second less, having a double bunch, fit for carriage and to ride on, called Becheti, bred only in Asia; the third sort, called Raguahill, small, able to travel (for they are unfit for burdens) above an hundred miles in a day. The king of Timbuctoo can send messengers on such camels to Segelmesse or Darha, 900 miles distant, in the space of eight days at the farthest. He further states that such enduring swiftness would be almost incredible, were it not corroborated by the best authorities, who all agree in their accounts of the speed of the Heirie, El Heirie, or Maherry of the desert—Purchas's Raguahill. "When thou shalt meet a heirie," say the Arabs in their poetical mode of expression, "and say to the rider 'Salem Aleik,' ere he shall have answered thee 'Aleik Salem,' he will be afar off, and nearly out of sight, for his swiftness is like the wind."



Dromedary (*Camelus Dromedarius*).

The 'Sabayee,' said to be the fastest breed of the swift Dromedary, will, it is asserted, perform a journey of thirty-five days' caravan travelling (about 18 miles a day) in five days, performing 630 miles in that small period of time. Riley often travelled on a dromedary at the rate of 7 or 8 miles an hour for nine and ten hours a day; and Lyon says that the Maherry of the Northern African Arabs will continue at a long trot of 9 miles an hour for many hours together.

Besides the swift variety above alluded to, the species varies in colour, like the Bactrian, being sometimes cream-coloured or even white. There are specimens in the Gardens of the Zoological Society in the Regent's Park.

The natural family of the *Camelidæ* comprises also the South American form so well known by the name of *Llama*. [LLAMA.]

A fossil species, *C. Sivalensis*, of this genus was discovered by Dr. Falconer and Captain Cautley in the Tertiary deposits of the Sewalik Hills of Hindustan. The crania, jaws, and teeth of this species are to be seen in a fine state of preservation in the British Museum. It was nearly related to the existing species, but exceeded them by at least one-seventh in height.

CAMERARIA, a genus of plants belonging to the natural order *Apocynaceæ*. *C. latifolia* is called the Bastard Manchineel-Tree in the countries where it grows, on account of its possessing properties similar to the Manchineel. The true Manchineel is the produce of *Hippomane Manchinella*, one of the Spurgeworts. [HIPPOMANE.]

CAMOMILE, or CHAMOMILE. [ANTHEMIS.]

CAMPA'NULA (diminutive of *Campana*, a bell, on account of the form of its flowers), a genus of plants the type of the natural order *Campanulaceæ*. It has a 5-cleft calyx, the corolla mostly bell-shaped, with five broad and shallow segments, the anthers free, the filaments dilated at the base, the stigma 3-5-fid, the capsule not elongated, 3-5-celled, and opening by lateral pores outside the segment of the calyx. This genus is one of the largest in the vegetable kingdom, although from time to time the number of its species has been reduced by the formation of new generic types. Eight species are described by Babington as British. The species of Smith were more numerous, but Babington recognises Heister's genus *Specularia* for the old *C. hybrida* (*Prismatocarpus hybridus* of L'Heritier) and its allies, and Schrader's genus *Wahlenbergia* for the *C. hederacea*. The older names of the genus *Campanula* are *Trachelium* and *Cervicaria*, names which were given to it on account of the supposed efficacy of many of the species in the cure of disorders of the neck and trachea. Hence also the common name Throatwort. All the species are herbaceous, with mostly perennial roots, and the radical leaves differing in form from those of the stem. They are natives of the northern hemisphere.

C. edulis, Chobs, Okab, is a hispid plant with a thick root, erect 1-flowered stems, ovate-lanceolate crenate leaves; lobes of the calyx linear-lanceolate, equal in length to the corolla, which is hispid. It is a native of Arabia Felix. Its root is thick and sapid, and contains a considerable quantity of starch. It is on this account frequently eaten by children, as are the roots of many other species.

C. glomerata, Clustered Bell-Flower, has the leaves minutely crenate-serrate, the lowermost stalked, ovate-lanceolate, generally cordate at the base, the upper leaves half-clasping, sessile, ovate, acute; the flowers sessile in terminal and axillary clusters. This is a native of Europe, especially in mountainous districts. In Great Britain it is found in dry pastures on limestone. It is the *Trachelium minus* and *Cervicaria minor* of Lobel and Dodonæus. It is often cultivated in our gardens, and a great number of wild varieties have been described by Alphonse De Candolle.

C. Trachelium, Nettle-Leaved Bell-Flower, has the leaves coarsely doubly serrate, hispid, the lower one cordate, with long stalks, upper nearly sessile, ovate or lanceolate, acuminate; flowers racemose, peduncles 2-3-flowered; segments of the calyx triangular-lanceolate, entire, erect; the stem erect, angular. This is a European species It is found in the south of England, and has large blue bell-shaped flowers. A decoction of this herb was formerly used in disorders of the throat, but the properties of the genus are medicinally inert.

C. rotundifolia, Hare-Bell, Blue-Bells, Milkwort, has the radical leaves cordate or reniform, shorter than their stalks; stem-leaves linear, the lower ones lanceolate; flowers one or more racemose, corolla turbinate, campanulate. It has pretty blue flowers, and is a favourite throughout Europe. In France it is called Clochette; in Germany Weisen-Busch, and Grassglas. The juice of the flowers makes a very good blue ink, and when mixed with alum a green one. The roots of this species also may be eaten.

C. pyramidalis is a glabrous plant with leaves glandular, toothed, the lower ones petiolate, ovate-oblong, somewhat cordate, the stem-leaves sessile, ovate-lanceolate; the flowers numerous, pyramidally racemose, the lobes of the calyx acuminate, spreading, the capsule spherical, deeply furrowed. It is indigenous on rocks and walls in Carinthia, Carniola, and Dalmatia. From its having been a great favourite in the gardens of Europe, it has now become naturalised in many places where it was not originally a native. It has not often been found wild in Great Britain, though it is commonly cultivated for the sake of its tall raceme of beautiful blue flowers. It is in great demand in Holland, where it is employed to ornament halls and staircases, and to place before fire-places in summer, for which purpose it is planted in large pots and trained in a fan-manner so as to hide a large surface. In the shade it remains in bloom two or three months. "The art of producing a very large plant is to begin with pots of a small size, and shift frequently during two years, till at last the plant occupies a pot of a foot or more in diameter. Rich light soil should be used, but no animal manures or recent dung, as these are very injurious. Cuttings of the roots flower the second and seedlings the third year. *C. carpatica* and *C. grandiflora* may be treated in the same manner." (Loudon.)

C. Rapunculus, Rampion, has leaves crenate, the radicle leaves oblong-elliptical narrowed into a petiole, the stem-leaves linear-lanceolate, sessile, the raceme few-flowered, the segments of the calyx lanceolate. It is a native of Marocco and Barbary, also of the south of Europe, and extends as far north as Norfolk in England. It has a fusiform thick white root, which looks like a little turnip; hence the specific name *rapunculus*, being the diminutive of *rapa*, or radish. In Germany it is called Rapunzel, in France Raiponce, in Italy Raperonzola; the English Rampion appears to be the same word. It is much cultivated in France and Italy, and sometimes in Britain, for the sake of the roots, which are "boiled tender and eaten hot with sauce, or cold with vinegar and pepper." (Loudon.) In its cultivation the seed should be sown in the spring on deep light soils, in drills; and in the autumn of the year the plants will be ready for use. The *C. persicifolia*, a doubtful native of Britain, and the *C. Rapunculoides*, an indigenous plant, may be used for the same purposes as *C. Rapunculus*.

C. liliifolia (*Adenophora liliifolia*, Ledebore) has alternate leaves, the radical ones petiolate, ovate-roundish, cordate, toothed; the corolla campanulate, the style exserted. It is a native of Siberia, and of the east of Europe. Like many others of the genus it has an edible root, which is sometimes divided into several turnip-formed tubers. The flowers are numerous and sweet-scented. It is interesting from the fact that the leaves before blossoming are crowded together on the summit of the stem, so as to form a green rose-like body. But as the axis elongates, the leaves become afterwards scattered on the prolonged stem. The roots are eaten in China both raw and cooked.

The other British species of this genus not described are *C. latifolia*, Great Bell-Flower, common in the North; *C. Rapunculoides*, very rare; and *C. patula*, frequent in hedges and thickets. [SPECULARIA; WAHLENBERGIA.]

(Loudon, *Encyclopædia of Plants*; Koch, *Flora Germanica*; Babington, *Manual of British Botany*; Burnett, *Outlines*; Don, *Gardener's Dictionary*.)

CAMPANULA'CEÆ, *Bellworts*, the Campanula Tribe, a natural order of Monopetalous Dicotyledonous Plants, the character of which is to have an inferior three or more celled fruit containing many minute seeds, combined with a regular corolla, distinct stamens equal in number to the lobes of the corolla, dilated bases to the filaments, a downy style, and a milky juice. It consists of plants usually herbaceous, sometimes shrubby, scattered over all parts of the globe, but most abundant in the form of species related to the common *Campanula*, or Bell-Flower, in the milder parts of Europe and Asia. Of 500 species only 19 are found within the tropics. The flowers are commonly blue, purple, or white, occasionally rose-coloured, very rarely yellow, as in a Canary shrub called *Musschia aurea*. None of the species are poisonous, notwithstanding that the order is very closely allied to the dangerous *Lobeliaceæ*, which hardly differ except in having irregular flowers and syngenesious stamens. The affinities of this order are with *Compositæ* through *Lobeliaceæ*, and also with *Solanaceæ* and *Vacciniaceæ*. It embraces 28 genera and about 500 species.

Rampion (*Campanula Rapunculoides*).

1, The base of the corolla, with the stamens; 2, a stamen separate; 3, a calyx with the style and stigma; 4, a ripe seed-vessel; 5, a section of the same; 6, seeds natural size; 7, a seed magnified; 8, a section of the same.

CAMPANULARIA. [POLYPIFERA.]

CAMPHOR is a substance produced by several plants, and in its chemical characters belongs to the class of Vegetable Oils. It is yielded in greatest abundance by the natural order *Lauraceæ*, from several species of which Camphor might be produced. It is however obtained for commercial and medicinal purposes from the *Camphora Officinarum*, Nees (*Laurus Camphora* of Linnæus). A substance called Borneo Camphor, having similar properties to that from the natural order *Lauraceæ*, is obtained from the *Dryobalanops Camphora*. This Camphor does not come into Europe on account of the great demand for it in the Chinese markets. [CAMPHOR, *Medical Uses of*, in ARTS AND SC. DIV.]

CAMPHOR-OIL, a substance obtained in Borneo and Sumatra from the *Dryobalanops Camphora*. It is supposed to be Camphor in an imperfect state of formation. [DRYOBALANOPS.]

CAMPHORA, a genus of plants belonging to the natural order *Lauraceæ*. This genus was constituted by Nees von Esenbeck for the *Laurus Camphorifera* of Kämpfer, the plant which yields the Camphor of commerce. It is known by its hermaphrodite panicled naked flowers; 6-cleft papery calyx, with a deciduous limb; 9 fertile stamens, 3 in a row, the inner row with two stalked glands at their base; the anthers 4-celled, the outer turned inwards, the inner outwards; the fruit placed on the obconical base of the calyx; the leaves triply nerved, glandular in the axils of the principal veins; the leaf-buds scaly.

C. officinarum, the Camphor Laurel, is a tree with lax smooth branches; the leaves are bright-green and shiny above, paler beneath, and somewhat coriaceous, with a sunken gland at the axils of the principal veins, projecting at the upper side, opening by an oval pore beneath. This plant is a native of Japan and China, and is cultivated in most of the warmer parts of the world. The Camphor of commerce is yielded by this tree, which is cultivated most extensively in the island of Formosa, from whence it is taken to Canton, which is the principal market for Camphor.

CAMPION. [LYCHNIS; SILENE.]

CAMPONTIA, a genus of supposed Marine Annelides, first described by Dr. Johnston. Of this genus Dr. Johnston says, "When I first described this animal its close resemblance to some caterpillars was particularly mentioned, but the suspicion of its being actually a larva did not occur to me; for I believed it to be an established fact among entomologists that no insect passed its preparatory stages in sea-water. I have been informed however that Mr. M'Leay, and no higher authority can be given, has proved that the worm in question is the larva probably of some dipterous fly; and if this opinion be correct (which its anatomy strongly confirms), then it will follow that at least one larva naturally lives and undergoes its changes in the sea—a conclusion which I think is one of some importance, and at variance with our present notions. Our *Campontia cruciformis* may be found at all seasons at the roots of sea-weed and corallines in pools left by the recess of the tide. The very specimens before me were procured by myself a few days ago in parts to which no fresh-water could have access, and which are covered to the depth of several feet every tide, for they are near low-water mark." (*Mag. Nat. Hist.* vol. viii.)

CA'MPSIA (Lepeletier and Serville), a genus of Coleopterous Insects, of the section *Heteromera*, sub-section *Stenelytra* (Latreille), and family *Helopidæ*. [HELOPIDÆ.]

CAMPTO'CERUS (Dejean), a genus of wood-feeding Coleopterous Insects, belonging to the section *Xylophagi* of Latreille. [XYLOPHAGI.]

CAMPTODO'NTUS (Dejean), a genus of Coleopterous Insects, of the family *Scaritidæ*, closely allied to *Oxystomus*; from which genus however the present is distinguished by the species having the labial palpi shorter than the external maxillary: antennæ with the basal joint scarcely longer than the two following joints taken together. [SCARITIDÆ.]

CAMPYLOMY'ZA (Wiedeman), a genus of Dipterous Insects, of the family *Tipulidæ*. It has the following characters:—Proboscis curved; antennæ filiform, 14-jointed, two basal joints tolerably thick, the remaining short, cylindrical, and covered with fine hairs; body short; femora elongated; wings hairy, with one marginal cell, and three posterior cells, the first and second divided by an indistinct nervure.

The species of this genus are all extremely minute, and found on the leaves of trees.

C. bicolor is less than one-twelfth of an inch in length, of a blackish colour, with the edges of the abdominal segments pale; legs pale-yellow. This species and three or four others inhabit this country.

CA'MPYLUS (Fischer), a genus of Coleopterous Insects, belonging to the family *Elateridæ*. The species of this genus are distinguished by their having the hinder part of the head free, or not sunk into the thorax as far as the eyes, as is usually the case in this tribe. The eyes are globular and projecting: the antennæ are rather long, obscurely pectinated, and inserted close to the eyes beneath a projecting frontal ridge; thorax narrow; elytra much elongated, and somewhat linear.

C. dispar, a common insect in this country, is found on the leaves of trees, and on nettles and other plants. It is nearly half an inch long, and of an ochreous colour, with the under part of the body more or less black: sometimes the posterior part of the head, the disc of the thorax and elytra, and the femora are black.

About six or seven species of this genus have been discovered, most of which are European. The above-described species is the only one known to inhabit England.

CAMWOOD (German, Kammholz; French, Bois de Cham; Portuguese, Pao Gabão), a red dye-wood, the colouring matter of which is similar to that of Nicaragua or Peach-Wood. It is the produce of a plant belonging to the natural order *Leguminosæ*, called *Baphia nitida*. It is used with alum and tartar as a mordant. It does not afford more than a third part of the colouring matter yielded by an equal quantity of Brazil-Wood. It is used likewise by turners for making knife-handles, and by cabinet-makers for ornamental knobs to furniture. The greatest part of the Camwood imported into Europe is brought from Sierra-Leone.

CANARIUM, a genus of plants belonging to the natural order *Amyridaceæ*. *C. commune* yields a gum which is said to have the same properties as the Balsam of Copaiva. The fruit, which is a three-cornered nut, is eaten in Java both raw and dressed; and an oil is expressed from them which when fresh is eaten at table, and when stale is used for burning in lamps. The raw nuts are apt to bring on diarrhœa.

CANARY-BIRD, or CANARY-FINCH, Le Serin de Canarie of the French, Der Canarienvogel of the Germans, Canario of the Italians, the Canary of the English, *Fringilla Canaria* of Linnæus. This bird is the well-known songster which is to be found caged in every house where the inmates are fond of song-birds. The Canary Islands are the most frequented haunts of the species. In the wild state the prevailing hue, according to the observations of Adanson, Labillardière, and others, is gray or brown, mingled however with other colours, but never reaching the brilliancy of plumage exhibited by the bird in captivity—a brilliancy arising from long domestication and repeated crosses with analogous species. Its introduction into Europe is stated by some to have taken place in the 14th century; but Bechstein names the beginning of the 16th. "The arrival," says the author last quoted, "of the canary in Europe, is thus described:—A vessel which in addition to its other merchandise was bringing a number of these birds to Leghorn, was wrecked on the coast of Italy, opposite the island of Elba, where these little birds, having been set at liberty, took refuge. The climate being favourable they increased and would certainly have become naturalised, had not the wish to possess them occasioned their being caught in such numbers that at last they were extirpated from their new abode. From this cause Italy was the first European country where the canary was reared. At first their education was difficult, as the proper manner of treating them was unknown; and what tended to render them scarce was that only the male birds were brought over,—no females. The gray of its primitive colour, darker on the back and greener on the belly, has undergone so many changes from its being domesticated, from the climate, and from the union with birds analogous to it (in Italy with the citril-finch, the serin; in our country—Germany—with the linnet, the green-finch, the siskin, and the goldfinch), that we now have canaries of all colours. If we had not sufficient proof that canaries came originally from the Fortunate Islands, we should think the citril-finch, the serin, and the siskin were the wild stock of the domesticated race. I have seen a bird whose parents were a siskin and serin, which perfectly resembled a variety of the canary which is called the green. I have also seen mules from a female gray canary, in which was no trace of their true parentage. The gray, the yellow, the white, the blackish, and the chestnut are the principal varieties, and it is from their combination and from their tints that we derive the numerous varieties that we now possess. Those canaries that have the upper part of the body of a dusky green or linnet-brown, and the under part the yellowish-green of the green-bird, with dark brown eyes, are the strongest, and most nearly resemble the primitive race. The yellow and white often have red eyes, and are the most tender. The chestnut are the most uncommon, and hold a middle rank for strength and length of life between the two extremes. But as the plumage of the intermediate ones is a mixture of these principal colours, their value depends on the pretty and regular manner in which they are marked. The canary that is most admired amongst us now is one with the body white or yellow, the head, particularly if crested, wings, and tail, yellowish-dun: the second in degree is of a golden yellow, with the head, wings, and tail black, or at least dusky gray. Next follow the gray or blackish, with a yellow head and collar; and the yellow, with a blackish or green tuft, which are very much valued. As for those that are irregularly spotted, speckled, or variegated, they are much less sought after, and are used to pair with those of one colour, white, yellow, gray, brown-gray, and the like."

The usual length of a Canary is about 5 inches, of which the tail measures about two and a quarter. The bill is about 5 lines in length, strong, sharply pointed, and inclining to white. The shanks, or feet as they are technically called, are about 8 lines long, and of a flesh-colour.

The female is very like the male, but is generally less bright in colour, smaller about the head, shorter about the neck and body, not so high on the shanks, and altogether of a form somewhat less elegant than that of the male. There is a bean-shaped feather under the bill, and the temples and circles round the eyes are deeper in colour than the other parts of the body.

The Canary breeds freely with allied species of birds, and many hybrids are recognised by breeders. Amongst the more common are the following:—

1. Mules bred from a hen Canary and a Goldfinch.—These partake of the parental colours on both sides. The finest are produced from yellow or white hen canaries.

2. Mules bred from a hen Canary and a male Siskin.—The young always resemble the Siskin in shape. If the mother be green they will be like a hen Siskin; if she be white or yellow they will be lighter in colour than a Siskin, without however any great difference.

3. Mules bred between a hen Canary and a Green-Bird, or a Citril-Finch.—When the mother is neither white nor yellow the young do not differ much from the Gray or Green Canary; but they are generally rather more slender, and their bills are also shorter and thicker.

4. Mules bred between a hen Canary and a Linnet.—These, if the mother be white or yellow, will be speckled; if she be gray they will resemble her generally, but their tails will be longer.

Most of these mules are fruitful, and there is no great difficulty in getting the parents to pair; but when the union is with species more remote, the difficulty increases in proportion.

5. Mules between a hen Canary and a Bullfinch.—Bechstein says that the eggs of this union seldom prove fruitful; but Dr. Jassy of Frankfort obtained mules of a bullfinch and a canary, by making other canaries sit on the eggs and bring up the young, a plan pursued in Bohemia.

Besides the birds above enumerated, chaffinches, yellowhammers, &c. have been tried, but with no good success. Bechstein says that he never saw a male canary very fond of a female yellowhammer, nor a male of the latter kind of a female canary, though the plumage may be selected so as to offer a striking resemblance.

It will be observed that in all the five instances recorded the Canary is always the mother. The reason why breeders select the male of the other species when mules are desired is, because a female siskin, goldfinch, &c. could not easily be induced, if at all, to lay her eggs in an artificial nest like a canary.

The hybrids between these various species are stated to be fruitful, and to have the power of continuing their mixed forms. The first eggs of these hybrids are said to be very small, and the young hatched from them very weak. The eggs of the next year are said to be larger, and the nestlings stronger and stouter.

In order to obtain bright and good plumage, those birds whose colours are clear and whose spots are clean and well defined should be placed together. A brownish-gray or greenish bird paired with one of a lively yellow often produces young of a dim white and of other admired colours. Two crested birds should never be joined, for their offspring are frequently hatched with part of the head bald, or otherwise deformed in plumage.

Bechstein gives the following directions for forwarding the breeding of Canaries:—"The best time for pairing canaries is the middle of April. Either one male and one or two females are placed in a large cage, or many of both sexes are united in a room or aviary, having the advantage of a south aspect. Nests made of turned wood or osiers are given them, as straw ones are too easily torn. It is a good plan to place in the room or aviary slips of pine, which being cut in February do not lose their leaves. If a little inclosure of wire-gauze can be fixed over the window, where the birds can enjoy the fresh air, nothing will more effectually contribute to render the young healthy and robust. Birds which are to be paired for the first time should be previously placed in the same cage for seven or eight days, in order to become acquainted and accustomed to live together. If two females are to be caged with one male, it is especially necessary that they should be together long enough to leave off quarrelling, and the pairing-cage should be divided into two equal parts, communicating by a sliding-door. This being done, a lively male and one of the females should be placed in the first division; as soon as she has laid the male should be moved into the other division, the door of separation being shut; but as soon as the other has also laid the door may be left open: the male will then visit the females alternately, and they will not trouble themselves about each other; but without these precautions jealousy would incline them to fight and destroy each other's eggs. When it is intended to place a great many females, double or treble the number of males, in a room or aviary, the latter should always be first paired with a single female, which will ever after remain the favourite; and it will only be when she is about to sit that he will pair with the others; and this is all the notice he will take of them, for afterwards he will only notice their young. It is from these mothers however that the most and the best birds are generally procured. If the floor of the room or aviary is well covered with moss, little else need be added for making the nests, otherwise they should be supplied with the hair of cows and deer, hog's bristles, fine hay, lint, wool cut two or three inches long, paper-shavings, and the like. That which is coarsest serves for the outside, and the softest and finest for the inside. If they have shrubs, traces of the natural instinct of the canary are soon observed in the nests, which they construct without the help of the turner or basket-weaver; but they are of an inelegant form, and the outside is not very carefully finished. The females alone, as is usual among birds, are the builders, the males only choosing the situation and bringing the materials. It is in the nest, where the female is in continual motion, that the pairing takes place; she invites the male by constant little chirpings, repeated more quickly the nearer she is to laying. Seven or eight days are generally reckoned from the first pairing to the laying of the first egg; the other eggs, whose number varies, without exceeding six, are laid successively every following day, and often at the same hour. The laying ended, pairing continues during the first days of incubation. If the pairs agree they must be left entirely to themselves, without endeavouring to use art to help nature, as many do. It is usual to take away the first egg and substitute an ivory one, which is repeated with the others to the last, preserving them in the meantime in a box filled with fine dry sand: they are afterwards restored all together to the nest to be hatched."

Upon this practice there is a difference of opinion, as the plan above recommended causes the mother a greater loss of heat, and burdens her at once with five or six little ones, which coming together disturb rather than please her; whereas in seeing them hatched successively one after the other her pleasure is increased, and her strength and courage are supported. "Very intelligent bird-fanciers," adds Buffon, "assure us that by not removing the eggs from the female, and leaving them to be hatched in succession, they have always succeeded better than when they have substituted ivory eggs." The hen Canary will generally lay three or four times in the year, from April to September, and some will even continue to lay during their moult. The eggs are of a delicate sea-green hue, spotted at one end more or less with violet or maroon colour. About the eighth day after the hen has begun to sit, the eggs may be examined by holding them between the flame of a candle and the eye. Those which are good will by that time exhibit well-developed blood-vessels, whereas the bad ones will continue clear or be already addled—these should be thrown away. It may be doubted however whether the better course be not to leave the hen quite undisturbed. The cock will sometimes take his turn for some hours in the day; but the hen seldom approves of this: as soon as she has taken her hasty meal she flies back to the nest, and if the male, whose capabilities as a hatcher she seems strongly to question, do not retire, she pecks him till he does. On the thirteenth day the young generally make their appearance. While incubation is going on the place where the birds are confined should be kept quiet; for it is asserted that sudden jarring noises, such as the violent slamming of a door or the discharge of a gun will kill the young in the shell. We have above seen that it is usual to give two females to one male; and it is alleged that if one of the former should die during incubation, the survivor immediately takes charge of the eggs, to the care of which she so entirely devotes herself that she repels the caresses of her mate, whose solace she was while the deceased was sitting.

As soon as the young break the shell, two jars should be placed near the feeding-trough. In one of these there should be a quarter of a hard egg, yolk and white together, chopped very fine, with a bit of crumb of white bread or biscuit, which has been soaked in water, and afterwards well pressed to get out the moisture. In the other jar rape-seed, well boiled and then washed in fresh water, should be placed; great care must be taken not to let this food become sour, which would destroy the nestlings. The cock-bird is the principal nurse after hatching.

It is sometimes necessary to bring up the young by hand, and then a paste should be made of white bread or biscuit pounded very fine, rape-seed well bruised, a small quantity of the yolk of an egg, and water. The nestlings must be fed with a quill cut into the shape of a spoon, and should not have less than ten or twelve meals a day; four beaksful well piled up on the quill constitute a meal. On the thirteenth day they will begin to feed themselves, and in four weeks they may be removed to other cages. Care however must be taken to supply them for some time with the paste above described, together with the food of full-grown birds, as a sudden privation of the former has been known frequently to occasion death; especially if the nestlings are deprived of it when moulting.

Mr. Rennie says, "It sometimes happens in very dry seasons that the feathers of the young birds cannot develop naturally; a bath of tepid water, employed on such an occasion by Madame ——, was so successful, that I cannot do better than recommend it. The same lady succeeded equally well in similar circumstances in hatching late eggs; she plunged them for some minutes in water heated to the degree of incubation, and immediately replaced them under the mother; in a short time she enjoyed the pleasure of seeing the little ones make their appearance. This interesting experiment may be applied to all sorts of birds, and may be particularly useful in regard to those of the poultry-yard."

About the thirteenth or fourteenth day, by which time the nestlings can eat alone, the males begin to warble and so do some of the females, but in a more disjointed style. The males, which may then be easily distinguished, should be forthwith separated, each bird being placed in a cage by himself (which must be first covered with a piece of linen and afterwards with a darker curtain) apart from every other bird, in order that his education may begin, if it is intended that his natural song should be superseded by an artificial melody; if he is left unseparated beyond the fourteenth day he will retain a portion of his father's song, and murder his acquired melody by intermingling the paternal notes. His musical lesson must be repeated five or six times in the day, especially in the morning and evening, his master performing the desired air either on a flageolet or a bird-organ; but, as has been observed in the case of the bullfinch, if the instrument be not in perfect tune the whistling of a man of taste is infinitely preferable. From two to six months, according to the memory and the abilities of the scholar, will be spent in this musical education. Some canaries have been thus taught to repeat correctly two or three airs, and others have learned to pronounce distinctly a few short words; for they possess great quickness and correctness of ear, and have excellent memories.

When the more natural song is preferred, those canaries are most esteemed which introduce into their warblings the notes of the nightingale, wood-lark, or tit-lark, and this may be easily accomplished by placing those birds near the young canaries. The canaries of the Tyrol are more frequently taught to introduce the notes of the nightingale, while those of England more frequently interweave those of the wood-lark. "In Thuringia," says Bechstein, "the preference is generally given to those which, instead of a succession of noisy bursts, know how, with a silvery sonorous voice, to descend regularly through all the tones of the octave, introducing from time to time the sound of a trumpet. There are some males which, especially in the pairing season, sing with so much strength and ardour, that they burst the delicate vessels of the lungs and die suddenly."

Canaries may be made to sing in the night—some do this of their own accord. The tuition must commence early in their youth by covering the cage, and thus keeping them in the dark during the day long enough for them to be hungry; they are thus brought to feed by candle-light, and at last sing. The hen birds will also sing, particularly in the spring, but in an unconnected style. Old hens past breeding will often sing in this way the year round.

There are societies in London for promoting the breeding of Canaries, and amateurs distinguish upwards of thirty varieties.

Mr. Rennie mentions two sorts of Canaries, "the plain and variegated, or as they are technically called, the gay spangles or mealy, and jonks or jonquils. These two varieties are more esteemed than any of the numerous varieties which have sprung from them; and although birds of different feathers have their admirers, some preferring beauty of plumage, others excellence of song, certainly that bird is most desirable where both are combined. The first property of these birds consists in the cap, which ought to be of fine orange-colour, pervading every part of the body except the tail and wings, and possessing the utmost regularity, without any black feathers, as by the smallest speck it loses the property of a show bird, and is considered a broken-capped bird. The second property consists in the feathers of the wing and tail being of a deep-black up to the quill, as a single white feather in the wing or tail causes it to be termed a foul bird; the requisite number of these feathers in each wing is 18, and in the tail 12. It is however frequently observed that the best-coloured birds are foul in one or two feathers, which reduces their value, although they may still be matched to breed with." These form the leading features of excellence; but it is generally the custom of the societies above mentioned to award the prize to the competitor who produces a bird nearest to the model published by them the season prior to that wherein the competitors are to show for the prize.

The fullest information on the subject of breeding and treating the Canary will be found in Bechstein's *Cage-Birds*.

CANARY-GRASS. [PHALARIS.]

CANCER, a genus of Short-Tailed *Crustacea*, the type of the family *Canceridæ*. Dr. Leach restricted the genus *Cancer* to the form of *Cancer Pagurus*, Linn., the large eatable Crab of our coasts, which was, when he defined the genus, the only species known. It has the following characters:—

External antennæ with the basilar joint broad, very long and thick, filling the hiatus between the inner canthus of the orbit and the front, and terminating forwards in a strong, angular, tooth-like projection, directed forwards and a little inwards, reaching beyond the frontal line. The terminal or moveable portion is slender, very short, and arises from the internal part of the basilar joint nearer to the cell of the internal antennæ than to the orbit. The internal antennæ, instead of lying obliquely outwards or transversely, as in most other genera of this section, are directed forwards—a character by which *Cancer* may at once be distinguished from *Platypodia*, *Carpilius*, *Xantho*, &c. The second joint of the inner footstalk of the external pedipalps is excavated at the anterior part of the inner margin; in some species the notch is confined to the angle, in others it extends half way down the side of the joint. The first pair of feet is nearly equal; in some specimens of each species the difference in size being scarcely appreciable. They are generally very robust. The remaining feet have no spines, but are in most species more or less hairy. The abdomen of the male has five, and that of the female seven joints.

With the exception of our indigenous species, *Cancer Pagurus*, they are all, as far as their localities are known, exclusively natives of the coasts of the hotter parts of America.

Mr. Bell, in a paper on the genus *Cancer* ('Zool. Trans.' i. 335), gives three new species, namely, *C. longipes*, *C. Edwardsii*, and *C. dentatus*, brought home by Mr. Cuming and Mr. Miller, besides *C. irroratus* of Say, and *C. Pagurus*, which last, as it was considered the type by Dr. Leach, we select as an example.

C. Pagurus is the Great Crab of the English coasts. Mr. Bell gives the following description of it:—Carapace transversely oblong, flattened, but little higher in the middle than at the sides, somewhat rounded before and behind; the surface minutely granulated, smooth, with the regions but slightly marked. Latero-anterior margin slightly recurved, divided into ten quadrate lobes, the sides of which are contiguous and the margins entire; the last lobe inconspicuous, and passing into the posterior marginal line, which terminates immediately anterior to the posterior transverse ridge. Front trifid, the teeth of nearly equal length and size. Orbits round, with a strong triangular tooth over the inner canthus, which does not project so far as the front; and a smaller one filling the space between the two superior fissures. External antennæ with the basilar joint much elongated, and terminating forwards in an obtuse tooth; the first joint of the moveable portion club-shaped, the second cylindrical, the remaining portion setaceous. Internal antennæ directed forwards, the anterior half doubled directly backwards in a state of rest. The basilar joint broad, cup-shaped, its outer edge projecting forwards; the second joint (the first of the moveable portion) cylindrical, the penultimate with a small, hooked, and recurved process at the apex. Pedipalps as in the rest of the genus. Sternum minutely punctated, and furnished with small patches or lines of short scanty hair. Abdomen in the male with the margin fringed with short hair; the last joint forming an equilateral triangle. Anterior feet large, robust, smooth, without spines or tubercles, minutely granulated; the hand rounded, without crest, the inner surface exhibiting only the rudiments of the five lines of puncta, so conspicuous in other species of the genus. The remaining feet furnished with numerous fasciculi of stiff hairs, the last joint in all furrowed, and terminated by a short strong nail. Colour above reddish-brown, the legs more red, the claws deep shining black; beneath whitish. Locality, coasts of Great Britain, &c., and of western Europe. Great numbers are annually caught on the coasts of Great Britain. They sometimes attain a large size, weighing ten or twelve pounds.

Pennant states that this species inhabits rocky coasts, and is the most delicious meat of any, and that it casts its shell between Christmas and Easter. "There are some species," says Milne-Edwards, in his article 'Crustacea,' in the 'Cyclopædia of Anatomy and Physiology,' "such as the crabs and the *Brachyura* generally, in which the carapace presents a considerable expansion on either side, forming two large compartments in which the greater mass of the thoracic viscera is contained. Under these circumstances it would be impossible for the animal to escape from its dorsal covering by the relatively inconsiderable opening which this part presents on its inferior aspect. This renders it necessary that the carapace, instead of being cast off by simply rising in a single piece, should give way and separate in some direction or another, and this it does by splitting along the curved lines, extending on either side from the mouth to the origin of the abdomen, in the course of which the epimeral pieces cohere with the dorsal one." (Collinson, 'Phil. Trans.' 1746 and 1751; 'Hist. Nat. des Crustacés,' t. 1, p. 56.) Sir Charles Lyell says ('Principles of Geology'), "A large female crab (*Cancer Pagurus*) covered with oysters, and bearing also *Anomia Ephippium* and *Actiniæ*, was taken in April, 1832, off the English coast. The oysters include individuals of six years' growth, and the two largest are four inches long and three inches and a half broad. Both the crab and the oysters were seen alive by Mr. Robert Brown. This specimen is in the collection of my friend Mr. Broderip, who observes that this crab, which was apparently in perfect health, could not have cast her shell for six years, whereas some naturalists have stated that the species moults annually, without limiting the moulting period to the early stages of growth of the animal."

The genus *Cancer* of Linnæus included a large number of species, and the term Crab, which is a translation of it, is in common parlance applied to the great bulk of the Brachyurous Crustaceans.

For the Blood-Spotted Crab of the Asiatic seas (*Cancer maculatus*, Linn., &c.) and the Coralline Crab (*Cancer corallinus*, Fabr.), Dr. Leach instituted the genus *Carpilius*, characterised by the existence of a single tooth on the border of the carapace, and by the tridentated front; and, for the Eleven-Toothed Crab (*Cancer undecimdentatus*, Fabr.), the carapace of which is smooth, with 11 crenulated teeth on each antero-lateral border, and black toothed fingers, spoon-shaped at the end, he founded the genus *Clorodius* or *Chlorodius*. Milne-Edwards enumerates four species of *Carpilius* and seven of *Chlorodius*. He considers the fossil Crabe aux Grosses Pinces, *Cancer macrochelus*, Desm. ('Hist. Nat. des Crustacés Fossiles,' p. 91, pl. vii. fig. 1-2), *Cancer Lapidescens*, Rumph. ('Amb. Rariteit Kamer,' pl. 60, f. 3), as referrible to the genus *Carpilius* rather than to the division of Crabs properly so called. It should be remembered that Milne-Edwards's genus *Cancer* (Crabe) differs from that of Leach. The former includes under that name such forms as *Cancer roseus* (*Carpilius roseus* of Rüppell), *C. lobatus*, *C. esculptus*, *C. limbatus* (*Xantho granulosus*, Rüp.), *C. Savignii* and *C. Acanthus*, excluding Leach's *Cancer*, the type of which is the eatable Crab of our coasts, to which form Milne-Edwards gives the name *Platycarcinus*. It does not appear that any species of *Cancer*, Leach, *Platycarcinus*, Milne-Edwards, has been found in a fossil state.

CANCROMA. [BOAT-BILL.]

CANDY-TUFT. [IBERIS.]

CANIS, a genus of Carnivorous *Mammalia*, of which the common Dog may be regarded as the type.

Under the Linnæan genus *Canis* are to be found the Dogs (*Canis familiaris*); the Wolves (*Canis Lupus*); the Hyænas (*Canis Hyæna*); the Foxes (*Canis Vulpes*), &c.; the Jackals (*Canis aureus*); the Mexican Wolf (*Canis Mexicanus*), Xoloitzcuintli of Hernandez; and *Canis Thous* of Surinam.

Cuvier arranges under the genus *Canis* Les Chiens, the Dogs properly so called (*Canis familiaris* and its varieties); the Wolves (*Canis Lupus*, *C. Mexicanus*, *C. jubatus*); and the Jackals, Chacal or Loup Doré (*Canis aureus*): and he observes, that the Foxes (which Brisson and others have separated under the name of *Vulpes*) may be distinguished from the Wolves and the Dogs by their longer and more tufted tail; by a more pointed muzzle; by the pupils of their eyes, which by day present a kind of longitudinal slit instead of the round form; by the superior incisors being less lobated (echancrées); and, he observes on their fetid odour, their disposition to dig for themselves earths, and to prey upon the weaker animals. These he places in a sub-genus, including the Zerda (*Megalotis* of Illiger, *Canis Megalotis* of Lalande, *Canis Zerda* of Gmelin); at least he terms the Zerdas "espèces de renards," though he seems to consider them as a section, and notices them as the *Megalotis* of Illiger. The *Hyæna venatica* of Burchell, *Hyæna picta* of Temminck (Wild Dog of the Cape), terminates Cuvier's *Canidæ*, and he then passes on to the Civets (*Viverra*).

M. Lesson in his 'Manuel' begins the second section of the Digitigrades with the genus *Canis*, and he adopts the following subdivisions:—

1. Those genera which have the pupil of the eye round, including the Dogs properly so called, the Wolves, and the Jackals.
2. Those genera in which the pupil of the eye contracts vertically, the Foxes and the Zerdas.
3. The Dogs with Hyæna-like feet; the Hyæna-Dog, *Canis pictus*, Desm., *Hyæna picta*, Temm., *Lycaon*, Brookes.

The genus *Canis* being mostly restricted at the present day to the animals of Lesson's first section, this article will be confined to the animals commonly called Dogs, Wolves, and Jackals.

Dogs.

C. familiaris, the Dog. The specific description given by Linnæus is simply "Canis caudâ (sinistrorsum) recurvatâ"—"dog with tail curled towards the left"—and his lengthened description, after enumerating the varieties, of which he gives eleven, though it may appear to some almost ridiculously minute and not very delicate, is eminently characteristic. Cuvier observes that the Domestic Dog (*Canis familiaris*, Linn.), is distinguished by its recurved tail, and that it varies infinitely besides in stature, form, colour, and the quality of the hair. It exhibits, he adds, "the most singular, the most complete, and the most useful conquest that man has made. The whole species is become our property; each individual is entirely devoted to his master, adopts his manners, distinguishes and defends his property, and remains attached to him even unto death; and all this springs not from mere necessity, nor from constraint, but simply from reconnaissance and a true friendship. The swiftness, the strength, and the highly developed power of smelling of the dog, have made him a powerful ally of man against the other animals, and were perhaps necessary to the establishment of society. It is the only animal that has followed man all over the earth."

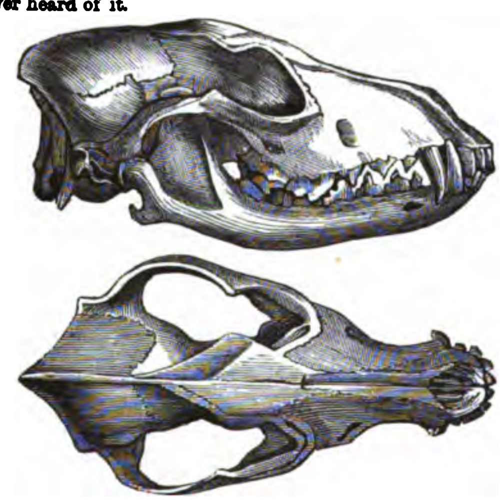
It is a question of considerable interest as to what was the parent-stock of the Dog. Some zoologists are of opinion that the breed is derived from the Wolf; others that it is a familiarised Jackal; all agree that no trace of it is to be found in a primitive state of nature. That there were dogs or rather animals of the canine form in Europe long ago we have evidence from their remains, which we shall presently notice; and that there are wild dogs we know. India, for example, affords many of them, living in a state of complete independence, and without any indication of a wish to approach the dwellings of man. These dogs, though they have been accurately noticed by competent observers, do not throw much light on the question. They may have escaped from the dominion or half dominion of man, and have betaken themselves to a vagabond life. It becomes necessary however to examine into the state of these dogs, some of which are entirely wild and keep to the mountain and forest, whilst others hang about the villages, and though without owners give tokens of a more social disposition, and are tolerated as the scavengers of the place, which they clear of disgusting incumbrances, somewhat after the Portuguese fashion.

Colonel Sykes thus describes the Dukhun (Deccan) Dog, *Canis Dukhunensis*, Sykes, Kolsun of the Mahrattas, *Cuon Dukhunensis*:—"Red, paler underneath; tail bushy, pendulous; pupil rounded. This is the Wild Dog of Dukhun. Its head is compressed and elongated; its nose not very sharp, the eyes are oblique: the pupils round, irides light brown. The expression of the countenance that of a coarse ill-natured Persian Grayhound, without any resemblance to the Jackal, the Fox, or the Wolf, and in consequence essentially distinct from the *Canis Quao* or *Sumatrensis* of General Hardwicke. Ears long, erect, somewhat rounded at the top, without any replication of the tragus. Limbs remarkably large and strong in relation to the bulk of the animal, its size being intermediate between the Wolf and the Jackal. Neck long. Body elongated. Between the eyes and nose red brown: end of the tail blackish. From the tip of the nose to the insertion of the tail 33 inches in length: tail 8½ inches. Height of the shoulders 16½ inches." Colonel Sykes adds that none of the domesticated dogs of Dukhun are common to Europe. The first in strength and size is the Brinjaree Dog, somewhat resembling the Persian Grayhound but much more powerful. The Pariah Dog he states is referrible to M. Cuvier's second section. This is very numerous, not individual property, but breeds in the towns and villages unmolested. The Colonel remarks that the Turnspit Dog, long backed, with short crooked legs, is frequently found among the Pariahs. There is also a petted minute variety of the Pariah Dog, usually of a white colour, and with long silky hair, corresponding to a common Lapdog of Europe; this is taught to carry flambeaux and lanterns. The last variety noticed is the dog with hair so short as to appear naked like the *Canis Ægyptius*. It is known to Europeans by the name of the Polygar Dog. ('Zool. Proc.,' part i.) In 1832 the skin of the Wild Dog of Nepaul was compared by Colonel Sykes with a specimen of the Kolsun of the Mahrattas above described, and he stated his impression to be that the animals are identical, differing only by the denser coat and more woolly feet of the Nepaul race, a difference readily accounted for by the greater cold of the elevated regions inhabited by it. Colonel Sykes is also of opinion that the Kolsun is identical with the Buansuah, an Indian dog, described by Mr. B. H. Hodgson under the name of *Cuon primævus*. Specimens of these dogs are to be seen in the British Museum, in the Catalogue of which institution they are not only made specifically distinct, but are placed under the genus *Cuon* as distinct from *Canis*.

Mr. Bell, in his 'History of British Quadrupeds,' also discusses this difficult question. "In order," says Mr. Bell, "to come to any rational conclusion on this head, it will be necessary to ascertain to what type the animal approaches most nearly, after having for many successive generations existed in a wild state, removed from the influence of domestication and of association with mankind. Now we find that there are several different instances of the existence of dogs in such a state of wildness as to have lost even that common character of domestication, variety of colour and marking. Of these two very remarkable ones are the Dhole of India and the Dingo of Australia: there is besides a half-reclaimed race amongst the Indians of North America; and another also partially tamed in South America which deserve attention; and it is found that these races in different degrees, and in a greater degree as they are more wild, exhibit the lank and gaunt form, the lengthened limbs, the long and slender muzzle, and the great comparative strength which characterise the wolf; and that the tail of the Australian dog, which may be considered as the most remote from a state of domestication, assumes the slightly bushy form of that animal. We have here then a considerable approximation to a well-known wild animal of the same genus, in races which, though doubtless descended from domesticated ancestors, have gradually assumed the wild condition; and it is worthy of especial remark, that the anatomy of the wolf, and its osteology in particular, does not differ from that of the dogs in general, more than the different kinds of dogs do from each other. The cranium is absolutely similar, and so are all or nearly all the other essential parts; and to strengthen still further the probability of their identity, the dog and wolf will readily breed together, and their progeny is fertile. The obliquity of the position of the eyes in the wolf is one of the characters in which it differs from the dogs; and although it is very desirable not to rest too much upon the effects of habit on structure, it is not perhaps straining the point to attribute the forward direction of the eyes in the dogs to the constant habit, for many successive generations, of looking forwards to their master and obeying his voice."

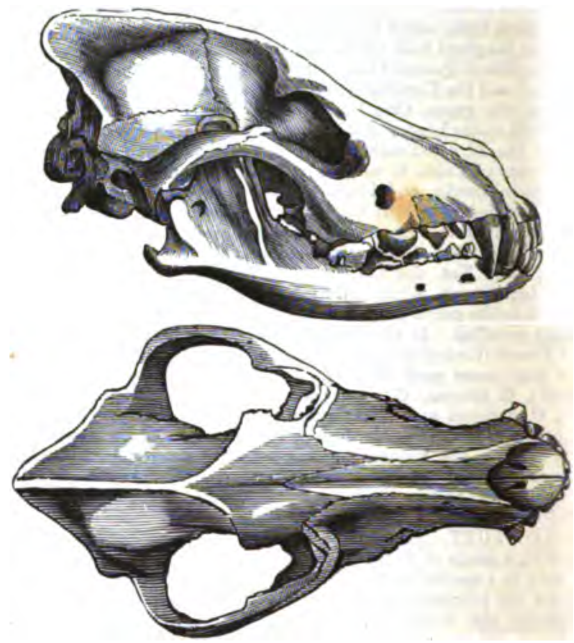
Another criterion, and a sound one, is the identity of gestation. Sixty-three days form the period during which the bitch goes with young. Precisely the same time elapses before the she-wolf gives birth to her offspring. Upon Buffon's instance of 73 days, or rather the possibility of such a duration in the gestation of a particular she-wolf, we do not lay much stress when opposed by such strong evidence of the usual period being 63 days. The young of both wolf and dog are born blind, and see at the same or about the same time, namely, at the expiration of the 10th or 12th day.

Hunter's important experiments proved without doubt that the Wolf and the Jackal would breed with the Dog; but he had not sufficient data for coming to the conclusion that all three were identical as species. In the course of those experiments he ascertained that the jackal went 59 days with young, whilst the wolf went 63 days; nor does he record that the progeny of the dog and jackal would breed together: and he knew too well the value of the argument to be drawn from a fertile progeny not to have dwelt upon the fact if he had proved it; not to have mentioned it, at least, if he had ever heard of it.

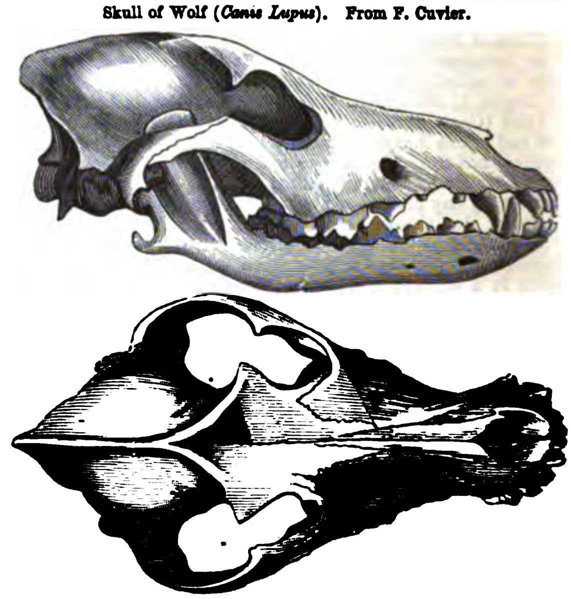


Skull of Jackal (*Canis aureus*). From F. Cuvier.

Mr. Bell disposes of the objection arising from the alleged untameably savage disposition of the wolf by relating two anecdotes, one on his own authority and the other on that of Mons. F. Cuvier, in proof of the susceptibility of attachment to man, and the appetite—for it is an appetite—for his caresses on the part of the wolf. The first occurred in the Gardens of the Zoological Society in the Regent's Park, London, and was exhibited in the person of a she-wolf, who came forward to be caressed, and even brought her pups to be caressed also, whenever Mr. Bell or any one whom she knew approached her den. Indeed she killed all her unfortunate young ones in succession by rubbing them against the bars of her cage in her zeal to have them fondled by her friends. The second happened in the Ménagerie du Roi at Paris, and no faithful dog could show more affecting instances of attachment to his master, or distress on account of his absence, than did the male wolf which is the subject of Mons. F. Cuvier's touching account. "With all these analogous properties of form and structure"—we quote Mr. Bell—"as well as of disposition, I cannot but incline at least to the opinion that the wolf is the original source from which all our domestic dogs have sprung: nor do I see in the great variety which exists in the different races sufficient ground for concluding that they may not, all of them, have descended from one common stock. The turnspit and the mastiff, the pug and the grayhound, are perhaps more unlike each other than any of the varieties of other domestic animals; but if it be true that variation depends upon habit and education, the very different employments to which dogs have in all ages been trained, and the various climates to which they have been naturalised, must not be lost sight of as collateral agents in producing these different forms. The care too with which dogs of particular breeds are matched with similar ones, for the purpose of keeping the progeny as pure as possible, has doubtless its effect in promoting such distinctions." The same author thus sums up his opinion:—"Upon the whole, the argument in favour of the view which I have taken, that the wolf is probably the original of all the canine races, may be thus stated: the structure of the animal is identical, or so nearly so as to afford the strongest à priori evidence in its favour. The dog must have been derived from an animal susceptible of the highest degree of domestication, and capable of great affection for mankind; which has been abundantly proved of the wolf. Dogs having returned to a wild state, and continued in that condition through many generations, exhibit



Skull of Wolf (*Canis Lupus*). From F. Cuvier.

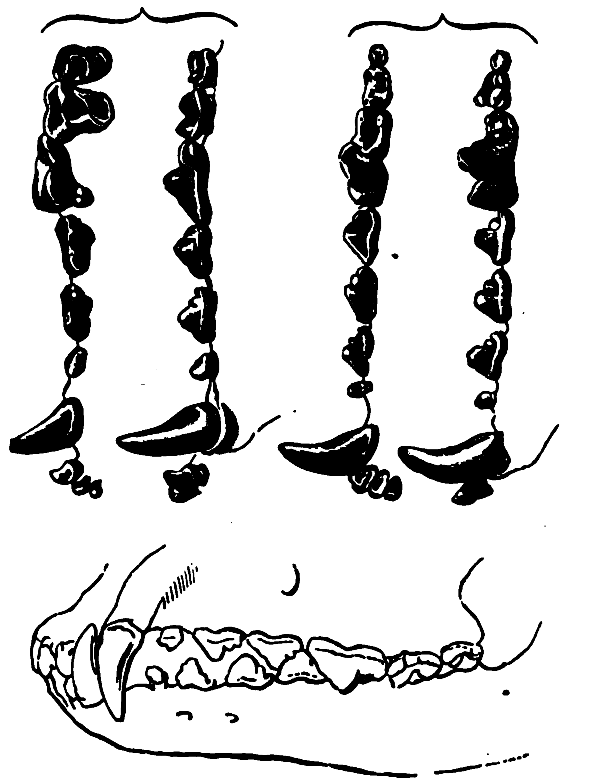


Skull of Canada Wolf (*Canis Lupus*). From F. Cuvier.

characters which approximate more and more to those of the wolf, in proportion as the influence of domestication ceases to act. The two animals will breed together, and produce fertile young. The period of gestation is the same."

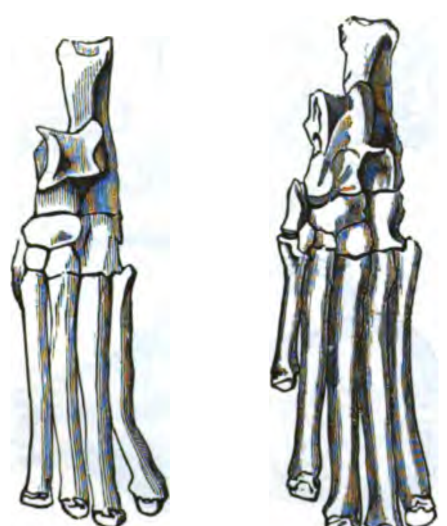
We have given above the skull of a wolf, that it may be compared with those of the different varieties of dogs.

Dental formula: incisors, $\frac{6}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{6-6}{7-7} = 42$.
Such is M. Lesson's statement of the dentition of the great genus *Canis* of Linnæus. F. Cuvier says that Dogs in general have 40 teeth, namely, six incisors, two canines, three false molars, one carnassier, and two tubercular teeth in the upper jaw; and six incisors, two canines, three false molars, one carnassier, and two tubercular teeth in the lower jaw. Of all these teeth, he observes, none change their shape in any appreciable degree in any race whatever. Only there is sometimes found an additional false molar or tubercular tooth.



Teeth of Dog.

Fore feet with five toes; hind feet with four toes; claws not retractile.

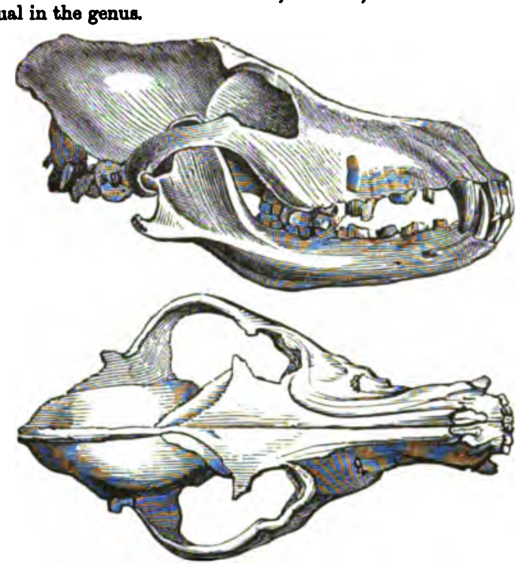


Feet of Dog. From F. Cuvier.

Generally speaking all dogs have five toes on the fore feet and four on the hind feet, with the rudiment of a fifth metatarsal bone, which does not show itself externally. Nevertheless some dogs have this fifth toe very long and well proportioned, and advancing as far as the origin of the first phalanx of the neighbouring toe; and in those dogs which have only a rudimentary fifth bone of the tarsus, this bone articulates itself to the lower facet of the great cuneiform bone, which is itself placed in relation with the scaphoïd bone, the second cuneiform bone, and the second bone of the metatarsus, counting as one the rudiment in question. But in the dogs that have the fifth toe complete, a fourth cuneiform bone is developed between the first and the second toe, and in that case, in some varieties, the great cuneiform bone elevates itself, and on its internal side offers a large articulating facet to the astragalus.

The tail is very variable in the number of caudal vertebræ, which range from twenty-one down to three or even two.

Of dogs which have been regarded as varieties or species, one of the most remarkable is the Australian Dog, or Dingo (*Canis Dingo* of Blumenbach). It is so wolf-like in its appearance, that Bewick figures it as the 'New-South-Wales Wolf.' Governor Philip describes the height of this species, when standing erect, as rather less than 2 feet, and the length 2½ feet. The head, he says, is formed much like that of a fox, the ears short and erect, with whiskers from 1 to 2 inches in length on the muzzle. The general colour of the upper parts is pale brown, growing lighter towards the belly; the hind part of the fore legs and the fore part of the hinder ones white, as are the feet of both; the tail is of a moderate length, somewhat bushy, but in a less degree than that of a fox: the teeth, he adds, are much the same as is usual in the genus.



Skull of Dingo (*Canis Dingo*). From F. Cuvier.

This description may be considered as accurate, with the exception that the animal generally bears a greater affinity to the Wolf than the Fox. "It has," says the author last quoted, describing a female, "much of the manners of the dog, but is of a very savage nature, and not likely to change in this particular. It laps like other dogs, but neither barks nor growls if vexed and teazed; instead of which it erects the hairs of the whole body like bristles, and seems furious: it is very eager after its prey, and is fond of rabbits or chickens raw, but will not touch dressed meat. From its fierceness and agility it has greatly the advantage of other animals much superior in size; for a very fine French fox-dog being put to it, in a moment it seized him

Dingo (*Canis familiaris Australasiæ*, or *C. Dingo*).

by the loins, and would have soon put an end to his existence had not help been at hand. With the utmost ease it is able to leap over the back of an ass, and was very near worrying one to death, having fastened on it so that the creature was not able to disengage himself without assistance: it has also been known to run down both deer and sheep. A second of these is in the possession of Mr. Lascelles, of which we have received much the same account in respect of its ferocity; whence it is scarcely to be expected that this elegant animal will ever become familiar."

Mr. Bell, in his work above quoted, describes the first effect of the dominion of man upon this wolf-like dog:—"The effect of domestication in producing variation in colour, to which allusion has already been made, has lately been exhibited in a very striking and interesting manner in the menagerie of the Zoological Society. An Australian bitch, or Dingo, had a litter of puppies, the father of which was also of that breed: both of them had been taken in the wild state, but were of the uniform reddish brown colour which belongs to the race, and the mother had never bred before; but the young, bred in confinement and in a half-domesticated state, were all of them more or less spotted."

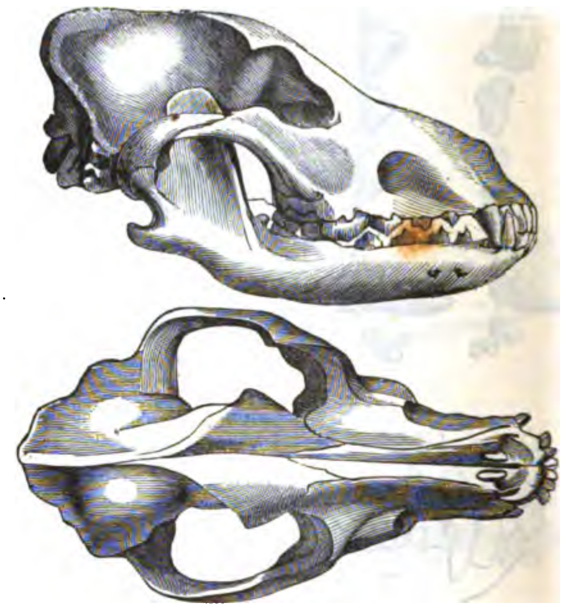
If we turn to the dogs of other comparatively uncivilised nations, we find the prick ears and other indications of the half-reclaimed animal. The Esquimaux Dog (*Canis familiaris Borealis*), and the Hare-Indian or Mackenzie River Dog (*Canis familiaris Lagopus*), will occur as instances to those who have been familiar—and who is not?—with the histories of our northern expeditions and the Garden of the Zoological Society of London in the Regent's Park. In that menagerie the three dogs last named might at one time be seen side by side, affording the best opportunities for comparison. Peter, the Esquimaux Dog, kept in the garden, was of a dingy-white with a tinge of yellow on the upper parts, gradually fading away upon the sides; in short, of nearly a uniform colour; but in general this race exhibits a predominance of black markings. Thus Akshelli, brought from the Polar Sea by Mr. Richards in Captain Parry's first voyage, and described by Mr. Children in the 'Zoological Journal,' was almost entirely blackish, or of a colour nearly approaching to black on the upper parts, and white underneath, tail included. Akshelli seldom barked, but if displeased uttered a low wolfish growl, and was a very powerful dog. Peter was brought to this country by Lieutenant Henderson, one of the companions of Captain Ross, in his first voyage, and lived long at the Regent's Park. He was very good tempered and familiar. The Hare-Indian Dogs, it is said, are never known to bark in their own country; and it is worthy of note that those which were brought from thence to the Regent's Park never barked at all, but the younger one which was born here barked like the other dogs. It is curious to observe these steps.

"The period," says Mr. Bell, "at which the domestication of the dog first took place is wholly lost in the mist of antiquity. The earliest mention of it in the Sacred Scriptures occurs during the sojourn of the Israelites in Egypt—'But against Israel shall

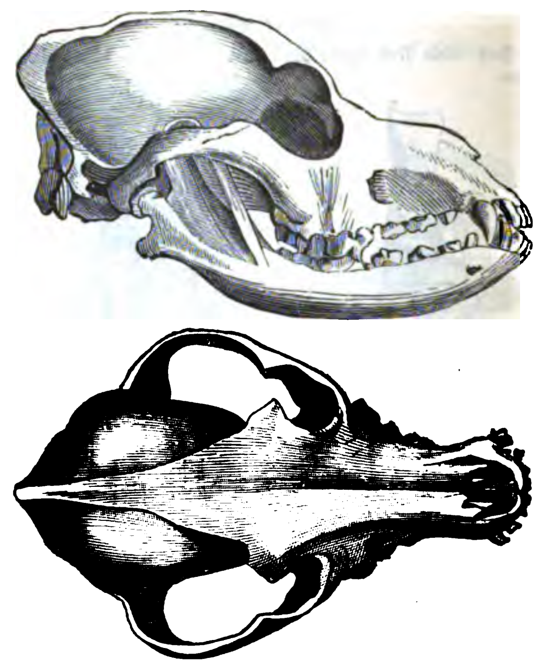
Asiatic Street-Dogs.

not a dog move his tongue.' It is again mentioned in the Mosaic law in a manner which would seem to show that they were the common scavengers of the Israelitish camp, as they are still in many of the cities of the East:—'Neither shall ye eat any flesh that is torn of beasts in the field: ye shall cast it to the dogs.' A similar office seems to be repeatedly alluded to in the course of the Jewish history:—'Him that dieth in the city shall the dogs eat, and him that dieth in the fields shall the fowls of the air eat;' a common curse, as it would appear, as it occurs verbatim on no less than three separate occasions in the First Book of Kings; and evidently intimates a violent and disgraceful death, without the honour of sepulture. The dog was considered by the Jews as eminently an unclean animal, and was the figure selected for the most contemptuous insults. It is impossible not to be struck with the striking similarity which exists in the feelings of many oriental nations at the present day, among whom the very phraseology of the Scriptures is, with little modification, applied to a similar purpose."

One circumstance should be borne in mind throughout an inquiry into the origin of the Dog. None of the wild dogs, however apparently living in a state of nature, have ever been found to return to the true form of Wolf.



Skull of Shepherd's Dog (Chien de Berger). From F. Cuvier.

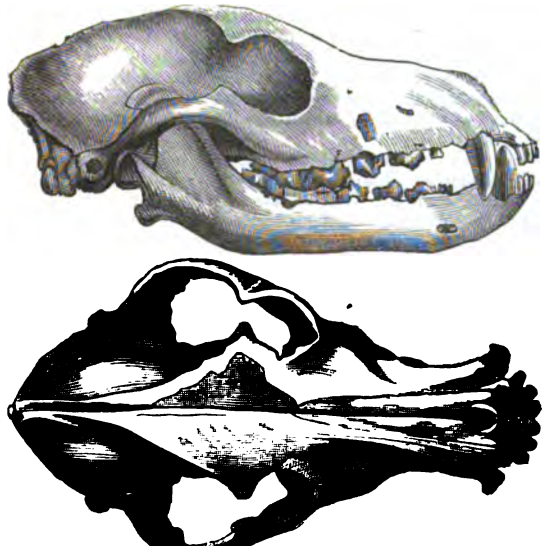


Skull of Spaniel. From F. Cuvier.

The Shepherd's Dog, a variety which was most probably one of the first that civilised and settled man called in aid to preserve his flocks from beasts and birds of prey and the depredations of roving human tribes, is remarkable for the capacity of its cranium and its great sagacity.

It is indeed distinguished by this cranial development even above the Spaniels and their varieties, and the Hounds, which comprise the most useful and intelligent dogs. In the Bull-Dogs and Mastiffs, Dogues de Forte Race of the French, though the head is one-third larger than those of the Shepherd's Dog and of the Spaniels, 'Barbets,' the cranial capacity is not by any means so great.

Skull of Dogue de Forte Race. From F. Cuvier.

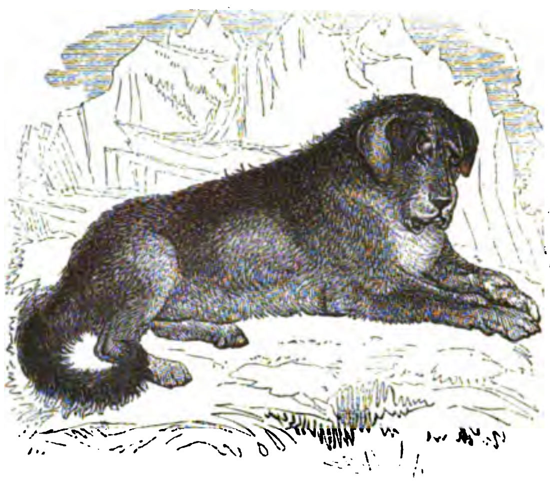


Skull of Chien Matin.

Dr. Caius, the physician of queen Elizabeth's time, wrote several papers on natural history for the use of Gesner, his correspondent and friend. In one of these treatises he divides the British dogs into —1st, The most generous kinds, which he subdivides into the Dogs of Chace, including the Hounds, namely, the Terrier, Harrier, and Bloodhound; and the Gazehound, Grayhound, Leviner or Lyemmer, and Tumbler: the Fowlers, namely, the Spaniel, Setter, Water-Spaniel, or Finder: and the Lap-Dogs, namely, the Spaniel-Gentle, or Comforter. 2nd, The Farm-Dogs, namely, the Shepherd's Dog and the Mastiff, or Ban-Dog. 3rd, Mongrels, namely, Wappe, Turnspit, and Dancer.

Bewick enumerates the following:—The Shepherd's Dog, the Cur-Dog, the Greenland-Dog, the Bull-Dog, the Mastiff, the Ban-Dog, the Dalmatian or Coach-Dog, the Irish Grayhound, the Highland Grayhound, the Gazehound, the Grayhound, the Italian Grayhound, the Lyemmer, the Lurcher, the Tumbler, the Terrier, the Beagle, the Harrier, the Fox-Hound, the Old English Hound, the Kibble Hound, the Blood-Hound, the Spanish Pointer, the English Setter, the Newfoundland Dog, the Rough Water-Dog, the Large Water-Spaniel, the Small Water-Spaniel, the Springer or Cocker, King Charles's Dog, the Pyrame Dog, the Shock-Dog, the Lion-Dog (a small and rare variety), the Comforter (a small Spaniel), the Turnspit, and the Pug. We could add many more to this list, which is long enough. The French divide the dogs into three groups, namely, the Mâtins, the Spaniels (including the Hounds and Pointer), and the Dogues (the last containing the Mastiff, Bull-Dog, &c.).

We give the gigantic Tibet Dog as a fine example of the Mastiffs. Dr. Wallich gave to Mr. Broderip the data which enabled the latter



The Tibet Dog (*Canis familiaris*, var. *Molossus Thibetanus*).

to write the following account:—"These noble animals are the watch-dogs of the table-land of the Himalaya Mountains, about Tibet. Their masters, the Bhoteas, to whom they are most strongly attached, are a singular race, of a ruddy copper-colour, indicating the bracing air which they breathe, rather short, but of an excellent dispostion. Their clothing is adapted to the cold climate they inhabit, and consists of fur and woollen cloth. The men till the ground and keep sheep, and at certain seasons come down to trade, bringing borax, tincal, and musk, for sale. They sometimes penetrate as far as Calcutta. On these occasions the women remain at home with the dogs, and the encampment is watched by the latter, which have an almost irreconcileable aversion to Europeans, and in general fly ferociously at a white face. A warmer climate relaxes all their energies, and they dwindle even in the valley of Nepaul." Some specimens were brought to this country by Dr. Wallich; they were placed in the Zoological Society's Garden in the Regent's Park, but died soon after their arrival. The Hon. Edward Gardner, British resident at the court of the Raja of Nepaul, never heard of any other instance of this variety being domesticated by Europeans.

In all the varieties the period of gestation is 63 days. The litter is generally numerous, often as many as eight or nine. The whelps are born blind, and do not see till nine days are fully expired: they sometimes see on the tenth, and sometimes not till the twelfth day. At the fourth month the teeth begin to change, and at two years the growth of the animal is considered complete. A dog is considered old at the expiration of five years, and the limits of his existence rarely exceed 20 years. It is confidently stated that in all the varieties, if a Dog has any white on any part of his tail, that colour will invariably be found at the tip.

For the special qualities of particular varieties of the Dog see the articles BEAGLE, BLOOD-HOUND, GRAYHOUND, HARRIER, POINTER, PUG, SETTER, SPANIEL, TERRIER, WOLF-DOG.

Wolves.

C. Lupus (Linnæus), the Wolf. Lieutenant-Colonel Hamilton Smith makes *Lupus* the first section of his first sub-genus *Chaon*, of the Diurnal *Canidæ*, or Canine group furnished with a round pupil of the eye.

In this section he comprises the Common Wolf, *Lupus vulgaris*; the Black Wolf, *L. Lycaon*; the Dusky Wolf, *L. nubilus*, Wied.; and the Wolf of the Southern States of North America, *L. Mexicanus*, Smith.

In the second section, *Lyciscus*, or as he terms the group the Lyciscan Dogs, he places the North American Wolf, *L. latrans*; and the Caygotte of Mexico, *L. Cagottus*, Smith.

With regard to the American Wolves, Colonel Smith remarks that whether they be distinct from those of the eastern hemisphere, or primeval varieties, is not as yet satisfactorily established. The high authority of Sir John Richardson he observes leans towards the opinion that they are different species; while Prince Maximilian of Wied, perhaps still more practically conversant with the races of both continents, thinks that they are not specifically distinct. To this last-mentioned opinion Colonel Smith states that his own somewhat extensive researches lead him to subscribe; but he qualifies this statement by observing that while our ideas respecting the characteristics of species remain unsettled the difference of conclusion is perhaps only formular.

In M. Lesson's 'Manuel' the following existing Wolves appear as distinct species:—the Common Wolf, *C. Lupus*, Linn.; the Mexican Wolf, *C. Mexicanus*, Desm.; the Red Wolf, *C. jubatus*, Desm.; the Prairie Wolf, *C. latrans*, Harl.; and the Dusky Wolf, Loup Odorant, *C. nubilus*, Say.

Colonel Smith observes that the typical Wolf of Europe and Asia, and the varieties belonging to this tribe in America, may be described as animals occupying the two continents from within the Arctic circle on the north, to Spain, and perhaps to Marocco on the west side of the Old Continent; to Syria, and beyond the Crishna in India; and to near the Isthmus of Panama in the New World. Farther south, in the last-mentioned part of the globe, they are, he remarks, replaced by an aberrant canine, the Red Wolf of Cuvier; and in the first by Hyænas, the Painted Lycaon (*Canis pictus*), and perhaps by other species not as yet fully developed. "In China," says Colonel Smith, "wolves abound in the province of Xantung [Changtung?]; but how far they are found to the south is not known. Buffon, from the account of Adançon (Adanson), asserts the existence of a powerful race of wolves in the Senegal country, hunting in company with the lion; but the name is most likely applied to a hyæna, a lycaon, or one of the red chrysean group." ('Naturalist's Library.')

The following must be the passage alluded to:—Adanson states that one night a lion and a wolf (loup) entered together in the court of the house where he slept; they raised themselves by turns by placing their feet on the timber-work of the roof (comble), as he could easily hear, and carried off their provision. In the morning the occupiers of the dwelling were satisfied, from the well-marked impressions of their feet in the sand, that the animals came together, and perceived the place whence they had taken away two fish: doubtless, says Adanson, each took his own. This theft, he adds, was moderate for two such carnivorous animals, but they did not choose the smallest. "I do not know," continues the French traveller, "that it has been before observed that the wolf goes (fraye) with the lion; nevertheless the fact is not extraordinary; there are daily proofs of it in this country, and every evening the wolf may be heard howling at the side of the lion. I have witnessed the same thing a hundred times in all my voyages on the Niger (the Senegal), and I know, without possibility of doubt, that the wolf is often found with the lion without having anything to fear. It is not that the size of the African wolf, which is much superior to that of the wolf of Europe, makes any impression on the lion; it is only because the flesh of the former is no temptation to the latter: and what confirms me in this opinion is, that I never saw the two lions which were kept in the middle of the village of Senegal attack the dogs which were exposed to them, or which they met when they were unchained; whereas they fell upon the first horse or child which came in their way."

Le Vaillant and the French generally called the Spotted Hyæna Loup Tacheté; and the terms Tigre and Tigresse are used generally for any large spotted cat. Thus we have an account of the 'Hardiesse du Tigre' in Adanson's very next sentence, where he says—"Some days after this visit of the lion with the wolf we received one from a tigress, which came to the same place with her young one and also carried away two fish." In the 'New History of Ethiopia, being a Full and Accurate Description of the Kingdom of Abessinia, vulgarly, though erroneously, called the Empire of Prester John; in four books: by the learned Job Ludolphus, Author of the Ethiopic Lexicon; made English by J. P. Gent. Folio, London, 1682,'—is the following passage:—"Tygers and panthers are much more cruel and fierce than lyons, for they never spare mankind; yet they covet the Ethiopians before white men, as more accustomed to that sort of dyet. These two beasts differ only in colour; for the panthers are brown, spotted with black; the tigers gold-coloured, with fine black spots like five-leaved grass: they are beasts of a dreadful celerity and boldness; by night they break into villages, and make doleful massacres among the poor innocent cattle; yet Alvarez affirms that these butcheries never happen in Midra-Bahrà." It is almost superfluous to add, that the Tiger, properly so called, does not inhabit Africa.

C. Lupus, the Common Wolf, is known by the following characters:—It is yellowish or fulvous gray; hair harsh and strong, longest below the ears and on the neck (particularly the throat), shoulders, and haunches; muzzle black; cheeks and parts above the eyes ochreous, gray in very old subjects; upper lip and chin white; eyes oblique; tail not curling; a blackish streak or band on the fore legs about the carpus; height at the shoulder from 27 to 29 inches.

Variety white: either as an albino, or according to the French writers, from the effect of the northern climate in the winter. Colonel Smith is of opinion that the white wolves occurring sometimes among the races of middle Europe are mere cases of albinism.

This is the wolf that more commonly infests the western countries of Europe. Cuvier state that it is found from Egypt to Lapland, and seems to have passed over into America. Colonel Smith remarks that the French wolves are generally browner and somewhat smaller than those of Germany; that the Russian race is longer, and appears more bulky and formidable from the great quantity of long coarse hair on the cheeks, gullet, and neck; their eyes are very small, and their whole aspect peculiarly savage and sinister; that the Swedish and Norwegian wolves are similar to the Russian in form, but appear heavier and deeper in the shoulder, lighter in colour than the Russian race, and in winter totally white; that the Alpine wolves are brownish-gray and smaller than the French; those of Italy and to the eastward towards Turkey fulvous.

This is the variety, most probably, which formerly lurked in the uncleared woody districts of the British Islands; for that Wolves were once numerous here is as clear as that the Bear once prowled in Scotland and Wales. It would be a waste of paper and space to detail the documentary evidence, and that to be derived from ancient coins, gems, and sculptures, which prove that the *Lupus* of the Roman historians and poets, and the *Lupa* which was fabled to have suckled Romulus and Remus was the same animal with the ancient British Wolf. Whatever the Romans might have done to put down these ferocious but cowardly beasts of prey, they left enough for their Saxon and Norman successors to do. Edgar applied himself to their extirpation in earnest, enlisting English criminals in the service by commuting the punishment awarded for their crimes to a delivery of a given number of wolves' tongues, and liberating the Welsh from the payment of the tax of gold and silver on condition of an annual tribute of 300 wolves. But the vast wild tracts and deep forests of ancient Britain were holds too strong even for his vigorous measures. What the numbers and consequent danger had been may be imagined from the necessity that existed in the previous reign of Athelstane (A.D. 925) for a refuge against their attacks. Accordingly a retreat was built at Flixton in Yorkshire, to save travellers from being devoured by these gaunt hunters. The Saxon name for the month of January, Wolf-Moneth, in which dreary season hunger probably made the wolves most desperate, and the term for an outlaw, 'Wolf's-Hed,' implying that he might be killed with as much impunity as a wolf, also indicate the numbers of these destructive beasts, and the hatred and terror which they inspired.

That Edgar failed in his attempts at extirpation is manifest from a mandamus of Edward I. to all bailiffs, &c. to give their assistance to his faithful and beloved Peter Corbet, whom the king had enjoined to take and destroy wolves (lupos), "cum hominibus, canibus, et ingeniis suis modis omnibus quibus viderit expedire," in all forests and parks and other places in the counties of Gloucester, Worcester, Hereford, and Salop, where they could be found. King John, in his grant, quoted by Pennant from Bishop Lyttelton's collection, as being in the possession of the dean and chapter of Exeter, mentions the wolf (lupum) among the beasts of chace which the Devonshire men are thereby licensed to kill.

In Derbyshire certain tenants at Wormhill held their lands by the duty of hunting and taking the wolves ('Wolve Hunt') which harboured in the county. Even so late as 1577 the flocks of Scotland appear to have suffered from the ravages of wolves, which do not seem to have been rooted out of that portion of the kingdom till about the year 1680, when Sir Ewen Cameron's hand laid the last wolf low. In Ireland wolves must have lingered as late as the year 1710, about which time the last presentment for killing them in the county of Cork was made.

The Black Wolf is a name given to a variety which is most frequent in Southern Europe, and particularly in the Pyrenees and to the south of those mountains, where they are more common than the ordinary or last-mentioned wolf, which the Black Wolf equals in stature, and, if anything, exceeds in strength. Cuvier says that it is found, but very rarely, in France. Colonel Hamilton Smith relates an anecdote illustrative of its great size and weight. One of these wolves at a battue in the mountains near Madrid came bounding towards an English gentleman who was present at the sport, through the high grass and bushes, so large that the sportsman took it for a donkey. Seven were slain; and this gentleman, though active and in the flower of life, could not lift one entirely from the ground. The specimen figured by the Colonel came from the banks of the Tagus, and he describes it as equal to the largest mastiff, of a very dark brown colour, with ears larger and the muzzle thicker than the Common Wolf, but withal resembling a very large and shaggy Wolf-Dog.

"The Spanish Wolves," says Colonel Smith, "congregated formerly in the passes of the Pyrenees in large troops, and even now the Lobo will accompany strings of mules as soon as it becomes dusky. They are seen bounding from bush to bush by the side of travellers, and keeping parallel with them as they proceed, waiting an opportunity to select a victim; and often succeeding unless the muleteers can reach some place of safety before dark, and have no dangerous passes to traverse. Black wolves occur again in the mountains of Friuli and about Cattaro."

The Vekvoturian Mountain-Wolf of Russia, described by Pallas, belongs to the black variety. Colonel Smith thinks that the Rossomak of the Lenas in Siberia, with shining black valuable fur, is probably the same.

The female of the Common Wolf produces four or five at a litter and although it is said that until the young can see, the female carefully hides them from the male, for fear he should devour them, it is certain that he hunts for them and brings them food, consisting for the most part of the smaller quadrupeds, partridges, moor-game, &c., after they have the use of their eyes, and that both parents take their offspring out to teach them to hunt as soon as they are strong enough.

The Common Wolf (*Canis Lupus*).

Several varieties or species of Wolf are met with in Asia. The Landgah, or Indian Wolf, is the *Canis pallipes* of Sykes, and the *Saccalius Indicus* of Hodgson. It is an inhabitant of Nepaul.

The wolves of Asia Minor are fulvous, but the colour is more predominant and has more red in it than that of the Italian wolves.

Of the Indian wolves, one, the Beriah, is described as being of a light fox-colour inclining to dun, not larger than a grayhound, slenderly made, but bony; the head and ears long, like those of a Jackal, and the tail long, but not very hairy; the other, which is smaller, Colonel Smith refers to his Lyciscan group. The last-named zoologist refers the black Derboun of the mountains of Arabia and the south of Syria to the Wolf.

The wolf, or the lupine forms of the genus *Canis*, are found in America. Sir John Richardson, in the 'Fauna Boreali-Americana,' observes that the Common Wolves of the Old and New World have been generally supposed to be the same species—the *Canis Lupus* of Linnæus. The American naturalists have indeed, he remarks, described some of the northern kinds of wolf as distinct; but it never seems to have been doubted that a wolf possessing all the characters of the European Wolf exists within the limits of the United States. He then goes on to point out that the wolf to which these characters have been ascribed seems to be the Large Brown Wolf of Lewis and Clark; and, according to them, it inhabits not only the Atlantic countries, but also the borders of the Pacific and the mountains which approach the Columbia River, between the great falls and rapids, but is not found on the Missouri to the westward of the Platte. Richardson remarks that he had seen none of these Brown Wolves.

In the 'New Description of Virginia' (1649) wolves are mentioned among the beasts found there; and Lawson notices the Wolf of Carolina and thus describes him :—"The Wolf of Carolina is the dog of the woods. The Indians had no other curs before the Christians came amongst them. They are made domestic. When wild they are neither so large nor fierce as the European Wolf. They are not man-slayers, neither is any creature in Carolina unless wounded. They go in great droves in the night to hunt deer, which they do as well as the best pack of hounds: nay, one of these will hunt down a deer. They are often so poor that they can hardly run. When they catch no prey they go to a swamp, and fill their belly full of mud; if afterwards they chance to get anything of flesh, they will disgorge the mud and eat the other. When they hunt in the night, and there is a great many together, they make the most hideous and frightful noise that ever was heard. The fur makes good muffs. The skin, dressed to a parchment, makes the best drum-heads, and if tanned makes the best sort of shoes for the summer-countries."

Catesby says :—"The wolves in America are like those of Europe in shape and colour, but are somewhat smaller. They are more timorous, and not so voracious as those of Europe. A drove of them will fly from a single man, yet in very severe weather there have been some instances to the contrary. Wolves were domestic with the Indians, who had no other dogs before those of Europe were introduced, since which the breed of wolves and European dogs are mixed and become prolific. It is remarkable that the European dogs that have no mixture of wolfish blood have an antipathy to those that have, and worry them whenever they meet. The wolf-breed act only defensively, and, with his tail between his legs, endeavours to evade the other's fury. The wolves in Carolina are very numerous, and more destructive than any other animal. They go in droves by night, and hunt deer like hounds, with dismal yelling cries."

Sir John Richardson gives a minute description of the *Canis Lupus occidentalis*, American Wolf, the Missouri Wolf of Lewis and Clark, and states that he does not mean to assert that the differences existing between it and its European congener are sufficiently permanent to constitute them, in the eye of the naturalist, distinct species. The same kind of differences, he observes, may be traced between the foxes and native races of the domestic dog of the New World and those of the Old; the former possessing finer, denser, and longer fur, and broader feet, well calculated for running on the snow. These remarks were elicited by a comparison of living specimens of American and Pyrenean wolves; but he had not an opportunity of ascertaining whether the Lapland and Siberian wolves, inhabiting a similar climate with those of America, had similar peculiarities of form, or whether they differed in physiognomy from the wolf of the south of Europe. He therefore considered it unadvisable to designate the northern wolf of America by a distinct specific appellation, lest he should unnecessarily add to the list of synonyms. The word *occidentalis*, which is affixed to the Linnæan name of *Canis Lupus*, is, he tells us, to be considered as merely marking the geographical position of that peculiar race of Wolf.

This animal is very common throughout the northern regions of America, but more or less abundant in different districts. "Their foot-marks," says Richardson, "may be seen by the side of every stream, and a traveller can rarely pass a night in these wilds without hearing them howling around him. They are very numerous on the sandy plains which, lying to the eastward of the Rocky Mountains, extend from the sources of the Peace and Saskatchewan rivers towards the Missouri. There bands of them hang on the skirts of the buffalo (bison) herds, and prey upon the sick and straggling calves. They do not, under ordinary circumstances, venture to attack the full-grown animal; for the hunters informed me that they often see wolves walking through a herd of bulls without exciting the least alarm; and the marksmen, when they crawl towards a buffalo for the purpose of shooting it, occasionally wear a cap with two ears, in imitation of the head of a wolf, knowing from experience that they will be suffered to approach nearer in that guise. On the Barren-Grounds through which the Coppermine River flows I had more than once an opportunity of seeing a single wolf in close pursuit of a rein-deer; and I witnessed a chace on Point Lake when covered with ice, which terminated in a fine buck rein-deer being overtaken by a large white wolf, and disabled by a bite in the flank. An Indian, who was concealed on the borders of the lake, ran in and cut the deer's throat with his knife, the wolf at once relinquished his prey and sneaked off. In the chase the poor deer urged its flight by great bounds, which for a time exceeded the speed of the wolf; but it stopped so frequently to gaze on its relentless enemy, that the latter, toiling on at a 'long gallop' with its tongue lolling out of its mouth, gradually came up. After each hasty look the poor deer redoubled its efforts to escape; but, either exhausted by fatigue or enervated by fear, it became, just before it was overtaken, scarcely able to keep its feet."

The same author observes that the wolves destroy many foxes, which they easily run down if they perceive them on a plain at any distance from their hiding-places; and he relates that in January 1827 a wolf was seen to catch an Arctic Fox within sight of Fort Franklin, and although immediately pursued by hunters on snow-shoes, it bore off its prey in its mouth without any apparent diminution of its speed. The same wolf, he adds, continued for some days to prowl in the vicinity of the fort, and even stole fish from a sledge which two dogs were accustomed to draw home from the nets without a driver. As this kind of depredation could not be allowed to go on, the wolf was waylaid and killed. It proved to be a female, which accounted for the sledge-dogs not having been molested. He further states that the buffalo-hunters would be unable to preserve the game they kill from the wolves if the latter were not as fearful as they are rapacious. The simple precaution of tying a handkerchief to a branch, or of blowing up a bladder and hanging it so as to wave in the wind, is sufficient to keep herds of wolves at a distance. At times, however, he says that they are impelled by hunger to be more venturous, and that they have been known to steal provisions from under a man's head in the night, and to come into a traveller's bivouac and carry off some of his dogs. "During our residence at Cumberland House in 1820," continues Sir John, "a wolf, which had been prowling round the fort, and was wounded by a musket-ball and driven off, returned after it became dark, whilst the blood was still flowing from its wound, and carried off a dog from amongst fifty others, that howled piteously, but had not courage to unite in an attack on their enemy. I was told of a poor Indian woman who was strangled by a wolf, while her husband, who saw the attack, was hastening to her assistance; but this was the only instance of their attacking human life that came to my knowledge. As the winter advances and the snow becomes deep, the wolves, being no longer able to hunt with success, suffer from hunger, and in severe seasons many die. In the spring of 1826 a large gray wolf was driven by hunger to prowl amongst the Indian huts which were erected in the immediate vicinity of Fort Franklin, but not being successful in picking up aught to eat, it was found a few days afterwards lying dead on the snow near the fort. Its extreme emaciation and the emptiness of its intestines showed clearly that it died from inanition."

We learn from the same excellent authority that the American Wolf burrows, and brings forth its young in earths with several outlets, like those of a fox. Sir John Richardson saw some of their burrows on the plains of the Saskatchewan, and also on the banks of the Coppermine River. The number in a litter he states to vary from four or five to eight or nine. After referring to the instances recorded in the narratives of Captain Parry and Captain Franklin of the association of the female wolves with the domestic dog, he relates that he was informed that the Indians endeavour to improve their sledge-dogs by crossing the breed with wolves, and he adds, that the resemblance between the northern wolves and the domestic dog of the Indians is so great, that the size and strength of the wolf seem to be the only difference. "I have more than once," says he, "mistaken a band of wolves for the dogs of a party of Indians; and the howl of the animals of both species is prolonged so exactly in the same key, that even the practised ear of an Indian fails at times to discriminate them."

Captain Lyon gives the following account of the Esquimaux wolf-trap. It is made of strong slabs of ice, long and narrow, so that a fox can with difficulty turn himself in it, but a wolf must actually remain in the position in which he is taken. The door is a heavy portcullis of ice, sliding in two well-secured grooves of the same substance, and is kept up by a line, which, passing over the top of the trap, is carried through a hole at the furthest extremity; to the end of the line is fastened a small hoop of whalebone, and to this any kind of flesh-bait is attached. From the slab which terminates the trap, a projection of ice, or a peg of wood or bone, points inwards near the bottom, and under this the hoop is lightly hooked; the slightest pull at the bait liberates it, the door falls in an instant, and the wolf is speared where he lies.

The following varieties of the North American Wolf are enumerated by Sir John Richardson:—

Variety *a.* Common Gray Wolf, *Lupus griseus*, the Mahaygan of the Cree Indians, and the Amarok of the Esquimaux.

Variety *b.* The White Wolf, *Lupus albus.*

Variety *c.* The Pied Wolf, *Lupus sticte.*

Variety *d.* The Dusky Wolf, *Lupus nubilus*, *Canis nubilus* of Say.

The Dusky Wolf (*Lupus nubilus*).

Variety *e.* The Black American Wolf, *Lupus ater*, *Canis Lycaon* of Harlan.

C. latrans (Say), the Prairie Wolf, *Lyciscus latrans* of Smith.

The animals which are thus distinguished have been long known to voyagers on the Missouri and Saskatchewan, as distinct from the Common Wolf. They are the Small Wolves of Du Pratz; the Prairie Wolf of Gass; the Prairie Wolf and Burrowing Dog of Lewis and Clark, and of Schoolcraft; the Cased Wolves of the Hudson's Bay Company's lists; and the Meesteh-chaggoneesh of the Cree Indians.

Sir John Richardson states that the northern range of the Prairie Wolf is about the 55th degree of latitude, and that it probably extends southward to Mexico. It associates, according to him, in greater numbers than the Gray Wolf of the same districts; it hunts in packs, and brings forth its young in burrows on the open plain remote from the woods. On the banks of the Saskatchewan these animals start from the earth in great numbers on hearing the report of a gun, and gather round the hunter expectant of the offal of the animal which he has slain. They are much more fleet than the Common Wolves. Sir John Richardson was informed by an experienced hunter who had resided for forty years on the Saskatchewan, that the only animal on the plains which he could not overtake, when mounted on a good horse, was the Prong-Horned Antelope, and that the Prairie Wolf was the next in speed.

C. ochropus, the Coyotl, *Vulpes Indica* of Hernandez ('Hist. Quadr. Novæ Hisp.,' c. xiii.), appears to be the Caygotte of the Mexican Spaniards, and is "most probably," the *Lyciscus Cagottis* of Smith. This appears to be the animal mentioned by Mr. Bullock, in his 'Six Months in Mexico.' "Near Rio Frio," says that traveller and assiduous collector, "we shot several handsome birds, and saw a cayjotte or wild dog, which in size nearly approached the wolf. He stood looking at us at a short distance from the road, and it was not till a gun was fired at him that he deliberately moved off."

Hernandez describes the Coyotl to be an animal unknown to the Old World, with a wolf's head, vivid large and pallid eyes, small and sharp ears, a long black and not thick muzzle, muscular legs, crooked and thick claws, a very rough and thick tail, a noxious bite, approaching in form to the Fox, to which genus it is perhaps to be referred, and intermediate between it and the Wolf in size; for it is twice the size of the fox and less than the wolf, wherefore it is said to attack and kill not only sheep and similar animals, but stags, and sometimes even men. It is covered with brown and white long hair, is sagacious in hunting and vulpine in its manners, and so pertinacious an avenger of wrongs, and so mindful of the abstraction of its prey, that it will recognise the robber after many days, will follow him, and sometimes set upon him with others of its own kind, &c. It is however grateful to its benefactors. It lives in many places of New Spain, and especially in those which are colder. It feeds upon the weaker animals, maize and other frumentaceous vegetables, and sugar-cane.

The Aguara Guazu of D'Azara is the *Canis jubatus* of Cuvier, the Loup Rouge of the French, the *Canis campestris* of the Prince de Wied, and the Maned Aguara, *Chrysocyon jubatus*, of Smith.

D'Azara thus describes this Red Wolf, to which the Payaguas Indians give the name of Paraepaga, and the Chilians that of Culpeu. In Moxos, he says, the animal goes by the appellation of Ocorome.

Length of an adult male exactly 5 feet, that of the tail 19 inches, the hairs being 4 inches long. Height in front 2 feet 10⅓ inches, behind 2 feet 11 inches; circumference close to the fore legs wanting half an inch of 2 feet, of the middle of the neck 1 foot; and of the head, before the ears, 1 foot 3 inches; the ears 6 inches high, in their broadest part 4 inches, erect, but not exactly sharp, and very thick. From the tip of the muzzle to the ears 9¾ inches, and to the inner angle of the eye 5 inches; the whiskers 2⅓ inches long, and black. The upper jaw projecting 1 inch; the canine teeth 10 lines long, although they were very much worn; eye small and somewhat sunk; from the eye forwards the muzzle of almost equal thickness to the tip. Under the head a great white spot; long hair within the ears, and extreme half of tail white also. Fore and hind feet to the claws, lower jaw from the corner of the mouth forwards, and extremity of upper jaw, black; rest of the coat clear yellowish-red. Mane commencing at the occiput and continuing erect till beyond the shoulder, 5¾ inches long, red in the first half of each hair, and black in the remainder towards the tip. Hair all over the body, including the belly, except the lower part of the fore legs, very long, and on the extremity of the spine 4⅓ inches. D'Azara observes that it is neither completely flattened nor very rough, and would make good carpets. Hair of the tail rather bushy and of the same length as on the body.

D'Azara caught four males at different times which were identical, the smallest towards the end of September, which appeared to him to have been whelped at the end of July or the beginning of August. D'Azara's friend Noseda caught another about two months old, and in the hope of domesticating it, fed it on raw beef, which it was unable to digest, and which caused its death. D'Azara and Noseda caught another afterwards, about three months old, and gave it raw beef but seldom; when it was given however the animal threw it up, and to prevent this its meat was cooked, but still it was not digested. This Aguara got loose from its chain and escaped. During its short captivity, if anybody approached, it growled and barked like a dog, but more vehemently and confusedly. It drank by lapping, and when feeding trod on the flesh, which it tore to pieces with its teeth. This animal was fond of rats, sugar-cane, oranges, eggs, and small birds; but did not appear to be attracted by the poultry, which sometimes passed within its reach without its attempting to pounce upon them.

D'Azara further states that in a wild state they do not commit havoc on the herds or smaller flocks; and as they inhabit only the extensive lowlands and marshes of Paraguay as far as the river Plata and near its mouth, he has no doubt that they feed on rats, guinea-pigs, small birds, and certain vegetables, if these fall in their way; but chiefly on snails, toads, frogs, and other reptiles, and on the land-crabs, which are abundant in the plains and sand-banks. They walk with very long paces, run much, and are, D'Azara adds, great plunderers, although they always fly from man, and even from dogs. They are solitary in their habits, and are said to swim well; and in their wild state to utter no sound but 'gouaa,' which they often and loudly repeat so as to be heard at a great distance. The sexes have no very marked difference.

The Aguara Dogs (*Dusicyon* of Smith) are a distinct race; and so are the Aguara Foxes (*Cerdocyon* of the same author).

Jackals.

C. aureus (Linnæus), the Jackal, or Tschakkal, Chacal or Loup Doré of the French, Adive of Buffon.

The dental formula of this species is that of the Dog. The pupil of the eye is round like those of the dog and wolf. Yellowish-gray above, whitish below; thighs and legs yellow; ears ruddy; muzzle very pointed; tail reaching hardly to the heel (properly so called). The colours sometimes vary, and the back and sides are described by Mr. Bennett as of mixed gray and black, and as abruptly and strikingly distinguished from the deep and uniform tawny of the shoulders, haunches, and legs. The head nearly of the same mixed shade with the upper surface of the body.

It is an inhabitant of India, other parts of Asia, and Africa. Cuvier says that Jackals are met with from India and the environs of the Caspian Sea to Guinea, but that it is not certain that they are all of the same species.

The habits of the Jackal are gregarious, hunting in packs, and the pests of the countries where they are found, and where they burrow in the earth. In their huntings the Jackals will frequently attack the larger quadrupeds, but the smaller animals and the poultry are their most frequent prey. Their cry is very peculiar and piercing. Captain Beechey notices it as having something rather appalling when heard for the first time at night; and he remarks, that as they usually come in packs, the first shriek which is uttered is always the signal for a general chorus. "We hardly know," continues the Captain, "a sound which partakes less of harmony than that which is at present in question; and indeed the sudden burst of the answering long-protracted scream, succeeding immediately to the opening note, is scarcely less impressive than the roll of the thunder-clap immediately after a flash of lightning. The effect of this music is very much increased when the first note is heard in the distance (a circumstance which often occurs), and the answering yell bursts out from several points at once, within a few yards or feet of the place where the auditors are sleeping." These animals are said to devour the dead on the battle-field, and to scratch away the earth from the shallow graves in order to feed on the corpses.

John Hunter ('Phil. Trans.') has recorded the case of a female Jackal which whelped in this country. The period of gestation was about the same as that of the dog, and the whelps were blind at first.

The story of the Jackal being the lion's provider may have arisen from the notion that the yell of the pack gives notice to the lion that prey is on foot, or from the Jackal's being seen to feed on the remnants of the lion's quarry.

Cuvier observes that it is not certain that all the Jackals are similar ('of the same species'); those of Senegal, for example the Dieb, (*Canis anthus*, F. Cuvier), he remarks, stand higher on the legs, and appear to have the muzzle sharper and the tail rather longer.

The offensive odour of the Jackal has been given as one of the reasons against reducing it to a state of domestication. We do not see what advantage is to be derived from such a process, but if it were desirable that objection it seems would not hold. Colonel Sykes, who notices it as the Kholah of the Mahrattas and as being numerous in Dukhun (Deccan), had in his possession at the same time a very large wild male and a domesticated female. The odour of the wild animal was almost unbearable; that of the domesticated Jackal was scarcely perceptible.

Jackal (*Canis aureus*).

Some are of opinion that the 300 foxes between whose tails Samson is said to have put firebrands in order that they might set fire to the crops of the Philistines (Judges, xv. 4, 5) were jackals. Many of the modern oriental names for the last-mentioned animals—Chical of the Turks, Sciagal, Sciugal, Sciachal, or Shacal of the Persians—come very near to the Hebrew word 'Shual.' Hasselquist, speaking of "*Canis aureus*, the Jackcall, Chical of the Turks," says:—"There are greater numbers of this species of fox to be met with than the former (*Canis Vulpes*), particularly near Jaffa, about Gaza, and in Galilee. I leave others to determine which of these is the fox of Samson."

Fossil Canidæ.

The remains of the Dog and Wolf have been found in Great Britain. If there were no historical records to prove that the wolf was once an inhabitant of these islands, its abundant remains would testify to the fact. They were not present in any considerable number in the Bone-Caves of Kirkdale which were so diligently examined by Dr. Buckland, but they have been found at Paviland in Glamorganshire and at Oreston near Plymouth. After alluding to the difficulty which was more particularly expressed by Cuvier of distinguishing between the Wolf and the Dog, Professor Owen referring to some specimens from Kent's Hole says:—"The more important points of concordance between the skull from Kent's Hole and those of the existing wolf leave no reasonable ground for doubting their specific identity; and the naturalist who does not admit that the dog and the wolf are of the same species, and who might be disposed to question the reference of the British Fossils described in the present section to the wolf must in that case resort to the hypothesis that there formerly existed in England a wild variety of dog having the low and contracted forehead of the wolf, and which had become extinct before the records of the human race. The conclusion however to which my comparison of the fossil and recent bones of the large *Canidæ* have led me is, that the wolves which our ancestors extirpated were of the same species as those which, at a much more remote period, left their bones in the limestone caverns by the side of the extinct bears and hyænas."

Recognisable remains of the Dog have however been obtained from Bone-Caves. Dr. Schmerling has described and figured an almost entire skull, two right rami of lower jaws, a humerus, ulna, radius, and some smaller bones, indicating two varieties of the domestic dog, from some Bone-Caves near Liège.

CANNA, a genus of plants belonging to the natural order *Marantaceæ*. It has spathaceous flowers, simple anthers attached to the edge of a petal-like filament, an inferior ovary, thick club-shaped erect free style, a linear obtuse stigma. There are several species of this genus, all of which are known by the name of Indian Shot. They are inhabitants of South America and of the East Indies.

C. Indica has the inner limb of the corolla trifid, the segments lanceolate, acuminate, straight. This species, with *C. patens* and *C. coccinea*, are common plants within the tropics on all the continents. In America and Brazil they are known by the common name of Wild Plantains. Their leaves are large and tough, and are mostly chosen for forming envelopes for articles of commerce. Hence the French call these plants Balisiers. The seeds of most of the species are round, black, shining, hard, heavy, and about the sixteenth of an inch in diameter, resembling shot, for which they are sometimes used as a substitute. They are roasted and employed in infusion in the same manner as coffee. They yield also a purple dye.

C. edulis has smooth leaves and stems coloured at the base, the roots tuberous and large, the middle segment of the corolla very short. This is one of the species of the order the rootstock of which is used for making arrowroot. Nearly all the species contain starch in the rootstock, which renders them fit to be used as food after being cooked. The starch is separated by tearing the rootstock in pieces and submitting it to the action of water. The water with the starch suspended is poured off from the ligneous portion of the rootstock, and the starch is afterwards allowed to subside. Clusius says that the *C. lutea* grows in the open air in Spain and Portugal, and that the inhabitants of those countries use the seeds for making rosaries.

Many of the species will bear the open air in the summer in this country. They require a light rich soil, and may be increased by dividing the roots or by sowing the seed. They should be planted out in a warm border early in the summer.

(Loudon, *Encyclopædia of Plants*.)

CANNABINACEÆ, *Hempworts*, the Hemp Tribe, a natural order of Exogenous Plants. This little order which has been separated from *Urticaceæ* embraces two well-known plants, the Hop (*Humulus Lupulus*) and the Hemp (*Cannabis sativa*). They are distinguished from the Nettle Tribe by having a solitary suspended ovule, and a hooked ex-albuminous embryo, with a superior radicle. [HUMULUS; CANNABIS.]

CA'NNABIS (in Greek Κάνναβις, and in Latin also *Cannabis*), a genus of plants belonging to the natural order *Cannabinaceæ*.

Cannabis sativa, the Common Hemp, is a plant nearly allied botanically to the nettle, with which it even agrees in its general appearance. It is an annual diœcious plant, with erect nearly-simple stems from 4 to 6 feet high, and covered with rigid hairs. The leaves are either alternate or opposite, digitate, and stalked; the leaflets are five in number, narrow, lanceolate, sharp-pointed, serrated, rough, pale-green on the under side; the uppermost leaves have only three leaflets. The male flowers grow in little bunches at the axils of the upper leaves; they are pendulous from short stalks, and have a calyx of five spreading narrow lanceolate sepals, containing five stamens. The female flowers appear in close leafy clusters at the axils of the upper leaves, and consist of a roundish calyx, split half-way down into two parts, and containing a simple 1-celled ovary terminated by a couple of awl-shaped stigmas. The fruit is a lenticular body, looking like and commonly called a seed.

This is the only species known; it is said to be a native of Persia, and is certainly wild, according to Roxburgh, "among the hills and mountains north of India, as well as common everywhere in the gardens of the natives throughout Asia." It is now universally distributed over the north of Europe. Herodotus, iv. 74, describes it as growing in Scythia, north of the Danube, a country which he had visited. We must from this conclude that the plant is really a native of north and east Europe.

It is from its possessing a remarkably tough kind of woody tissue capable of being manufactured into linen and cordage, that hemp is best known; and for its good qualities in this respect it is unrivalled among the many species possessing similar properties. But it also contains a deleterious narcotic secretion of great energy. If one remains for any length of time amongst a plantation of young hemp, head-ache and vertigo are often the result; in hotter countries these effects are much more violent, a kind of intoxication being speedily produced. Oriental nations have taken advantage of this to add another to the list of intoxicating drugs, which they contrive to substitute for the forbidden wine of western people. The powdered leaves mixed with some kind of aromatic are infused in water and drunk, when a drowsy ecstatic feeling comes on, which is said to be much more agreeable than that produced by opium. The leaves are also mixed with tobacco for smoking. The two chapters of Herod., iv. 74, 75, are curious as to its intoxicating effects, &c. The drug obtained from hemp is called bang, or haschish, or cherris: gangika or ganga, kinnab, subjah, majah, are other names for it. The seeds of hemp abound in a thick mucilage, and are used medicinally for the preparation of emulsions: a useful oil is obtained from them by pressure. The hemp develops its active properties more in warm climates, hence for medicinal purposes it is brought into this country from India under the name of *Cannabis Indica*.

CANNON-BALL-TREE. [COUROUPITA.]

CANTHA'RIDÆ, a family of Coleopterous Insects of the section *Trachelides*. It has the following characters:—Hooks of all the tarsi cleft; antennæ generally filiform; head usually broader than the thorax, and divided posteriorly by an indentation; thorax for the most part narrower behind than before; elytra soft and flexible, and in most of the species inclosing the sides of the abdomen. The genus *Cantharis* may be distinguished from other genera of this family by the following characters:—Antennæ long and filiform, the second joint very short; maxillary palpi short, the joints nearly equal, the terminal joint slightly exceeding the others in bulk; head a little wider than the thorax, which is slightly elongated, and has the anterior part suddenly narrowed, forming as it were a neck; elytra elongate, and somewhat linear.

Cantharis vesicatoria, the Spanish Fly, or Blister-Beetle, is well known for its medical uses. [CANTHARIS VESICATORIA, in ARTS AND SC. DIV.] It is about three-quarters of an inch in length, and of a bright-green colour; the legs and antennæ are bluish-black.

This insect is found but rarely in this country. It appears in the month of June and frequents ash-trees, upon the leaves of which it feeds. *C. vesicatoria* is also found in France, but in Italy and Spain it appears to be most abundant.

When touched these insects feign death, and emit an odour of a highly penetrating nature. Their larvæ live in the ground, and feed upon the roots of plants.

CANTHARIS. [CANTHARIDÆ.]

CANTHARUS, a genus of Acanthopterygious Fishes belonging to the family *Sparidæ*. It has a deep compressed body; a single elongated dorsal fin; teeth of rather small size, numerous, conical, placed in several rows, those of the outer row rather larger and more curved than those forming the inner rows; mouth rather small; branchiostegous rays, six. (Yarrell.) One species of this genus appears on the coasts of Great Britain, the *C. griseus* of Cuvier and Valenciennes. It is the *Sparus lineatus* of Montagu. It is common on the coasts of Kent, Sussex, and Devonshire, where it is called the Black Bream. It is also called the Black Sea-Bream, but it is a different fish from the Sea-Bream (*Pagellus centrodontus*). Mr. Yarrell says, "It enters harbours, and is frequently taken by anglers from rocks and pier-heads." It takes common baits, but seems principally to feed on marine vegetables.

CAOUTCHOUC. [INDIA-RUBBER.]

CAOUTCHOUC, FOSSIL. [BITUMEN.]

CAPERCALI, CAPERKALLY, or CAPERCALZE, the Scotch name for the Capercail, Wood-Grouse, or Cock of the Wood, the *Tetrao Urogallus* of Linnæus.

Pennant refers this bird to the Coc de Bois, or Faisan Bruyant, of Belon, and the Gallo Cedrone of the Italians; and it is very probable that these and other names, namely, Gallo di Monte, Gallo Selvatico, Gallo Alpestre, Fasan Negro, and Fasiano Alpestre, were applied both to the Caperkally and the Black-Cock, according to the different localities where the species occurred. [BLACK-COCK.] Part of Belon's description of his Coc de Bois—such, for example, as the plume "si noire et reluisant au-dessous du col, et de l'estomach, qu'elle monstre en estre toute changeante," and the tail with the feathers "voultées, c'est à dire courbées en arc, et larges par le bout, ayant quelque petites madrures blanches," might apply to the Black-Cock, while "the size approaching to that of the peacock"—"the head not less than that of a bustard, with the great massive trenchant beak,"—are much more applicable to the Caperkally, which is Le Grand Coq de Bruyères of Brisson, the Coq de Bruyère ou Tetrao of Buffon, Kjader of the 'Fauna Suecica,' Tjaderhona of Hasselquist, the Tetrao Auerhan of Temminck, Auer Hahn of Frisch, Auerwaldhuhn of Bechstein, the Peacock of the Wood (*Pavo sylvestris*) of Giraldus Cambrensis, Capricalca of Sibbald, the Cock of the Mountain or Wood (called by the Venetians Gallo di Montagna) of Willughby, the Cock of the Wood or Mountain of Ray, Wood or Great Grous of Pennant, Ceiliog Coed of the ancient British, *Urogallus seu Tetrao major* of Aldrovand, *Tetrao Urogallus* of Linnæus, and *Urogallus vulgaris* of Fleming.

Temminck says that this bird is numerous in the north of Asia, and in Russia towards Siberia: and that it is common in Livonia, sufficiently abundant in Germany, in Hungary, and in certain parts of the Archipelago: he adds that it is more rare in France, and never found in Holland. Pennant states that these birds are common in Scandinavia, Germany, France, Italy, and several parts of the Alps. It is added in a note, on the authority of Hasselquist, that the bird was shot in the Isle of Milo on a palm-tree, and on that of Belon that it is found in Crete; and it is observed that the English translator of Hasselquist gives a false name to it, calling it Black Game. Mr. Lloyd says that it is to be found in most parts of the Scandinavian peninsula; indeed as far to the north as the pine-tree flourishes, which is very near to the North Cape itself. He adds that the bird is very rare in the more southern of the Swedish provinces.

That it was once frequent in the British Islands there is no doubt, though it is now utterly extinct as a wild British species. Ray says: "Anglia hunc non alit. In Hiberniâ inveniri dicitur." Pennant writes: "This species is found in no other part of Great Britain than the Highlands of Scotland, north of Inverness, and is very rare even in those parts. It is there known by the name of Capercalze, Auercalze, and in the old law-books Caperkally—the last signifying the Horse of the Woods—this species being, in comparison of others of the genus, pre-eminently large." He also says: "In our country I have seen one specimen, a male, killed in the woods of Mr. Chisolme, to the north of Inverness. About the year 1760 a few were to be found about Thomas Town, in the county of Tipperary, but I suspect that the breed is now extinct in every part of Ireland." Graves (1813) says: "This species is nearly extinct in Great Britain; two instances of its being killed in Scotland within these few years are the only satisfactory accounts we have received of its being recently found in these kingdoms. One was killed by a gentleman of the name of Henderson near Fort William about six years ago, and sent to Dundee; but the vessel that conveyed it to London was detained so long on the passage that the bird became so putrid that only the head and legs could be preserved. The other specimen was shot by Captain Stanton near Burrowstoneness two winters ago; they were both males. Some few are said to be yet remaining in the pine forests of Scotland, and also in the mountainous parts of Ireland." Bewick speaks of it as very rare in Great Britain. In the last edition of Montagu (1833) it is stated that the bird was last seen in 1760 in the woods of Strathglass, that it continued in Strathspey till 1745, and that recent attempts have been made to re-introduce it from Norway without success. Selby (1825) alludes to its extirpation, and omits the species. Jenyns (1835) observes that it was formely abundant in the mountainous forests of Scotland and Ireland, but that it is now extirpated. A living pair came into the possession of the Zoological Society of London, but they did not long survive the loss of liberty.

"A few years ago," writes Mr. Lloyd in his interesting 'Field Sports,' "I procured a brace of those birds, consisting of cock and hen, for a friend of mine, Mr. Thomas Fowell Buxton, the member for Weymouth, then resident at Cromer Hall in Norfolk. After a lapse of a few months the hen laid six eggs, and from these, in process of time, six capercali were produced. The chicks lived until they had attained to a very considerable size, when, owing to the effects, as it was supposed, of a burning sun, to which they had been incautiously exposed, the whole of them, together with the mother, died. On this mishap the old cock, the only survivor, was turned loose into the game preserves, where he remained in a thriving condition for about a year and a half. At last however he also met his doom, though this was supposed to be owing rather to accidental than natural causes."

In further corroboration of the fact that the Capercali will breed when in confinement, we make the following quotation from Mr. Nilsson's work. That gentleman's authority was the öfwer director of Uhr; and the birds alluded to were at a forge in the province of Dalecarlia:—

"They were kept together during the winter in a large loft over a barn, and were fed with corn, and got occasionally a change of fresh spruce-fir, pine, and juniper sprigs. Early in the spring they were let out into an inclosure near the house, protected by a high and close fence, in which were several firs and pines, the common trees of the place. In this inclosure they were never disturbed; and during the sitting season no one approached except the person who laid in the meat, which at that time consisted of barley, besides fresh sprigs of the kinds before mentioned. It is an indispensable rule that they shall have full liberty, and remain entirely undisturbed, if the hens are to sit and hatch their young. As soon as this had occurred, and the brood were out, they were removed to the yard, which was also roomy, and so closely fenced that the young ones could not escape through; and within this fence were hedges and a number of bushes planted. Of the old ones one of the wings was always clipped, to prevent their flying. I have seen several times such broods, both of black game and capercali, eight to twelve young ones belonging to each hen. They were so tame that, like our common hens, they would run forward when corn was thrown to them. They should always have a good supply of sand and fresh water."

M. Greiff gives the following directions for rearing the young:—

"The eggs, usually so called, to be found in ant-hills and stubble, are to be gathered; hard boiled eggs are to be chopped and mixed amongst fine moistened barley-meal; also pea-haulm and trefoil-grass are to be given them for food, and water to drink, which must be placed so that they cannot overturn the pitcher, for they suffer very much if they get wet when they are young. Dry sand and mould they never should be without. When they get larger, and cabbage-leaves, strawberries, cranberries, and blueberries are to be had, they are fond of such food: and when they are full grown they eat barley and wheat; and in winter they should get young shoots of pine and birch-buds. I have seen many people who thought they treated young birds well by giving them juniper berries; but they never resort to this kind of food but in case of necessity."

The following observations of Professor Nilsson show how well this bird is adapted for the game preserve:—

"When the capercali is reared from the time of being a chicken, he frequently becomes as tame as a domestic fowl, and may be safely left by himself. He however seldom loses his natural boldness, and, like the turkey-cock, will often fly at and peck people. He never becomes so tame and familiar as the black-cock. Even in his wild state the capercali frequently forgets his inherent shyness, and will attack people when approaching his place of resort. Mr. Alderberg mentions such an occurrence. During a number of years an old capercali cock had been in the habit of frequenting the estate of Villinge at Wermdö, who, as often as he heard the voice of people in the adjoining wood, had the boldness to station himself on the ground, and, during a continual flapping of his wings, pecked at the legs and feet of those that disturbed his domain."

For the details of the experiment made by Lord Fife in the years 1828, 1829, 1830, and 1831, we must refer the reader to Mr. Wilson's interesting paper in 'Jameson's Journal' for July 1832. Suffice it to say that, after some failures, Mr. Wilson, in August, 1831, saw at Braemar five young Capercali which had been hatched there, and were, with their parents, in good health. The intention of the Thane was, "as soon as some healthy broods had been reared in confinement to liberate a few in the old pine woods of Braemar, and thus eventually to stock with the finest of feathered game the noblest of Scottish forests." In 1844 five young birds were hatched in the aviary of the late Lord Derby at Knowsley.

Temminck makes the food to consist of many sorts of berries, the buds and young shoots of the leaves of trees and of alpine shrubs; also of insects, but rarely of seeds. Mr. Lloyd says that it feeds principally on the leaves of the Scotch fir (Tal), and very rarely on those of the spruce (Gran): also on juniper berries, cranberries, blueberries, and others common to the northern forests, and occasionally in the winter time on the buds of the birch, &c. The young, he says, are for the most part sustained at first on ants, worms, insects, &c.

Temminck says that the nest is formed in high herbage and under bushes, and that the hen lays from 6 to 16 obtuse eggs of a dirty white colour, marked with yellowish spots. Latham states that he is well informed that the nest of one found in Scotland was placed on a Scotch pine: "if so," says Montagu, "it differs from all the genus, who are known to lay their eggs on the bare ground." Mr. Lloyd, who had the best opportunities for ascertaining the fact, observes that the hen makes her nest upon the ground, and lays from 6 to 12 eggs, and that her young keep with her till towards the approach of winter; but that the cocks separate from the mother before the hens. The same author describes, evidently from personal observation, the 'lek,' or play, of the male in the breeding season, and as it is in itself most interesting, and corrects some errors which have gone abroad on the subject, we make no apology for inserting it:

"At this period, and often when the ground is still deeply covered with snow, the cock stations himself on a pine and commences his love-song, or play as it is termed in Sweden, to attract the hens about him. This is usually from the first dawn of day to sunrise, or from a little after sunset until it is quite dark. The time however more or less depends upon the mildness of the weather, and the advanced state of the season.

"During his play the neck of the capercali is stretched out, his tail is raised and spread like a fan, his wings droop, his feathers are ruffled up, and, in short, he much resembles in appearance an angry turkey-cock. He begins his play with a call something resembling 'peller, peller, peller;' these sounds he repeats at first at some little intervals; but as he proceeds they increase in rapidity until at last, and after perhaps the lapse of a minute or so, he makes a sort of gulp in his throat, and finishes with sucking in as it were his breath.

"During the continuance of this latter process, which only lasts a few seconds, the head of the capercali is thrown up, his eyes are partially closed and his whole appearance would denote that he is worked up into an agony of passion. At this time his faculties are much absorbed, and it is not difficult to approach him: many indeed, and among the rest Mr. Nilsson, assert that the capercali can then neither see nor hear; and that he is not aware of the report or flash of a gun, even if fired immediately near to him. To this assertion I cannot agree, for though it is true that if the capercali has not been much disturbed previously he is not easily frightened during the last notes, if so it may be termed, of his play; should the contrary be the case, he is constantly on the watch, and I have reason to know that even at that time, if noise be made, or that a person exposes himself incautiously, he takes alarm and immediately flies.

"The play of the capercali is not loud, and should there be wind stirring in the trees at the time, it cannot be heard at any considerable distance. Indeed during the calmest and most favourable weather it is not audible at more than two or three hundred paces.

"On hearing the call of the cock, the hens, whose cry in some degree resembles the croak of the raven, or rather perhaps the sounds 'gock, gock, gock,' assemble from all parts of the surrounding forest. The male bird now descends from the eminence on which he was perched to the ground, where he and his female friends join company. The capercali does not play indiscriminately over the forest, but he has his certain stations, 'Tjador-lek,' which may perhaps be rendered his playing grounds. These however are often of some little extent. Here, unless very much persecuted, the song of these birds may be heard in the spring for years together. The capercali does not during his play confine himself to any particular tree, as Mr. Nilsson asserts to be the case, for on the contrary it is seldom he is to be met with exactly on the same spot for two days in succession.

"On these lek several capercali may occasionally be heard playing at the same time; Mr. Greiff, in his quaint way, observes 'it then goes gloriously.' But so long as the old male birds are alive they will not, it is said, permit the young ones or those of the preceding season to play. Should the old birds however be killed, the young ones in the course of a day or two usually open their pipes. Combats, as it may be supposed, not unfrequently take place on these occasions, though I do not recollect having heard of more than two of those birds being engaged at the same time.

"Though altogether contrary to law, it is now that the greatest slaughter is committed among the capercali; for any lump of a fellow who has strength to draw a trigger may, with a little instruction, manage to knock them down. But as the plan of shooting these noble birds during their play is something curious I shall do my best to describe it.

"It being first ascertained where the lek is situated, which is commonly known to the peasants and others in the vicinity, the sportsman (if so he may be called) proceeds to the spot, and listens in profound silence until he hears the call of the cock. So long however as the bird only repeats his commencing sound he must, if he be at all near to him, remain stationary; but the instant the capercali comes to the wind-up, the gulp, &c., during which, as I have said, his faculties of both seeing and hearing are in a degree absorbed, then he may advance a little. But this note lasts so short a time that the sportsman is seldom able to take more than three or four steps before it ceases, for the instant that is the case he must again halt, and if in an exposed situation remain fixed like a statue. This is absolutely necessary, for during his play, excepting when making the gulp, &c., the capercali is exceedingly watchful, and easily takes the alarm. If all remain quiet, the bird usually goes on again immediately with his first strain; and when he once more comes to the final note, the sportsman advances as before, and so on, until he gets within range of shot.

"To become a proficient at this sport requires a good deal of practice. In the first place a person must know how to take advantage of the ground when advancing upon the capercali, for, if full daylight, this is hardly practicable (whatever may be said to the contrary) in exposed situations; and in the next, that he may not move forward excepting upon the note which is so fatal to that bird. This is likely enough to happen if it be an old cock that has been previously exposed to shots, for he often runs on, as I have repeatedly heard him, with 'peller, peller, peller,' until one supposes he is just coming to the gulp, when he suddenly makes a full stop. If therefore a person was then incautiously to advance he would in all probability instantly take to flight.

"At the lek the cocks most commonly fall the sacrifice; for the hens, as well from their colour more resembling the foliage of the trees as from the sportsman having larger and better game in view, usually escape. This is a fortunate circumstance; as were a proportionate slaughter to take place among the latter as the former, the breed in many parts of the Scandinavian peninsula would soon be exterminated.

"Though this plan of shooting the capercali during the spring is common throughout most parts of Scandinavia, I am told that in Norrland and Wästerbotten, from whence Stockholm is furnished with its principal supplies of game, that destructive practice is not generally adopted. This arises from the people in those districts having sense enough to know that if they kill too many of the cocks in the spring, there is little probability of there being a good breed during the succeeding autumn."

Our limits will not permit us to enter into the details of the more legitimate chace, which will be found in Mr. Lloyd's book: suffice it to say that the rifle is the instrument used by the fair sportsman, and that in the course of his sport Mr. Lloyd observed, that when the weather is cold and the snow loose and soft, the capercali not unfrequently buries himself beneath its surface during the night season, and once in a while he found the bird in that situation in the day-time; so that the old wood-cuts of grouse nestling under the snow are not entirely without foundation. Mr. Lloyd remarks that the capercali often becomes the prey of the great horned owl. [BUBO.]

As an article of food the capercali is justly admired; and the rapidity of communication consequent upon the increased and increasing development of the powers of steam now furnishes annually the shops of the London poulterers with a supply in the spring. Some assert that at certain seasons the flavour of the bird is rendered extremely unpleasant by the fir-buds which then form its food; but those which we have tasted were excellent. The hen, though smaller, is in our opinion preferable to the cock. In preparing the bird for roasting, the breast should be skinned and a veal-caul spread over it.

Male.—Elongated feathers of the throat black; the rest of the head and neck ashy black; eyebrows red; wings and scapulars brown, sprinkled with small black dots; breast changeable green; belly and abdomen black, with white spots; rump and flanks sprinkled with ashy zigzags on a black ground; tail-feathers black, with some small white spots disposed at about two inches from their extremities; bill nearly 3 inches long, very strong, hooked, and of a whitish horn-colour; iris clear brown; length about 2 feet 10 inches; usual weight from 9 to 12 lbs. Graves says that the fine specimen from which his figure was taken measured 3 feet 1½ inch in length, 7 feet 5 inches in breadth, and weighed 15 lbs. 2½ ounces.

Capercali (*Tetrao Urogallus*), male.

Female.—Striped and spotted with red or bay, black and white; feathers of the head bright ruddy, and those of the breast deep red; tail ruddy, striped with black; bill blackish-brown; size about one-third less than that of the male.

Young Males, after their first Moult.—Breast of a less lustrous green than in the old birds, and the ash-colour predominating over the black; some red feathers spotted with black are scattered irregularly over the plumage. Before the first moult the young males resemble the females.

Mr. Lloyd says that the capercali occasionally breed with the black game, the product of which are in Sweden called Racklehanen: these partake of the leading characters of both species; but their size and colour greatly depend upon whether the connection was between the capercali cock and the gray hen, or vice versâ. "Out of twenty racklehanar, which is the male, two, according to Mr. Falk, are not alike; and the difference of colour observable among the racklehönan, which is the female, but very rare, is still greater. Racklehanen are very seldom to be met with. During my stay in Wermeland, however, Mr. Falk had two of these birds in his possession, and I myself shot a third." The bird here alluded to was probably the Rakelhan (*Tetrao medius* of Meyer), which Temminck observes, some naturalists, and recently M. Nilsson, have erroneously considered a hybrid between the Capercali and Black-Cock. But at Braemar, in 1828, in consequence of the death of the hen which had been imported with a cock, a common barn-door hen was introduced to the latter. The result, according to Mr. Wilson, was, that she laid several eggs, which were placed under other hens; but from these eggs only a single bird was hatched, and when it was first observed it was found lying dead. It was, however, an evident mule or hybrid, and showed such unequivocal marks of the capercali character as could not be mistaken.

CAPERS, the young flower-buds of *Capparis spinosa*. [CAPPARIDACEÆ.]

CAPILLAIRE. [ADIANTUM.]

CAPILLARY VESSELS, so called from their hair-like minuteness. The blood-vessels of the body consist of arteries and veins, the arteries carrying the blood from the heart, and the veins returning it to the heart. The blood-vessels that supply the body are arborescent, that is, the branches which spring from the aorta successively increase in number and diminish in size as they proceed from the heart towards their ultimate terminations in the system. In like manner the veins divide. These ultimate terminations of the arteries, together with the first origins of the veins, constitute a peculiar system of vessels termed the Capillary System. These capillary vessels are too minute to be detected by the naked eye; but in the transparent parts of the body of a living animal, when brought under the field of the microscope, they become perfectly visible, as in the web of the frog's foot, the mesentery of the rabbit, the tail of the tadpole, &c. The greater number of the arteries and veins are then seen to be directly continuous with each other, no substance intervening between the two orders of vessels. No words can describe the beauty of the sight presented by the flow of the vital fluid through these minute tubes. Myriads of vessels not visible to the naked eye instantly come into view. In one case the direction of a minute artery being suddenly altered it is reflected on itself, and thus becomes an incipient vein; in other cases minute branches are sent off from an artery into a parallel vein; and in a third case several minute arterial ramifications are continuous with a single vein. The venous capillaries are generally larger and more numerous than the arterial, and they communicate more freely with each other.

The minute capillary vessels are totally distinct both in structure and office from the large trunks from which they spring. All the tunics of the capillary arteries diminish in thickness and strength as the tubes lessen in size, but more especially the middle or fibrous coat [ARTERY]; "but this coat may still be distinguished by its colour in the transverse section of any artery whose internal diameter is not less than the tenth of a line, but it entirely disappears in vessels too small and too remote to receive the wave of blood in a manifest jet. But while the membranous tunics diminish, the nervous filaments distributed to them increase. The smaller and thinner the capillary the greater the proportionate quantity of its nervous matter; and this is most manifest in organs of the greatest irritability. The coats of the capillaries successively becoming thinner and thinner at length disappear altogether, and the vessels ultimately terminate in membraneless canals formed in the substance of the tissues."

Of the capillary arteries which it has been stated terminate by direct communication with the capillary veins, some are large enough to admit of three or four of the red particles of the blood [BLOOD] abreast; the diameter of others is sufficient to admit only of one; whilst others are so small that they can transmit nothing but the serum of the blood. Their prevalent size in the human body may be stated at from $\frac{1}{3500}$th to $\frac{1}{2000}$th of an inch when naturally filled with blood. As long as the capillary is of sufficient magnitude to receive three or four blood globules abreast, it is evident that it possesses regular parietes; but by far the greater number, before they communicate with veins, lose altogether their membranous coats. There are no visible openings or pores in the sides or ends of the capillaries by means of which the blood can be extravasated preparatory to its being imbibed by the veins. There is nowhere apparent a sudden passage of the arterial into the venous stream, no abrupt boundary between the division of the two systems. The arterial streamlet winds through long routes, and describes numerous turns before it assumes the nature and takes the direction of a venous streamlet. The ultimate capillary rarely passes from a large arterial into a large venous branch.

The capillary network differs in the size and width of the meshes in different parts. It is very close in the lungs and in the choroid coat of the eye; close also in muscle, in the skin, and in most parts of the mucous membrane, in glands and secreting structures, and in the gray part of the brain and spinal cord. On the other hand, it has wide meshes and comparatively few vessels in the ligaments, tendons, and other allied textures. (Sharpey.)

All the great organic functions of the living body are performed mainly by the capillary vessels. Their action is essential to secretion, nutrition, calorification, and every other process which is indispensable to the support of life. From experiment, it has been inferred that these vessels possess an active contractile power altogether independent of the impulse derived from the heart. Under the ordinary condition of the circulation, the blood indeed flows through these capillary vessels by the force communicated to the circulating fluid by the contraction of the heart; but the evidence brought forward seems to indicate that stimulants of various kinds applied directly to the capillary arteries, without in the least affecting the heart's action, are capable of modifying to a considerable extent the action of the capillaries; sometimes causing them to contract and at other times to dilate; sometimes quickening the flow of the blood through them; at other times retarding it, and not unfrequently altogether arresting its progress.

For an account of the development of the capillaries, see BLOOD-VESSELS.

CAPI'TULUM, a head of flowers, a particular form of inflorescence. Theoretically botanists consider it an undeveloped spike, the axis of which becomes a receptacle, and the external empty bracts an involucre. It really consists of a number of small flowers, which in the majority of plants are arranged upon an elongated stalk, or arranged upon a flattened or horizontal stalk. The Dandelion, the Daisy, the Groundsel, and all *Compositæ*, have an inflorescence of this nature; it is vulgarly looked upon as a flower.

CAPNEA. [ACTINIADÆ.]

CAPPARIDA'CEÆ, *Capparids*, the Caper Tribe, a natural order of Dicotyledonous Polypetalous Plants, having a superior fruit, parietal placentæ, an embryo curved upon itself, without albumen, four petals and sepals, a great number of stamens, and an ovary elevated upon a long stalk. They are known from *Cruciferæ* by their indefinite stamens and reniform seeds. All of them appear to be more or less acrid. They are bushes or herbs found all over the tropics, and not extending in many places beyond them. Egypt and the south of Europe, which are inhabited by *Capparis spinosa* and similar species, offer the greatest exceptions to the rule.

Some of the American species of *Capparidaceæ* are very poisonous; others act as vesicatories; and a few are merely stimulant. To the latter class belongs the *Capparis spinosa* of the south of Europe. This

Caper-Tree (*Capparis spinosa*).

1, An expanded flower; 2, a petal; 3, a calyx with the stalked ovary; 4, a horizontal section of the fruit; 5, a longitudinal section of the seed; 6, an embryo extracted from the seed-coat.

plant grows naturally upon rocks and ruins all over the south of France and Italy, rendering them inconceivably gay with its large white blossoms, from the centre of each of which there springs a long tassel of deep lilac stamens. The flower-buds constitute the Capers of the shops, the quality of which depends exclusively upon the age at which they are gathered, the smallest and youngest being the dearest and most delicate, and the largest and oldest the coarsest and cheapest. On an average each plant of the caper-bush gives a pound of buds. The consumption of capers in this country is inconsiderable, not amounting to more than about 60,000 lbs. a year.

Several other species of *Capparis* possess stimulating properties There is a plant found in the neighbourhood of Carthagena called Fruta de Buno, supposed to be a *Capparis*, the fruit of which is extremely poisonous. The fruits of a species of *Cratæva* are eaten. *Polanisia icosandra* acts as a vesicatory. The root of *Cleome dodecandra* is used as a vermifuge in the United States. The order has 28 genera and about 340 species.

CAPREÆ, a sub-tribe of the family *Bovidæ* amongst the Ruminant *Mammalia*, and equivalent to the sub-tribes *Boveæ* [BOVIDÆ], *Antilopeæ*, *Strepsiceræ* [ANTILOPEÆ], and *Oveæ* [OVEÆ], according to Dr. Gray's arrangement of the *Mammalia* in the British Museum. The *Capreæ* include what are commonly known by the name of Goats. The classification of these animals has been the cause of much difference of opinion.

Ray established three genera of Ruminants with bisulcated hoofs. 1. *Bovinum genus*—the Oxen. 2. *Ovinum genus*—the Sheep. 3. *Caprinum genus*—the Goats; comprising the Common Goat, the Ibex, the Chamois, the Gazelles, &c.

Klein's second family of quadrupeds consisted of those which have a divided horny hoof. The type of the first genus was the Ox; of the second, the Sheep; of the third, the Goat; of the fourth, the Stag; and of the fifth, the Hog.

Brisson's fifth order consisted of those quadrupeds which have no incisor teeth in the upper jaw, but have eight in the lower jaw, and the hoof cloven. The first section consists of those which have simple horns; and comprises, as genera, the Giraffe, the Goat, the Sheep, and the Ox. The quadrupeds with branched horns, the Stags, follow.

Linnæus in his last edition (the 12th) makes *Capra* the fourth genus of his fifth order (*Pecora*), placing it between *Cervus* and *Ovis*: the genus contained the species *Hircus*, *Ibex*, *Mambrica* (Syrian Goat), *Rupicapra* (Chamois), &c., including some of the Antelopes and *Capra Ammon* (*Tragelaphus* and *Musimon* of Gesner).

Gmelin, in the 13th edition of the 'Systema Naturæ,' arranges the genus *Capra* under the same order, between *Antilope* and *Ovis*, to which latter genus he transfers the Musmon, *Capra Ammon* (Gmel.) of Linnæus, *Ovis Ammon* of Gmelin.

Pennant, in the first and third edition of his 'Synopsis,' placed the Goats between the Sheep and the Giraffe, the latter being followed by the Antelopes: in his 'British Zoology' the Goats are arranged between the Sheep and the Deer.

M. Lesson, in his 'Manuel' (1827), arranges the *Capridæ* (Les Caprées) between the *Bovidæ* (Les Bovinées) and the *Ovidæ* (Les Ovinées).

In both his editions of the 'Règne Animal,' Cuvier gives the Goats (*Capra*) the same position under his Ruminants à Cornes Creuses (*Cavicornia*—Hollow-Horned Ruminants, or those whose horns have a bony core), namely, between *Antilope* and *Ovis*.

Fischer (1829) arranges the genus *Capra* (which he divides into two sections—1, *Barbatæ*, *Capræ* of authors; 2, *Imberbes*, *Oves* of authors) between *Antilope* and *Bos*.

Dr. J. E. Gray, as we have seen, places *Capra* among the *Bovidæ*. In his interesting 'Spicilegia Zoologica' (1830), where he figures the female of the Nubian Goat, the genus appears under that family. He had previously so arranged it in the 'Annals of Philosophy' (1825); and Mr. W. S. M'Leay, in his paper 'On the Comparative Anatomy of certain Birds of Cuba' ('Linnæan Transactions'), speaking of the *Mammalia*, observes that the normal and aberrant groups were distinguished and named by Aristotle in his 'Historia Animalium,' but had not, to his knowledge, appeared again in any work until Dr. Gray had the honour of reviving them in the 'Annals of Philosophy.'

Referring our readers to the works of Messrs. F. Cuvier, De Blainville, Desmarest, Desmoulins, Erxleben, Geoffroy, Hasselquist, Illiger, Lichtenstein, Meyer, Schreber, Shaw, Zimmermann, and others, for their views on this subject, which, however interesting and desirable for the student, our limits will not permit us to dwell on here, we proceed to notice the observations of Mr. Hodgson in the 'Zoological Proceedings' for 1834.

Mr. Hodgson, after remarking on the difficulty experienced by zoologists in the determination of distinctive marks adequate for the separation of the genera *Antilope*, *Capra*, and *Ovis*, insists that, as he has shown, the character founded on the presumed absence of cavities in the cores of the horns connected with the frontal sinus is incorrect, and he conceives that the value of the characters which are generally admitted by authors as distinguishing between the genera *Capra* and *Ovis* may be tested by a comparison of the wild race of either genus which belongs to the Himalaya. He then describes *Capra Jharal*, which is "clad in close short hair, and without the least vestige of a beard," as related to the Alpine *Ægagri* and to *Capra Jemlaica* and *Ovis Nahoor* (Hodgson), placing them both under the tribe *Capridæ* (H. Smith); and having completed the description of this wild goat and wild sheep, he proceeds to exhibit the points of difference and of resemblance between the two in the following table :—

Goat.	*Sheep.*
Whole structure stronger and more compact.	Less so.
Limbs thicker and more rigid.	Feebler and more slender.
Hoofs higher and more compact.	Lower and less so.
False hoofs well developed.	Evanescent.
Head smaller and finer.	Longer and heavier.
Facial line straight.	Chaffron arched.
Ears shorter and rounded.	Longer and pointed.
Tail short, flat, nude below.	Longer, less depressed, and half nude only.
Withers higher than croup.	Croup higher.
Fore legs stronger than hind.	Fore and hind equal.
Croup sloped off.	Not so.
Odorous.	Not so.
Nose moister, with nares short and wide.	Less moist, longer, and narrower.
Horns of medial size, keeled, and turned upwards.	Horns very large, not keeled, and turned to the sides.
Eye darker and keener.	Paler and duller.
Hair long and unequal.	Short and equal.
Back arched.	Back straight.
Bears change of climate well.	Bears it ill.
Is eminently curious, capricious, and confident.	Is incurious, staid, and timid.
Barks trees with its horns, feeding on the peel and on aromatic herbs.	Does not bark trees, and is less addicted to aromatics.
In fighting, rears itself on its hind legs, and lets the weight of its body fall on the adversary.	In fighting, runs a tilt, adding the force of impulse to that of weight.

In describing the wild sheep, Mr. Hodgson observes that the horns are inserted high above the orbits on the crown of the forehead, touching nearly at the base with their whole depth, and carrying the frontal bones very high up between them, the parietals being depressed in an equal degree. The goat's skull has, he states, the same form, but less strikingly developed; and he seems to think that this form of the skull would afford a just and general mark to separate *Ovis* and *Capra* from *Cervus* and *Antilope*, remarking that there is a gradation of characters in this respect among the Antelopes tending to the Caprine type in their general structure. Mr. Hodgson thus concludes: "The goat and sheep have in common hair and wool; no beard; no suborbital sinuses; evanescent muzzle; no inguinal pores; horns in contact at the top of the head; knees and sternum callous; angular and transversely wrinkled horns; striated ears; two teats only in the females; horns in both sexes; and, lastly, incisors of precisely the same form. Of the various diagnostics then proposed by Colonel Hamilton Smith, it would seem that the following only can be perfectly relied on to separate *Ovis* from *Capra*:—slender limbs; longer pointed ears; chaffron arched; nares long and oblique; very voluminous horns, turned laterally with double flexures. I should add myself the strong and invariable distinction—males not odorous, as opposed to the males odorous of the genus *Capra*. But after all there are no physical distinctions at all equivalent to the moral ones so finely and truly delineated by Buffon, and which, notwithstanding what Colonel H. Smith urges in favour of the courage and activity of sheep, will for ever continue to be recognised as the only essential diagnostics of the two genera."

Mr. Swainson ('Classification of Quadrupeds,' 1835) places the Goats (*Capra*) between the *Bovidæ*, or Bovine Family, and the Sheep (*Ovis*).

In an interesting paper on the *Ruminantia* ('Zoological Proceedings'), Mr. Ogilby, after observing on the first introduction by Illiger of the consideration of the muzzle and lachrymal sinus into the definitions of the genera *Antilope*, *Capra*, and *Bos*, and the application of those principles by Messrs. Lichtenstein, De Blainville, Desmarest, and Hamilton Smith, in the subdivision of the artificial genus *Antilope* into something more nearly approaching to natural groups (a reform but partial in its operation, and leaving the root of the evil untouched), makes *Capridæ*, which he places between *Moschidæ* and *Bovidæ*, the fourth family of the order *Ruminantia*.

The following is Dr. Gray's definition of the sub-tribe *Capreæ*:—Forehead convex, elevated behind; chin of males bearded; suborbital sinus none. Horns erect, compressed, curved backwards and rather outwards, and furnished with a longitudinal keel in front, deeper than wide at the base, and with transverse ridges in front. Hoofs four-sided, scarcely higher before than behind. The skull has a small suborbital fissure, no fossa; the masseteric ridge ascending high before the orbit; the auditory bulla prominent and compressed; the basi-occipital flat, with its processes developed; the middle incisors not expanded; the molars without supplemental lobes. The occipital plane of skull forms an acute angle with frontal plane. Cores of horns thick, porous, cellular; horns seated superiorly on the crest of the forehead, and by their union covering the top of the head. Canine teeth wanting. Teats two, rarely four. The males have a strong stench; they butt, first raising themselves on their hind legs and then coming down sideways against their enemies.

The following is a synopsis of the genera of *Capreæ*:—

A. Muffle Naked.

1. *Hemitragus.* Horns trigonal, compressed, and knotted in front.
2. *Kemas.* Horns square, flat, and cross-ridged in front.

B. Muffle Hairy.

3. *Ægoceros.* Horns roundish, conical.
4. *Capra.* Horns square, flat, and nodose in front.
5. *Hircus.* Horns trigonal, compressed, sharp-edged, and knotted in front.

Dr. Gray refers the Common Goat, which must be taken as the type of the family, to the last genus, of which it is the only species.

Hircus Ægagrus, the Goat, is Αἴξ (ὁ καὶ ἡ, but generally used for the female), *τράγος*, *χίμαρος* (the male), *ἔριφος* (young male kid of three or four months), *χίμαιρα* (young female before its first winter), of the Greeks; *Caper*, and *Hircus* (male), *Capra* (female), *Hœdus* or *Hædus* (a young male kid), *Hædulus* or *Hœdillus* (a very young male kid, or kidling, *ἔριφος*), *Capella* (female kid), of the Romans; Becco (male), Capra (female), Capretto and Caprettino (kid and kidling), of the Italians; Bouc (male), Chèvre (female), Chevreau (kid), of the French; Cabron (male), Cabra (female), Cabrito (kid), of the Spanish; Cabram (male), Cabra (female), Cabrito (kid), of the Portuguese; Bock (male), Geisz (female), Bocklein (kid), of the Germans; Bok (male), Giyt (female), of the Dutch; Bock (male), Geet (female), Küdh (kid), of the Swedes; Buk, Geedebuk (male), Geed (female), Kid (kid), of the Danes; Bwch (male), Gafr (female), Mynn (kid), of the ancient Britons. It is the *Capra Hircus* of Linnæus; the *Capra Caucasia*, H. Smith; *Ægoceros Capra*, Pallas; *Capra Ægagrus*, Gmelin.

The varieties of this animal are very numerous; and many of these are regarded by writers on natural history as species.

The Goat affords another example of the uncertainty which clouds the history of our domestic animals; and to this day zoologists are not entirely agreed as to the species from which it is derived. Professor Bell, in his 'History of British Quadrupeds,' says,—"The opinions of naturalists have been much divided respecting the original stock of our domestic goat; some referring it to the *Ægagrus* and others to the Ibex. Buffon appears to have adopted the latter opinion; but most modern zoologists who have paid much attention to the question, and who have brought to the consideration of it all the helps which recent discoveries in philosophical zoology have furnished, have leaned to the belief that the *Ægagrus*, or wild goat of the mountains of Caucasus and of Persia, is the true original stock. The zoological characters of this animal certainly bear a closer resemblance to those of the domestic breeds; and it is worthy of remark that the horns of the Persian domestic goat, though smaller, are similar in form to those of the Paseng, or *Ægagrus*. The arguments which have been urged from the intermixture of the Ibex with the common goat are at present of little value, as the facts recorded are very deficient. The large goats which are reported to have been brought from the Alps and the Pyrenees to the Garden of Plants in Paris, and which were stated to have been wild, were probably the progeny of the Ibex with the common goat, as there is no proof of the existence of the true *Ægagrus* in Europe. These were found to be capable of producing offspring, and the details are given by M. Fred. Cuvier with great clearness; but the old fault still remains—the question is not set at rest by these observations; for we are only informed that they produce offspring, without any statement whether they will breed inter se, or only with the common goat. The progeny however were either prematurely brought forth, or lived only a short time in a sick or languishing condition. Surrounded by these doubts, and without the power of satisfactorily solving them, it is better perhaps to leave the question to be decided by future experiments, should the opportunity ever occur of determining the results of interbreeding between the Ibex, the *Ægagrus*, and the common goat, particularly with reference to the mutual fertility of the offspring."

Buffon's opinion is not very clearly stated, nor is it certain that he had a very distinct idea on the subject. Sonini, in his 'Travels in Greece and Turkey,' after speaking of the wild solitudes that surround the Convent of St. John at Cape Malacca, in Candia, says: "Covies of red partridges delight in these inaccessible mountains, and there they live in safety. There also are to be seen wild goats, which leap from rock to rock with admirable address and agility. These wild goats, which are to be met with in the Isle of Candia, and several other islands of the same sea, are of the Bouquetin (*Capra Ibex*, Linn.), or mountain-goat species. The modern Greeks, as has been done by their ancestors, confound the Bouquetin and the Chamois under the same denomination of Wild Goat. The French habituated to the Levant also knew them by no other denomination than that of Chèvre Sauvage. It is to be presumed, in fact, that Buffon himself imagined that these two animals are not of a species different from that of the domestic goat."

Linnæus, in his 'Systema Naturæ,' (12th edition) gives the goat (*Capra Hircus*) an oriental origin; but seems to consider it as a distinct species. He says of it: "Habitat in Oriente in montosis Hircus et Capra cum Hœdo, victitans ramulis variis frondibusque arborum, lichenibus; hospitatur in Europâ." He does not mention the *Ægagrus*, but gives the Ibex (*Capra Ibex*) as a species.

Gmelin ('Syst. Nat.,' ed. 13) gives *Ægagrus* as the first species of the genus *Capra*, and it is followed by *Hircus*. Cuvier, in both editions, considers the Paseng (*C. Ægagrus*) to be the parent-stock of all the varieties of the domestic goat. He adverts to the Paseng as inhabiting the mountains of Persia in troops, and to the Oriental Bezoar as a concretion found in its intestines. Fischer speaks of the *Ægagrus* as being, without doubt, the parent of our Domestic Goat. Whilst upon this inquiry we must not omit the Jemlah Goat (*Capra Jemlaica*, of Hamilton Smith), which is said to inhabit the district of Jemlah, between the sources of the Sargew and the Sampoo that is,

Paseng (*Hircus Ægagrus*, Gray).

Ibex (*Capra Ibex*, Gray).

says Colonel Smith, the most elevated range of Central Asia, forming the nucleus between the western and south-eastern branches of the Himalaya Mountains. This animal appears to be the same as the Jhâral of the Nepaulese, *Capra Jhâral* (*Hemitragus Jemlaicus*, Gray,) described by Mr. Hodgson ('Zool. Proc.,' 1834), from a fine male specimen kept in his garden at Nepaul. He states that the Jhâral is found wild in the Kachâr region, in small flocks, or solitarily, and gives its character as bold, capricious, wanton, eminently scansorial, pugnacious, and easily tamed and acclimatised in foreign parts. He remarks that the Jhâral has a close affinity, by the character of the horns. to the Alpine *Ægagri* and still more nearly, in other respects, to *Capra Jemlaica*. It differs, he observes, from the former by the less volume of the horns, by their smooth anterior edge, and by the absence of the beard; from the latter, by the horns being much less compressed, not turned inwards at the points, nor nodose. He adds, that the Jhâral breeds with the Domestic Goat, and more nearly resembles the ordinary types of the tame races than any wild species yet discovered.

"No animal," says Pennant, "seems so subject to varieties (the dog excepted) as the Goat;" nor did its multitudinous transfigurations escape Pliny (lib. viii., c. 53). Cuvier observes that the Domestic Goat, *Capra Hircus*, varies infinitely in stature, colour, length, and fineness of the hair, and in size and even number of the horns. The goats of Angora, in Cappadocia, with their soft and silky hair, and those of Tibet, whose delicate wool is manufactured into the shawls (cachemires) so highly prized by the French beauties, are especially alluded to by him. To enumerate all the varieties would be to exceed our limits. The Angora Goat, which inhabits the tract that surrounds Angora and Beibazar, in Asiatic Turkey, where the goatherds bestow much care on their flocks, frequently combing and washing them, loses, it appears, the delicacy of its hairy covering when exposed to a change of climate and pasture; and Pennant hints his suspicions that the design of the Baron Alstroemer, a patriotic Swede, who imported some into his own country to propagate the breed for the sake of their hair, turned out fruitless. A spirited attempt to acclimatise the Cashmere Goat was made by an English gentleman, Mr. Towers, some years ago. The Cashmere Goats, which lived some time in the Gardens of the Zoological Society, and at the farm on Kingston-Hill, certainly did not appear to have suffered in the fineness of their coats; but it is one thing to keep an imported individual by care and attention in the same state, and another to carry on the breed from generation to generation in its pristine beauty, under a different sky and on a strange pasture. We have indeed been informed that the flock of Mr. Towers amounted to about forty, and that the shawls made from the produce of their hides were excellent. One of these shawls was presented to Queen Adelaide. The importance of this manufacture to the people of Cashmere may be estimated from the alleged fact that 16,000 looms are there in constant work, each loom giving employment to three men, the annual sale being calculated at 80,000 shawls. A preference is given to the wool of Tibet, and 24 pounds weight of the best of it is said to sell at Cashmere for 20 rupees. The wool is spun by women, and coloured afterwards. It appears also, from a book quoted in the 'Naturalist's Library' ('*Ruminantia*,' part 2, by Sir William Jardine), that a fine shawl, with a pattern all over it, takes nearly a year in making. The persons employed sit on a bench at the frame; sometimes four people at each, but if the shawl is a plain one, only two. The borders are marked with wooden needles, there being a separate needle for each colour, and the rough part of the shawl is uppermost while it is in progress of manufacture. A Tartar half breed, having been found to thrive well in a colder climate, has been introduced into France, not without success. The Cashmeres however which are brought from the kingdom of that name are the shawls in high request, and those who are curious in such articles should remember that there are in India several other goats besides the true Cashmere breed whose wool is employed for the same purpose.

The Jaal Goat, *Capra Jaela* (*Capra Nubiana*, Gray), is found in the mountains of Abyssinia, Upper Egypt, and Mount Sinai.

Jaal Goat, or Abyssinian Ibex (*Capra Nubiana*, Gray).

The Syrian Goat, with its excessively long ears, which is plentiful in the East, and, according to Pennant, supplies Aleppo with milk, is worthy of especial notice, as well as the Dwarf African, with its two hairy wattles under the chin, and the pretty little Whidaw Goat. Lieutenant-Colonel Sykes, in his 'Catalogue of the Mammalia,' obtained by him in Dukhun (Deccan), notices *Capra Hircus*, Linn.: Bukee, of the Mahrattas. The goats in Dukhun are gaunt, stand high on their legs, have the sides much compressed, and are covered with long shaggy hair, which in most is black. Ears nearly pendent. Irides ochrey-yellow or reddish-yellow. Tail always carried erect in movement.

Pennant states that the Domestic Goat (*Capra Hircus*), inhabits most parts of the world, either native or naturalised, and that it bears all extremes of weather, being found in Europe as high as Wardhuys in Norway, where they breed and run out the whole year; but in winter only have, during night, the shelter of hovels. In that season they feed on moss and the bark of fir-trees, and even on the logs cut for fuel. Pennant quotes Dr. Solander as authority to show that in Norway and West Bothnia their skins formed an article of commerce, and says that these animals thrive equally well in the hottest part of Africa and in India and its islands. It is not, he adds, a native of the New World, having been introduced there first by the discoverers of that continent. In Britain the Domestic Goat is become comparatively rare, and even in its strong hold, Wales, it is no longer plentiful. In South Wales a goat is seldom seen, but there are still some wild ones in Glamorganshire. Their flourishing condition in the Principality at one time may be imagined from the size of the horns of the Cambrian he-goat mentioned by Pennant; they were 3 feet 2 inches long, and measured 3 feet from tip to tip.

Few animals, when properly treated, are more useful to man; and though it never can answer to breed the goat in districts which will carry sheep, in rocky and woody countries it is invaluable. The manufactures from the hair have been alluded to. The pillow of goats' hair that supported the head of the image with which Michal deceived the messengers of Saul when he sought David's life (1 Sam. xix. 13-16) will occur to every one; and Pennant thinks that the variety which furnished it was the goat of Angora. In the days of wigs, the hair of the common Domestic Goats of this country was in high request, and the whitest were made of it. The best hair for this purpose was selected from that which grew on the haunches, where it is longest and thickest. In Pennant's time a good skin, well haired, was sold for a guinea, though a skin of bad hue, and so yellow as to baffle the barber's skill to bleach, did not fetch above eighteen pence or two shillings. Goats' hair is at present used in the manufacture of wigs for the dignitaries of the church, and the members of the bar and the bench. The skin, particularly that of the kid, is of high importance to the glove manufacturer; it is also said to take a dye better than most others. The horns are useful for knife-handles; and the suet, it is alleged, makes candles far superior in whiteness and goodness to those made from that of the sheep or the ox, and, according to Pennant, brings a much greater price in the market. The flesh of the kid is good. "The haunches of the goat," writes the author last quoted, "are frequently salted and dried, and supply all the uses of bacon; this by the natives is called Côch yr wden, or hung venison. The meat of a castrated goat of six or seven years old (which is called Hyfr) is reckoned the best; being generally very sweet and fat. This makes an excellent pasty, goes under the name of rock-venison, and is little inferior to that of the deer." The medical properties of goats' milk and whey have been highly extolled, and the cheese is much valued in some mountainous countries.

The odour of the Goat, strong at all times, becomes insufferably powerful in the rutting season (from the beginning of September to November), but this pungent scent is not supposed to be unwholesome; and horses are said to be refreshed by it, whence the animal is frequently to be seen about stables. The female brings forth from the latter end of February to the latter end of April, after a gestation of four months and a half, generally two but sometimes three and even four young. The activity with which these animals will securely bound from rock to rock, and the unshaken firmness with which they will fix themselves on the edge of the highest precipices, are wonderful. Pennant says that when two are yoked together, as was frequently practised, they will, as if by consent, take large and hazardous leaps, and yet so time their mutual efforts as rarely to miscarry in the attempt. Nicholas Hasselgren in his 'Swedish Pan' ('Amœn. Acad.') states that goats eat 449 plants and refuse 126. The same author states that though they will eat greedily and safely long-leaved water-hemlock, monkshood kills them. Their favourite food consists of the tops, tendrils, and flowers of mountain shrubs and of aromatic herbs; to this delicate diet was supposed to be owing the salubrity of the milk. The blood was supposed to have its healing properties also: that of a he-goat dried is mentioned by Pennant as a great recipe in some families for the pleurisy and inflammatory disorders, and is noticed in Dr. Mead's 'Monita Medica.' As an enemy to the vine it was sacrificed to Bacchus; and the subject is prettily touched in many epigrams and verses, both Greek and Latin. The elegant lines of Ovid beginning "Rode caper vitem" are familiar to scholars. In that dark and melancholy time when modern witchcraft was supposed to be rife, and when the very absurdity of the alleged facts seems to have sharpened the belief of the credulous, and increased their eagerness to shed innocent blood, the Goat figures not only as the conveyance on which the witches flew through the air to their diabolical festivals, but as the shape in which Satan himself often exhibited his person to his votaries.

There is no doubt that the Domestic Goat will breed with the Sheep. F. Cuvier states that the mule which is the result of the connection participates in the nature of its parents, and is fruitful, but reproduces with difficulty. "I have had," says this zoologist, "a similar female mule, which in its form inclined to the sheep, while it leant to the she-goat in its gait and in its hair (par ses formes tenoit du mouton, et de la chèvre par ses allures et ses poils); it did not couple till the third year with a goat, and was fruitful."

During a visit to Rhenish Germany in the autumn of 1837 Mr. Ogilby learned from Professor Cretzschmar, the well-know editor of the mammalogical part of Dr. Rüppell's first 'Atlas,' the success of an experiment which the professor had been carrying on for some years in the neighbourhood of Frankfort-on-the-Main, to ascertain the possibility of procuring a cross between the Cashmere Goat and the Saxon Merino Sheep. With this intention Professor Cretzschmar had two or three years ago procured a large Cashmere buck, which was put into a stable with twelve Merino ewes. For two seasons however his hopes were disappointed, and it was not till the season of 1836 that the desired union took place. During the spring of that year the sheep very freely took the buck, and produced fine healthy lambs, which were, when Mr. Ogilby obtained his information, rather better than a year old. They were kept in a large stable with a number of pure Merinos, which is the usual mode of treating these valuable animals in that part of Germany, where the land is all under the plough, and there are neither sheep nor grazing farms; and so closely did they resemble the pure Saxon breed, that it was impossible to perceive any difference in their external characters.

The species of the genera of *Capreæ* in the British Museum Catalogue are as follows:—

Hemitragus Jemlaicus, the Jhâral or Tehr. This animal inhabits the loftiest mountains of India.

Kemas Warryato, the Warryato or Jungle Kemas. It is a native of India, and has been called the Wild Sheep of Tennasserim.

Ægoceros Pyrenaica, the Pyrenean Tur. It is a native of the Pyrenees, and is regarded by some as a variety of the Ibex.

Æ. Caucasica, the Tur, or Zac. It inhabits the Caucasus, and is sometimes called the Caucasian Ibex.

Capra Ibex, the Ibex, or Stein-Boc. This animal is a native of the European Alps.

C. Sibirica, the Tek or Takija. It is a native of Siberia, and is frequently referred to the Ibex.

C. Himalayana, the Sakeen or Skyn. It is also called the Himalaya Ibex. Dr. Gray observes that this is not probably distinct from *Ibex* (*Capra*) *Sibirica*.

C. (?) *lævicornis*, the Smooth-Horned Ibex. It is probably a hybrid.

C. Nubiana, the Beden, or Jaela. It is an inhabitant of Egypt, Arabia, and Crete.

C. Valie, the Walie. A specimen is in the Frankfort Museum.

Hircus Ægagrus, the Goat.

Fossil remains of the Goat have been found at Walton in Essex. Professor Owen says, on this discovery:—"Whether the *Capra Ægagrus* (*Hircus Ægagrus*) or the *Capra Ibex* should be regarded as the stock of the domesticated goat of Europe has long been a question amongst naturalists; the weighty arguments which may be drawn from the character of the wild species which was contemporary with the *Bos primigenius* and *Bos longifrons* in England is shown by the present fossil to be in favour of *Capra Ægagrus*." (Owen, *British Fossil Mammals*.)

CAPRE'OLUS. [CERVIDÆ.]

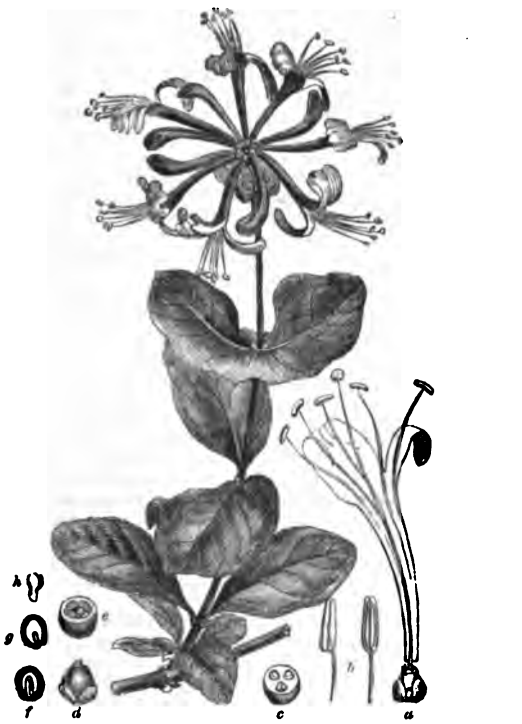
CAPRE'OLUS, an old name for the tendril of a vine.

CAPRICORNI. [AMMONITES.]

CAPRICORNIS. [ANTILOPEÆ.]

CAPRIFOLIA'CEÆ, *Caprifoils*, the Honeysuckle Tribe, a natural order of Monopetalous Dicotyledons, having an inferior ovary, opposite leaves without stipules, and a small embryo lying in a considerable mass of horny albumen. The type of the order is the genus *Caprifolium*, or Honeysuckle; the genera that are associated with it in part consist of dismemberments of *Lonicera*, and in part of plants having a resemblance to them in habit. The genera most dissimilar to *Caprifolium* are *Sambucus* and *Viburnum*; but their characters are more dependent for their dissimilitude upon the shortness of the tube of their corolla, and the manner in which the flowers are arranged, than upon any actual differences of organisation. *Caprifoliaceæ* differ from *Cinchonaceæ* in little except the want of stipules between the leaves, and consequently there is great resemblance in their sensible properties; their bark being often astringent, their leaves sometimes emetic, and the seeds of *Triosteum perfoliatum* similar to coffee.

The fragrance of the Honeysuckle is well known. The flowers of the Elder (*Sambucus nigra*) have a reputation as a medicinal agent. The plant dedicated to Linnæus, the *Linnæa borealis*, belongs to this order, and is said to possess diaphoretic and diuretic properties. The berries of *Lonicera cærulea* are a favourite food of the Kamtchatkadales. Elderberry wine is a favourite beverage in some parts of England. The order has 14 genera and about 220 species.



Honeysuckle (*Caprifolium perfoliatum*).

a, Flower opened to show the insertion of the five stamens; *b*, front and back view of anthers; *c*, horizontal section of ovary; *d*, fruit; *e*, the same in section; *f*, seed; *g*, the same in section, showing the embryo; *h*, embryo.

CAPRIMULGUS, a genus of Birds belonging to the tribe *Insessores* and the family *Caprimulgidæ*. One of the species, *C. Europæus*, the Night-Jar, Night-Churn, or Fern-Owl, is a native of Great Britain. It is a nocturnal bird, hence its names. The species of *Caprimulgus* are also called Goat-Suckers. [GOAT-SUCKERS.]

CAPRISCUS, a genus of Fishes, to which some authors refer the European File-Fish. [BALISTES.]

CA'PROS, a genus of Acanthopterygious Fishes, belonging to the family *Scomberidæ*.

Only one species of this genus has yet been discovered; the *Capros aper* of Lacepède, and *Zeus aper* of Linnæus.

The characters of the genus are:—Body short, somewhat ovate, much compressed, and covered with small serrated scales; mouth capable of considerable protrusion. Dorsal fin emarginated (as in the dories), but no spines at the base, nor at the base of the anal fin.

Capros aper, the Boar-Fish, in general appearance is not unlike the dory (to which it is in fact closely allied), but, independent of other characters, may be distinguished by its mouth being more attenuated and protractile, the body being covered with scales, and the want of long filaments to the dorsal spines. This fish appears to be most generally about 6 inches in length, of a pale carmine colour above and silvery-white beneath. The colour of the upper part extends more or less down the sides of the body, and sometimes several orange-coloured bands are observable extending from the back downwards. The lateral line is not readily seen, excepting in recent specimens, when it is said to have a crystalline appearance. This fish is a native of the Mediterranean, and has been found on our own coast, but very rarely; a third specimen has recently been recorded as British. An interesting account of this fish will be found in Yarrell's 'History of British Fishes.'

CAPROVIS. [OVIS.]

CAPSELLA, a genus of plants belonging to the natural order *Cruciferæ*, the sub-order *Angustiseptæ*, the tribe *Lepidineæ*. It has a triangular-obcordate pouch; compressed valves, keeled but not winged; numerous seeds; simple filaments. The species of the Linnæan genus *Thlaspi*, without wings to their valves, form this genus. The best known is the common Shepherd's Purse (*C. Bursa Pastoris*). It is an annual herb, very variable in habit, a follower of man, and springs up wherever he fixes his abode. As a weed it is frequently very troublesome in gardens. It may be got rid of by hoeing in hot and dry weather whilst it is in flower, but if it be allowed to ripen its seed it is with difficulty eradicated. Koch describes several varieties of this plant. He also describes two other species as inhabitants of Germany. *C. procumbens* (*Lepidium procumbens* of Linnæus), and *C. pauciflora*, apparently a variety of the last. (Koch, *Flora Germanica;* Babington, *Manual of Brit. Bot.*)

CA'PSICUM, a genus of plants belonging to the natural order *Solanaceæ*. The species are called Bird-Peppers. The shell of the fruit is fleshy and coloured, and contains a pungent principle, which also exists in its seed in great activity. On this account both the fruit and seeds of different species of *Capsicum* are in request as a condiment, and either in the unprepared state or ground, when they are called Cayenne Pepper, form a conspicuous feature amongst the plants affording stimulating oils used by man. In Europe the *Capsicum* enters largely into the seasoning of food and the preparation of pickles, and in warmer countries it constitutes one of the first necessaries of life either green or ripe. The species from which the fresh Capsicums used in Europe are principally obtained is the *Capsicum annuum*, a weedy plant found wild in South America and the West Indies. This species grows from one to two feet high, forming a dark green bush, with ovate or ovate-lanceolate leaves; its flowers are small and white; its fruit is extremely variable in size, colour, position, and even in quality. Red and yellow are the prevailing colours; the oblong-conical is the ordinary figure; and to hang in a drooping position is the most usual direction of the fruit. But round, ovate, and even depressed fruit is known, and many varieties constantly bear their fruit in an erect position. Most of them are too pungent for European palates; but the large Red Bullock's Heart and Yellow Tomato Capsicums are mild enough to be sliced with salad.

A much hotter species is the *C. fruticosum*, or Goat-Pepper, a native of the East Indies, which differs from the *C. annuum* in being a shrub and in its fruit being very small. There is also a kind cultivated by the Chinese, with black fruit; and botanists recognise many others, but they appear to be in many cases mere varieties of *C. annuum* or *C. fruticosum*.

The acrid principle of *Capsicum* has been analysed by Braconnot ('Annales de Chimie,' vol. vi., p. 122), who found it not to be volatile, to dissolve readily in water, more freely in alcohol and ether, and that it is mixed with mucilage, wax, and resin.

The species of *Capsicum* are easily brought to perfection in this country. Their seeds are sown in a hot-bed in the beginning of April; the young plants are managed like other tender annuals; and about the end of May they are planted in the open air under a south wall. They will readily ripen their fruit in such a situation.

CAPSULE, a vague name given by botanists to any kind of dry seed-vessel containing many cells and seeds. It usually opens by valves.

CARA'BIDÆ, a family of Coleopterous Insects of the section *Pentamera* of Latreille. This family, named as above by M'Leay, is nearly identical with Latreille's section *Grandipalpi* as given in Cuvier's 'Règne Animal.' The distinguishing characters are:—Anterior tibiæ without emargination on the inner side; head narrower than the thorax; eyes rather prominent; palpi with the terminal joints often compressed, large, and somewhat triangular in shape; mandibles simple, moderately long, and rather thick.

The species of the *Carabidæ* are usually large, and adorned with brilliant metallic colours.

CA'RABUS, a genus of Coleopterous Insects, of the family *Carabidæ*. This must not be confounded with the genus *Carabus* of Linnæus, which according to many of the modern authors is divided into several families, and each of those families contains numerous genera. The necessity for sub-dividing the group called *Carabus* by Linnæus will be seen when it is taken into consideration that there are probably now about 800 species discovered.

The genera *Carabus*, *Tefflus*, *Procerus*, *Procrustes*, and *Calosoma*, contain the largest species of the Carnivorous Beetles, and together appear to form a natural group: we will therefore here notice the distinguishing characteristics of each, omitting those of *Calosoma*, which will be found under that head. These genera are usually arranged in succession as follows:—*Tefflus*, *Procerus*, *Procrustes*, *Carabus*, and *Calosoma;* and their chief technical characters may be readily seen by the following table:—

1. Anterior tarsi the same (or nearly so) in both sexes.
   - *a*. Labrum entire . . . . . *Tefflus*.
   - *b*. Labrum bilobate . . . . *Procerus*.
2. Anterior tarsi with the three or four basal joints dilated in the males.
   - *a*. Labrum trilobate . . . . *Procrustes*.
   - *b*. Labrum bilobed . . . . *Carabus*.

In *Tefflus*, *Procerus*, and *Carabus*, there is a simple tooth-like process in the emargination of the mentum; whilst in *Procrustes* this process is broad and slightly notched at the apex. The terminal joint of the palpi in these genera is nearly triangular, and larger in the males than in the females. In *Procerus* this joint is much larger in proportion than in either *Carabus* or *Procrustes;* and in *Tefflus* it is most developed, and is of an elongate form, slightly convex anteriorly. (*Fig.* 2.)

Tefflus Megerlei. The only species known of this genus is nearly two inches long, and is black; the thorax is almost double the width of the head, slightly convex and rugose, and has the lateral and posterior margins reflected; it is truncated anteriorly and posteriorly, and the lateral margins and posterior angles are rounded; the elytra are elongate-ovate, very convex, and furnished with seven smooth elevated longitudinal ridges, and in the space between these ridges there is a chain of small elevated tubercles; the legs and antennæ are moderately long. This rare and conspicuous insect is found in Senegal and on the coast of Guinea.

Procerus scabrosus is about two inches in length, and in the broadest part of the elytra about three-quarters of an inch in width, and of a bluish-black colour; the thorax is broad, truncated anteriorly and posteriorly, very slightly convex, and rugose; the elytra are oval, convex, and covered throughout with small tubercles. This is the largest of the carnivorous beetles known.

Carabus violaceus.

M. le Comte Dejean describes three other species belonging to this genus, which are all of a beautiful blue or violet colour above, and black beneath. The *Proceri* are often found under dried leaves in the forests and on the mountains of Russia, Hungary, and Asia Minor: they are the giants of European *Carabidæ*.

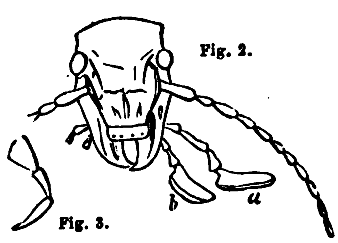


Fig. 2, Head of *Teflus Megerlei*, magnified. *a*, maxillary palpus; *b*, labial palpus.
Fig. 3, maxillary palpus of *Carabus violaceus.*

Four species of the genus *Procrustes* have been described, the largest of which, *P. coriaceus*, is recorded as British; it is however so rare in this country as to have given rise to doubts as to its being strictly an inhabitant. In France and Germany it is tolerably common, and is found in woods. *P. coriaceus* is rather more than an inch and a half in length, and of a dull black colour; the thorax is nearly smooth; the elytra are rugose, and of an ovate form.

Of the genus *Carabus* upwards of 120 species have been described, the greater portion of which inhabits Europe, Siberia, Asia Minor, and the northern parts of Africa.

From the immense number of species Count Dejean has found it necessary in his descriptions to arrange them under 16 divisions, founded principally on the sculpture of the elytra. Mr. Stephens, in his 'Illustrations of British Entomology,' describes 17 species: the most common are—*C. violaceus*, *C. monilis*, *C. catenulatus*, *C. hortensis*, *C. cancellatus*, and *C. arvensis*, all of which are tolerably abundant in the neighbourhood of London.

C. hortensis is very frequently met with on pathways (especially early in the morning), and not uncommonly with a worm in its jaws. It is about an inch long; the head and thorax are of a copper-like hue, and the elytra are brassy-green; the under parts of the body are black; the elytra are faintly sculptured, and exhibit three longitudinal rows of impressions, and numerous rows of very delicate confluent punctures.

C. violaceus is equally common with the last; it is dull black, and has the margin of the elytra of a copper-like hue; this tint is also more or less observable on the thorax; the elytra are very delicately punctured, and appear smooth to the naked eye, in which respect this species may be easily distinguished from *C. catenulatus*, which has the elytra distinctly sculptured. *C. catenulatus* also differs in form considerably from *C. violaceus*; it is dull black, and has the thorax and margins of the elytra of a purple or blue colour. Its locality is heaths and commons, where it is found under clods of turf, &c.

C. cancellatus appears to confine itself to old pollard-willows, at the roots and under the loose bark of which it is found in abundance. This species is about three-quarters of an inch long, and of a brassy hue above. The elytra are adorned with three distinct longitudinal rows of oblong elevated tubercles, and between these there is a smooth elevated stria.

(Dejean, *Species Générale des Coléoptères.*)

CARACHICHU, a name given in Brazil to the *Solanum nigrum*. It is also called Erva Moria. [SOLANUM.]

CARADOC FORMATION, the uppermost of the two great divisions of the Lower Silurian Strata of Murchison. It is not well and clearly seen except in Salop, the Abberley and Malvern Hills, Woolhope, May Hill, and other points on the eastern borders of Wales.

CARAGA'NA, a genus of Papilionaceous Yellow-Flowered Shrubs, formerly comprehended in *Robinia*. Several species are cultivated in gardens, but they are not much valued. They are exclusively found in Asiatic Russia, Tartary, and the north of India; one of them, the *Caragana Gerardiana*, is one of the plants called Tartarian Furze by travellers.

CARAMBOLA. [AVERRHOA.]

CA'RANX, a genus of Acanthopterygious Fishes, and belonging to the family *Scomberidæ*. This genus is distinguished chiefly by the lateral line of the body being furnished with a series of scaly plates. These plates are horizontally keeled (especially on the posterior half of the body), and frequently terminate in a spine or an angular projection, the point of which is directed backwards. The remainder of the body is covered with small scales. There are two distinct dorsal fins; the last rays of the posterior one are sometimes but slightly connected by membrane, or separated into spurious fins. Some free spines are placed before the anal fin. The teeth are very minute.

Several species of this genus inhabit the seas of Europe, but we are aware of only one which has occurred off the British coast, the *Caranx tracturus*. This fish, well known by the name of the Scad or Horse-Mackerel, is frequently met with on various parts of the coasts both of England and Ireland, and at times occurs in such immense shoals that the whole sea as far as the eye can reach appears alive with them. The Scad is about the size of the mackerel, to which it comes near in affinity. The body is more even in width (that is, less tapering towards the head and tail), and is of a dusky olive-colour above, exhibiting in certain lights splendid hues of blue and green; the lower part of the body is silvery-white, with the exception of the throat, which is black; there is also a black spot just above the pectoral fin. This species, like many others found on our own coasts, occurs also on those of the Mediterranean. In some of the species of the genus *Caranx* the scaly plates are observable only on the posterior half of the lateral line, and the anterior part is furnished with small scales.

C. punctatus of Cuvier has but a single spurious dorsal and anal fin, whilst the *C. Rotleri* (*Scomber Rotleri* of Bloch) has several. *Scomber dentus* (Bloch), and one or two other species now included in this genus, are remarkable for having a single range of teeth and the body of a more elevated form.

C. Carangus (*Scomber Carangus* of Bloch), a large species of this genus from the Antilles, weighing from 20 lbs. to 25 lbs., is of a silvery hue, and has a black spot on the operculum; the body is compressed, and of a somewhat ovate form; the head is obtusely terminated. This fish is good eating, whilst the Bastard Carangue (*C. Guaraterebra*), another which closely resembles it, but wants the black spot, is apt to prove poisonous.

CARANXO'MORUS, a genus of Acanthopterygious Fishes belonging to the family *Scomberidæ*.

CARAPA, a genus of plants belonging to the natural order *Meliaceæ*. *C. Touloucouna* yields the Talliooonah or Kundar Oil, which has a reputation as an anthelmintic. It is said to be well suited for burning in lamps. The bark of the root of *C. obovata* is bitter and astringent. The bark of *C. Guianensis* is used as an anthelmintic and febrifuge. (Lindley, *Vegetable Kingdom.*)

CA'RAPUS, a genus of Fishes belonging to the Apodal Malacopterygians.

CARAWAY. [CARUM.]

CARBO, a genus of Birds, of the order *Natatores* and the tribe *Pelecanidæ*, to which Temminck referred the Common Cormorant. It is now usually placed in the genus *Phalocrocorax*. [PHALOCROCORAX.]

CARBON is one of the elements which occurs pure in nature. In this state it is called *Diamond*, and forms one of the most precious gems. [DIAMOND.] It is also found in a tolerably pure condition in *Graphite* (*Plumbago* or *Black-Lead*). This substance contains from 90 to 96 per cent. of Carbon, with the rest iron. [GRAPHITE.] Carbon enters largely into the composition of Amber [AMBER], and also of mineral Caoutchouc and the various forms of Bitumen. [BITUMEN.] It forms the distinguishing element of *Coal*. [COAL.]

CARBONIFEROUS SYSTEM, the great group of strata which includes nearly all the valuable coal yet discovered. It consists of—

D. The Coal Formation.
   c. The Millstone-Grit Group.

B. The Mountain Limestone Formation.
   a. The Limestone-Shale Group.

The portions marked *a*, *c*, are the least constant in range and character; the Limestone-Shale graduates in South Wales to Devonian Strata, and in Ireland constitutes the Yellow Sandstone series of the northern counties. (Griffith.) Most of the coal of Ireland belongs to the Millstone-Grit group. [COAL FORMATION; MOUNTAIN LIMESTONE.]

CARBUNCLE. [GARNET.]

CARCHA'RIAS, a genus of Fishes of the Shark Tribe. [SQUALIDÆ.]

CARDAMINE, a genus of plants belonging to the natural order *Cruciferæ*, the sub-order *Siliquosæ*, and the tribe *Arabideæ*. It has a compressed pod, flat nerveless valves, a capitate stigma, the seeds in a single row, with the funiculus simple and filiform. The species, which are numerous, are usually smooth herbs, with stalked, entire, lobed, or pinnately cut leaves, and racemes of white or red flowers.

C. pratensis, Cuckoo-Flower, Bitter-Cress, Common Ladies' Smock, has pinnate leaves, the leaflets of the lower leaves roundish, slightly angled, those of the upper leaf linear-lanceolate, entire; the petals three times longer than the calyx, spreading; the stamens half the length of the petals; stem terete. This plant has large lilac-coloured flowers, and is exceedingly abundant in some parts of the country. It has a bitter taste, hence its name Bitter-Cress. It is generally in blossom when the cuckoo returns to this country, and at that period covers the fields as though linen was bleaching: these circumstances explain its other common English names. Till recently it retained a place in the London and Dublin Pharmacopœias. At one time it had the reputation of being a diuretic and antispasmodic, and a drachm of the flowers was administered as a dose in hysteria, chorea, epilepsy, and other nervous affections. It is a native of Europe, Asia, and America, and is abundant throughout Great Britain.

Babington describes four other species of *Cardamine* as natives of Great Britain, *C. impatiens*, *C. sylvatica*, *C. hirsuta*, *C. amara*: with the exception of the last they are common plants. *C. bellidifolia* has been figured in the 'English Botany' as a British plant, but no station for it is known. The leaves of *C. hirsuta*, when ripe and laid upon the ground, put forth buds which produce a new plant. It is extensively propagated in this way in moist soils. It is said that other species have the same property. *C. impatiens* is so named from its pods when fully ripened expanding suddenly with force when touched, and throwing the seeds to a distance.

(Don, *Gard. Dict.*; Loudon, *Encyc. of Plants*; Babington, *Manual of British Botany*.)

CARDIOSPERMUM, a genus of plants belonging to the natural order *Sapindaceæ*. The root of one of the species, *C. Halicacabum*, is said to be diuretic, diaphoretic, and aperient. In the Moluccas the leaves are cooked and eaten.

CARDIUM, a genus of Bivalve *Mollusca* belonging to the Acephalous *Lamellibranchiata*. It is the type of the family *Cardiadæ*, and the species are known by the common name of Cockle. The shell is equivalve, more or less cordiform, oblong or transversely ovate, usually inflated, closed or gaping posteriorly, longitudinally ribbed or furrowed in radiating fashion from the prominent beaks, rarely smooth; ribs often scaly or spiny; margin almost always crenulated. Hinge composed of two oblique primary teeth in each valve and two remote lateral ones (in certain exotic forms, the teeth become partially or wholly obsolete). The ligament short, external, conspicuous; pallial impression simple. The animal is suborbicular, tumid, its mantle freely opening in front with plain or less frequently fringed edges, conspicuously fimbriated in the neighbourhood of the two very short slightly-separated siphons, the branchial one of which is always fringed at the orifice. Foot very large, cylindrical, geniculated. Branchial leaflets unequal, labial palps rather long and triangular. (Forbes and Hanley.)

The shells belonging to this genus are very widely distributed, and many of them are remarkable for the elegance of their form and colouring. The species are about 200 in number. "We find," say the authors of the 'History of British Mollusca,' "the great assemblage of Cockles in the Indian Ocean, a region where about a third of the species are congregated. Around this centre the number of specific forms diminishes, though found in every sea. They are most plentiful everywhere within the tropics, and diminish as we proceed northward and southward; but some of the forms most prolific in individuals and most gregarious in habit are present in cold climates, and make up by abundance for the absence of variety. Of these several are valuable articles of food; and it may be said of all the *Cardia* that they hold a high rank among *Mollusca*, both for nutritive qualities and excellence of flavour. The genus contains several remarkable abnormal forms; some of the most singular are to be found in the Caspian and other relics of the great Aralo-Caspian Sea—the demonstration of which mighty inland ocean is among the finest discoveries of Sir Roderick Murchison.

"The geological distribution of this interesting group corresponds in extent with the geographical. Even in Palæozoic Strata we find the fossilised remains of Mollusks closely allied if not belonging to *Cardium*. In the Secondary Rocks, even in their oldest members, well-marked forms of *Cardium* are not unfrequent, often singularly similating those of existing times. During the later part of the Secondary epoch and the beginning of the Tertiary a group of half-ribbed cockles seemed to have been developed at the expense of ordinary forms, and to have dwindled away as they came near our own epoch, when but two or three allies of them are found." (Vol. ii. p. 3, 4.)

Cockles inhabit all parts of the ocean. Some species are constantly met with between high and low water marks, and they have presented themselves from the deepest sea-beds. Each species has however a very definite range. They lie buried in sand or sandy mud, often occurring in prodigious quantities. According to the researches of Dr. W. B. Carpenter, the shell of the genus *Cardium* has a very definite elementary structure. Externally it presents a tubular structure, but internally there is little development of organic structure.

C. edule (Linnæus), the Common or Eatable Cockle, is known by the following characters:—It is neither triangular nor porcelain-white. It has radiating ribs, which are neither armed with spines nor tubercles. This bivalve assumes a variety of appearances, and the adult especially differs from the young. Forbes and Hanley include under this the following species of other writers:—*C. vulgare*, Da Costa; *C. crenulatum*, Lamarck; *C. pectinatum*, Lamarck; *C. arcuatum*, Reeve; *C. zonatum*, Brown; *C. obliquum*, Woodward; *C. rusticum*, Chemnitz; *C. glaucum*, Bruguière; *C. Lamarckii*, Reeve; *C. Belticum*, Reeve.

This species is met with in most parts of the British Islands, and is almost everywhere regarded as a pleasant article of diet. The ordinary run of examples are from four-fifths of an inch to one inch in length, but on the coast of Devon, and especially at Limpstone on the mouth of the Ex, where they are cultivated in beds, they attain a much greater size. It is a gregarious animal, inhabiting the sands at low water, especially where there are large tracts of sand in the neighbourhood of estuaries.

The Common Cockle has a wide geographical range, extending southward to the Canary Isles. It is also found in the Caspian Sea. It occurs fossil in the Red Crag.

The other British species enumerated by Forbes and Hanley, are—*C. aculeatum*, *C. echinatum*, *C. rusticum*, *C. nodosum*, *C. fasciatum*, *C. pygmæum*, *C. Suecicum*, and *C. Norwegicum*. They regard *C. Grœnlandicum*, *C. serratum*, *C. medium*, and *C. muricatum*, as spurious in the British Fauna.

CARDOON, a name applied to the blanched leaflets and stems of *Cynara Cardunculus*. [CYNARA.]

CARDUELIS, a genus of Birds belonging to the tribe *Insessores*, division *Conirostres*, and the family *Fringillidæ*. It has a lengthened conical compressed beak; the point attenuated and acute; commissure slightly curved. The nostrils basal, lateral, covered by small incumbent plumes. Wings lengthened, pointed; the first, second, and third quills longest, and nearly equal. The tail moderate, slightly forked. Feet with the middle toe longer than the tarsus, which is equal to the hind toe; lateral toes short, of equal length; claws slender, curved, and acute.

There are two species of this genus indigenous in Great Britain, the Goldfinch and the Siskin.

C. elegans (*Fringilla Carduelis*), the Goldfinch, is a well-known bird. It has a gay plumage, lively habits, an agreeable form and song, and a disposition to become attached to those who feed it. In captivity they can be taught a variety of tricks, such as drawing up water for themselves to drink in a thimble bucket, or opening the lid of their seed-box. They may be often seen performing with canaries in the streets of London.

The Goldfinch builds a very neat nest, and lays four or five eggs of a pale bluish-white colour, with a few spots and lines of pale purple and brown. It is a very general inhabitant of the British Islands. It is also found in Sweden, and is abundant in Germany, France, Provence, Spain, and Italy. It is found also at Corfu, Sicily, Malta, and Crete.

The whole length of this bird is 5 inches. It has a whitish horn-colour beak, black at the tip; the circumference at the base of the beak crimson-red; cheeks and ear coverts white; top of the head black; nape of the neck white; the back and rump a dusky wood-brown; the carpal portion of the wing and the smaller wing-coverts black; the greater wing-coverts and the outer edge of the basal half of each primary brilliant gamboge-yellow; the remaining portion of the primaries black; under surface of the body dull white. (Yarrell.)

C. spinus (*Fringilla spinus*), the Siskin. [ABERDEVINE.]

CARDUUS. [THISTLE.]

CAREX, a genus of plants belonging to the natural order *Cyperaceæ*, and the tribe *Cariceæ*. The flowers are diclinous, arranged in imbricated spikes, each covered by a glume; the female flowers have a single urceolate persistent perigone, in which the nut is completely inclosed; one style with two or three stigmas; the male flowers have three stamens without a perianth. The species for the most part are inconspicuous and unattractive plants. They are however exceedingly numerous. Lindley, in Loudon's 'Encyclopædia of Plants,' describes 105 species, and this is probably not more than half that are now known. Babington describes 66 species as natives of Great Britain, being the largest number of species of any genus of phænogamous plants in this country. Koch, in the 'Flora Germanica,' describes 103 species as natives of Germany and Switzerland. Although so numerous, they serve directly few of the purposes of man or the higher animals. Their leaves are tough and hard, so that none of them are eaten by cattle except in cases of great necessity. They are for the most part inhabitants of wet and swampy grounds, in bogs, fens, and marshes, in the temperate and northern parts of the world. In the hop-grounds of Great Britain the leaves of some of the species are used for tying the bines of the hops to the poles. In Italy they are used for placing between the staves of wine-casks, are woven over Florence flasks, and occasionally employed for making chair-bottoms. The leaves of the *Carex sylvatica*, according to Linnæus, are combed and dressed, and used as a warm lining for gloves and shoes; and thus protected, the Laplanders seldom suffer from being frost-bitten.

C. arenaria has a place in some of the continental Pharmacopœias; its root-stock being a reputed diaphoretic and diuretic. It is used under the name of German Sarsaparilla, and is employed in cases of skin-disease, as well as in secondary syphilis.

The *C. hirta* and *C. disticha* are often substituted fraudulently or by mistake for it, but do not, according to Bischoff, possess such active properties. It is not known to the practitioners in medicine of this country.

C. arenaria grows on the sands of the sea-shore, and is one of the plants which, in conjunction with the *Elymus*, *Arundo*, and *Psamma*, binds the loose sands, and forms them into solid embankments. Although most of the species are devoid of striking beauty, some of them when in flower are much admired on account of the elegant drooping of their panicles of golden-coloured flowers. This is the case with *C. remota* and *C. Fraseri*. Unattractive as the mass of these plants are to the general observer, they have been carefully studied by botanists, and Willdenow, Goodenough, Wahlenberg, Sckuhr, Scopoli, Boott, Babington, and S. Gibson have done much to throw light upon this obscure genus. Their importance in nature however must not be estimated by their appearance or their utility to man. They frequently form the only vegetation of the swamp, and by their existence and decay they gradually form a soil, on which plants more immediately useful to man may be grown.

CARIACUS. [CERVIDÆ.]

ÇARIAMA, or SARIAMA, the name by which the *Palamedea cristata* of Gmelin, *Dicholophus cristatus* of Illiger, *Microdactylus* of Geoffroy, the Saria of the Guaranis of Paraguay, and the Seriema or Ceriema of the Brazilian natives, is known to the Portuguese colonists of Brazil.

Marcgrave, Piso, D'Azara, Geoffroy, and the Prince de Wied have entered into a detailed history of this bird, which has always attracted the notice of zoologists on account of the curious relations which its structure indicates to the *Grallatores* (Waders), the Gallinaceous birds, and even the *Struthionidæ*.

It is found in the great solitary mountain-plains, surrounded by the forests which extend over so large a proportion of Brazil, and where its sonorous voice often breaks the silence of the desert. It is also found in Paraguay, but is said to occur there more rarely. It feeds in a state of nature on lizards, insects, and molluscous animals, and not improbably small seeds occasionally.

The habits of the wild Çariama are of the most retired description. A tenant of the vast solitudes that form its wide spreading home, it flies from the face of man; and being almost always on the watch is very difficult of approach. Stalking slowly on the plain its eye instantly notes the distant intruder, and after a moment's hesitation it decides either to stay or fly, according to the circumstances. Those who have had the best opportunities of observing them in their native wilds state that the hunters, though surrounded by these birds, cannot without considerable labour obtain them. As soon as the bird perceives that it is pursued, it sets off with great rapidity; the pursuer follows on horseback, but it is not till after a sharp and tedious course, with all its turns and windings, that the Çariama, wearied out, either crouches on the ground, or alights on some bush or tree. Till this happens the horseman in vain seeks for an opportunity to throw his lasso or pull his trigger.

But wild as the bird is in its natural state it is easily domesticated, and will live sociably with the other tenants of the poultry-yard. In this state they will eat little pieces of meat, but are said to refuse maize, though it is probable that other kinds of grain may not be disagreeable to them. When thus tamed they will walk about the hamlet or village where they have been brought up, and even return after taking short trips in the fields like the poultry. The flesh is described as very good food; the Brazilians however do not hunt it for the game-bag.

The nest is composed of dry sticks and branches, covered with cow-dung, and placed upon a low or a moderately high tree. The eggs are generally two in number and white.

It has the neck covered with long loose barbed feathers, floating and silky upon the nape, somewhat like those of the bittern: when the bird is excited or frightened it can raise them. A light crest consisting of a few disunited feathers forms an ornamental tuft on the front, and advances upon the base of the bill, which it overshadows, reminding the observer of the crests of the *Rupicolæ* (Cocks of the Rock) in its disposition. Space round the eyes naked, the nakedness, which is bluish, reaching to the bill. The upper eye-lid fringed with long dark eye-lashes. Feet long and slender, and the toes very short, whence Geoffroy's name. Tail rounded and of moderate length.

The general colour of the Çariama is an earthy-brown on the upper parts, while the lower parts are whitish. All the neck-feathers are finely rayed with zigzags of darker brown than that which forms the general ground-colour of the plumage. The two middle feathers of the tail are brown: the others for the most part black, with white extremities, and marbled with black upon a white ground at their insertion. The wing-feathers are blackish and traversed by white bands dotted with blackish. There are delicate zigzags of a clear brown on the feathers of the front of the neck, the ground colour of these feathers being whitish. The feathers of the breast and belly are longitudinally rayed with white in the direction of the shafts. The naked part of the leg, the feet, and the toes are of an orange-red. The bill, which is of a bright coral red in the adult, is blackish or marbled with black and reddish in the younger birds. The iris is yellow.

D'Azara gives 30 inches as the length of the young bird described by him; that of the Prince de Wied was half an inch more, and the adult male of the Museum of the Netherlands, from which Temminck's figure was taken, measures, according to him, 32 inches. The nestlings are covered with down, and with the iris of a very lively yellow. They are very soon able to run.

Temminck, after observing that the Çariama at first view seems to offer some resemblance to the Secretary-Bird of Africa (*Gypogeranus serpentarius*), remarks that this resemblance vanishes upon a closer inspection, and that, if it be permitted to form any judgment from the forms solely, it would seem probable that the skeleton of the Çariama, which was not known when he wrote, ought to have some relationship

Çariama (*Palamedea cristata*).

with that of the Common Bittern (*Botaurus stellaris*), of the Agami (*Psophia crepitans*), and the *Grallatores* generally. There is a skeleton of a female in the museum of the Zoological Society of London presented by the Earl of Derby, in whose possession the bird died. An account of the anatomy of this bird by Mr. Martin was published in the 'Proceedings of the Zoological Society.' In this paper Mr. Martin observes that "in its general aspect the skeleton of the Çariama is very remarkable. The comparative shortness of the neck, the compactness of the chest, and stoutness of the ribs, together with the abbreviated condition of the wings, appear as if out of harmony with the length of the limbs, especially of the tibia and tarsus, while the toes concluding this length of limb are short, the hinder one being situated high and not touching the ground.

"Though the Çariama in its osseous structure exhibits but little resemblance to the birds of the Raptorial order, it approaches that order very remarkably in the structure of the eye, which is surrounded by a firm consolidated osseous ring. This ring departs materially in its formation from what obtains among the *Grallatores* generally, where it is imbricated and slight, and indeed scarcely merits the name of osseous."

For the anatomy of the bird we refer the reader to Mr. Martin's paper, but we may observe that, according to Mr. Martin, "in the whole of the visceral arrangement a close affinity may be observed to the *Grus* tribe." In the Stanley Crane (*Anthropoides paradisæus*, Bechst.) the intestines are similarly disposed in folds or loops, and the two cæca, given off 6 inches from the anus, are 4 inches long. In the Stanley Crane however the muscular coat of the gizzard is thicker than in the Çariama, being in some parts an inch across, while in the latter bird it is about one-fourth of an inch; hence is there in this point an index of a less vegetable regimen. In the Stanley Crane the total length of the intestines is 5 feet 3 inches. In the Çariama it is 3 feet 5½ inches.

CA'RICA, a genus of plants belonging to the natural order *Papayaceæ*. One of the species, *C. Papaya*, is a remarkable tree found in various parts of South America, with a simple unbranched erect trunk, from 12 to 20 feet high, abounding in a milky juice, having broad 7-lobed leaves a foot at least long, and unisexual flowers, the males of which are monopetalous, with ten short stamens inserted in the mouth of the corolla; the females polypetalous, with a single ovary, having a starry sort of stigma. The fruit is thus described by Hooker in the 'Botanical Magazine:' "The corolla falls away, and the germen in coming to maturity becomes pendent; the tree, too, advancing in height casts its lower leaves from below the flowers, and the fruit constituting a large oblong kind of berry, or more correctly speaking pepo, rests suspended upon the leafless part of the trunk, much in the same way as that of the *Artocarpus*, or Bread-Fruit. The surface, when the fruit is ripe, is a pale and rather dingy orange-yellow, obscurely furrowed, and often rough with little elevated points. The flesh is very thick, coloured, but paler than the outside, and there passes through it longitudinally five bundles of vessels. In the centre is a considerable cavity, with five longitudinal ridges, and these are thickly clothed with numerous seeds." This fruit is called the Papaw, and is accounted of considerable interest in the tropical part of the world. An excellent history of its uses is compiled in the work already quoted, from which we borrow the following: "The papaw-tree is of rapid growth. St. Pierre probably spoke from his own knowledge when he described Virginia as having planted a seed which in three years' time produced a trunk 20 feet high, with its upper part loaded with ripe fruit. It is for the sake of this fruit mainly that the plant is cultivated; but if the flavour were not better than that yielded by what ripened in our stove, I cannot recommend it as at all agreeable." Brown, in his 'Natural History of Jamaica,' tells us that "it has a pleasant sweetish taste, and is much liked by many people; that while young it is commonly used for sauce; and when boiled and mixed with lime-juice and sugar is not unlike or much inferior to that made of real apples, for which it is commonly substituted." In the opinion of Sloane it is not a very pleasant fruit, even when helped with pepper and sugar; and the more ordinary use, he adds, of this fruit is before it is ripe, when, as large as one's fist, it is cut into slices, soaked in water till the milky juice is out, and then boiled and eaten as turnips or baked as apples. The juice of the pulp, according to Descourtilz, in the 'Flore Médicale des Antilles,' is used as a cosmetic to remove freckles on the skin caused by the sun; and the negroes in the French colonies employ the leaves to wash their linen, instead of soap. As a medicinal plant the Papaw-Tree is particularly deserving of notice. Hernandez long ago spoke of the milky juice of the unripe fruit as a powerful vermifuge, which has been confirmed by M. Charpentier Cossigni, as mentioned in the 'Asiatic Researches' by Dr. Fleming (vol. ii. p. 162). A single dose, that gentleman says, is sufficient to cure the disease however abundant the worms may be. Another French writer (Poupée Desportes) recommends the use of the seed instead of the juice. But the most extraordinary property of the Papaw-Tree is that which is related, first I believe by Brown, in his 'Natural History of Jamaica,' namely, that "water impregnated with the milky juice of this tree is thought to make all sorts of meat washed in it very tender; but eight or ten minutes steeping, it is said, will make it so soft that it will drop in pieces from the spit before it is well roasted or turn soon to rags in the boiling." Mr. Neill mentioned this circumstance more fully in his interesting 'Horticultural Tour through Holland and the Netherlands;' and it has repeatedly been confirmed to me by gentlemen of this country who have been long resident in the West Indies, and who speak of the employment of the juice for such a purpose as of quite a general occurrence; and more, that old hogs and old poultry which are fed upon the leaves and fruit, however tough the meat they afford might otherwise be, are thus rendered perfectly tender, and good too, if eaten as soon as killed, but that the flesh very soon passes into a state of putridity. The juice causes a separation of the muscular fibres. Nay, the very vapour of the tree serves the purpose; hence many people suspend the joints of meat, fowls, &c. in the upper part of the tree in order to prepare them for the table. Such is the effect upon hogs that feed upon the fruit, that the good housewives reject the flesh of such if it is destined for salting, well knowing that it is not sufficiently firm for that purpose.

"Whether this power of hastening the decay of meat be attributable to the animal matter or fibrine contained in the juice of the Papaw or not, I will not pretend to say; but the presence of such is a fact scarcely less wonderful than the property just alluded to. Two specimens of the juice were brought from the Isle of France; in the one it had been evaporated to dryness, and was in the state of an extract; in the other the juice was preserved by being mixed with an equal bulk of rum. Both were subjected to analysis by Vauquelin. The first was of a yellowish-white colour and semi-transparent. Its taste was sweetish. It had no smell, and was pretty solid; but attracted moisture when kept in a damp place. The second was reddish-brown, and had the smell and taste of boiled beef. When the first specimen was macerated in cold water the greatest part of it dissolved; the solution frothed with soap. The addition of nitric acid coagulated it, and rendered it white; and when boiled it threw down abundance of white flakes. When the juice of the Papaw is treated with water the greatest part dissolves; but there remains a substance insoluble, which has a greasy appearance. It softens in the air, and becomes viscid, brown, and semi-transparent. When thrown on burning coals it melted, let drops of grease exude, emitted the noise of meat roasting, and produced a smoke which had the odour of fat volatilised. It left behind it no residue. The substance was fibrine. The resemblance between the juice of the Papaw and animal meat is so close that one would be tempted to suspect some imposition, were not the evidence that it is really the juice of a tree quite unquestionable. This fibrine had been supposed previously to belong exclusively to the animal kingdom; but it has since been found in other vegetables, especially in *Fungi*."

C. digitata, the Chambum, is a Brazilian plant, and regarded with little less honour than the Upas-Tree itself. Pöppig says the juice which spirted on his face when he cut into the tree only caused itching in the face and a few blisters on the hands. The male flowers have a very disgusting smell.

CARINA, in Botany, the two oblique front petals of a Papilionaceous flower, united by their contiguous edges into an organ having a figure something like that of the keel of a boat.

CARINA'RIA, the name of a genus of *Mollusca*, arranged by Cuvier under his fifth order of Gasteropods (Lamarck's *Heteropoda*) as the type of that order, and by De Blainville under the first family (*Nectopoda*) of his order *Nucleobranchiata*. The shells of this genus were formerly known to collectors under the names of Venus's Slipper and the Glass Nautilus: indeed one of the species is the *Argonauta vitreus* of Gmelin.

The body of the animal is sub-cylindrical, elongated, transparent, dotted with elevated points, prolonged posteriorly, and furnished towards the upper part of its posterior extremity with a sort of fin, which performs the part of a rudder. A reddish thin compressed sub-circular fin, beautifully reticulated by decussating muscular fibres, furnished with a sort of acetabulum or sucker, rises from the belly nearly opposite to the point on the back occupied by the shell. With the aid of this fin it floats along. M. Verany says that, notwithstanding the greatest possible attention, he has not been able to discover the use of the sucker, or rather suctorial disc, in the ventral fin; but there can be little doubt that it is analogous to the foot in Gasteropods, and that the animal avails itself of its powers of adhesion by sticking to rocks or other submarine bodies, and thus lying at anchor, as it were, in repose, with the frail shell that protects the circulating and respiratory organs, together with the liver and generative gland, lowermost—the same position occupied by it when the animal is in motion.

The head is capable of contraction within the body, and is provided with a sort of retractile proboscis. There are two tentacula of some length and of a subconical shape, placed laterally at the insertion of the head; and there are two eyes situated at the base of the tentacula. The mouth is furnished with a circular jaw, armed with four rows of teeth, of which the two internal ones are fixed and small.

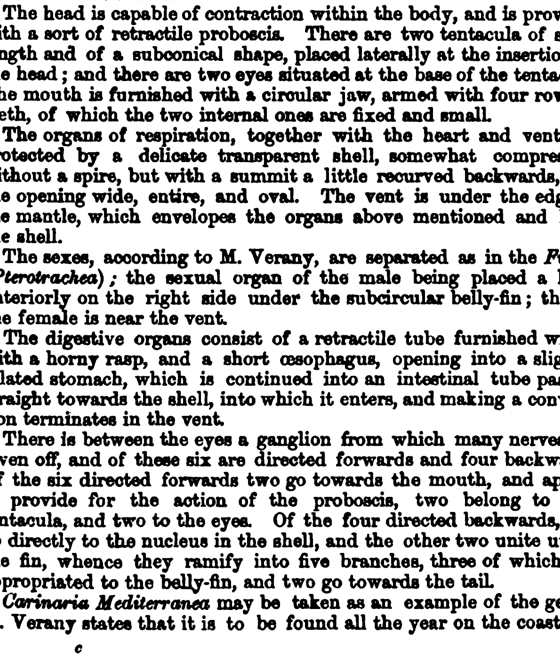
The organs of respiration, together with the heart and vent, are protected by a delicate transparent shell, somewhat compressed, without a spire, but with a summit a little recurved backwards, and the opening wide, entire, and oval. The vent is under the edge of the mantle, which envelopes the organs above mentioned and lines the shell.

The sexes, according to M. Verany, are separated as in the *Firolæ* (*Pterotrachea*); the sexual organ of the male being placed a little anteriorly on the right side under the subcircular belly-fin; that of the female is near the vent.

The digestive organs consist of a retractile tube furnished within with a horny rasp, and a short œsophagus, opening into a slightly dilated stomach, which is continued into an intestinal tube passing straight towards the shell, into which it enters, and making a convolution terminates in the vent.

There is between the eyes a ganglion from which many nerves are given off, and of these six are directed forwards and four backwards. Of the six directed forwards two go towards the mouth, and appear to provide for the action of the proboscis, two belong to the tentacula, and two to the eyes. Of the four directed backwards, two go directly to the nucleus in the shell, and the other two unite under the fin, whence they ramify into five branches, three of which are appropriated to the belly-fin, and two go towards the tail.

Carinaria Mediterranea may be taken as an example of the genus. M. Verany states that it is to be found all the year on the coasts (in



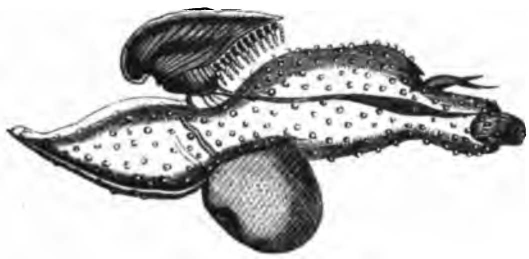
Carinaria Mediterranea, male.

a, Situation of the ganglion or brain; *b*, eye; *c*, head; *d*, retractile tube; *f*, digestive tube; *g*, shell containing the organs of respiration, heart, &c.; *h*, the posterior or rudder-fin; *i*, ventral-fin; *k*, the sucker; *l*, *l*, nerves. The figure, with slight modification, is taken from Verany's.

the neighbourhood of Nice), but that it is sufficiently abundant in the months of May, June, and July. He further observes that it is rare to find it with the shell entire, that it feeds on gelatinous bodies and on very small fishes, such as *Atherina nana* (the Dwarf Atherine), and that he has often found in the stomach the remains of other *Carinariæ*, which satisfies him that the species is mutually destructive.

Delle Chiaje, who has placed the animal in its proper position with relation to the brain, has given a careful and detailed account of its organisation in his 'Memorie sulla Storia e Notomia degli Animali senza Vertebre del Regno di Napoli,' vol. ii. p. 214, illustrated in his plates 14 and 15. Delle Chiaje makes the spermatic canals rise at the posterior base or insertion of the ventral fin and proceed to the genital organ, near the origin of what we have termed the rudder-fin; but he gives no external view of the apparatus so conspicuous in M. Verany's figure.

Carinaria has never yet been taken in any other than warm latitudes. Three species, *C. vitrea*, *C. fragilis*, and *C. Mediterranea*, are recorded without reckoning Lamarck's *C. cymbium*.



The above is copied from the Iconographie of Cuvier's 'Animal Kingdom,' and represents the *Carinaria* with its back uppermost. It is denominated *Carinaria cymbium*, but there can be no doubt that it is *Carinaria Mediterranea*.

CARLINA. [THISTLE.]

CARNATION, a kind of Dianthus or Pink, a variety of the *Dianthus Caryophyllus* of botanists, much esteemed by florists for the beautiful colours of its sweet-scented double flowers. It is usually grown in rich light loamy soil, in which sand enough is mixed to prevent water stagnating, and is propagated either by cuttings or layering. A great many varieties are cultivated, the most esteemed of which are those with a strong tall stem about 3 feet high, and regularly formed flowers, with the stripes or markings clear, well defined, and broadest near the end of the petals. From their colours they are technically distinguished into Flakes, which have but one colour, disposed in stripes upon a white ground; Bizards, which have stripes of two colours; and Picotees or Piquettees, which have petals notched at the edges, and spotted instead of striped upon a ground that is most commonly pale-yellow.

CARNELIAN. [AGATE.]

CARNI'VORA, a term generally applicable to any creatures that feed on flesh or animal substances, but definitely applied to that order of the *Mammalia* which prey upon other animals.

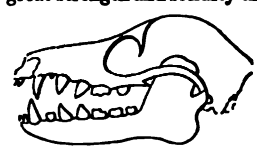
The forms of this order are varied, and the number of species considerable. Furnished like Man and the *Quadrumana* with three sorts of teeth, and nails or claws on the feet, they entirely differ from those two orders in never having the thumbs of the anterior extremity capable of being opposed to the other fingers. The greater or less development of their molar teeth as cutting or lacerating instruments seems to determine the kind of animal food fitted for their support. Those *Carnivora* which have their molars totally or partially tuberculated partake of a diet in which vegetables form a greater or less proportion, and those which have them serrated as it were with points live principally on insects. There are other modifications of these molars, fitting them for crushing bones or dividing animal muscle, according to the exigency of the animal; but in all, as a general rule, the articulation of the jaw does not permit of horizontal movement, the power being simply that of opening and shutting, upwards and downwards, like a pair of shears.

In their general organisation the prevailing feature of the skull is the great development of the zygomatic arch, affording room for the action of the powerful muscles that work the trenchant jaw; the orbit is not separated from the temporal fossa. The articulation of the bones of the fore-arm in most of the *Carnivora* is so constructed as to allow of free motion, though in a degree inferior to that bestowed on the *Quadrumana*. The brain (cerebrum) is considerable in bulk, well marked, but without a third lobe, and does not cover the cerebellum. Of all the senses that of smelling seems to be in the highest perfection, the pituitary membrane being extended over a manifold labyrinth of bony plates. The intestines are comparatively short, the nature of their food requiring less elaboration than that necessary for the extraction of nourishment from vegetables.

Cuvier gives the name of Carnassiers (Flesh-Eaters) to the order, and divides it into the following families:—

I. *Cheiroptera*.

These, as he observes, have still some affinities with the *Quadrumana*, as is manifested by the pendulous genital organ of the male, and the position of the teats of the female on the breast. Their distinguishing character consists of a fold of the skin, which rising at the side of the neck is extended between the fore feet and the fingers or toes, so as to suspend the animal in the air, and in those genera which have the bones of the hand sufficiently developed to spread a sufficient extent of this membranous skin, there is a power of executing all the evolutions required for flight. Strong clavicles and large shoulder-blades were required for this feat, and we accordingly find great strength and solidity thrown into those parts; but as the rotatory motion of the fore-arm would have been worse than useless, inasmuch as it would have weakened the force of the impulse of the membranous wing, and would have consequently lessened the power of flying, we find it almost entirely absent. Four great canine teeth are found in all the genera of this large family; but the number of their incisors varies. Some idea will be formed of the arrangement of the teeth in the *Cheiroptera* from the annexed cut.



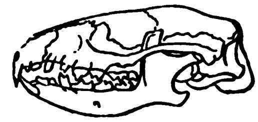
Skull of *Pteropus Keraudrenius*.

In the *Cheiroptera*, as we have seen, the teats are pectoral, but in all the rest of the families they are ventral.

The next family in Cuvier's arrangement is—

II. *Insectivora*.

The lateral membranes with which the *Cheiroptera* are furnished are no longer to be found in the *Insectivora*, which still have clavicles; and their molars like those of the first family are serrated with conical points. In their dental system the position and relative proportion of their incisors and canine teeth vary. Some have long incisors in front, followed by other incisors and canines lower than the molars, a scale of dentition to be found among some of the *Quadrumana* (*Tarsius*), and approaching in a degree the dental system of the *Rodentia*. Others have large and widely-separated canines, between which are small incisors, the most ordinary disposition of the teeth in the *Quadrumana* and *Carnivora*. The feet are short, and their motions comparatively feeble; the male organ is furnished with a sheath, and the teats are ventral. There is no cæcal appendage, and the entire sole of the foot is applied to the ground in walking. Their habits, resembling in a degree those of the *Cheiroptera*, are frequently nocturnal and subterranean. Insects form their principal nourishment, and many of them, especially in cold countries, pass the winter in a dormant state.



Skull of common Hedgehog (*Erinaceus Europæus*).

Hitherto we have seen the carnivorous organisation in a comparatively mitigated state, but we now approach Cuvier's third family, the *Carnivora*, properly so called, which have every part of their frame, in the cats especially, formed for the destruction of other animals. In two of the tribes, but more particularly in one, namely, the *Plantigrades*, the carnivorous form is indeed somewhat modified: but among these three tribes we find the greatest harmony of parts, fitted for keeping down the numbers of the granivorous and phytophagous animals, to be anywhere observed among the *Mammalia*.

III. *Carnivora*.

In this family we have the thirst for blood at its highest degree of development, and with it the power and the instruments for gratifying the appetite. Four large, long, and distant canines, separated by the intervention of six incisors in each jaw (the root of the second of the lower incisors being a little deeper planted than the others)—molars, either formed entirely with cutting edges, or constructed partly with blunt tubercles; these, with the powerful mechanism of the jaw in which they are set, present a most formidable apparatus for finishing the bloody task which the rest of the frame of the *Carnivora* is so nicely adapted for commencing and continuing. The more completely trenchant these molars are, the more completely carnivorous are the habits of the animal, and the different gradations may be in general safely traced by observing the proportional extent of surface, considered with reference to its tubercular or cutting shape. The Bears, which, taken as a whole, may be said to be capable of supporting themselves entirely on vegetables, have nearly all their molar teeth tuberculated. [BEAR.]

The anterior molars have the most cutting edges, and then comes a molar larger than the rest, with a tuberculated heel or process more or less developed, and behind it one or two small teeth almost entirely flat. With these small teeth the dogs, as Baron Cuvier has observed, masticate the grass which they occasionally swallow for medicinal purposes: he also agrees with M. Frederic Cuvier in naming the great molar above and its antagonist below 'carnassières,' or flesh-cutters; the anterior pointed molars, false molars; and the posterior blunt molars, 'tuberculeuses,' or tuberculated molars.

By observing these differences of dental form, the genera of *Carnivora* are most surely established, and it may be laid down as a general rule, that those carnivorous animals which have the shortest jaw and the least development of the false molars are those in which the sanguinary propensity and the destructive power co-exist in the highest degree.

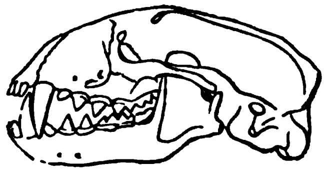
Many of the genera apply the whole sole of the foot (particularly of the hinder one) to the ground in walking, and this sole is generally destitute of hair. These are called *Plantigrada*.

Others again walk on the tips of the toes, as it were, and these, the *Digitigrada*, are endowed with great swiftness of foot. The clavicle in both is merely a bony rudiment suspended in the flesh.

Cuvier divides his *Carnivora* into the four following tribes:—

1. *Plantigrades.*

These possess a great facility, from the structure of the sole, of rearing themselves up on the hind feet. Cuvier observes that they participate in the comparative slow motion and nocturnal life of the *Insectivora*, and that they are like them deprived of a cæcum. The greater part of those whose geographical distribution is confined to cold countries pass the winter in a dormant state. They have all five toes on each foot. [BEAR; BADGER.] The annexed cut will serve as an example of the dental form and arrangement.



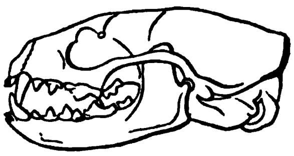
Skull of Common Badger (*Meles vulgaris.*)

2. *Digitigrades.*

This tribe is separated by Cuvier into two subdivisions:—

Subdivision *a.*

The animals composing this subdivision have been called Vermiform, from the comparatively great length and flexibility of their bodies and the shortness of their legs. Every one who has watched the serpentine movements of a ferret must have been struck with the great facility of motion given by this form, and its particular adaptation for passing through small openings and narrow burrows, and turning therein. Like the former families they have no cæcum, but unlike them they are not lethargic in winter. Though small they are of indomitable courage and ferocity, and literally most bloodthirsty, for the greater part of them live principally upon that fluid. The annexed cut will give an example of the general form of the skull and teeth.

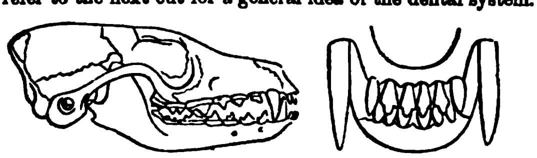


Skull of Polecat (*Putorius Zorilla*).

Subdivision *b.*

These have two flat tuberculated molars behind the upper great flesh-cutter, which has itself a sufficiently large heel or process. Many of these live upon carrion, and all have a small cæcum. [CANIS.]

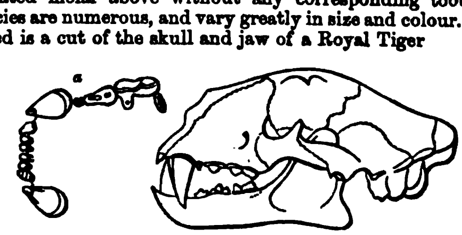
We refer to the next cut for a general idea of the dental system.



Skull of Common Fox (*Vulpes vulgaris*).

3. *Cats* (*Felidæ*).

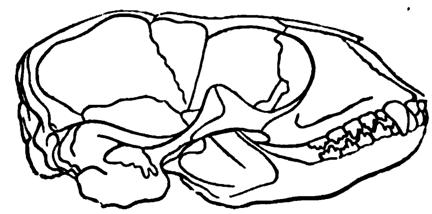
In this tribe we have the destructive power most highly developed. The short round muzzle, the abbreviated and powerful jaw, and the retractile claws sheathed by means of elastic ligaments when the animal is in a state of repose, so that they are kept sharp and ready for action, form with the rest of the organisation a destructive type of the highest order. All the Cats have two false molars above and two below; their upper flesh-cutter has three lobes and a blunt heel or process within; while the lower one has two pointed and cutting lobes, but without any heel or process; and they have but one small tuberculated molar above without any corresponding tooth below. The species are numerous, and vary greatly in size and colour. [FELIS.] Subjoined is a cut of the skull and jaw of a Royal Tiger



Skull of Royal Tiger (*Felis Tigris*). *a*, Teeth of upper jaw.

4. *Amphibia, or Amphibious Carnivora.*

Those who have seen a seal on the land will have noticed the comparative helplessness of the animal; for the short limbs enveloped in the skin only serve them by assisting their awkward shufflings when in that situation. But as they never come on the land excepting for the purposes of repose, basking in the sun, or suckling their young, their organisation is adapted to that element in which the great portion of their life is spent. The moment the Seal enters the water he is completely at his ease. Then the oar-like membranous hands and feet, or flippers, as some of our northern navigators not unaptly term them, the elongated body and moveable spine with its powerful muscular machinery, the narrow pelvis, and the close waterproof fur, afford, when taken together, a model for swimming. The annexed cut of the skull of a Common Seal will illustrate the general form and arrangement of the teeth. [PHOCIDÆ.]



Skull of Common Seal (*Calocephalus vitulinus*).

Fossil Carnivora.

Remains of the Mammiferous *Carnivora* are found abundantly in the Ossiferous caverns and Osseous Breccia. Those of a lion, a tiger [FELIS], bears, a glutton, a weasel, a wolf [CANIS], a fox, a dog, and hyænas, have been satisfactorily identified; but the bears, especially the great Cavern Bear (*Ursus Spelæus*) [BEAR], and the hyænas [HYÆNA] seem to have been predominant in many of the localities.

CAROB-TREE. [CERATONIA.]

CAROLINA PINK. [SPIGELIA.]

CARP. [CYPRINIDÆ.]

CARP-BREAM. [BREAM.]

CARPEL, a term applied to the fruits of plants. If the fruit of a pæony is examined it will be found to consist of two or more hollow bodies terminated by a stigma, and containing vegetable eggs or ovules; taken collectively these are called a Pistil, but each separate body is a Carpel. A carpel is a transformed leaf, with its edges brought into contact, united, and generating ovules at the inside of the suture, while its midrib is lengthened and distended as a stigma. If several carpels are arranged in the centre of a flower, they have exactly the same respective position as the same number of leaves would have; and their sutures and stigmas are placed in the same position as the united edges and distended points of so many leaves would be placed. Supposing these carpels to grow together by their sides, their sutures will then be, with the ovules that belong to them, in the centre of the body formed by such a union. When fruits or pistils are composed of several carpellary leaves, or carpels not united, they are called Apocarpous. When the carpels grow together, the pistil or fruit is said to be Syncarpous. (Schleiden, *Principles of Scientific Botany.*)

CARPHOLITE, a Mineral, a variety of *Prehnite* [PREHNITE], occurring in minute radiated stellate tufts, of a straw-yellow colour and silky lustre. It is brought from the tin-mines of Schlackenwald in Austria, with fluor-spar.

CARPHOSIDERITE, a yellow Phosphate of Iron, brought from Greenland. It occurs in reniform masses. (Dana, *Mineralogy.*)

CARPI'NUS, a genus of plants belonging to the natural order *Cupuliferæ*, and distinguished obviously from the Beech (*Betula*), the Oak (*Quercus*), &c., by its cupule being prolonged on one side into a leafy lobe, while its other lobes are shorter, and, as it were, abortive. *Ostrya*, the Hop Hornbeam, differs in having an inflated membranous cupule surrounding each nut. The following species are known:—

C. Betulus, Common Hornbeam. It is an indigenous British tree very common in copses, and frequently pollarded by the farmer. When allowed to acquire its natural appearance, it forms a graceful tree from 50 to 60 feet high, very often branching to within a short distance of the ground. In general appearance it resembles the Beech, but it does not acquire the smooth plump bole of that tree, nor are its leaves so shining. Its wood is coarse, and unfit for cabinet-makers' work, on account of the large size of its medullary processes; but it is tough, and well suited for cogs, handles of tools, and for other purposes in which strength is required. It is much consumed on the continent as fuel. Like the Beech, the Hornbeam, if stunted, retains its withered leaves all the winter; and as it bears clipping and close pruning remarkably well, it is much employed for hedges where winter shelter is required. The distinctive character of the Common Hornbeam is—leaves oblong, cordate, oblique at the base, doubly serrated, smooth, with the veins of the under side, which is very shining, downy at the axils. Lobes of the cupules nearly entire. A cut-leaved variety is known in gardens.

C. Americana, American Hornbeam. It has ovate oblong leaves, obliquely cordate at the base, doubly or almost simply serrated, smooth, with the veins of the under side downy at the axils. Lobes of the cupules somewhat falcate and serrated. Common from Lower Canada to the Carolinas, and extremely frequent in almost all soils except pine-barrens and swamps. It is a smaller tree than the European Hornbeam, not usually acquiring a greater height than 15 to 20 feet, although specimens have been found as much as 30 feet high. From the small size of this species it is little used by the Americans: its wood appears however to have the same properties as that of *C. Betulus.*

C. orientalis, Oriental Hornbeam. It has oblong doubly-serrated cordate leaves, and very little oblique at the base; when young, rather downy: lobes of the cupules coarsely and unequally serrated. It is a bushy tree of small stature, found in the eastern parts of Europe and on the mountains of Caucasus. It is of no known use, and principally differs from the Common Hornbeam in its downy leafstalks and green much-lacerated cupules. It is the *C. duinensis* of Scopoli.

C. viminea is related to the last, but has taper-pointed leaves with simple or nearly simple serratures, and less deeply serrated lobes to the cupules. It is a large handsome tree with weeping branches, found on the mountains of Nepaul.

C. faginea, from the same country, is distinguished from the last by its woolly leafstalks and simply setaceo-serrated leaves, which are but little acuminated.

CARPOLOGY is a division of Botany comprehending what relates to the structure of seeds and their seed-vessels, or what is commonly called fruit. The subject is usually treated of incidentally in all elementary botanical works; and with much care by Mirbel in his 'Élémens de Botanique;' Lindley, in his 'Introduction to Botany;' and especially by Schleiden in his 'Principles of Scientific Botany.' [FRUIT.]

CARRAGEEN MOSS. [ALGÆ.]

CARRION-CROW. [CORVIDÆ.]

CARROT. [DAUCUS.]

CARR-SWALLOW, a name for the Black Tern (*Sterna fissipes*). [STERNIDÆ.]

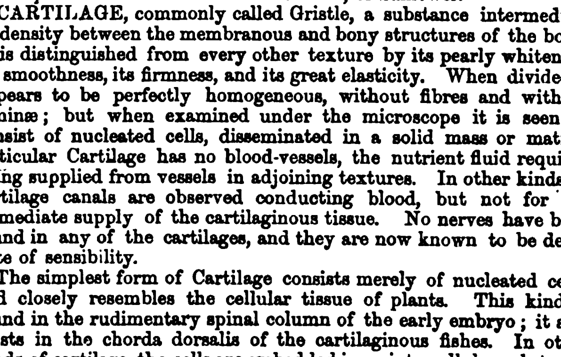
CARTER, a Cornish name for the Whiff, a fish belonging to the genus *Rhombus.* [PLEURONECTIDÆ.]

CA'RTHAMUS, a genus of plants belonging to the natural order *Compositæ. C. tinctorius,* the Safflower, is a pretty annual plant, found wild in Egypt and the Levant. It has an erect cylindrical stem, branching near the summit, a foot or two high, and furnished with sharp-pointed, oval, sessile, somewhat spiny leaves. The flowers grow in heads, inclosed in a roundish spiny involucre; the florets are of an orange-yellow, becoming red when dried. These latter contain a colouring principle called Carthamite, which is employed by dyers as the source of some of the more delicate rose-colours, and the rich scarlet called Ponceau; it also constitutes the basis of the cosmetic known by the name of Rouge.

The dried flowers of *Carthamus* are exported in great quantities from Egypt, and are very like saffron to the eye, on which account they have been employed to adulterate that drug, and the plant itself has acquired the name of Bastard Saffron, or Safflower.

CARTILAGE, commonly called Gristle, a substance intermediate in density between the membranous and bony structures of the body. It is distinguished from every other texture by its pearly whiteness, its smoothness, its firmness, and its great elasticity. When divided it appears to be perfectly homogeneous, without fibres and without laminæ; but when examined under the microscope it is seen to consist of nucleated cells, disseminated in a solid mass or matrix. Articular Cartilage has no blood-vessels, the nutrient fluid required being supplied from vessels in adjoining textures. In other kinds of cartilage canals are observed conducting blood, but not for the immediate supply of the cartilaginous tissue. No nerves have been found in any of the cartilages, and they are now known to be destitute of sensibility.

The simplest form of Cartilage consists merely of nucleated cells, and closely resembles the cellular tissue of plants. This kind is found in the rudimentary spinal column of the early embryo; it also exists in the chorda dorsalis of the cartilaginous fishes. In other kinds of cartilage the cells are embedded in an intercellular substance, presenting certain varieties of appearance.

A  B

Articular Cartilage from the head of the humerus. Vertical sections. A, section close to the surface; B, section far in the interior.

In Articular Cartilage the cells are oval or roundish, dispersed in groups through a nearly homogeneous intercellular substance. The cells measure from the 1300th to the 900th of an inch in diameter. In the interior part of the incrusting cartilages the cells usually assume a more or less linear arrangement. In the different cartilages the cells vary in size and form.

Ordinary permanent cartilage contains about three-fifths of its weight of water and becomes transparent when dried. It is resolved into chondrin by boiling. Cartilage contains a certain amount of mineral matters. Frommherz and Gugert obtained 3·4 per cent. of ashes. When analysed these ashes were found to consist of—

Carbonate of Soda	35·07
Sulphate of Soda	24·24
Chloride of Sodium	8·23
Phosphate of Soda	0·92
Sulphate of Potash	1·20
Carbonate of Lime	18·37
Phosphate of Lime	4·06
Phosphate of Magnesia	6·91
Oxide of Iron, and loss	1·00

The vital processes are carried on very slowly in cartilage. It is subject to absorption, and when thus removed by disease or when taken away by operation it is not again renewed. When fractured or broken the union is not effected by new cartilage, but by fibrous or areolar tissue, or bone.

Cartilage is not only closely allied to bone in the mechanical arrangement of its component fibres and in its chemical composition, but it sometimes supplies the place of bone, as in the fœtus and in young persons. Cartilages of this class, which regularly disappear as ossification advances, are called Temporary, in contradistinction to the Permanent, which remain during all periods of life. Permanent Cartilages either cover the extremities of the bones in the moveable joints or articulations, and are thence called Articular; or are attached to the extremities of the ribs, and are thence termed Costal. The Articular Cartilage consists of a layer of the same shape as the extremity of the bone which it covers, varying in thickness from one or two lines to the fraction of a line, and over its external or free surface there is always reflected a fine and delicate membrane, termed the synovial, which secretes the fluid by which the joint is lubricated and its free and easy motion secured, denominated synovia, or joint oil.

The Costal Cartilages, which are cartilaginous productions of the osseous ribs, are much larger and thicker than the Articular, assist in the formation of the thoracic cavity, and perform a very important part in the function of respiration.

The distinctive property of this peculiar form of organised matter, to which the name of Cartilage has been given, is elasticity, on which depends the specific use of this substance in the economy. It is mainly an adjunct to bones, counteracting certain evils which, but for the intervention of some substance of this kind, must necessarily have resulted from the hard unyielding nature of the osseous fibres. Covering the extremities of bones, or interposed between layers of bony fibres, without in the least diminishing the firmness and strength of the osseous fibres, it enables the bones to yield in the shocks to which the body is exposed in the ever-varying movements of the frame; defends them from fracture and displacement; and at the same time protects the great centres of the nervous system, the spinal cord and brain, from the concussions and jars to which these tender and delicate organs would, but for its interposition, have been constantly exposed.

(Quain's *Elements of Anatomy,* by Sharpey; Carpenter, *Principles of Physiology;* Simon, *Animal Chemistry;* Schwann, *On the Accordance in the Structure of Animals and Plants;* Kölliker, *Handbuch der Gewebelehre.*)

CARUM (from Caria in Asia Minor, where the plant was originally found), a genus of plants belonging to the natural order *Umbelliferæ,* to the sub-order *Orthospermeæ,* and to the tribe *Ammineæ.* It has an obsolete calyx, obcordate petals, with a narrow acute inflexed point, oblong fruit, carpels with five filiform ridges, interstices with single vittæ, a depressed stylopodium. The species are glabrous herbs, with perennial tuberous edible roots, pinnate leaves, and white flowers.

C. Carui, Common Caraway, has a fusiform root, bipinnate leaves, leaflets cut into linear segments, no partial involucre, the general involucre absent or of only one leaf. It is a native throughout the whole of Europe in meadows and pastures. It is found in Great Britain, but can only be regarded as a naturalised plant. The fruit of this plant is known in shops by the name of caraway seeds. [CARUM CARUI, in ARTS AND SC. DIV.] The leaves of this plant are frequently used in spring to put in soups, and the roots are boiled and eaten as parsnips, to which some persons prefer them.

Several varieties have been described by botanists. One of these is the American species *C. C. elongatum,* which has the segments of the leaves linear elongated.

C. verticillatum has the general and partial involucres of many leaves, the leaves pinnate, and the leaflets linear. The segments of the leaflets spread in such a way as to appear whorled; hence the trivial name. It is a native of the western parts of Europe. In Great Britain and Ireland it occurs as a rare plant in damp hilly pastures.

C. bulbocastanum of Koch, is the *Bunium bulbocastanum* of Linnæus. [BUNIUM.] It is the *Scandix* and *Sium bulbocastanum* of Sprengel and Moench. Babington, in his 'Manual,' has restored the Linnæan species. (Babington, *Manual of British Botany*.)

CARU'NCULA, a name applied by botanists to protuberances found occasionally surrounding the hilum of a seed. It is sometimes also called a Strophiloa. Parts of this kind occur on the seeds of *Euphorbia Lathyris*.

CA'RYA, a genus of plants belonging to the natural order *Juglandaceæ*. The species are North American trees, comprehending the various kinds of Hickory. This genus was formerly combined with *Juglans*, or the true Walnut; but it is distinguished by the shell of its nuts not being deeply furrowed, and by the catkins of the male flowers growing in threes. This must not be confounded with *Careya*, a genus of Indian *Myrtaceæ*.

Several species of Hickory are recognised by botanists; but, according to Michaux, the timber of all of them is so similar in quality that it is impossible to distinguish it. The bark of the Hickory is in all cases remarkable for the lozenge-shaped arrangement of its woody tissue. The wood is coarse-grained, very heavy, exceedingly tough and strong, and red at the heart; but on the other hand it decays quickly when exposed to the weather, and it is subject to be attacked by worms. It is on these accounts chiefly employed for the shafts and springs of carriages, for large screws, such as those of bookbinders' presses, for bows, chair-backs, whip-handles, wooden-cogged wheels, hoops for casks, and a variety of similar purposes. When burnt, hickory-wood consumes slowly, gives out a great heat, and forms a heavy coal, which remains glowing for a long while. It is considered to be upon the whole the best of all woods for fuel: it has however the fault of crackling and scattering about its sparks.

C. olivæformis, the Pecan or Pecana Nut (*Juglans angustifolia*, 'Hortus Kewensis'). This is a swamp species, with a slender stem, sometimes as much as 70 feet high. Its leaves are a foot to 18 inches long; their stalks are downy; the leaflets, which are 2 or 3 inches long, or as much as 5 inches on very strong shoots, are taper-pointed and firmly serrated. Their nuts are oblong, very smooth, angular in only a slight degree, about 1½ inch long, and thinner shelled than the other sorts. The kernel is good to eat, and by far the best of the hickories; on this account the nuts are a small article of North American trade. The Pecan Nut is found in Upper Louisiana and New Orleans. It is common on the banks of rivers in Missouri, Illinois, and Arkansas. It does not occur, except in straggling specimens, more than 200 miles above the mouth of the Ohio.

C. sulcata (*Juglans laciniosa*, Michaux), Thick-Shell-Bark Hickory, Springfield or Gloucester Nut, is very common in all the low grounds, adjoining the Ohio and its tributaries, where, along with three-thorned gleditschias, black walnuts, Virginian bird-cherries, American elms, planes, and different species of *Acer*, it forms dense forests; it is seldom found west of the Alleghanies. Its trunk is as much as 80 feet high, on which it has a noble spreading head. Its bark, like that of some of the other hickories, strips off in ribands from 1 to 3 feet long, which separate at their extremities and curl backwards, finally adhering to the trunk only by their middle. The leaves vary in length from 8 to 20 inches; in form they are very like those of *C. alba*, but they usually have six or eight leaflets instead of four, which is the invariable number in that species. The nuts are oblong, sharp-pointed at each end, with four elevated angles, and a thick shell of a yellowish-brown colour, not white as in *C. alba*. They are brought to market in North America under some of the names mentioned above.

C. alba (*Juglans squamosa*, Michaux), White-Shell-Bark, Shag-Bark, Scaly-Bark Hickory. The shaggy appearance of the bark adverted to in speaking of the last species has caused the above names to be applied to this common species. It extends from South Carolina to the neighbourhood of Portland in the state of New Hampshire, where it is said to disappear. It is the most slender-stemmed of all the hickories, its trunk being sometimes 80 or 90 feet high and not more than 2 feet in diameter, and is described as a magnificent tree in its native forests. The young buds are woody, and slightly orange-coloured. The leaves are often 20 inches long; they have only four leaflets and an odd one, which are smooth and bright green above, finely downy on the under side, and serrated at the edge. The nuts are whitish, nearly round, hardly pointed at each end, angular, compressed, thick-shelled, remarkably small in proportion to the size of the fruit with its fleshy rind upon it. The kernel is next in quality to that of the Pecan Nut. They form a common article of market commerce.

C. tomentosa, Mocker-Nut Hickory, so called in consequence of the smallness of the kernel compared with the size of the nut. Its leaflets are from 7 to 9 in number, slightly round, very downy on the under side; they become bright-yellow in the autumn. The leaf-buds are thick, short, whitish-gray, and very hard in the winter season. The nuts are sessile, roundish, and inclosed in a rind which only opens half-way to let them drop out; they are light-brown, angular, and very little pointed. The bark of this species does not scale off, but rends into deep fissures. It grows the slowest of all the hickories, and is found chiefly in forests from New England to Virginia and in the Alleghanies; Pursh says in fertile soils, but Michaux adds that it nevertheless is the only hickory which makes its appearance in those sterile tracts called pine-barrens, where however it is only a scrubby bush. In the most favourable situations it rarely grows more than 60 feet high, and is usually a gnarled inelegant tree. Nuttall mentions a variety of this species as occurring a few miles from Philadelphia, with "fruit nearly twice the ordinary size, as large as an apple."

C. microcarpa. Leaflets about five, oblong-lanceolate, sharply serrate, and obviously tapered to the point; smooth on each side, glandular beneath. Fruit roundish, with a small thin-shelled nut, which is somewhat quadrangular and abruptly rounded at the end, with a very small point. According to Nuttall this is found wild on the banks of the Schuylkill, in the vicinity of Philadelphia, where it forms a large tree with an even bark. The fruit is much like that of *C. tomentosa*, and eatable, but very small, not exceeding the size of a nutmeg.

C. amara, Bitter Nut, or Swamp Hickory; found from the state of Vermont in the north, as far as the most southern parts of the American Union. In woods near New York, Michaux measured several individuals which were 10 or 12 feet in circumference, and from 70 to 80 feet high; but in general it is smaller. It is the latest in leafing of all the hickories. The leaflets are from 7 to 9 in number, smooth, coarsely and irregularly serrated, long, lanceolate, and more wrinkled than in other species. The fruit is small, roundish, with a thin rind; the nuts are obovate, depressed at the end, with a central projecting point; they have no angles, and are broader than they are long; the shell is thin and brittle, and the kernel so bitter and austere that even squirrels refuse to eat it. This species is easily known in winter by its yellow buds.

C. aquatica, found only in the lower parts of the southern states of the American Union, in swamps, and by the side of ditches surrounding rice-fields, along with red maples, deciduous cypresses, and Carolina poplars. It is readily known by its very narrow taper-pointed leaflets, which vary in number from 9 to 11. Its fruit is small, ovate, tuberculated, angular, and placed upon stalks in little clusters. The nuts are bright brown, ovate, angular, but little pointed at either end; they are very thin-shelled, and contain an extremely little kernel. The tree grows from 40 to 50 feet high, and is of much less value than the other species.

C. porcina, the Pig-Nut Hickory, or Hog-Nut. This is most common in the middle states, beginning with Lancaster County, Pennsylvania, in the north. It is one of the largest trees in the United States, growing to the height of 70 or 80 feet, with a diameter of 3 or 4 feet. Its brown shoots and oval very small buds distinguish it in winter. The leaflets are lanceolate, very taper-pointed, regularly serrated, and from 3 to 7 in number; they are quite smooth on each side, and on vigorous shoots in shady places their stalks are violet. The fruit is sessile, and varies in form from pyriform to spherical: its little nuts correspond in this respect with their rind; they are scarcely at all angular, and always rounded at the apex, with a sharp point; the shell is very thick and hard; the kernel sweet but small, and difficult to extract.

C. myristicæformis, Nutmeg Hickory. This is a little brown species, of which Michaux obtained a single branch with about 30 nuts at Charlestown from a negro gardener, who procured them in the neighbourhood of that city. Its leaves are like those of *C. aquatica*, but not quite so long and narrow. The fruit is sessile, oval, tuberculated, and contains a small smooth brown striated nut, with an exceedingly thick shell, and a very small kernel. Elliott, who resided near Charlestown, and wrote on the plants of Carolina, could never gain any further intelligence of this plant.

(Michaux, *Arbres Forestiers de l'Amérique Septentrionale*.)

CARYO'CAR, the only genus of the natural order *Rhizobolaceæ*, one of whose species yields the Butter-Nuts of the London fruiterers' shops. One species is described by Aublet, under the name of *Pekea butyrosa*, as a large tree with a trunk 80 feet high, and 3 feet in diameter. The berries are covered by a rind two or three lines thick, and consisting internally of a buttery yellowish substance, which melts between the fingers, and which is sometimes used in cooking instead of animal butter. Under the rind lies a stone covered all over with slender stings, which easily separate, and become very troublesome to those who open the stones; within is a kidney-shaped kernel covered with a brownish membrane, and very good to eat; it is commonly served at table. It is called Pekea by the blacks in the neighbourhood of Oyapoco in French Guyana, where it is much cultivated. The species that furnishes the Butter-Nuts of the London markets is much like this, but is called Tata-youba by the natives of Guyana, and differs in having no stings upon the surface of the stone of its fruit: this is the *Pekea tuberculosa* of Aublet; the *Caryocar tomentosum* of modern botanists.

Another species, the *Caryocar nuciferum*, bears what are called the Suwarrow, or more properly Saouari, Nuts of commerce. It has only three leaflets to each leaf, each with a toothed margin and a taper-pointed extremity; the flowers are very large, deep brown externally and rich crimson in the inside; the fruit is in form like an egg, covered with a thick rough brown rind, beneath which is a soft greenish buttery substance. The nut has a stinging surface, and contains a very excellent kernel, from which may be extracted an oil like that from sweet almonds.

CARYOCATACTES. [NUCIFRAGA.]

CARYO'CRINITES, a genus of *Crinoidea*, from the Palæozoic Limestone of North America.

CARYOPHYLLA'CEÆ, *Cloveworts*, the Pink Tribe, a natural order of plants, the type of which may be considered the *Dianthus caryophyllus*, or Common Garden Pink. It consists of plants having narrow opposite undivided leaves, arising from tumours at the articulations of the stem; flowers with a definite number of hypogynous stamens; a fruit with a central placenta, and seeds that usually have the embryo rolled round mealy albumen. The species are in many cases mere weeds. In no instances have they properties of any importance, being mostly inert; but are occasionally objects of cultivation on account of their pretty flowers, as is the case in the whole genus *Dianthus*, and in several species of *Silene*, *Agrostemma*, *Lychnis*, and *Saponaria*. The order has always been divided into two parts, one of which has the sepals combined into a tube, and the other the sepals wholly distinct: Dr. Lindley at one time regarded these as distinct natural orders, the former constituting *Silenaceæ*, the latter *Alsinaceæ*. Of these the last-mentioned is very near *Illecebraceæ*, and formerly contained species that are now known to belong to that order. The other members of this family have relations with *Malvaceæ* and *Geraniaceæ*. The most important application of any of the species is the use of *Saponaria*, Soapwort, for washing. The order contains 43 genera and upwards of 1000 species. [LYCHNIS; SAPONARIA; SILENE; STELLARIA; SPERGULA.]

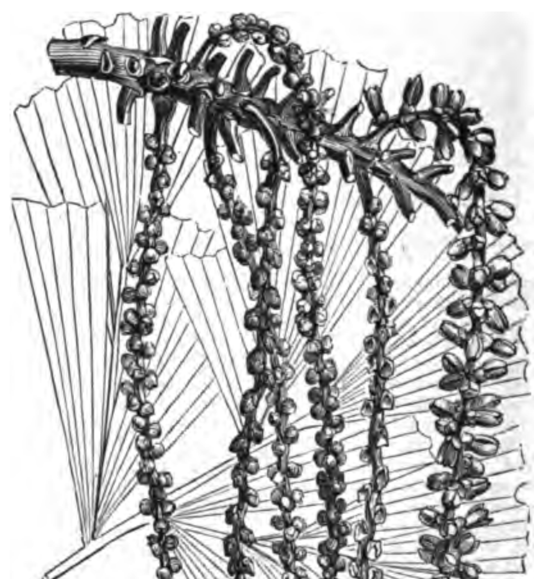
Lychnis grandiflora.

1, Unexpanded flower; 2, calyx; 3, pistil and stamens; 4, a petal, with stamen attached; 5, anther impregnated; 6, a back view of the same; 7, fruit, with calyx remaining after impregnation; 8, the same without the calyx, and as it opens when mature; 9, the same cut horizontally.

CARYO'PHYLLIA, a genus of Corals of the section *Madrephylliæa* of De Blainville. [MADREPHYLLIÆA.]

CARYO'TA, a genus of plants belonging to the natural order of Palms. It has pinnated leaves and wedge-shaped leaflets, strongly toothed at the extremity; monœcious polyandrous flowers; a somewhat peltate stigma; and a 1- or 2-seeded pulpy fruit, with the embryo near the point of the albumen. The best known species, *Caryota urens*, is a native of most of the tropical parts of Asia, especially in mountainous situations, where, according to Roxburgh, it grows to be one of the largest of the Palm Tribe. Its trunk is described as being 60 feet high, thick in proportion, and slightly marked with annular scars, produced by the fall of its leaves. Its wood is so hard as to be cut with some difficulty, and is consequently of considerable value, provided the soft sap-wood in the centre is scraped away. Its leaves are pinnate, the leaflets obliquely triangular, the apex of the triangle being the point where they are attached to the stalk; their end is irregularly toothed, as if bitten or gnawed by an animal (technically præmorse); and their general appearance is on this account so remarkable that Rumf compares them not inaptly to the fin of a fish. The mass of flowers (spadix) is said to be from 6 to 16 feet long, divided into many simple branches, which are pretty thickly covered with innumerable sessile flowers. The fruit is called a berry, 1-celled, roundish, about the size of a plum, with a thin yellow rind, so acrid that it produces a severe sensation of burning if applied to the skin; and hence its name, *urens*. It is generally stated, apparently upon the authority of Rumf, that this noble species


Caryota urens.


Caryota urens. A portion of the spadix.

of palm yields no sap fit for manufacture into wine, and that the sago obtained from the soft central part of its stem is of such inferior quality as only to be employed in times of famine. Roxburgh however gives a very different account of it. He says:—"This tree is highly valuable to the natives of the countries where it grows in plenty; it yields them during the hot season an immense quantity of toddy, or palm-wine. I have been informed that the best trees will yield at the rate of 100 pints in the 24 hours. The pith, or farinaceous part, of the trunk of old trees is said to be equal to the best sago; the natives make it into bread, and boil it into thick gruel. I have reason to believe this substance to be highly nutritious. I have eaten the gruel, and think it fully as palatable as that obtained from the Malay countries." This remarkable tree is not uncommon in this country in hot-houses where palms are cultivated.

CASCARILLA, an aromatic bark yielded by more than one species of *Croton*, a genus of plants belonging to the natural order *Euphorbiaceæ*. [CROTON.]

CASEARIA, one of the five genera of plants constituting the natural order *Samydaceæ*. Several of the species are used medicinally. The leaves of *C. ulmifolia* are astringent, and in the Brazils are applied to recent wounds. A decoction of the leaves of *C. lingua*, called by the Brazilians Cha de Frade and Lingua de Fin, is used in fevers and inflammatory disorders. *C. astringens* is used as an external application on account of its astringent properties. *C. Anavinga*, an Indian species, is bitter. The leaves of *C. esculenta* are eaten, but the root is bitter and purgative. (Lindley, *Vegetable Kingdom*.)

CASHEW-NUT. [ANACARDIACEÆ.]

CASSA'VA, or Manioc, a nutritious fecula obtained from the roots of *Jatropha* or *Janipha Manihot*, and some allied species. This plant belongs to the natural order *Euphorbiaceæ*, and abounds in a highly poisonous juice, which contains Hydrocyanic or Prussic Acid, so that very small doses produce the most dangerous consequences. The acid however is easily driven off by heat, and consequently there is no practical difficulty in procuring the nutritious substance in a pure state. In order to effect this the roots are peeled, well washed, and then ground between millstones till they are reduced to the state of paste. This is subjected to pressure for the purpose of depriving it as far as possible of the juice; the residue is placed in vessels over a brisk and regular fire, and continually stirred until it becomes dry; it then acquires a granular appearance, is gradually cooled, and afterwards packed in barrels, when it may be preserved for a great length of time. Half a pound of this substance daily is said to be sufficient to support a vigorous man. Tapioca is a preparation of Cassava, but contains less nutritive matter. Tapioca consists almost entirely of starch.

CA'SSIA (from the Greek κασσία), a genus of plants belonging to the natural order *Leguminosæ*. It consists of a large number of species, chiefly inhabiting the tropical or temperate parts of the world, and including among them the plants that produce the Senna leaves so commonly employed as a purgative. The genus *Cassia* belongs to the sub-order *Cæsalpinieæ* of *Leguminosæ*, and is characterised by De Candolle as follows:—Calyx consisting of five sepals which scarcely adhere at their base, but are more or less irregular. Petals five, unequal in size; stamens ten, distinct from each other; the three lowest being the longest, the four intermediate ones shorter and straight, and the three uppermost deformed; such of the anthers as are perfect open at the point; ovary stalked, usually curved; legume variable in form; the species consist of trees, shrubs, or mere herbs; the leaves are simply and abruptly pinnated, and usually bear glands on their stalks; the leaflets are opposite each other. Between 200 and 300 species are described by botanists.

C. acutifolia, a small under-shrub, with ovate lanceolate sharp-pointed leaflets, yellow flowers in terminal erect racemes, and compressed velvety legumes an inch long and half an inch broad. It is found wild in Egypt, Sennaar, and Abyssinia, and forms an important article in the commerce of those countries. It is chiefly sent to Alexandria for shipment, whence it has gained the name of Alexandrian Senna among the drug-merchants. It is considered the most valuable of all the sennas.

C. obovata, Aleppo Senna, has obovate very-blunt leaflets, and curved pods, with a very slight covering of down. The flowers are pale yellow. It is common in the same countries as the last, and mixed with it in commerce; it however chiefly constitutes the Aleppo Senna.

C. lanceolata. Leaflets very narrow and acute; pods plano-compressed, straightish, a little tumid in the middle. Found wild in Arabia, whence it is exported under the name of Senna of Mecca. It is a good deal cultivated in India, on which account, and from its being usually shipped for Europe from Indian ports, it has acquired the name of East Indian Senna in the market. As a species it appears to differ very little if at all from *C. acutifolia*.

Of the different species of *Cassia* mentioned above only the leaves are used in medicine. *C. Fistula* and other species are now referred to *Cathartocarpus*. [CATHARTOCARPUS.]

The leaflets of several different species of *Cassia* belonging to the section Senna constitute the various kinds of Senna called Senna leaves. In addition to the leaflets, the leaf-stalks and pods are frequently present, especially in the Alexandrian Senna, which contains also the leaves and pods of *Tephrosia Apollinea*, and the leaves, but rarely the follicles, of *Cynanchum Arghel*, Delile (*C. oleæfolium*, Nectoux), a plant belonging to the natural order *Apocynaceæ*, which possesses deleterious properties. The leaves of this last-named plant constitute two parts in ten of the Senna of Alexandria. The Tripoli Senna is free from it, as is likewise the Trinivelly Senna, which is now the best and cheapest in the markets of this country, and should always be preferred, as much of the griping tendency of common Senna is due to the presence of the Argel leaves. The Senna Leaves met with in the continental markets or shops are frequently adulterated with the leaves and berries of the *Coriaria myrtifolia*, a very poisonous plant.

When free from adulterations, Senna furnishes a most valuable purgative medicine; but when impure, its action is accompanied with nausea, griping, and other unpleasant symptoms. It is desirable therefore to free it from impurities before administering it or subjecting it to the action of water to form an infusion. [SENNA, in ARTS AND SC. DIV.]

CASSIA BUDS. The unexpanded flowers, when they have attained about a fourth of their complete size, of a species of *Cinnamomum*, are collected and sold under this name. Much diversity of opinion exists respecting the particular species of plant which yields this article. Professor C. G. Nees von Esenbeck (who is perhaps the best authority) says it is chiefly *C. aromaticum* (Nees), and partially *C. dulce* (Nees), *Laurus dulcis* (Roxb.), *Cinnamomum Chinense* (Blum.); while Dr. Th. Fr. Ludwig Nees von Esenbeck ascribes it to *Laurus Tamala* (Hamilton, 'Linn. Trans.' xiii. p. 556, the *L. Cassia*, 'Hort. Beng.'), and Dierbach to the *L. Cubeba* (Lour.), which last supposition is at variance with the statement of Louriero ('Flora Cochinensis,' p. 310), respecting the action of the berries of that species.

Cassia Buds have the appearance of nails with heads of different sizes and shapes, according to the period of growth when collected. But an artificial process is employed by the Chinese collectors, of pressing the top against a flat hard body, by which the ovary or fruit is prevented falling out. Externally they are of a dark or grayish-brown; the fruit, which is within, is of a bright brown. The taste and odour resemble cinnamon. By distillation they yield a heavy yellowish-coloured oil. It was at one time supposed that an inferior sort, nearly devoid of taste, which is met with in commerce, was the genuine, which had been previously deprived of its oil; but Martius showed that this was a spurious kind, which is distinguished from the true by having the upper part of the calyx marked by six slits or incisions. It is moreover not so round as the true sort, and is furnished with a longer foot-stalk. It should be remembered that the term *Cassia* used here has no relation to the genus which yields the Sennas of commerce. [CASSIA.]

The uses of Cassia Buds are the same as those of cinnamon and cloves.

CA'SSICUS, a genus of Passerine Birds, of the family *Conirostres*, allied to the Beef-Eaters and Starlings. They are distinguished, among other characters, by their large, conical, and sharply pointed beaks. The species of *Cassicus* are all inhabitants of America. They are gregarious, and feed upon grain and insects.

CA'SSIDA, a genus of Coleopterous Insects of the family *Cassidiadæ*. It has the following characters:—Body generally somewhat oval or orbicular, and sometimes nearly square: thorax semicircular or forming the segment of a circle, the margins projecting considerably beyond and covering the head; the elytra also have the margins projecting, and forming as it were a kind of shield to the body; mandibles with several small notches; the exterior maxillary lobe as long as the inner one. [CYCLICA.]

CASSIDI'ADÆ, Leach (*Cassidariæ*, Latreille), a family of Coleopterous Insects of the section *Cyclica* of Latreille. [CYCLICA.]

The species of this family are distinguished by their having the antennæ rather short, filiform or slightly thickened towards the apex, placed on the anterior part of the head, and almost close together. The legs are short and contractile; the tarsi are flattened, soft, and velvet-like beneath; the penultimate joint bilobed, the lobes completely inclosing the terminal joint; body generally very flat.

CASSOWARY. [STRUTHIONIDÆ.]

CASTA'NEA, a genus of plants belonging to the natural order *Corylaceæ*, one of the species is the Sweet Chestnut. From the similarity in their name one would be disposed to believe that the genus to which Horse-Chestnuts belong was nearly related to this; they are however extremely different in everything except the unimportant circumstances of the fruit of both being prickly; and even in regard to this, their resemblance is more apparent than real, for the prickly part of the fruit of *Castanea* is an involucre, while that of the Horse-Chestnut is a pericarp; and the so-called seeds of *Castanea* are seed-vessels, while the parts which in the Horse-Chestnut correspond with these are really seeds. [ÆSCULUS.]

C. vesca (*C. vulgaris*, Lam.), the Sweet Chestnut, or Spanish Chestnut, is a deciduous tree of considerable size, with long shining serrated sharp-pointed leaves, clusters of long spikes of pale greenish-yellow unisexual minute flowers, having no corolla, and fruits consisting of a roundish prickly husk or involucre, technically called a cupula, and analogous to the cup of the acorn or the beard of the filbert, in which are contained one or more dark-brown ovate sharp-pointed nuts, each of which conceals a large single seed, and is tipped by the remains of several rigid styles. The seeds contain a large quantity of nutritive starchy matter, of a sweet flavour, on which account Chestnuts are extensively used as food in the countries where the tree abounds. In all Spain, the southern parts of France, Italy, and the adjacent countries, Sweet Chestnuts, either raw, or roasted, or ground into flour, or prepared in some other way, form a common article of diet. It is however not the wild *Castanea* which furnishes the nuts that are principally consumed in the south of Europe, and exclusively exported to more northern countries, but a number of cultivated varieties, the nuts of which are larger, and the seeds sweeter; of these the most remarkable are the Corive, the Ganiaude, the Egalade, and the Marron Cornu of the south of France. The Sweet Chestnut is a native of all the southern parts of Europe, extending eastward to the Caucasus, beyond which it hardly passes in Asia. In North America it occurs wild in great abundance in the hilly and mountainous parts of Virginia, the two Carolinas, and Georgia, as well as other districts, not however reaching beyond New Hampshire to the north. Michaux distinguishes the American from the European Chestnut as a peculiar species, but hardly upon sufficient grounds. It is always included as a wild plant in our English Floras, but upon no sort of authority. It is said indeed that its timber forms a considerable part of our oldest buildings, and that it has been ascertained to be the material out of which were constructed the ancient piles that have from time to time been taken from the Thames, the roof of Westminster Abbey, the church of St. Nicholas at Great Yarmouth, erected in the reign of William Rufus, and the timbers of other places; but these statements have arisen from the singular mistake of confounding the timber of *Quercus sessiliflora* with that of *Castanea vesca;* it is to the former that are to be referred all the supposed cases of ancient chestnut wood found in English buildings. [QUERCUS.] The Sweet Chestnut in its wild state acquires an unusual size. On Ætna, where it constitutes forests, there are trees of great antiquity, one of which, called the Hundred-Horse Chestnut, from its being able to contain a hundred mounted men in its hollow, has or had a circumference of above 160 feet; and in the department of the Cher, near Sancerre, there is still standing a tree of this species, which at 6 feet from the ground measures more than 30 feet in circumference, and is to all appearance still sound. It is stated that 600 years ago this was called the Great Chestnut-Tree, and its actual age is computed at 1000 years. The wood of the chestnut is well suited for paling or piles, as it resists well the influence of water; it is also used for mill-timber and for water-works, but it is not in this country of much importance.

Several varieties are cultivated in this country, among which are a shining-leaved, a variegated, and a cut-leaved sort; they are multiplied by grafting on the common Sweet Chestnut.

C. pumila, the Chinquapin-Nut, is a shrub rather than a tree, with leaves hoary on the underside, and small sweet nuts. It is a native of the United States of North America, especially in damp mountainous situations on a gravelly soil.

There are other species in India and on the west coast of North America.

CASTANOSPE'RMUM, a genus of plants belonging to the natural order *Leguminosæ*. The only known species of this genus is described as forming a tree from 30 to 40 feet high in the forests near Moreton Bay in Australia. It has unequally-pinnated leaves, with elliptical ovate acuminate entire smooth leaflets. The flowers are papilionaceous, and bright saffron-yellow. The pods are large, solitary, and pendulous, produced by the two-years'-old wood, obtuse, rather inflated, and containing from 3 to 5 large chestnut-like seeds. The shade afforded by the foliage is said to excel that of most Australian trees. By the natives the seeds are eaten on all occasions: they have when roasted the flavour of a Spanish chestnut, and travellers assert that Europeans who have subsisted upon them have experienced no other unpleasant effect than a slight pain in the bowels, and that only when the seeds are eaten raw. They are however hard, astringent, and not at all better than acorns. (Hooker, *Botanical Miscellany.*)

CA'STNIA, a genus of Lepidopterous Insects.

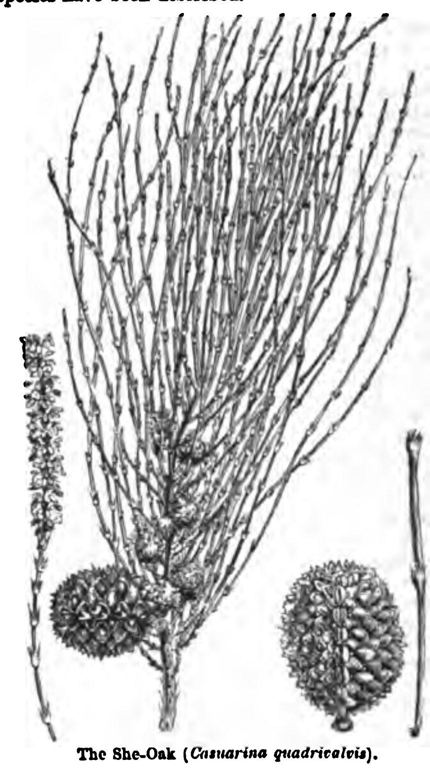
CASTOR. [BEAVER.]

CASTOR, a colourless, transparent, feldspar-like mineral from Elba. Its hardness is 6·5 and specific gravity 2·38 to 2·4. It has the following composition:—

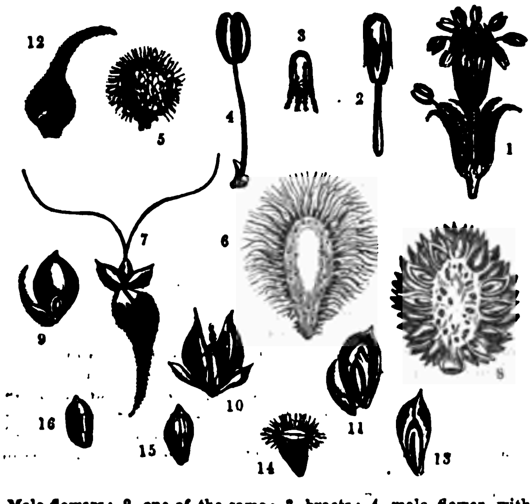
Silica	78·0
Alumina	18·9
Oxides of Iron and Manganese	1·6
Lithia, Potash, and Soda	2·8

CASTOREUM. [BEAVER.]

CASUARINA'CEÆ, a natural order of Incomplete Exogens, whose branches are in all cases long, drooping, green, and wiry, with very small scale-like sheaths, in the room of leaves. The flowers are unisexual, and disposed in verticillate spikes; they have neither calyx nor corolla, are monandrous, and their ovaries are lenticular, with a solitary erect ovule. The fruit consists of hardened bracts, inclosing the small fruits, which are winged. This very small family, which is exclusively Asiatic, Australasian, and Polynesian, is allied to *Myricaceæ* and *Betulaceæ*. In habit and in their striated stems *Casuarinaceæ* are like the arborescent species of *Equisetum*. The timber of some species forms the Beef-Wood of the New South Wales colonists, and is of excellent quality. The young branches and cones of *Casuarina quadrivalvis*, the She-Oak, when chewed yield a pleasant acid. Cattle are said to be fond of them. The only genus is *Casuarina*, of which about 20 species have been described.



The She-Oak (*Casuarina quadrivalvis*).



1, Male flowers; 2, one of the same; 3, bracts; 4, male flower, without its bracts; 5, female flowers; 6, section of the same; 7, one of the same; 8, section of the cone; 9, capsule; 10, the same opened; 11, section of the same 12, a bractea; 13, seed; 14, section of the same; 15, seed without an envelope, 16, embryo.

CAT. [FELIDÆ.]

CATABRO'SA, a genus of plants belonging to the natural order of Grasses, and to the tribe *Festucineæ* of that order. It has unequal very short glumes, rounded or truncate, without lateral ribs, much shorter than the spikelet; the flowers usually two, rounded on the back, distant; the outer palea membranous, with three ribs ending in teeth, which do not quite extend to the summit, and are connected by the scarious margin; the styles terminal; the upper glume has two very short faint lateral nerves, the awn absent. This is a genus formed by Palisot de Beauvois, and adopted by Babington in his 'Manual of British Botany.' The only British species is the *C. aquatica;* it has an equal panicle, with half-whorls of patent branches, and obtuse broadly linear leaves. It is found in ponds and ditches and wet sands. (Babington, *Manual of Brit. Bot.*)

CATALPA, a genus of plants belonging to the natural order *Bignoniaceæ*. It has a 2-parted calyx; campanulate corolla, with a ventricose tube, and an unequal 4-lobed limb; 5 stamens, two of which are fertile, the other three sterile; the stigma bilamellate;

the capsule silique-formed, long, cylindrical, 2-valved; the dissepiment opposite the valves; the seeds membranous at the margin, with pappus at the base and apex. The species are trees with simple leaves, opposite or disposed three in a whorl; the flowers terminal, panicled.

C. syringæfolia has flat cordate leaves, three in a whorl. This plant is a native of North America, and is found on the banks of the Ohio, Mississippi, and Delaware, also in the forests on the Wabash in Illinois, where it occurs in so great abundance that the wood is cut up for palings. It is a low-spreading singular-looking tree, with succulent shoots, easily injured by the frost. The leaves are large and come out late; the petals are white, spotted with purple and yellow. It is a plant well adapted for large shrubberies. There is one in the gardens of Gray's Inn, which is said to have been planted by Lord Bacon. The name of the genus appears to have been derived from the plant growing on the banks of the Catawba River. It does not bear fruit in this country.

C. longissima has oblong or ovate-lanceolate leaves, acuminated, three in a whorl, undulated. It is a tree 30 or 40 feet in height. It contains much tannin in its bark. It is known in the West Indies, by the name of French Oak, and the French call it Chêne Noir.

There are several other species of *Catalpa*, all elegant plants. The *C. syringæfolia* thrives well in common garden soil, and may be propagated by seeds or divisions of the root. The other species grow well in a mixture of loam, peat, and sand, or any light rich soil. Cuttings half-ripened root readily if planted in sand with a hand-glass over them.

CATAPHRACTUS, a genus of Fishes to which some Ichthyologists refer the Armed Bull-Head. [ASPIDOPHORUS.]

CATA'STOMUS, a genus of Fishes belonging to the Abdominal *Malacopterygii* and family *Cyprinidæ*. The fishes of this genus are peculiar to the rivers of North America, and the species may be distinguished from others of the Carp section by their having the lips thick and pendent, and crenated or fringed at the edges; the dorsal fin short, as in the genus *Leuciscus* (which contains the Roach, Dace, &c.), and opposite to and above the ventral fins. M. Lesueur describes 17 species of this genus in the 'Journal of the Academy of Natural Sciences of Philadelphia.'

CATCHFLY, a name applied to several plants which have the property of retaining insects, either by their viscid surface or by some other means. In *Apocynum androsæmifolium*, and some others, they are caught in the hairs that clothe the mouth of the corolla; in *Silene* by the glutinous substance that exudes from the calyx; in *Dionæa* by the collapsing of the two sides of the irritable-toothed leaves. [SILENE; DIONÆA; LYCHNIS.]

CATECHU, an extractive matter containing large quantities of tannin, obtained from species of *Acacia*. [ACACIA.]

CATENI'PORA, a genus of Corals found only in the Palæozoic Strata, and in Britain only in Silurian Rocks. [MADREPHYLLIÆA.]

CATERPILLAR, a name given to the larva state of Butterflies and Moths. [LARVA.]

CAT-FISH. [ANARRHICAS.]

CATHA, a genus of plants belonging to the natural order *Celastraceæ*. *C. edulis* is the Kat or Khât of the Arabs. "It would appear," says Dr. Lindley, "to be of a stimulating character. According to Forskähl the Arabs eat the green leaves with greediness, believing them to have the power of causing extreme watchfulness, so that a man may stand sentry all night long without drowsiness. They also regard it as an antidote to the plague, and assert that a person wearing a twig of it in his bosom may go among the infected with impunity; they even believe that the plague cannot appear in places where the tree is cultivated." ('Vegetable Kingdom,' p. 587.) At the same time Forskähl adds, "The taste of the leaves does not seem to indicate such virtues."

CATHARTOCARPUS (from *καθαίρω*, to purge, and *κάρπος*, fruit), a genus of plants belonging to the natural order *Leguminosæ*. It has very blunt sepals, hardly joined at the base, more or less unequal; 5 unequal petals; 10 unequal free stamens, the three lower ones longest, the four middle ones short and straight, the three upper ones bearing abortive difformed anthers; the anthers ovate, opening by two chinks at the apex; the ovary stipitate; the legumes terete or a little compressed, indehiscent, woody with elevated sutures, transversely many-celled inside, the cells 1-seeded and filled with pulp; the seeds elliptic, rather compressed, horizontal. The species are trees with abruptly-pinnate leaves and racemes of large yellow flowers. In appearance they are not unlike the Common Laburnum when in flower. This genus of plants was formerly comprehended under *Cassia* [CASSIA], but was separated by Persoon, who has been followed by Lindley, Nees von Esenbeck, and others. The habit of these trees and the character of their fruit differ from the species of *Cassia*. It is also undoubtedly desirable that a genus like *Cassia*, with nearly 200 species, should be subdivided.

C. Fistula, the Purging Cassia, or Pudding Pipe-Tree, has leaves with 4-6 pairs of ovate rather acuminated glabrous leaflets; the petioles glandless; the racemes loose, bractless; the legumes cylindrical, rather obtuse, smooth. It is supposed to have been originally a native of tropical Africa, but is now extensively diffused over the globe, and is found abundantly in Hindustan, China, the East Indian Islands, the West Indies, and South America. It is a tree from 30 to 40 feet high, with yellow flowers and long cylindrical black pods, from 9 inches to 2 feet in length. The valves of this pod are thin, hard, and brittle; and its cavity is divided by numerous thin brittle transverse dissepiments; the partitions thus formed have each a single hard flattened ovate seed, surrounded by a soft pulp. The pulp has a sweetish flat not unpleasant taste, and is separated by boiling the pod in water, straining the fluid, and then evaporating it to the consistence of a thick extract. This extract acts as a mild purgative on the system, and was long in great repute in Europe on that account. It is now however seldom used; and although admitted into the lists of Materia Medica of the British Pharmacopœias, is only placed there as entering into the composition of the Electuarium Cassiæ and the Confectio Sennæ. The pulp, according to Henry, consists of 61 per cent. of sugar, 6·75 of gum, and 13·25 of tannin. It probably also contains Cathartine or an analogous principle.

C. Javanicus, Horse-Cassia, has leaves with 12-15 pairs of ovate obtuse glabrous leaflets; glandless petioles; axillary racemes; nearly cylindrical, very long, and transversely torose legumes. It is a native of Java and the Moluccas. Its legumes are above two feet in length, and contain a black cathartic pulp, which is used as a horse-medicine in the East Indies. G. Don has described a species of *Cathartocarpus* (*C. conspicuus*), which is a native of Sierra-Leone, where the pods are called Monkey Drum-Sticks.

(Christison, *Dispensatory;* Don, *Gardener's Dictionary*.)

CATILLUS, a fossil genus of Bivalve Shells, allied to *Crenatula* and *Perna*, so named by Cuvier and Brongniart. In the Chalk occur species of large size, remarkable for their largely fibrous texture. They have also been called from this circumstance *Inoceramus* by Sowerby, who includes in the genus one species from the Lias and others from the Gault.

CATKIN, in Botany, a kind of inflorescence which differs from the spike in nothing but its falling off the stem by an articulation, after its temporary office as the support of the organs of reproduction is accomplished. It occurs in the willow, the poplar, the birch, &c., which hence are sometimes called Amentaceous plants, *amentum* being the Latin name of the catkin.

CATLINITE, a form of argillaceous mineral called Pipestone by the North American Indians. It comes from the Coteau des Prairies, and is a red claystone or compacted clay. A similar material is now accumulating on the north shore of Lake Superior, at Nepigon Bay. Another variety is used by the Indians of the north-west coast of America. (Dana, *Mineralogy*.)

CAT-MINT. [NEPETA.]

CATOBLEPAS. [ANTILOPEÆ.]

CAT'S-EYE, a form of Chalcedony, of a greenish-gray colour, having a peculiar opalescence, or glaring internal reflections, like the eye of a cat: the effect is owing to filaments of asbestos. It comes from Ceylon and Malabar, and possesses considerable value as a gem. (Dana, *Mineralogy*.)

CAT'S-TAIL GRASS, the common name of *Phleum pratense*, an agricultural plant, also called Timothy Grass. [PHLEUM.]

CAU'CALIS, a genus of plants belonging to the natural order *Umbelliferæ*, the sub-order *Campylospermeæ*, and the tribe *Caucalineæ*. It has a calyx of five teeth, the petals obcordate, with an inflexed point, outer ones radiant and bifid, the point slightly laterally compressed, the carpels with filiform bristly primary and more or less prominent secondary ridges, all bearing 1-3 rows of prickles. The species are herbs, with multiplied leaves and white flowers. They are called by the common name of Bur-Parsley. Two of the species are found in England, *C. daucoides* and *C. latifolia*. They are found in corn-fields on chalky soils; the last is a rare plant, and has been probably introduced. (Babington, *Manual of British Botany*.)

CAUDISONA. [VIPERIDÆ. *See* SUPPLEMENT.]

CAULERPITES, a group of Fossil Fucoid Plants, of which many species occur scattered through nearly all the marine formations. In the Oolites seven species have been found. The recent genus *Caulerpa* is found in warm southern climates.

CAULIFLOWER. [BRASSICA.]

CAULINIA, a genus of aquatic plants, belonging to the natural order *Naiadaceæ*. One of the species, *C. fragilis*, exhibits a circulation in its transparent joints, and was one of the first plants in which this phenomenon was noticed by Amici, and also probably by Costa.

CAVIA. [CAVY.]

CAVY is the vulgar name applied to various species of animals belonging to the genus *Cavia*. Of these the most common is *C. Aperea*, the Restless Cavy, or Guinea Pig. An account of this animal, with the species to which it is allied, will be found under HYSTRICIDÆ.

CAWK. [BARYTES.]

CAYENNE PEPPER. [CAPSICUM.]

CAYMAN. [ALLIGATOR.]

CEANOTHUS, a genus of plants belonging to the natural order *Rhamnaceæ*. The calyx is 5-cleft, campanulate, cut round after flowering, with the base permanent and adhering to the fruit; petals hooded, with long spreading claws; fruit dry, 3-celled, loculicidal, with papery valves: cells 1-seeded. The species are smooth or pubescent shrubs, with erect branches; alternate serrated 3-nerved leaves; and very slender white blue or yellow flowers, disposed in terminal panicles, or in axillary racemes. They are natives of North America.

C. Americanus, Red Root, New Jersey Tea, has ovate acuminate serrated leaves, pubescent beneath; flowers arranged in axillary elongated thyrses, with a pubescent rachis. An infusion of the twigs of this plant is used in Canada for venereal diseases. During one of the wars with America the leaves of this plant were used in New Jersey as a substitute for tea. It dyes wool of a fine strong nankin-cinnamon colour, and is a beautiful shrub when in flower.

There are several other species of this genus, natives of North and South America. They are small neat shrubs, with large red roots, which give them the name of Red Root. They grow very well in this country, and may be planted in any common garden soil, and form proper plants for the front of a shrubbery. They may be propagated by layers or seeds. Those from Mexico and the greenhouse species must be protected from frost during the winter. Cuttings will root in sand under a hand-glass.

(Lindley, *Flora Medica;* Don, *Gardener's Dictionary.*)

CEBADI'LLA, CEVADILLA, or SABADILLA, the Spanish-Mexican name for a species of *Veratrum*, the seeds of which are an article of considerable importance in consequence of their having been found to contain a considerable quantity of Veratria. Much interest has been excited about this drug, from the obscurity that is supposed to hang about its origin. It has always been understood to come from Mexico. Retzius, who first referred the Cebadilla to *Veratrum*, had no better materials to describe it from than a bit of the inflorescence which he found among a sample of the seeds. Smith, under *Veratrum* (in 1819), traced out its synonyms in Rees's 'Cyclopædia,' but without throwing much light upon its history. Fée, in 1828, knew no more about it than what Retzius had stated, adding that the meaning of the word was Little Oat—Cebadilla being a diminution of Cebada, the Spanish for Oat. He considered it was fit for use as a horse-medicine, and to destroy vermin. At a later period Descourtilz referred, in his 'Flore des Antilles,' the *Veratrum Sabadilla* of Retzius to a West Indian plant; and shortly after it was ascertained that there was also a Mexican Cebadilla, which corresponded entirely with the seeds of the shops. Thus again Mexico was fixed as the undoubted origin of that valuable production in which the principle Veratria is found more concentrated than in any known plant. Dr. Schiede discovered it in grassy places near the Hacienda de la Laguna in Barranca de Tioselo, on the eastern declivity of the Mexican table-land; and it has been since described by Schlechtendahl and Chamisso under the name of *Veratrum officinale.* Lindley has constituted a new genus for this plant, and calls it *Asagræa officinalis.* It has the following characters:—Root bulbous; plant usually growing in tufts; leaves linear, tapering to the point, even, quite smooth, entire, channeled on the upper side, keeled at the back, four feet long, rather weak; scape naked, as high as a man, quite simple, terminated by a raceme a foot and a half long; perianth deeply 6-parted, spreading, yellowish, small, persistent, with thick blunt linear segments, of which three are rather broader than the others; filaments six, somewhat club-shaped, yellowish, inserted into the base of the perianth, the three that are opposite to the broader segments rather longer than the others, and all longer than the perianth; anthers rather large, yellow, cordate at the base, obtuse; pollen yellow; ovary superior, consisting of three carpels united by their sutures; styles very short; fruit tricapsular, the capsules adhering by their suture, but readily separated; lower flowers hermaphrodite and fertile, upper male, and sterile on account of the abortion of the ovary; flowers have the smell of the Common Barberry. This plant produces the true Mexican Cebadilla or Sabadilla, which is now extensively employed in making the alkaloid Veratria. But in the shops there appear to be seeds of two distinct species, one of which is the *V. Sabadilla*, the other the plant now described, which differs in having linear keeled channeled, and not ribgrass-like leaves, yellow and not purple flowers, segments of the perianth linear and shorter than the filaments, and not ovate or lanceolate, and longer than the filaments. Nearly related to this is a *V. frigidum*, found in the alpine regions of Orizaba, where it flowers in September: this has blackish-brown flowers, and is reckoned a poisonous plant by the Mexicans, who call it Sevoeja. It is referred by Lindley to the genus *Helonias.* [VERATRUM; HELONIAS.]

CEBRIONITES (Latreille), a family of Coleopterous Insects belonging to the section *Malacoderma.* It has the following characters:—Body generally somewhat oval and convex; wing-cases rather soft and flexible; thorax broader than long, widest at the base, and with the hinder angles acute, or produced into a spine. Antennæ generally longer than the head and thorax; mandibles terminating in a simple point; joints of the palpi of nearly equal thickness; legs moderate, not contractile.

The species of this family are frequently found upon plants in marshy situations, but very little is known of their habits; their larvæ are supposed to live in the ground, and very probably subsist on the roots of plants.

The genus *Cebrio* is distinguished from other genera of this family by having all the joints of the tarsi entire, and without any velvet-like pellets beneath, and the posterior thighs of the same size as the anterior. About ten species of this genus have been discovered, most of which are peculiar to Europe. *Cebrio gigas*, a species not uncommon in France, is about three-quarters of an inch in length, and of a pale brownish-yellow colour. In the male the head and thorax and the legs (excepting the thighs) are black; the head and thorax are thickly punctured, and together with the elytra, which are striated, are covered with small yellowish hairs; the antennæ are long, and if extended backwards would reach about half way down the elytra. In the female there is so striking a difference in this organ, as to cause that sex to be mistaken for a distinct species: here the antennæ are very short, and if extended backwards would not reach farther than the base of the thorax; the basal joint is much longer than the other; the fourth and following joints are short, thick, and joined closely together. The legs of the female are also shorter and thicker in proportion than in the other sex.

It is said that the European species of this genus appear in great numbers after heavy rains.

During Mr. Kirby's observations he discovered no less than three parasites, belonging to the *Ichneumonidæ*, on the larva of the insect in question, which accounts for the great difference between the number of larvæ and that of the pupæ.

CECIDOMY'IA, a genus of Two-Winged Flies, belonging to the order *Diptera* and the family *Tipulidæ.* It is known by the following characters:—Wings resting horizontally, and having 3 longitudinal nervures; head hemispherical: antennæ as long as the body, and generally 24-jointed, the joints hairy (in the females 14-jointed); the 2 basal joints short; legs long, basal joint of the tarsi very short, second long.

Mr. Stephens, in his 'Catalogue of British Insects,' enumerates 26 species of this genus. They are always of small size, and many of them deposit their eggs on the young buds of various kinds of plants, where the larva is hatched, and transforms them into galls, in which it subsists and undergoes its metamorphosis.

C. salicina is common in France on willows in the month of May; it is of a blackish colour, covered with fine velvet-like hairs; the antennæ have 20 joints; the wings are slightly obscure and downy; length one-sixth of an inch.

This little fly fixes each of its eggs on a bud of the willow in the month of June. The bud at the time of its evolution, near the end of the month, instead of putting forth its branch, becomes enlarged at the base, and ultimately forms a gall in which the larva is lodged, nourished, and undergoes its metamorphosis: the larva is of a reddish-yellow colour, and assumes the pupa state in the winter, when the gall is become of a large size.

Other species of *Cecidomyia* produce similar deformities upon various parts of many species of plants, and resemble in this part of their habits the *Cynipidæ* among the *Hymenoptera.*

C. Tritici (*Tipula Tritici*, Kirby), an insect commonly known by the name of the Wheat-Fly, has occupied much of the attention of entomologists. Kirby published two accounts of its habits in the 'Linnæan Transactions' (vol. iv.).

This little fly is about one-twelfth of an inch in length, and of a reddish-yellow colour; the wings are milk-white, and exhibit the prismatic colours in certain lights: the eyes are black. The Wheat-Fly may be observed sometimes in the greatest abundance flying about wheat-fields in the month of June. It generally makes its appearance about seven or eight o'clock in the evening. "Although," says Mr. Kirby, "these insects are so numerous in the evening, yet in the morning not a single one is to be seen upon the wing; they do not however then quit the field which is the scene of their employment, for upon shaking the stalks of the wheat or otherwise disturbing them they will fly about near the ground in great numbers. I found their station of repose to be upon the lower part of the culm with their heads upwards." The fly totally disappears by the end of June. According to Kirby, it is about eight o'clock in the evening that they deposit their eggs. He has seen as many as twelve specimens thus occupied at the same time on a single ear, and observes that these flies are sometimes so numerous that, were all to lay their eggs and these to hatch, one-half of the grain would be destroyed.

The eggs are deposited by means of a long pointed and contractile tube, or ovipositor, generally upon the interior valvule of the corolla, just above the stigmata; and it occasionally happens that the fly is unable to retract its ovipositor, and being thus held prisoner it dies.

About the middle of June the larvæ are hatched, and may be seen adhering to the lower end of one of the anthers, and sometimes immersed in the woolly summit of the germen, or in the interior of the valvulæ of the corolla. These larvæ are simple minute grubs, without legs or any visible head, and of a yellowish colour; and their food consists of the pollen of the anthers, which it appears in the plants thus attacked is unfit for impregnation.

The pupæ are of a reddish colour, and in number bear no proportion to that of the larvæ. "I have seen," says Mr. Kirby, "more than once, seven or eight florets in an ear inhabited by the latter, and sometimes so many as thirty in a single floret, seldom less than eight or nine, and yet I have scarcely ever found more than one pupa in an ear, and had to examine several to meet with that. . . . . The pupæ that I have observed have generally been somewhat attached to the grain, and, what is worthy of notice, I never observed them within those florets where the larvæ had taken up their residence; they seem invariably to choose for their habitation, in their immediate state, one where the grain is uninjured, to which they may attach themselves."

In a field of 15 acres (planted partly with white and partly with red wheat), which Mr. Kirby carefully examined, and which was much attacked by these insects, he calculated that the havoc done by them would amount to five combs; he observed that the white wheat was most effected.

CECILIIDÆ (properly CÆCILIIDÆ), a family of Reptiles, which some naturalists have considered as belonging to the Batrachians, but which Cuvier, following Linnæus, places in his third and last family (Les Serpents Nus) of the Ophidians, observing that those who placed it among the Batrachians did so without knowing whether the form underwent a metamorphosis or not. In the 'British Museum Catalogue' of *Amphibia* it stands as a family of the third order of that class (*Pseudophidia*). The following synopsis of the genera is given in the same work:—

A. Muzzle pitted.

1. *Cæcilia*: the pit under each nostril.
2. *Siphonops*: the pit before each eye; body with broad rings.
3. *Ichthyophis*: the pit before each eye; body with narrow rings.

B. Muzzle not pitted.

4. *Rhinatrema*.

Cæcilia was named by Linnæus from the supposed blindness of the species. The eyes in fact are exceedingly small, and nearly hidden under the skin. Cuvier observes that in some species these organs are wanting altogether; and the following is his description of the genus:—The skin is smooth, viscous, and striated with annular folds. It would appear altogether naked, but on dissection scales well formed are found in its thickness; but these scales are delicate, and disposed regularly in many transverse rows between the wrinkles of the skin, as Cuvier himself saw with certainty in *C. glutinosa*, *C. albiventris*, and other species. The head is depressed; the vent is round, and very near the end of the body; the ribs are too short to circumvent the trunk, and the articulation of the bodies of the vertebræ is effected by facets with hollow cones, the depression in which is filled with a gelatinous cartilage, as in the Fishes and in some of the Batrachians. Their skull is united to the first vertebra by two tubercles, as in the Batrachians, a mode of union approached by the *Amphisbœnæ* only among Serpents. Their maxillary bones cover the orbit, which is only pierced in the form of a small hole, and the temporal bones cover the temporal fossa, so that the head when examined from above presents only a continuous bony shield. Their os hyoides, composed of three pairs of arches, may have led to the supposition that in early youth the bones supported gills. The maxillary and palatal teeth are arranged on two concentric lines, as in the *Protei*, but are often sharp and curved backwards, as in the true serpents. The opening of the nostrils is at the back of the palate, and the lower jaw has no moveable pedicle, while the tympanic bone is dovetailed (enchassé) with the other bones into the shield of the skull. The only ossiculum auditus, or auditory bone, is a small plate upon the fenestra ovalis, as is the case with the Salamanders.

Skull of a species of *Cæcilia*.

The auricle of the heart in these animals is not divided sufficiently deep to be regarded as double, but the second lung is as small as it usually is in the other serpents. The liver is divided into a great number of transverse leaves (feuillets). In their intestines Cuvier states that there is to be found a quantity of vegetable matters, vegetable earth, and sand.

The following species are given in the 'British Museum Catalogue:'—

C. gracilis, a native of South America. It is the *C. vermiformis* of Shaw.

C. tentaculata. It is the *C. albiventris* of Daudin.

C. compressicauda, a native of Guyana.

C. rostrata, a native of South America.

C. oxyura, from Malabar.

C. squalostoma, from Africa.

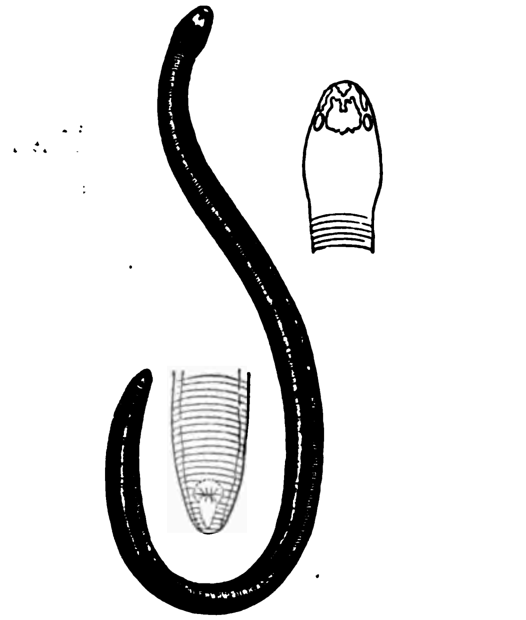
There are two species of *Siphonops*:—

S. interrupta (*C. annulata*, Mikan). It is a native of the Brazils.

S. Mexicana is a species found in Mexico.

The genus *Ichthyophis* has but one species, the *I. glutinosus* (*C. glutinosa* of Linnæus). It is a native of Ceylon.

The *C. bivittata* of Cuvier constitutes the genus *Rhinatrema*. The only species, *R. bivittatum*, is a native of Cayenne.



Cæcilia bivittata, Cuvier (*Rhinatrema bivittatum*, Dumeril).

CECROPIA, a genus of plants belonging to the natural order *Artocarpaceæ*. *C. peltata* yields from its juice caoutchouc. The bark is astringent. The stems are hollow; and its light porous wood is used by the natives of the countries where it grows to give light by friction. It is a native of South America.

CECROPS, a genus of Entomostracous *Crustacea*, the type of the *Cecropidæ*, a family of the *Pœcilopoda*. [Pœcilopoda.]

CEDAR-BIRD. [Bombycilla.]

CEDAR-TREES. [Abies.]

CEDRELA, a genus of plants, the type of the natural order *Cedrelaceæ*. It has the following characters:—Calyx 5-toothed; petals adnate to the torus; stamens 5, distinct; capsule 5-celled, 5-valved; seeds numerous, on each side of the dissepiment ending in a wing.

C. Toona, Bastard Cedar, has lanceolate leaflets, acuminate, entire, pale glaucous beneath. It is a native of the East Indies, where it is called Toon. It has an erect trunk of great height and size, with smooth gray bark. The flowers are very numerous, small, white, fragrant, like honey. The seeds are numerous, imbricated, winged. The bark is a powerful astringent, and is said to be a good substitute for Peruvian Bark in the cure of periodic diseases. Dr. Blume used it in Java with much success in the various forms of fever, dysentery, diarrhœa, &c. Horsfield also used it in dysentery.

C. odorata has leaflets ovate-lanceolate, entire, on short stalks. It is a native of Barbadoes and the Caribbee Islands. It is a large tree with a rough bark. The fruit is about the size of a partridge-egg. When fresh the bark and berries smell like assafœtida. The trunk is hollowed out into canoes. The wood is of a brown colour and has a fragrant odour, from which circumstance it is called Cedar in the British West India Islands. It is frequently cut into shingles for covering houses, but it is not adapted for ship-building on account of its being subject to the attacks of worms. It is not adapted for casks, as it gives its odour to whatever is placed in contact with it.

C. febrifuga (*Soymidia febrifuga*) has leaflets ovate-oblong, acuminated, quite entire. It is a native of Java. Its bark is said to have a better effect on some of the fevers of India than cinchona. It is also a powerful astringent. The wood is good for many purposes.

CEDRELA'CEÆ, a natural order of plants, belonging to the Syncarpous group of Polypetalous Exogens. The species are timber-trees: the timber is usually compact, scented, and beautifully veined; the leaves are alternate, pinnated, without stipules; the flowers are in terminal panicles. The essential characters of the order are: Calyx 4-5-cleft, petals 4-5, longer than the sepals; stamens 8-10, the filaments either curled into a tube or distinct, and inserted into a hypogynous disc; the style and stigmas simple; the cells of the ovary equal in number to the petals or flower, with the ovules 4 or often more, imbricated in two rows; the first capsular with the valves separable from the dissepiments, with which they alternate; the seeds flat, winged; albumen thin or none. This order is nearly related to *Meliaceæ*, from which it is chiefly distinguished by its winged and indefinite seeds.

The dotted leaves of some species connect this order with *Aurantiaceæ*. It contains 9 genera and about 25 species.

An essential oil called Wood-Oil is found in *Chloroxylon Swietenia* which is a native of the East Indies. The wood is of a deep yellow colour, and called Satin-Wood, remarkably close-grained, heavy, and durable, and comes nearer to box-wood than the produce of any other tree. *Flindersia* possesses a volatile oil. *F. Australis* is a native of Australia, and its wood is said to be not inferior to mahogany. *F. Amboinensis* is a native of the islands of Hitu and Ceram. The spiny part of the fruit is formed into rasps. It was on this account called by Rumphius *Arbor radulifera*. *Oxleya xanthoxyla* is a native of Australia. It attains a height of 100 feet. The wood is yellow, and employed for building boats. It is called Yellow-Wood. [SWIETENIA; CEDRELA.]

(Lindley, *Flora Medica;* Don, *Gardener's Dictionary;* Lindley, *Natural System.*)

CELANDINE, a name properly applied to the species of *Chelidonium*. [CHELIDONIUM.] It has however been given by some of our poets to the *Ranunculus Ficaria*, Linnæus (*Ficaria verna* of others), the vulgar name of which is Pilewort. [RANUNCULUS.]

CELASTRA'CEÆ, *Spindle-Trees*, the Spindle-Wood Tribe, a natural order of Polypetalous Exogens, consisting of shrubs or trees principally found in temperate latitudes, and not abounding in either the colder or the hotter parts of the world. They are found in Europe, Asia, North America, and South Africa. They have simple alternate or opposite leaves, a small number of perigynous stamens inserted into a fleshy disc and alternate with the petals; a superior syncarpous ovary immersed in the fleshy disc; and a superior capsular or succulent fruit, with a small number of ascending seeds. The order is not of much economical importance. A slight degree of acridity is said to have been detected in some of the species. *Euonymus Europæus*, the Spindle-Tree, the wood of which is used for butchers' skewers, is the commonest European form of this order.

Euonymus atropurpureus.

1, A front view of the flower; 2, the same from below, showing the calyx; 3, a view of the disc, with the stamens growing on it; 4, a stamen; 5, a ripe fruit; 6, a cross section of the same; 7, a seed; 8 and 9, sections of the latter.

The barks of *Celastrus scandens* and *C. Senegalensis* are said to be purgative and emetic, whilst the species of *C. venenatus* are reported to inflict the most painful wounds. The fruits of *Elæodendron ruber* are eaten at the Cape of Good Hope. The relations of the order are according to Lindley expressed thus:—

Aquifoliaceæ.

Sapotaceæ. CELASTRACEÆ. *Hippocrataceæ.*

Euphorbiaceæ.

It has 24 genera and 260 species.

CELERY. [APIUM.]

CELESTINE, the Native Sulphate of Strontia. It has its name from its pale blue colour. [STRONTIA.]

CELL, VEGETABLE. [CELLS; HISTOLOGY; TISSUES, VEGETABLE.]

CELLARIA. [CELLARIÆA.]

CELLARIÆA, or CELLARIADÆ, the second family, according to De Blainville's arrangement, of the sub-class *Polypiaria Membranacea*.

Animals hydriform, provided with very delicate ciliated tentacula, separated, distinct, contained in oval flattened membranous cellules, with a bilateral subterminal crescentic opening; usually provided with a moveable cartilaginous lip, forming by their lateral junction, in one or two tiers or stages, a cretaceous or membranous, limited, diversiform, and fixed polyzoarium. Ovicells external, globose, above the aperture of the cell.

This group corresponds pretty nearly with the *Escharadæ*, *Flustradæ*, and *Cellariadæ* of Fleming, and the *Escharina* and *Celleporina* of Ehrenberg; it also includes part of the sub-order *Cheilostomata*, of the *Polyzoa infundibulata* of Mr. Busk's 'Catalogue of Marine Polyzoa.' For further particulars respecting the structure of the animals and their habitations, reference must be made to POLYZOA, a few only of the principal forms being here noticed.

We shall notice here the principal generic forms of this group.

1. *Lunulites*. The number of species of this generic group, of which until lately only a few fossil forms were known, has been much augmented by the addition, not only of other fossil species, but also of several recent ones. The latter have also afforded a much more precise insight into the structure of the peculiar polyzoarium than it was possible to obtain from the inspection merely of fossil specimens. The division of the genus suggested by Lamouroux seems to be sufficiently founded in nature to justify its definitive adoption so far as it goes; and, in addition, a recent form described and figured in the 'Voyage of H. M. S. Rattlesnake' would seem to indicate the propriety of instituting a third generic or sub-generic type.

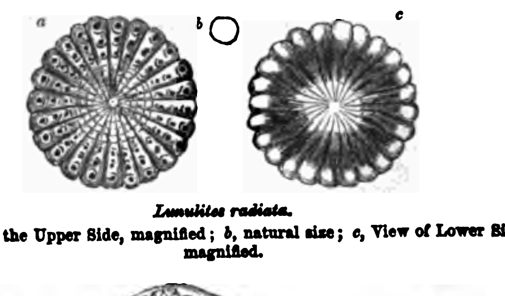
In all these forms the polyzoary, which is more or less regularly circular, convex above, and concave or flattened below, presents cells of two kinds—one set of which may be termed secondary or accessory; and it is according to the relative position of these cells as regards the others that the division of the genus is founded.

In one case the secondary cell, which is then considerably smaller than the other, is situated at the apex of the primary cell, immediately above the aperture (*Cupularia*). In a second form any distinction of size between the two sorts of cells is less or not at all obvious. The two sets of cells however are very differently arranged from those in the former case; the secondary being disposed more or less regularly in longer or shorter rows, alternate with the others, and like them radiating from the centre (*Lunulites*). Of the former of these forms the Lunulite en Parasol of Defrance may be taken to afford a type, and of the latter, *L. radiata*. In the third form the secondary cells are scattered more irregularly over the surface of the polyzoary. In this case the secondary cell is also superior to one of the other kind.

From the examination of recent forms it has been ascertained that the secondary cell probably contains nothing more than a mass of muscular substance for the movement of a vibratile spine or seta, of various forms and structure, and which corresponds with the vibraculum, or moveable setose organ, which is found on several of the *Polyzoa*, and particularly in the genus *Scrupocellaria*.

The arrangement of the group therefore into three genera would appear to be justifiable and convenient, namely, *Lunulites*, *Cupularia*, and *Selenaria*; which may be thus defined:—

Lunulites, Lamouroux. Polyzoarium circular or irregular, convex above, concave or flattened beneath; cells arranged in series



Lunulites radiata.

a, View of the Upper Side, magnified; *b*, natural size; *c*, View of Lower Side, magnified.

Defrance's Lunulite en Parasol.

a, A Portion magnified; *b*, natural size; *c*, three cells highly magnified.

radiating from the centre, and separated by alternate rows of cells supporting vibracular spines; under surface usually with radiating striæ, and the surface with minute perforations.

Recent species:—

L. capulus, Busk; 'Voyage of Rattlesnake.'
L. gibbosa, Busk; 'Cat. Brit. Mus.' pl. 112.
L. cancellata, Busk; „ „ pl. 113.

Cupularia, Lamouroux. Polyzoarium circular, regular, convex on the upper side and concave below; cells disposed quincuncially, each with a smaller vibracular cell at its summit; under surface with radiating lines, grooves, or ridges, or divided into sub-hexagonal areas; surface perforate or imperforate, smooth, or granular.

Recent species:—

C. Guineensis, Busk; 'Cat. Brit. Mus.,' pl. 114.
C. Owenii, Gray; „ „ pl. 115.
C. Lowei, Gray; „ „ pl. 116.
C. stellata, Busk; „ „ pl. 118.

Selenaria, Busk; 'Cat. Brit. Mus.' Polyzoarium circular, regular, convex above, concave below; cells disposed quincuncially, some (closed in front by a cribriform calcareous plate) furnished with a superior vibraculum.

Recent species:—

S. maculata, Busk; 'Voy. of Rattles.;' 'Cat. Brit. Mus.,' pl. 117.

Example, *Lunulites radiata*. Locality, Grignon, &c.

2. *Electra*. Animals unknown, contained in membranous vertical bell-shaped cellules, ciliated on the edges, and shut by a diaphragmatic membrane, with a very small and semilunar opening, and disposed in a verticillate form around an ideal axis.

Example, *Electra verticillata*.

Electra verticillata. *a*, natural size; *b*, magnified.

This is the *Flustra verticillata* of Gmelin (*Sertularia verticillata* of Esper); and this genus, which was separated by Lamouroux, scarcely deserves, as De Blainville remarks, to be distinguished from *Flustra pilosa*, whose cellules are occasionally somewhat verticillated; but in this he confounds two things perfectly distinct, though often misconceived.

3. *Flustra*. Cells contiguous; on both sides of the frond.

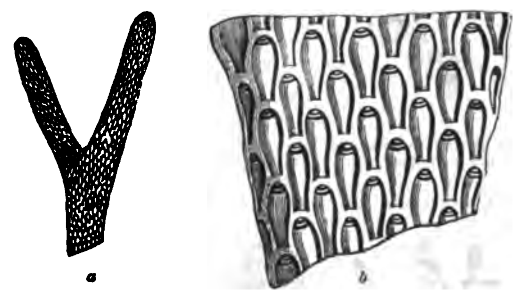
Flustra foliacea. *a*, natural size; *b*, some of the cells magnified.

4. *Carbasea*. Cells contiguous; on one side only of the frond.

Example, *Flustra carbasea*. Locality, seas of Scotland, &c.

Sir John Dalyell, in his interesting paper entitled 'Further Illustrations of the Propagation of Scottish Zoophytes' ('Edinburgh New Philosophical Journal,' April-July, 1836), gives the following account of the propagation of the *Flustræ*. Speaking of *Alcyonium*, he says, "We find it consists of a compact gelatinous or fleshy matter, studded with innumerable cells sunk in its substance, which are inhabited by vivacious hydræ. Different species or varieties occur in the Scottish seas, especially the *gelatinosum*, and a thin green flattened palmate kind, which has perhaps escaped the notice of naturalists hitherto. A white, opaque, ovoidal or nearly circular flattened corpusculum, previously invisible, issues from the fleshy part of these products whence it seems to be elicited, particularly by the influence of light. On removal of a small specimen that had already afforded many from a dark situation to a moderate degree of light, at least 150 quitted their recesses within an hour. These beings are endowed with much greater activity than the corpuscula of the *Actinia;* their courses are alike diversified; they swim through the water in all directions, regularly and irregularly, ascending to the surface or descending to the bottom, pursuing a straight line, describing an orbit, or tumbling about among the neighbouring substances. Meanwhile, as if of soft consistence, their form alters, and the action of the cilia environing the body is alternately depressed and relaxed. At length, having become stationary, a margin diffuses around the body, and supervening transparence of the centre soon exposes an inanimate hydra within, which in nine or eleven days is displayed perfect from its cell. The inner surface of each tentaculum is now clothed by a double row of stout dark cilia in rapid motion, but in opposite directions; for as those of one side strike upwards those of the other strike downwards. Further diffusion of the basis adhering below forms additional compartments for other hydræ. The propagation of the *Flustræ carbasea*, *foliacea*, and *truncata* ensues after a similar fashion. A ciliated corpusculum, spherical, ovoidal, or irregular, quits the leaf, pursues its course in the water, becomes stationary, adheres, and a nascent *Flustra* arises from the spot. Above ten thousand such corpuscula have been produced by a moderate-sized specimen of the *Flustra foliacea*, tinging the bottom of a vessel yellow from their multitude, and vitiating the water by their decay."

The same author, in the 'Proceedings of the British Association' (Edinburgh, September, 1834), thus clearly and elaborately describes the organisation of *Flustra carbasea:*—"The *Flustra carbasea* resembles a leaf divided into subordinate parts, one of the surfaces being studded with cells, and the other exhibiting elevations or convexities corresponding to their bottom, and the whole product is of a yellowish colour. Each cell, of a shuttle or slipper shape, level with the surface of the leaf, is inhabited by a vivacious polypus, exercising a percussive faculty both of the tentacula individually and of the whole head. Some of the cells are occupied occasionally by large bright yellow, irregularly globular, solid, ciliated animalcula, subsequently quitting them to swim heavily below. In several days they become motionless like the former, and die also without immediate decomposition. Next, there appears in just about the same spot below, occupied by the motionless animalculum, a yellow nucleus with a lighter diffusing margin. This in its further diffusion assumes a shuttle or slipper form; it becomes a single cell, which afterwards displays a polypus under the wonted figure and action. The adult *Flustra* was vertical, for the leaf is always erect; but here the new cell is horizontal. By a singular provision of nature, as only one side of the adult is cellular, the original cell is necessarily a root, sole, or foundation to admit subsequent enlargement, which in such zoophytes is always from a single cell. One end of the cell next rises vertically, wherein a second cell, with its polypus, is soon displayed overhanging the first, and at right angles to the plane of its position." (See also Professor Grant's 'Observations on the Polypes' of this species in the 'Edinburgh New Philosophical Journal.')



Flustra carbasea. *a*, A Portion, natural size; *b*, a Portion magnified.

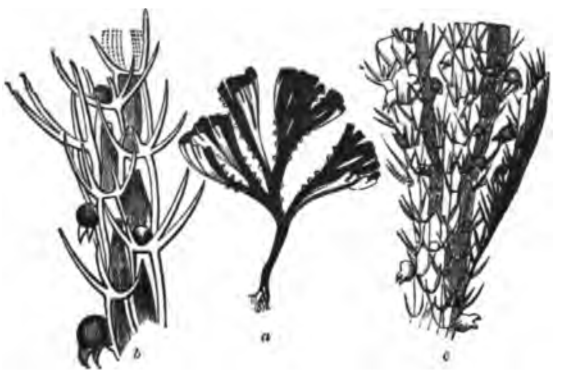
Example, *Flustra avicularis*. Locality, European seas; Seaford Bay, Sussex.

This species however should be removed from the genus *Flustra* altogether, as its affinities are clearly with that of *Bugula* (Oken). It is the *B.* (*Avicularia*) *flabellata*, J. V. Thompson, 'Manuscript, Brit. Mus.,' and its avicularia, or 'bird's-head' processes, from their size and transparency, are well adapted for the investigation of the structure of those curious organs.

5. *Elzerina*. Animals unknown, contained in sufficiently large oval elongated subhexagonal bordered cellules, having a membranous tympanum or drum, in which is pierced the sigmoid opening, forming by their quincuncial and circular arrangement the branches of a

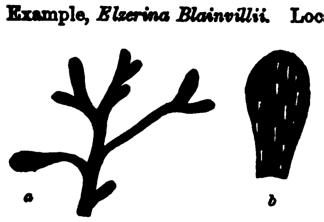
membranous, plant-like, non-articulated, dichotomous, and fixed polyzoarium.

Flustra avicularis. Showing a spherical mass of the natural size.



Flustra avicularis.
a, A Specimen showing the root and branching form of the natural size; *b*, *c*, portions magnified. From Sowerby's 'British Miscellany,' London, 1806.

Example, *Elzerina Blainvillii.* Locality, the seas of Australia.



Elzerina Blainvillii.
a, natural size; *b*, a portion magnified.

De Blainville observes that this genus was established by Lamouroux for a polype brought from the seas of Australia by Péron and Lesueur, which De Blainville examined in Lamouroux's collection, and that he has been satisfied that it is a genus which can hardly be distinguished from the phytoïd or plant-like *Flustræ*,—that it differs from them only in the union of the cellules, which form a circular quincunx, as in *Cellaria Salicornia*, and are still more soft and membranous.

Risso records two species of *Elzerina* in the Mediterranean, *E. venusta* and *E. mutabilis*; but De Blainville observes, that if it be true that their cellules are scattered, it is probable that those species do not belong to this genus, the characters of which it must be confessed are by no means at present well defined.

6. *Vincularia* (recent and fossil). Animals unknown, contained in oval subhexagonal regular cellules, having a subterminal semilunar orifice, and applied and united longitudinally in many rows, so as to form a cretaceous brittle polyzoarium, in the form of a little wand.

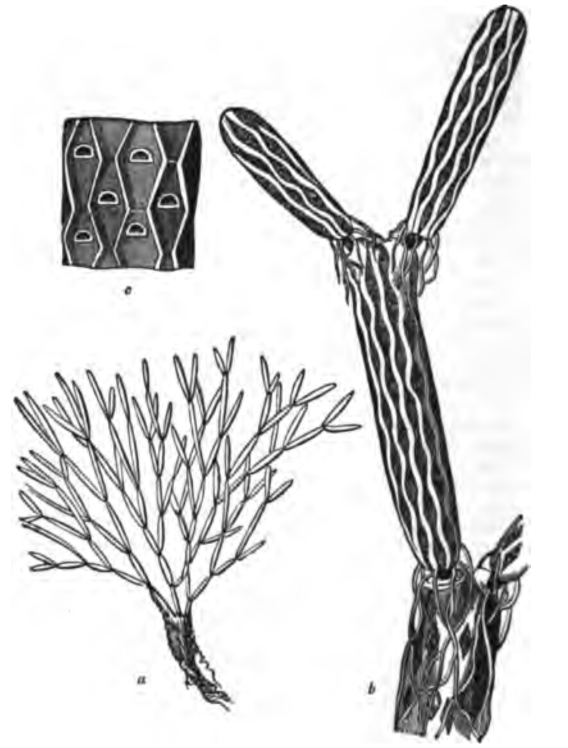
Example, *Vincularia fragilis.* Locality of the genus at present known, the Calcaire Tertiaire of Westphalia. A recent species occurs in the Pacific or Australian seas, and is figured in 'Cat. Brit. Mus.' pl. 65, *V. gigantea.*

De Blainville observes that this genus was established by Defrance, and that it has been adopted by Goldfuss under the denomination of *Glauconoma*, a denomination which De Blainville rejects, remarking that Goldfuss regards it as approaching nearly to *Cellaria Salicornia*, and stating that the *Vincularia fragilis* which he (De Blainville) examined in Defrance's collection might well be nothing more than a true *Flustra*, which is found in the same beds with *V. fragilis.* De Blainville adds in support of this opinion that Defrance showed him a specimen which was composed of two rows or series, instead of a single series only.

7. *Salicornaria.* Cells disposed around an imaginary axis, forming cylindrical branches of a dichotomously divided erect polyzoarium.

α. Species with Hexagonal Cellules, and with a transverse aperture. (Genus, *Salicornia* of Cuvier.)

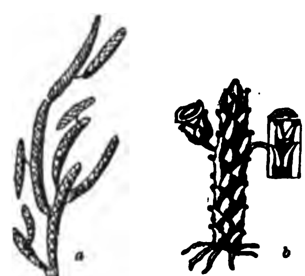
Example, *Cellaria Salicornia* (*Cellularia Salicornia* of Pallas; *Tubularia fistulosa* of Linnæus). Locality, European seas.



Cellaria Salicornia.
a, natural size; *b*, a portion magnified; *c*, a smaller portion still more highly magnified.

β. Species with Oval Cellules, and the aperture rounded and tubular.

Example, *C. ceroides* (*Sertularia ceroides* of Gmelin). Locality, Mediterranean and the Indian seas.



Cellaria ceroïdes.
a, natural size; *b*, a portion of the lower part magnified.

De Blainville observes that this genus, established by Pallas under the name of *Cellularia*, has been successfully simplified by Lamarck and by Lamouroux, who has established many genera at its expense. De Blainville further states that before Delle Chiaje no author who had described a species of a true *Cellaria* was known; but that the Neapolitan observer had filled this gap by informing us in his Memoirs that the polypes of *C. ceroides* bear a perfect resemblance to those of *Millepora* (*Myriapora*) *truncata.* Pallas made a curious observation relative to the rapid growth of *C. Salicornia*; for he found individuals an inch and a half long upon the eggs of *Squali*, which were still far from the time when the young are excluded. The genus as here characterised should perhaps rather be regarded as a family group, under which would be included two, if not three, genera, should the species here noticed and figured as *C. ceroides* prove to be a cheilostomatous polyzoan. The genera are *Salicornaria* (Cuvier), *Nellia* (Busk, 'Cat. Brit. Mus.').

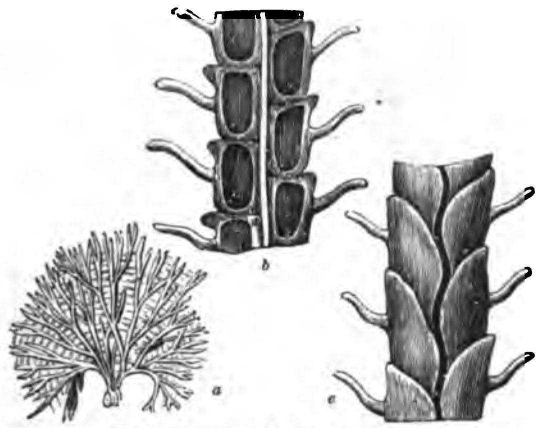
8. *Intricaria* (fossil). Animals unknown, contained in hexagonal elongated cellules with elevated borders, and covering the entire surface of a calcareous polyparium sufficiently solid, rush-like (joncacé) internally, composed of a considerable number of cylindrical branches irregularly anastomosed.

Example, *I. Bajocensis.*

De Blainville observes that this genus was established by Defrance for a pretty fossil polypier found by M. de Gerville in the department of La Manche; and he states that on examining it in the collection of the first named of those naturalists, he was satisfied that it approaches very nearly to the *Cellariæ*, and especially to *C. Salicornia* in the form of its cellules, while however it differs from it because it is not articulated, and because in all probability it did not adhere by radical fibrils. Lamouroux, he adds, thought it was a Millepora. At all events its place here seems to be doubtful.

9. *Canda.* Animals unknown. Cells rhomboidal, situated on the outer side for the lodgment of a vibraculum; no avicularium on the upper and outer angle.

Example, *C. arachnoidea*, Lamouroux (*Cellaria filifera*, Lamarck). Locality, seas of Australia.



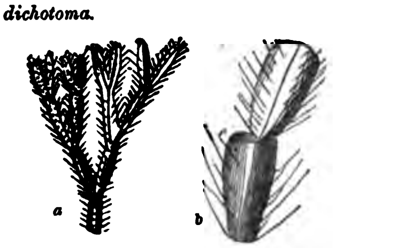
Canda arachnoidea. *a*, natural size; *b*, *c*, portions magnified.

De Blainville observes that this genus was established by Lamouroux for a species of *Cellaria* brought by Péron and Lesueur from the Australian seas, and which he saw in Lamouroux's collection, which now forms part of the Museum of Caen. The assemblage of cells resembles the vertebral column of a fish. Upon one of the surfaces are two rows of alternate cells, separated by an angular crest. Upon the other surface may be seen the back of the cells, with tubular filaments which reach transversely from one branch to another, and are analogous to the radiciform, or root-like tubes. He adds that it would appear that these transverse fibrils are sometimes wanting, as in the variety noted by Lamarck.

To this genus, as thus defined, also belongs *Canda reptans* (*Cellularia reptans* of our coasts).

10. *Caberea.* Animals unknown. Cells bi-multiserial, in the latter case quincuncial; back of branches furnished with large vibracula, which are placed obliquely in two rows, diverging in an upward direction from the middle line, where the vibracula decussate with those of the other; avicularia, when present, sessile on the front of the cell.

Example, *C. dichotoma.*



Caberea dichotoma. *a*, natural size; *b*, two cellules magnified.

British species. *C. Borgi* ('Audouin,' Savigny, 'Egypt,' pl. 12, f. 4); *C. Hookeri* (John's 'Brit. Zooph.' Ed. 2, pl. 60); but these two species have been confounded.

11. *Bugula.* Polyzoarium erect, phytoid, dichotomously divided into narrow ligulate bi-multiserial branches; no vibracula; avicularia when present pedunculate and articulated; cells elliptical (viewed behind), closely contiguous, aperture very large, margin simple, not thickened. (Colour not unfrequently red or blue.)

Example, *B. Neritina.* Locality, Mediterranean.

This genus was established by Oken, and was also constituted by Lamouroux under the name of *Acamarchis*; but was not adopted by Lamarck, nor by Dr. Fleming, who, according to De Blainville, confounds it with *Bicellaria.*

12. *Bicellaria.* Polyzoarium erect, phytoid, dichotomously divided into narrow ligulate biserial or multiserial branches; no vibracula; avicularia when present pedunculate and articulated; cells turbinate, distant; aperture directed more or less upwards; several spines, marginal or dorsal.

To the same family belong *Halophila* (Gray); *Bugula* (Oken).

Example, *Bicellaria ciliata*, *Sertularia pilosa.* Locality, European seas.

This division of *Cellariadæ*, *Crisiæ* of Lamouroux, *Cellariæ* of Lamarck, was separated by Dr. Fleming, who gave it the denomination of *Cellularia*, a name preoccupied as we have seen by Pallas for the whole family. Instead of this name De Blainville proposes that here given, and observes that Savigny, in the plate which he has devoted to *Cellariæ* in his great work on Egypt, has figured the solid part of four species, which being composed of two ranks of cellules should belong to this section.

Acamarchis Neritina. *a*, natural size; *b*, lower portion magnified.

13. *Notamia.* Cells opposite, in pairs; a pair of tobacco-pipe-shaped avicularia above each pair of cells, each arising from the inferior tubular prolongation of one of the cells in the pair next above.

Example, *N. bursaria.* Locality, European seas, &c.

This is the *Sertularia bursaria* of Linnæus, *Cellularia bursaria* of Pallas, *Dynamena bursaria* of Lamouroux.

To the same family belong *Gemellaria* (Savigny), *Didymia* (Busk), *Dimetopia* (Busk).

14. *Scruparia.* Cells uniserial; junctions rigid, or of the same consistence as the cells; polyzoary adnate or erect.

Example, *S. chelata*, Ellis and Linn.; *Cellularia chelata*, Pallas; *Eucratea chelata*, Lamouroux; *E. loricata*, Fleming. Locality, European seas.

In the same family are included *Hippothoa* (Lamouroux); *Ætea* (Lamouroux); *Beania* (Johnst.).

Lamouroux broke up this generic division into the genera *Eucratea* and *Lafoea.* De Blainville says that *Unicellaria*, under which he includes *Scruparia*, is easily characterised by the solitary disposition of its cellules, and that he had examined both *Eucratea* and *Lafoea* in Lamouroux's collection at Caen, and found the differences of too little value to warrant the separation.

15. *Catenicella*, De Blainville; *Catenaria*, Savigny. Animals unknown; contained in calcareous cells arising one from the upper and back part of another by a short corneous tube, all facing the same way and forming dichotomously divided branches of an erect, phytoid, polyzoary cell, at each bifurcation geminate.

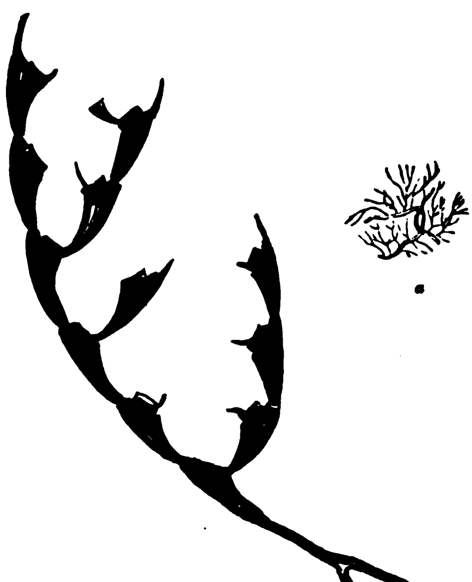
16. *Menipea.* Cells oblong, or attenuated downwards, imperforate behind, with a sessile avicularium, frequently absent on the upper and outer angle, and one or two sessile avicularia on the front of the cell below the aperture.

Synonyms. *Cellaria* (part), Linnæus, Solander.
Crisia (part), Lamouroux.
Tricellaria, Fleming, De Blainville, Gray.

The essential distinctive character of this genus, as here intended, consists in the presence of one or more sessile avicularia on the front of the cell below the aperture, and usually of a sessile avicularium at the upper and outer angle; no vibraculum. With the exception of one or perhaps two species the *Menipea* have three or six cells only in each internode; the branches consequently are loose and straggling, and usually incurved at the extremities, as is best seen in *M. cirrata.*

The genus appears to enjoy a wide geographical range, occurring from the Arctic Circle to the southern points of America and Africa.

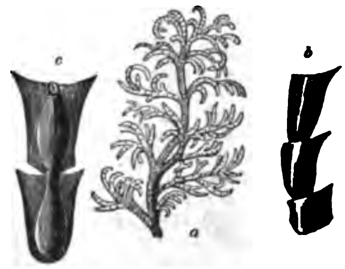
Notamia bursaria. a, natural size; b, a portion magnified.



Scruparia chelata. a, natural size; b, a portion highly magnified.

This genus (of which seventeen species are described and figured in the 'Cat. Brit. Mus.') admits of division into three subgeneric groups. The species are for the most part Australian, and with the exception of that described by Savigny, which might have been procured in the Red Sea, appear to be limited to the Southern Hemisphere.

The *M. hyalæa*, of which a figure is here given from Lamouroux, appears to be referrible to this genus.



Menipea hyalæa. a, natural size; b, c, cellules magnified.

For the best account of the species of this and other families of the *Polyzoa* the reader is referred to Mr. Busk's complete and beautifully illustrated 'Catalogue of the Marine Polyzoa' in the collection of the British Museum. [POLYZOA.]

CELLASTRÆA. [MADREPHYLLIÆA.]

CELLIPORA. [POLYZOA.]

CELLS. The ultimate structure of animal and vegetable bodies consists of minute vesicles which are called Cells. In both animal and vegetable structures these organs are not generally visible to the naked eye, as they vary from the 1-500th to the 1-10000th part of an inch in diameter. In all cases they consist of an enveloping membrane or cell-wall, which incloses in a space more or less enlarged certain constituents, called cell-contents. The nature of the substances which enter into the composition of the cell-walls and constitute the cell-contents, differs in the animal and vegetable kingdoms, but there are certain properties which all cells possess in common. Sometimes these properties are called vital, to distinguish them from the properties possessed by inorganic or mineral bodies, which are called physical. It will however be seen that, independent of the formative power by which particles of gelatine, cellulose, &c., arrange themselves in the form of cells, and again these cells arrange themselves into the forms of organs and beings of a specific form, there are few of the functions performed by cells that may not be referred to the action of physical forces. One of the first and most necessary conditions of the cell is, that it shall allow of the passage, through the membrane of which its walls are composed, of those substances by means of which it grows, and which it acts upon for the production of the peculiar secretions which characterise either specific beings or parts of their organisation. This function, which is called Absorption, seems referrible to the physical relations which exist between liquids and gases and the membrane of which the cell-wall is composed. [ABSORPTION.]

The liquid or gaseous contents which are thus introduced into the interior of cells undergo a variety of changes, according to the position, age, or other circumstances of the cell. Sometimes the fluid that is absorbed appears to be transmitted in compound structures from cell to cell without undergoing any great amount of change. In other cases the most decided chemical changes take place in the elements introduced. The cells of some parts of vegetable structures are an instance of the latter, in which carbonic acid and ammonia are absorbed with water, and converted, either during their passage through the cell-wall, or whilst in the interior of the cell, into cellulose, starch, sugar, protein, and other constituents of the cell. In other parts of plants the cells convey solutions of sugar and other substances without producing on them any change.

The constituents absorbed into the interior of the cell are the materials from which the cell-wall and all its contents are derived. The process by which the cell appropriates to itself these matters is called Assimilation. This function is supposed to be carried on by an independent force or power residing in the cell, or congeries of cells, which form an organ or a body, and has been called the 'assimilative force or property,' 'organising force,' 'plastic force.' It is necessary however in this process to separate between the changes by which one substance is converted into another, and which is probably the result of ordinary chemical force under other circumstances, and the power or force by which these substances are made to assume definite forms in cells and organs. The latter is a special force in the case of each cell, plant, or animal, and to which alone, of the changes involved in the function of assimilation, the term vital can be properly applied.

The result of the appropriation of the new matter absorbed from without in all cells is their enlargement or growth. This takes place in two ways: either the new matter is taken up into the interior of the substance of the cell-wall, which is always the case where the cell becomes augmented in size, or it is deposited in the form of layers in the interior of the cell. According as the first mode of growth is regular or irregular will be the form of the cell. The vegetable and animal kingdoms present almost all conceivable forms of cells, from the spherical and hexagonal cells observed in the lower forms of plants, and the less organised tissues of animals, as cartilage, up to the elongated vessels of the plant, and the irregular cells of bone or areolar tissue in animals. The animal kingdom presents by far the greatest variety in this respect, and so great are the changes that some of the animal cells undergo, that the terms Metamorphoses or Transformations have been applied to these changes. As examples of these cells we may quote—the horny scales of the epidermis, of the hair and the nails, and the laminated pavement, epithelium—in which the cells are flattened, polygonal, or fusiform, and the cell-wall is fused into one mass with the cell-contents; the contractile fibre-cells of the smooth muscles; the tubules of the lens; the prisms of the enamel; the various forms of bone-cells; and the transversely striated cells of muscular fibre.

All cells originate or are produced in the same way. Either they are developed free in vegetable or animal fluids, or they are produced in the interior of preceding cells. In all cases they originate in connection with a substance called protein, which exists in cells, either in the form of a small dark spot called a nucleus, or cytoblast, in the interior of which is a nucleolus, or of an expansion on the interior of the cell, when it is called the primordial utricle. Free cell-development has been observed to take place in plants, in saccharine and other liquids about to undergo the fermentation process, and amongst animals in the chyle, blood, and lymph. The exact mode of the development of cells under these circumstances has not been accurately observed, and the particles or granules of proteinaceous matter from which they are supposed to originate have not yet been proved to have had their origin independent of other cells. The most common form of cell-development is that in which the cell grows around or from the nucleus or primordial utricle. In the animal kingdom the development of the cell more frequently takes place around the nucleus, whilst in the vegetable kingdom its origin is more frequent from the folding in or contraction of the primordial utricle upon itself, by which means two cells originate in one.

Besides the development of cells around the nucleus and round the investing membrane, or primordial utricle, within the walls of the cell, a multiplication of cells frequently takes place by division of the whole cell. This takes place in many of the lower forms of animals and plants [PROTOZOA], and also in the red blood-corpuscles of the embryoes of birds and mammalia, and in the colourless blood-corpuscles of the tadpole. It is probable that further observation will extend our knowledge of this mode of cell-multiplication.

One of the highest problems for the physiology of the present day to solve is, the efficient causes of the phenomena of cell-development. The following propositions have been laid down by Kölliker as an attempt to follow up Schwann's idea of the analogy between chemical changes in inorganic bodies and those which occur in cells:—

1. The nucleus of the cell arises in the first place as a precipitate in an organisable fluid, and afterwards becomes consolidated in such a manner that a special investment and contents with a nucleolus appear. Its development may in this case be compared to that of inorganic precipitates, yet the constantly globular figure and size of the nuclei which are just formed, indicate some essential though not yet recognised condition peculiar to them.

2. In the development of cells by division the cell-nucleus plays exactly the same part which was previously ascribed to the nucleolus, and the occurrence of the formation of cells in this manner demonstrates that chemical conditions are not necessarily concerned therein.

3. In cell-development around portions of contents, and in the cleavage process, the nuclei also operate as simple centres of attraction upon a certain mass of blastema, and then follows the formation of a membrane upon the surface of this mass, which is most simply understood as a condensation of the blastema.

4. In the cell-development directly around the nucleus the investment with blastema is wanting, and the nucleus develops the membrane immediately around itself.

From what has been previously said, it will be seen that the cells are the active seat of the functions of both animals and plants, and the most conspicuous results of organisation takes place in consequence of their agency. They not only constitute the mass of the body, but by their agency alone all the special secretions and products of individual plants and animals are formed. The food is conveyed into the body by cells, the blood of animals is charged with cells, and the functions of locomotion and sensation are carried on by the agency of cells. Nor are these last functions peculiar to the animal kingdom. Contractility and sensibility seem to be the property of the substance (protein) of which the nucleus and primordial utricle are composed. To this substance Mr. Huxley proposes to give the name Endoplast, and thus concludes a lecture on the identity of structure of plants and animals:—

"In both plants and animals then there is one histological element, the Endoplast, which does nothing but grow and vegetatively repeat itself; the other element, the periplastic substance (the cell membrane) being the subject of all the chemical and morphological metamorphoses, in consequence of which specific tissues arise. The differences between the two kingdoms are, mainly, 1, that in the plant the Endoplast grows, and, as the primordial utricle, attains a large comparative size; while in the animal the Endoplast remains small, the principal bulk of its tissues being formed by the periplastic substance; and, 2, in the nature of the chemical changes which take place in the periplastic substance in each case. This distinction however does not always hold good, the Ascidians furnishing examples of animals whose periplastic substance contains cellulose.

"The plant then is an animal confined in a wooden case, and nature, like Sycorax, holds thousands of 'delicate Ariels' imprisoned within every oak. She is jealous of letting us know this; and among the higher and more conspicuous forms of plants reveals it only by such obscure manifestations as the shrinking of the Sensitive Plant, the sudden clasp of the *Dionæa*, or, still more slightly, by the phenomena of the *Cyclosis*. But among the immense variety of creatures which belong to the invisible world she allows more liberty to her Dryads; and the *Protococci*, the *Volvox*, and indeed all the *Algæ*, are during one period of their existence as active as animals of a like grade in the scale. True, they are doomed eventually to shut themselves up within their wooden cages and remain quiescent; but in this respect they are no worse off than the Polype, or the oyster even."

For further information on the subject of Cells, see the articles ANIMAL KINGDOM; BLOOD; HISTOLOGY; BOTANY; CILIA; TISSUES, VEGETABLE; TISSUES, ANIMAL; and also CELLS [*See* SUPPLEMENT].

(Sharpey, in Quain's *Elements of Anatomy;* Kölliker, *Handbook of Human Histology*, translated for the Sydenham Society by Huxley and Busk; Carpenter, *Manual of Human Physiology; Principles of Physiology;* Mohl, *On the Vegetable Cell*, translated by Henfrey; Schleiden, *Principles of Scientific Botany*, translated by Lankester; Schleiden, *On Phytogenesis;* Schwann, *On the Identity of Structure in Plants and Animals*, translated by H. Smith for the Sydenham Society; Quekett, *Lectures on Histology;* Hassall, *Microscopic Anatomy of the Human Body;* Todd and Bowman *The Physiological Anatomy and Physiology of Man;* Quekett, *Catalogue of the Histological Series in the Museum of the Royal College of Surgeons, London; Quarterly Journal of Microscopical Science;* and *Transactions of Microscopical Society*, vol. i.)

CELLULAR TISSUE. This name has been given to certain forms of both animal and vegetable structures. In the animal kingdom it has been applied to that tissue which is found investing and forming the basis of all others. As however this tissue is not more strictly cellular than any of the other structures of the body, and is even less cellular under the microscope than many others, this term has been abandoned by recent anatomical writers, and the term Areolar Tissue substituted. [AREOLAR TISSUE.] The term Cellular Tissue is still made use of by botanists to distinguish those parts of plants in which the cells have not united together to form continuous tubes or vessels. The whole of the tissues of plants like those of animals originate in cells, and it is somewhat difficult to fix the limitations of this term. [CELLS; TISSUES, VEGETABLE.]

CELLULARES, a term applied to the large class of plants, which have also received the names *Cryptogamia, Acotyledons, Agamæ, Exembryonatæ*, and *Acrogens*. [ACROGENS.] It was especially adopted by De Candolle, the primary divisions of whose system consisted of *Vasculares*, or plants with both cellular and vascular tissue, and *Cellulares*, or plants furnished with cellular tissue only. These distinctions do not hold good anatomically, and since the more prominent recognition of the fact that cellular and vascular tissue originate alike in the cell, and are but forms of the same substance, these distinctions have been less regarded.

CELLULARIA. [CELLARIÆA.]

CELO'SIA a genus of plants belonging to the natural order *Amarantaceæ*, comprehending the flowers which gardeners call Cockscombs, on account of the crested flattened appearance of their inflorescence. The calyx consists of 5 narrow sharp-pointed sepals, surrounded by some bracts of the same shape and colour as themselves. The stamens are 5, and united into a plaited cup. The capsule is membranous, 1-celled, opens by a transverse fissure, and contains two or three seeds. The leaves are always alternate. Only two species are cultivated, namely *C. cristata* and *C. coccinea*.

C. cristata, the Common Cockscomb, is said to be a native of the East Indies, but it is more probable that it came originally from either Japan or China, for it is only seen in gardens in the East Indies. It varies in regard both to stature and colour, some of the sorts being as much as two feet high, while others do not exceed six inches; in colour it is seen with deep blood-red, purple, and yellowish-white combs, the latter however is seldom cultivated now.

C. coccinea is by no means so striking a plant as the last in appearance, for it forms little or no crest, but it bears its flowers in panicled spikes. It also is said to be a native of the East Indies, and varies with purple and silvery or yellow flowers.

Nothing can be more easy of cultivation than these flowers; and they are capable of being brought to an extraordinary size by good management.

CELSIA (named by Linnæus in honour of Olaf Celsius, D.D., professor of Greek, and afterwards of Theology, in the University of Upsal), a genus of plants belonging to the natural order *Solanaceæ*. It has a 5-parted calyx, a rotate 5-lobed corolla, 4 perfect stamens, didynamous, bearded. All the species are herbs with simple or pinnate leaves, the flowers disposed in loose terminal racemes, each rising from the axil of a bract or small leaf.

C. orientalis has the lower leaves jagged, those of the stem bipinnate. It is a native of Cappadocia and Armenia.

C. sublanata, shrubby clothed with woolly tomentum, the leaves oval-oblong, obtuse, crenated, wrinkled, soft. It is now cultivated in this country, but its native district is unknown. It has sweet-scented flowers. There are several other species of *Celsia*, all of them closely resembling the species of *Verbascum*, under which genus many of them have been described.

In the cultivation of the species of *Celsia*, the seeds should be sown on a gentle hot-bed, and when the plants are large enough they should be set in separate pots, as they require the protection of a greenhouse or frame the first winter. In the second year they may be planted out about the month of May in any warm sheltered situation. They will flower and ripen their seed in the open air. *C. sublanata* and *C. parviflora* being shrubby plants should be treated as Pelargoniums or other greenhouse shrubs.

(Don, *Gardener's Dictionary*.)

CE'LYPHUS, a genus of Dipterous Insects of the family *Lauxanidæ* (Macquart). It has the following characters:—Antennæ wide apart, as long as the head, stylet rather thick and covered with fine hairs; scutellum convex, and covering the abdomen.

This genus is one of the most extraordinary of the *Diptera*, the species having more the appearance of little beetles than two-winged flies; the peculiarity is caused by the immense size of the scutellum, which covers the whole abdomen and incloses the wings when at rest.

C. obtectus is about one-sixth of an inch in length; the head is yellow; the last joint of the antennæ is black; the thorax and scutellum are of a bluish black colour with violet reflexions; the former is broader than long; the abdomen is fawn-colour, the legs and wings are yellowish, the latter with the base brown. It inhabits Java.

C. scutatus very much resembles the one just described, but is of a greenish copper-colour above and beneath; it is found in the East Indies.

C. Africanus, is a small species inhabiting Sierra-Leone.

CENCHRIS, a genus of Snakes belonging to the family of Rattle-snakes. [CROTALIDÆ.]

CENTAU'REA, a very extensive genus of plants belonging to the Cynaraceous division of the natural order *Compositæ*, but comprehending no species of any importance to man. It has the following characters:—The pappus in many rows, unequal, the second row largest; the anthers with papillose filaments; involucre imbricated; receptacle chaffy; the fruit attached laterally above to the receptacle.

C. Cyanus, the Common Blue-Bottle of corn fields, is sometimes cultivated for the sake of its many-coloured flower-heads. Two others, *C. moschata*, the Purple or White Sultan of gardeners, and *C. suaveolens*, Yellow Sultan, are occasionally seen among other annuals in gardens.

C. Cyanus with the following are British species:—*C. Jacea; C. nigra*, the Black Knapweed; *C. nigrescens; C. Scabiosa*, Great Knapweed; *C. solstitialis*, Yellow Star-Thistle; *C. Calcitrapa*, Common Star-Thistle; *C. Isnardi*.

CENTAURY. [CENTAUREA.]

CENTIPEDE. [MYRIAPODA.]

CENTRANTHUS (from κέντρον, a spur, and ἄνθος, a flower), a genus of plants belonging to the natural order *Valerianaceæ*. It has a regular 5-lobed corolla with a spur, a single stamen, the fruit 1-celled, indehiscent, crowned with the limb of the calyx, expanded into a feathery pappus. The species are smooth herbs with undivided or pinnate leaves, and white or red flowers.

C. ruber, Red-Flowered Spurred Valerian, Red Valerian, has ovate-lanceolate leaves, spur much shorter than the tube of the corolla and twice as long as the germen. It is a native of Great Britain, in chalk-pits and on old walls. It has purple flowers, and attains a height of one or two feet. It has a sweet scent.

C. Calcitrapa has radical leaves, ovate, entire, the stem-leaves pinnatifid, the spur very short. It is a native of the coasts of the Mediterranean, and of the more temperate parts of France. It grows wild at Eltham in Kent, but there is little doubt of its being a naturalised plant there. The first species may have also been introduced, but it grows wild in many parts of Great Britain. Several other species are described and some are grown in gardens. They are elegant border-flowers, and will grow in any common soil, on walls or rock-work, and may be easily propagated by seed.

(Babington, *Manual of British Botany*.)

CENTRA'RCHUS, a genus of Fishes belonging to the section *Acanthopterygii* and the family *Percidæ*, and the subdivision 'with less than seven branchial rays.' In this genus the species have numerous spines in the anal fin; the tongue is furnished with a group of fine and very thickly-set teeth; the pre-operculum is entire; the angle of the operculum is divided into two flat points; and the body is compressed and somewhat oval; they inhabit the rivers of North America. The genus *Cychla* of some American ichthyologists is synonymous with the above.

CENTRINA. [SQUALIDÆ.]

CENTRI'SCUS (Linnæus), a genus of Fishes belonging to the section *Acanthopterygii* and to the family *Fistularidæ*. The species of this genus are principally distinguished by their having a long tubular snout, from which character they have received the names of Sea-Snipes, Trumpet-Fish, &c. The body is inclining to an oblong oval form, compressed, carinated beneath, and covered with scales. The mouth is small, obliquely cleft, and devoid of teeth. There are two dorsal fins; the rays of the first (which is placed very far back) are spinous; the ventral fins are small, and situated behind the pectorals.

Centriscus Scolopax (Linnæus), the Trumpet-Fish or Sea-Snipe (known in Cornwall by the name of the Bellows-Fish), is the only species yet discovered off the British coast, where it is rare; the Mediterranean appears to be its natural locality. Its length is about five inches; the body is oval and compressed; the snout is elongated, and forms a tube which extends about an inch and a half before the eyes, which are large; the back is elevated, and the part for some little distance anterior to the first dorsal fin is straight, whence it tapers rather suddenly to the tail. The anterior spine of the first dorsal (which has but three rays) is very large and denticulated beneath; the rays of the second dorsal are soft; the anal fin is elongated; the ventrals are small, and have a depression behind them in which they may be lodged. The body is covered with hard rough scales, which are minutely ciliated on the external edge.

Young specimens of this fish are of a shining silver-like colour; the adult specimens are reddish, with the sides of the head and under parts silvery or slightly tinted with a golden hue.

There is a figure of this curious fish given in Yarrell's 'British Fishes,' and also in Donovan's 'British Fishes.'

The genus *Amphisile* of Klein is closely allied to, and was included in the genus *Centriscus* by Linnæus; the species have the back mailed with larger scaly plates, of which the anterior spine of the first dorsal fin appears to be a continuation.

CENTRO'LOPHUS, a genus of Fishes belonging to the section *Acanthopterygii* and family *Scomberidæ*. The body is elongate, covered with minute scales; teeth small and numerous; palatine without teeth; one very long dorsal fin.

C. morio, the Black Fish, has been met with though very rarely on the British coast. It is of a black colour, the fins intensely so; the under parts are of a slightly paler hue. The head is rather blunt and rounded in front, and the mouth is small; the eyes are prominent; the body is compressed, and in a specimen 15 inches long is about 3 inches deep. There is a thin elevated ridge on the back, to which the dorsal fin is attached; this fin commences before the middle of the back (viewing it from the side), and extends almost to the tail; the pectoral fins are pointed; the ventral fins are bound down by a membrane; the tail is large and forked; the body is covered with very small scales.

In Mr. Yarrell's 'British Fishes,' one specimen is described as being 15 inches long, and another "measured 2 feet 8 inches in length, and weighed 14 lbs. The skin was observed to be so tough as to be stripped from the fish like that of an eel; no air-bladder was found. The taste was delicious." They were caught off the coast of Cornwall, and the species is described as having great strength and velocity.

CENTRONO'TUS, a genus of Fishes belonging to the section *Acanthopterygii* and family *Scomberidæ*. In this genus the spines, which in most of the Acanthopterygians form the anterior dorsal fin, are free or unconnected by membrane; they have all ventral fins.

The above characters are common to a large number of species of the *Scomberidæ*, and hence it has been thought convenient to seize some minor distinctions for the purpose of dividing the genus *Centronotus* into several sub-genera. In Cuvier's 'Règne Animal' they are as follows:—Sub-genus *Naucrates*, or those in which the body is elongate; the tail carinated at the sides, and which have two free spines before the anal fin. To this sub-genus belongs the Pilot Fish (*Naucrates ductor*), which is well known for its habit of following vessels to a considerable distance in order to feed upon what is thrown overboard; and it is under such circumstances that this fish has been occasionally met with on the British coast. It is about a foot in length, and of a bluish-gray colour, with five broad bands of deep violet. Its shape is something like that of the mackerel, but less tapering towards the head and tail. The pectoral and ventral fins are of moderate size, the latter very close together; the dorsal fin commences about midway between the head and the tail, and continues almost to the latter part; anterior to the dorsal fin there are three free spines: the tail is forked.

Elacates is another sub-genus. The species have nearly the form of the one last mentioned, but differ in the head being depressed, the tail not carinated, and there being no free spines before the anal fin. The next sub-genus, *Lichia*, has free spines before the dorsal and anal fins, and the tail not carinated at the sides. In front of the dorsal spines there is a single one laid flat and pointing forwards. The *Scomber amia* of Linnæus, a large fish upwards of 4 feet in length, which inhabits the Mediterranean, belongs to this section. There are two other species known from the same locality; the one here mentioned is distinguished by the lateral line being much curved and forming an S. The last sub-genus, *Trachinotus*, differs chiefly from *Lichia* in having the profile of the body deeper, and the dorsal and anal fins longer and more tapered.

CENTROPHORUS. [SQUALIDÆ.]

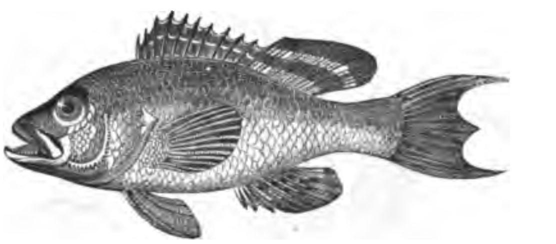
CENTROPO'MUS, a genus of Fishes belonging to the section *Acanthopterygii*, to the division Thoracic-Perches, and the family *Percidæ*. In this genus the muzzle is compressed, as in the pike, and the head, when viewed from the side, is much pointed; the lower jaw projects beyond the upper; the pre-operculum and operculum are covered with scales; the former is dentated, and the latter unarmed. There are two dorsal fins with a distinct intervening space; the anterior one has eight rays, and the posterior eleven; the teeth are very minute and crowded; the ventral fins are under the pectorals.

C. undecimalis, so named from its having eleven rays to the posterior dorsal fin, is common throughout South America, where it forms a considerable article of consumption, and is known by the name of the Sea-Pike; it frequents the mouths of great rivers, and sometimes extends its course up as far as the fresh water.

The Sea-Pike grows to a considerable size, and weighs sometimes as much as 25 lbs. The body is of rather a more elongate form than the common perch; its colour is greenish-brown above and silvery beneath; the anterior dorsal fin is gray; the other fins are yellowish, and finely dotted with black on the edges; the lateral line is black. This species is the only one of the genus known, and is the *Sciæna undecimalis* of Bloch.

CENTROPRI'STIS (Cuvier), a genus of Fishes belonging to the section *Acanthopterygii*, and to the family *Percidæ*, and belonging to the division with 'seven branchial rays and a single dorsal fin.' This genus is distinguished chiefly by the species having all the teeth fine, rather strong and recurved, and closely set: the pre-operculum is serrated; and the operculum is spined.

C. nigricans, the Black Perch or Black Bass, is abundant in the rivers of the United States, and is much esteemed for the table. It is of a deep olive-green colour above, and pinkish on the under parts; the dorsal fin is bluish, with pale transverse bands; the other fins are of a deeper hue; the tail and anal fins are spotted.



Black Perch (*Centropristis nigricans*).

This species is remarkable for having the tail doubly notched, the central and two outer parts projecting. This character however is not so distinct in old individuals. The young are marked with clouded transverse bands.

There are some few other species found on the American coast. The one above described is the *Perca varia* of Mitchell.

(*Transactions of the Literary and Philosophical Society of New York.*)

CENTROPUS (Illiger), a genus of Birds belonging to the order *Scansores*. The species are natives of India and Africa. They have a long pointed thumb-nail, the same as the larks. Their plumage is rigid and spinous. They build their nests in the holes of trees, and lay white eggs. They feed chiefly on grasshoppers, and dwell amongst reeds and other herbage, and do not often take to wing. Their flesh is not pleasant eating.

CENTU'NCULUS, a genus of plants belonging to the natural order *Primulaceæ*. It has a 4-parted calyx, corolla with a subglobose inflated tube and patent 4-parted limb, 4 stamens inserted in the throat of the corolla; the capsule many-seeded, opening all round transversely. The only species of this genus, *C. minimus*, is a native of Great Britain. It is a very minute plant with a prostrate stem, the leaves alternate, ovate, acute; the flowers pale rose-colour, subsessile, without glands at the base. It grows in damp, sandy, and gravelly places, and is known by the common name of Bastard Pimpernel. (Babington, *Manual of Brit. Bot.*)

CEPHAE'LIS, a genus of plants belonging to the natural order *Cinchonaceæ*. The species are remarkable among other things for their flowers growing in close heads, and being surrounded by involucrating bracts, which are sometimes richly coloured. They are chiefly interesting from comprehending the plant which yields the Ipecacuanha Root of the druggists. This species is the *Cephaelis Ipecacuanha*, and is a native of the forests of Brazil, growing in close damp shaded places, and flowering in the months of January and February. It was also met with by Humboldt and Bonpland in the mountains of New Granada. It is a perennial plant, with a weak stem not above 2 or 3 feet long, and usually lying almost prostrate. Its roots are contorted, from 4 to 6 inches long, about as thick as a goose-quill, and separating into rings which are about half as thick as the whole diameter of the root. The leaves collect about the end of the stem or its branches, are of an oblong ovate figure, slightly hairy, from 3 to 4 inches long, and connected by deeply-lobed fringe-like stipules. The flower-heads are very small, surrounded by green bracts, and placed upon the end of a long peduncle; when in flower they are said to be erect, but they are represented as being pendulous in that state as well as when in fruit. The flowers are small and white, and are succeeded by little purple berries. The Puri and Coroado Indians chiefly collect this drug, which furnishes them with a valuable means of barter with Europeans. They gather it at all seasons of the year, principally however in January, February, and March; and the only care they take is to separate the roots from the stem, to lay them up in bundles, and to dry them in the sun.

CEPHALANTHE'RA, a genus of plants belonging to the natural order *Orchidaceæ*, and to the tribe *Limodoreæ*. It has a converging perianth, the lip interrupted, the basal division saccate, jointed to the recurved terminal one, the stigma transverse without a rostellum, the anthers terminal, erect, moveable, shortly and thickly stalked, 2-celled, the cells with imperfect septa, the column elongated, the germen sessile, twisted. Three species of this genus are natives of Great Britain.

C. grandiflora, with ovate-lanceolate or ovate-pointed leaves, bracts longer than the glabrous germen, lips obtuse, included. It has white flowers, with the lips marked with several elevated longitudinal lines. It is found in dense woods, usually on a calcareous soil.

C. ensifolia, with lanceolate-pointed leaves, bracts much shorter than the glabrous germen, lips obtuse, included. The flowers are white, the lips marked with several elevated white lines and a yellow spot in front. It is a rare plant, and found in mountainous woods.

C. rubra has lanceolate acute leaves, bracts longer than the downy germen, the lip acute, as long as the petal. The flowers are purple, the lip white with a purple margin, marked with numerous wavy longitudinal lines. A very rare plant in mountainous woods.

(Babington, *Manual of Brit. Bot.*)

CEPHALANTHUS, a genus of plants belonging to the natural order *Cinchonaceæ*, of which it is one of the most northern representatives. *C. occidentalis*, the Button-Wood, derives its English name from the round balls of flowers with which it is covered in the month of August. This plant is common in swamps, ponds, and stagnant waters, from Carolina to Canada, forming a shrub from 6 to 15 feet in height, with a light spongy wood. The inner bark of its root is an agreeable bitter, and is frequently used as a remedy in obstinate coughs.

CEPHALA'SPIS, a singular genus of Fossil Placoid Fishes, established by Agassiz on specimens from the Old Red-Sandstone of Herefordshire, Forfarshire, &c. The head covering is like the anterior part of a Trilobite. *Cephalaspis Lyellii*, and *C. Lloydii* are British species.

CEPHALO'CULUS, Lamarck's name for a genus of *Branchiopoda*, which he established for the *Polyphemus Oculus* of Müller, and which he places next to *Cyclops*. [BRANCHIOPODA.]

CEPHALO'PODA, Μαλάκια of Aristotle, *Mollia* of Pliny, *Cephalophora* of De Blainville, *Antliobrachiophora* of Gray, a class of Mollusks whose mantle, according to Cuvier, unites beneath the body, and thus forms a muscular sac which envelops all the viscera. This body or trunk is fleshy and soft, varying in form, being either subspherical, sub-plano-elliptical, or elongato-cylindrical, and the sides of the mantle are in many of the species extended into fleshy fins. The head protrudes from the muscular sac, and is distinct from the body; it is gifted with all the usual senses; and the eyes in particular, which are either pedunculated or sessile, are large and well developed. The mouth is anterior and terminal, armed with a pair of horny or calcareous mandibles, which bear a strong resemblance to the bill of a parrot, acting vertically one upon the other. Its situation is the bottom of a subconical cavity formed by the base of the numerous fleshy tentacular appendages which surround it, and which have been termed arms by some naturalists and feet by others.

These appendages in the great majority of living species are provided with acetabula—suckers or cupping-glass-like instruments—by means of which the animal moves at the bottom of the sea, head downwards, or attaches itself to its prey or to foreign bodies. These suckers are either unarmed or armed with a long sharp horny claw, as in *Onychoteuthis*. In the unarmed acetabulum the mechanism for adhesion is so perfect during life that, as Dr. Roget well observes in his 'Bridgewater Treatise,' "while the muscular fibres continue contracted it is easier to tear away the substance of the limb than to release it from its attachment; and even in the dead animal the suckers retain a considerable power of adhesion." The same author clearly describes the apparatus by means of which the acetabulum executes its functions:—"The circumference of the disc is raised by a soft and tumid margin; a series of long slender folds of membrane, covering corresponding fasciculi of muscular fibres, converge from the circumference towards the centre of the sucker, at a short distance from which they leave a circular aperture; this opens into a cavity which widens as it descends, and contains a cone of soft substance rising from the bottom of the cavity, like the piston of a syringe. When the sucker is applied to a surface for the purpose of adhesion, the piston, having previously been raised so as to fill the cavity, is retracted, and a vacuum produced, which may be still further increased by the retraction of the plicated central portion of the disc. Here we have an excellent description of the apparatus for 'holding on,' but the explanation stops short of showing how the operation of 'letting go' is effected. We well remember in our youth going far out with an old fisherman of Dawlish to visit his floating nets which he had laid for the pilchards. As we looked down into the clear blue water we could see that the number of fish entangled was great; but to the great discomfiture of the fisherman, who was eloquent on the occasion, almost every other fish was locked in the embraces of a cuttle-fish plying his parrot-like mandibles to some purpose. The fisherman who seemed to regard these unbidden guests as an incarnation of all evil, carried a capacious landing-net, but so quick was the sight of these Cephalopods, so ready were they in letting go and agile in darting back or sideways clear of the net, that though the greedy creatures held on to the last moment, the fisherman did not secure above three out of the crowds that had spoiled his haul. Upon mentioning this to Mr. Owen, he informed us that the muscular arrangement enabled the animal, when it was disposed to let go its hold, to push forward the piston, and thus in a moment destroy the vacuum which its retraction had produced." The same author ('Cyclopædia of Anatomy and Physiology,' article 'Cephalopoda') has stated that in the Calamary the base of the piston is inclosed by a horny hoop, the outer and anterior margin of which is developed into a series of sharp-pointed curved teeth. These can be firmly pressed into the flesh of a struggling prey by the contraction of the surrounding transverse fibres, and can be withdrawn by the action of the retractile fibres of the piston. [SEPIADÆ.]

Digestive Organs.—The tongue, which is beset with horny points, lies between the mandibles, and the œsophagus widens into a kind of crop which leads to a gizzard nearly as fleshy as that of birds. To the gizzard succeeds a third stomach, which is membranous and somewhat spiral, wherein the liver, which is of considerable volume, pours the bile. The rectum opens into the infundibulum.

Respiratory Organs.—These are branchial, and the branchiæ are equal, symmetrical, and protected by the mantle under which they are concealed. The infundibulum, or funnel (entonnoir of the French), is a fleshy pipe or passage in front of the neck, through which the respiratory currents pass and the excrements are discharged. The young, as in other classes, respire more quickly than the adult. Dr. Coldstream saw an *Eledone*, one inch and a half in length, breathe eighteen times in a minute, while another of the same species, four inches in length, breathed only ten times in a minute.

Circulating Organs.—The higher organised Cephalopods present the remarkable circumstance of having three separate and well-organised hearts: one for the circulation of the arterial blood through the body, the other two for the propulsion of the venous blood through each gill or respiratory organ. Only the first of these hearts, or the 'systemic,' is present in the Pearly Nautilus, which is, according to Owen, the type of the lower order of the class. In both divisions the venous system is characterised by the glandular bodies appended to the branchial divisions of the vena cava, or main venous trunk.

Sexual Organs.—Separate and developed in distinct individuals. It is not determined whether impregnation is effected before the ova are excluded, during their exclusion, or afterwards. Cuvier was of opinion that fecundation is effected by arrosement, as in the majority of fishes. The ovary of the female is situated in the bottom of the sac. Two oviducts receive the eggs from the ovary, and carry them out across two large glands, which envelop them with a viscous substance, and unite them together into bunches like grapes.

Brain and Senses.—The brain is included in a cartilaginous cavity in the head, and gives off on each side a nervous cord, which forms in each orbit a large ganglion, whence proceed innumerable optic nervous filaments. The eye is composed of numerous membranes, and covered by the skin, which becomes transparent in front of the organ, and sometimes forms folds which perform the office of eyelids. Owen has observed that the cornea of *Rossia* is defended by a circular fold of integument, which can be completely closed by an orbicular sphincter in front of the eye—a structure which is probably required in this species in order to protect the cornea against the spicula of ice, with which its native seas abound, especially in the summer or thawing season. In the Calamary (*Loligo*) on the other hand, there is no tegumentary fold. The ear is nothing more than a small cavity hollowed out on each side near the brain, without semicircular canals or an external tube, and in this cavity is suspended a membranous sac containing a limpid fluid and a small compact stony substance or otolithe, a sort of ossiculum auditûs.

Ink-Bags.—The excretion from these bags is of a deep black, and in those species in which it occurs (for it is not common to the whole family) it is produced by a gland appropriated to its secretion, and reserved in a small bag till the exigencies of the animal call for its effusion to cloud the surrounding water in order that it may conceal itself. It has been long considered that the Indian Ink imported from China is manufactured from this secretion, but Cuvier observes that M. Rémusat has found nothing in Chinese authors confirmatory of this opinion. That it makes an excellent pigment even after having been buried for thousands of years in the earth is proved by Dr. Buckland's fossil ink, which he submitted to a celebrated painter, who immediately inquired from what colourman such good sepia might be procured.

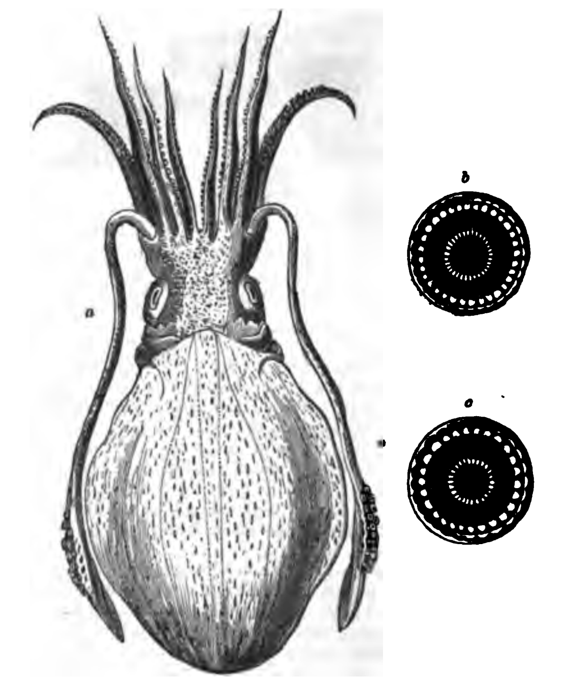
The skin of the naked species is changeable, showing spots which brighten and fade with a rapidity superior to the cuticular changes of the chamæleon.

Food.—Principally fishes and crustaceans; but there is little doubt that few animal matters come amiss to these mollusks, for they are most voracious.

Geographical Distribution.—Very wide. Hardly any sea is without some species of the family. Captain Ross discovered a new genus (*Rossia*, Owen), in the Arctic Ocean, which has since been found in our own seas. Fabricius describes two species which frequent the coasts of Greenland. ('Fauna Grœnlandica,' p. 361.)

Utility.—The flesh, especially that of the arms, is eatable, and is considered very nutritious. Though neglected in the British Islands, it is brought to table in other countries. The arms, cut into portions and prepared for cookery, are to be frequently seen in the Neapolitan market. The cuttle-bone is used for erasures, and manufactured into 'pounce' of the shops. The prepared ink is capable of being made into a pigment. That the Naked Cephalopods formed a favourite dish with the ancients, and were considered not unworthy of the most exquisite cookery, there is no doubt. (See for instance Athenæus, 'Deipnosoph.' lib. i. vi., vol. i., p. 14: lib. vii. lxxxvii. et cxxx., vol. iii., pp. 140 et 199: lib. xiv. xvii., vol. v., p. 255, Schweighäuser's edition.)

The natural division of the class is into those Cephalopods which are naked (*Cephalopoda nuda*), and those which are protected by an external shell (*Cephalopoda testacea*). Of the former, *Sepia officinalis*, the Common Cuttle-Fish, may be taken as an example; and the following cut will give a general idea of the form of a naked Cephalopod, but this varies in the different genera. In *Sepia officinalis* the soft parts are supported by a firm calcareous bone, the well-known cuttle-bone of the shops, and in all the naked Cephalopods (not including *Argonauta*) now existing, it would appear that some rudiment at least of a bony, horny, or cartilaginous support is to be found. [SEPIADÆ.]



The Cuttle-Fish (*Sepioteuthis sepiacea*).

a, *Sepioteuthis sepiacea*; the dotted line shows the place and shape of the dorsal piece, or cuttle-bone; *b*, the lower side of an acetabulum of *Octopus vulgaris*; *c*, of an acetabulum of *Eledone*.

The *Nautilus Pompilius* affords an example of the testaceous Cephalopods, or those which are protected by a shell. [NAUTILIDÆ.]

Professor Owen has however shewn the necessity of dividing this order into two groups, which he proposes to call *Dibranchiata* and *Tetrabranchiata*.

The *Dibranchiata* are characterised by possessing two branchiæ; and to this division all the Naked *Cephalopoda* belong, such as the species of the genera *Sepia*, to which the Common Cuttle-Fish belongs, *Loligo*, *Octopus*, *Rossia*, and *Ommastrephes*.

The *Tetrabranchiata* possess four branchiæ; and to this division the *Nautilus* [NAUTILIDÆ], and the bulk of the fossil species of *Cephalopoda* known under the names of *Ammonites*, *Goniatites*, *Ceratites*, &c., belong. The extinct animals of this division are by far the most numerous.

None of the *Tetrabranchiata* exist in the British seas; there are however several forms of *Dibranchiata*, of which the following synopsis from Forbes and Hanley's 'British Mollusca,' will give an idea :—

Family, OCTOPODIDÆ.
Genus, *Octopus*. [OCTOPODA.]
O. vulgaris.
Genus, *Eledone*. [OCTOPODA.]
E. ventricosa.

Family, TEUTHIDÆ.
Genus, *Sepiola*. [SEPIADÆ.]
S. Atlantica.
S. Rondeletii.
Genus, *Rossia*. [ROSSIA; SEPIADÆ.]
R. macrosoma.
R. Owenii.
Genus, *Loligo*. [LOLIGO.]
L. vulgaris.
L. media.
L. marmora.
Genus, *Ommastrephes*. [OMMASTREPHES.]
O. sagittatus.
O. todarus.
O. Eblana.

Family, SEPIADÆ.
Genus, *Sepia*. [SEPIADÆ.]
S. officinalis.
S. biserialis.
Genus, *Spirula*. [SPIRULA.]
S. Peronii.

Fossil Cephalopoda.

These are multitudinous, and in the bye-gone ages of the world appear to have been powerful instruments for keeping down the other tribes of ancient Testaceans, Crustaceans, and even Fishes; for many of them—certain *Orthocerata* and *Ammonites* for example—afford evidence of gigantic dimensions. In the periods prior to the Chalk Formation, and at the time of its deposit, they were the agents employed for this purpose, and were succeeded in the Tertiary period by the Fossil Trachelipods, which are either entirely absent or very scarce in the Secondary and Transition series, while the Fossil Cephalopods occur but rarely in the Tertiary beds. The extinct Ammonite [AMMONITES], Baculite, Belemnite, Hamite, Orthoceratite, Turrilite, and Scaphite, will readily occur to the fossil zoologist as some of the ancient class. The *Foraminifera*, formerly placed by D'Orbigny in this class, are now no longer regarded even as *Mollusca*. [FORAMINIFERA.]

The following is M. D'Orbigny's division and arrangement of the class *Cephalopoda*, including both recent and fossil genera :—

Order A. ACETABULIFERA, Fer. and D'Orb.; DIBRANCHIATA, Owen.

OCTOPODA. Genus, *Octopus*, Lam.; Ex., *O. vulgaris* (fig. 2506, 2507); *O. ventricosus* (2509).
" *Eledone.*
" *Philonexis*, D'Orb.
" *Argonauta*, Linn.; Ex., *A. Argo* (2530, 2532).

DECAPODA. " *Cranchia*, Leach; Ex., *C. scabra* (2515).

Fam. SEPIADÆ, Cuttle-Fishes. [SEPIADÆ.]
" *Sepiola*, Lam.; Ex., *S. vulgaris* (fig. 2510); *S. stenodactyla* (2511, 2512).
" *Rossia*, Owen; Ex., *R. palpebrosa* (2513).
" *Sepia*, Linn.; Ex., *S. officinalis* (2519, 2520).

Fam. LOLIGIDÆ.
" *Loligo*, Lam.; Ex., *L. vulgaris* (2518).
" *Sepioteuthis*, Blain., R. and F.
" *Teudopsis*, Deslongchamps. Foss.
" *Loligopsis*, Lam.
" *Histioteuthis*, D'Orb.
" *Leptoteuthis*, Meyer.
" *Beloteuthis*, Münster.
" *Belemnosepia*, Agassiz.

Fam. TEUTHIDÆ, Calamaries. [TEUTHIDÆ.]
" *Onychoteuthis*, Lichtenstein; Ex., *O. Banksii* (2516).
" *Enoploteuthis*, D'Orb.
" *Acanthoteuthis*, Wagner.
" *Kalæna*, Münster.
" *Ommastrephes*, D'Orb.

Fam. BELEMNITIDÆ. [BELEMNITES.]
" *Cenoteuthis*, D'Orb.
" *Belemnitella*, D'Orb.
" *Belemnites*, i. *Acuari*. Oolitic.
ii. *Canaliculati*. Oolitic.
iii. *Hastati*. Oolitic and Cretaceous.
iv. *Clavati*. Lias.
v. *Dilatati*. Neocomien.

Fam. SPIRULIDÆ. [SPIRULA.]
" *Spirula*, Lam.
" *Spirulirostra*, D'Orb.
" *Beloptera*, Dis.; Ex., *B. sepoidea* (2584); *B. belemnoidea* (2585).

Order B. TENTACULIFERA, D'Orb.; TETRABRANCHIATA, Owen.

1st Fam. NAUTILIDÆ. [NAUTILIDÆ.]
Genus, *Nautilus*; Ex., *N. Pompilius* (2521); *N. scrobiculatus* (2522).
Fossil species. *a. Striati.*
b. Radiati.
c. Lævigati.
" *Lituites*, Breyn, F.; Ex., *L. articulatus* (2581).
" *Hortolus*, Montfort, F.
" *Nautiloceras*, D'Orb., F.
" *Aploceras*, D'Orb., F.
" *Gomphoceras*, Lew., F.
" *Gonioceras*, Hall, F.
" *Orthoceratites*, Breyn, T.; Ex., *O. laterale.*
" *Actinoceras*, Bronn.
" *Endoceras*, Hall.

2nd Fam. CLYMENIDÆ. [CLYMENIDÆ.]
* Partitions without lateral or dorsal lobes.
Genus, *Melia*, Fischer.
" *Cameroceras*, Conrad.
" *Campulites*, Desh.; Ex., *C. ventricosus* (2582, 2583); *Phragmoceras*, Sow.
" *Trocholites*, Conrad.
** Partitions with one lateral lobe but no dorsal lobe.
Genus, *Clymenia*, Münster.
" *Megasiphonia*, D'Orb.

3rd Fam. AMMONITIDÆ. [AMMONITES.]
* Without a dorsal lobe.
Genus, *Oncoceras*, Hall.
" *Cyrtoceras*, Goldfuss; Ex., *C. depressum* (2580).
" *Gyroceras*, Meyer.
" *Cryptoceras*, D'Orb.
** One dorsal lobe.
Genus, *Stenoceras.*
*** Partitions angular, not branched; lateral lobes, and one-angular dorsal lobe.
Genus, *Goniatites* [GONIATITES]; Ex., *G. truncatus*, *G. Listeri*, *G. spirorbis*, *G. Gibsoni.*
i. *Linguati.*
ii. *Lanceolati*; Ex., *G. Henslowi* (2558).
iii. *Genufracti*; Ex. *G. striatus* (2563).
iv. *Serrati.*
v. *Crenati.*
vi. *Acutolaterales.*
vii. *Magnosillares*; Ex., *G. sublævis* (2557).
viii. *Nautilini*; Ex., *G. expansus* (2556).
" *Ceratites*, De Haan; Ex., *C. nodosus* (2547).
**** Partitions branched, one dorsal lobe.
Genus, *Ammonites*, Brug. [AMMONITES.]
i. Oolitic Groups.
Arietes. Lower Lias; Ex., *A. obtusus* (2538).
Falciferi. Upper Lias.
Amalthei.
Ornati. Oxford Clay.
Capricorni.
Coronati. Inf.-Oolite.
Armati. Upper Oolite.
ii. Oolitic and Cretaceous Groups.
Heterophylli. D'Orb.
Macrocephali.
Fimbriati. D'Orb.
Planulati.
iii. Cretaceous Groups.
Cristati.
Tuberculati.
Clypeiformes.
Pulchelli.
Rothomagenses (2548).
Dentati.
Flexuosi.
Compressi.
Angulicostati.
Ligati.
" *Scaphites*, Parkinson.
" *Crioceras*, Léveillé; Ex., *C. Duvallii* (2550).

Genus, *Toxoceras*, D'Orb.
„ *Baculites*, Lam.; Ex. *B. vertebralis* (2576).
„ *Ptychoceras*, D'Orb.
„ *Hamites*, Parkinson.
„ *Turrilites*, Lam.; Ex., *T. costatus* (2577).
„ *Heteroceras*, D'Orb.
„ *Helicoceras*, D'Orb.

CEPHALOPTERA. [SQUALIDÆ. *See* SUPPLEMENT.]

CEPHALOPTERUS. [CORACINA.]

CEPHALOPUS. [ANTILOPEÆ.]

CEPHALOTA'CEÆ, a natural order of Exogenous Plants. It consists of but one genus, and that of only one species, the *Cephalotus follicularis*, Australian Pitcher-Plant. It has the following essential characters:—Calyx coloured, 6-parted, with a valvate æstivation; no corolla; stamens 12; those opposite the sepal shortest, inserted into the edge of a deep glandular perigynous disc; anthers with a thick granular connective, carpels six, distinct, 1-seeded, ovate, erect; achenia membranous, opening by the ventral suture, surrounded by the persistent calyx and stamens; seed solitary (sometimes two), erect; embryo minute, in the base of the axis of a fleshy friable somewhat oily albumen. The *Cephalotus follicularis* has small white flowers, with a simple scape, bearing a compound terminal spike; the leaves are exstipulate, and have mingled amongst them operculate pitchers. This plant, according to Labillardière, is allied to *Rosaceæ*, and, according to Jussieu, to *Crassulaceæ*. Brown places the order between *Crassulaceæ* and *Francoaceæ*. Lindley points out its relations through the last order to *Pittosporaceæ* and *Sarraceniaceæ*, where the leaves of the plants are also converted into pitchers. He also formerly placed *Dionæa* in this order, and observed that it differed little from *Cephalotus* except in the presence of petals, and in the syncarpous fruit, with the seeds collected upon a flat central placenta. He now places *Dionæa* with *Droseraceæ* and *Cephalotus* in or near *Ranunculaceæ*. [DIONÆA.]

In cultivating the Australian Pitcher-Plant it should be placed in turfy peat soil either in a box or pot. It should be kept rather moist, and this may be effected by placing the pots in pans of water. The plants are always the healthier for allowing moss to grow over the surface of the soil in which they are planted. They can only be increased by seed.

(Lindley, *Natural System*; Don, *Gardener's Dictionary*.)

CEPHALOTES. [CHEIROPTERA.]

CEPHALOTUS. [CEPHALOTACEÆ.]

CEPHEA. [ACALEPHÆ.]

CEPHUS. [COLYMBIDÆ.]

CEPHUS, a genus of Hymenopterous Insects belonging to the family *Xiphydriidæ* (Leach). It has the following characters:—Antennæ rather long, growing gradually thicker towards the apex; head transverse, joined to the thorax by a distinct and rather long neck; mandibles exserted; maxillary palpi long and slender; body somewhat compressed, especially towards the apex; ovipositor distinct, exserted.

C. pygmæus is common in flowers, particularly buttercups. It is about one-third of an inch in length; black, with two yellow fasciæ on the abdomen; the palpi and tibiæ also more or less yellow. The larva of this insect is said to live in the stems of wheat. Mr. Stephens enumerates ten British species of this genus, most of which are black, with yellow fasciæ.

CEPO'LA (Linnæus), a genus of Fishes belonging to the section *Acanthopterygii* and family *Tænioidei*. The technical characters of this genus are:—Body much elongated, compressed, and tapering gradually towards the tail, which is pointed; head (when viewed from the side) about the same width as the body; snout short and obtuse; under jaw curved upwards; teeth curved and well developed; dorsal fin extending from the head to the tail (which is pointed); anal fin extending thence nearly the whole length of the body; branchiostegous membrane with six rays.

C. rubescens, the Red Band-Fish and Red Snake-Fish, has been found on the British coasts, but is not uncommon in the Mediterranean. It is of a pale carmine colour, and varies from 10 to 15 inches in length; it is very smooth and almost destitute of scales; the body is slender, much compressed, and tapers very gradually from the head to the tail. The riband-like and compressed form of the body increases with age; the young are somewhat oval, or almost round. The pectoral fins are small; the ventrals are situated rather anterior to the line of the origin of the pectorals, and have the first ray spinous. The dorsal and anal fins both extend to and join the tail, or caudal fin (which terminates in a point), so that they form one continued fin. (Yarrell's 'British Fishes;' Jenyn's 'Manual of British Vertebrate Animals;' Linnæan 'Transactions,' vol. vii., &c., where this fish was recorded as British for the first time by Colonel Montagu.)

C. tænia (Linnæus) is said to differ from the species just described in having a row of hard points along the side of the body above the lateral line, and in having an inner row of teeth in the lower jaw: it is however very probably not a distinct species.

CERADIA, a genus of plants belonging to the Corymbiferous division of the natural order *Compositæ*. *C. furcata* is a half-succulent plant inhabiting the most sterile regions of south-western Africa. It yields in some abundance a brittle resin-like substance, which gives out a fragrant odour when burnt, and has been called African Bdellium; it is however a very different thing from the true Bdellium. [BDELLIUM.]

CERAMBY'CIDÆ, a family of Coleopterous Insects of the section *Longicornis* (Latreille). They are characterised by the body being generally elongate; antennæ very long, as long or longer than the body; labrum very distinct and broader than long; maxillæ with the terminal processes membranaceous and projecting; mandibles moderate; eyes lunate, partly surrounding the basal joint of the antennæ; thorax nearly cylindrical, or orbicular, truncated before and behind; legs rather long, and generally compressed; tarsi spongy beneath, penultimate joint bilobed.

The *Cerambycidæ* are found in all parts of the globe, but they abound most in hot climates, and constitute a very extensive group of coleopterous insects, the most striking feature of which is the great length of the antennæ. One of their most important functions appears to be to assist with numerous other wood-feeding insects in the removal of old and decaying trees: it is in the larva state principally that this business is performed. The parent insect deposits her eggs in a hole excavated for the purpose. When these are hatched the larvæ commence feeding upon the wood, and in so doing excavate burrows in various directions, but mostly longitudinal; in this state they frequently live for two or three years, and the perforations which they make are very extensive.

The larvæ are elongate, broadest towards the head, and taper slightly towards the tail, and are composed of 13 segments. They have 6 legs (situated one on each side, on the under part of the three anterior segments of the abdomen) which are so minute as to be scarcely apparent. They move chiefly by means of the segments of the body, which have the upper and under surfaces flat and covered with minute tubercles. In making their way in the cylindrical or (what is almost always the case) oval burrows, the animal protrudes these parts of the segments above and beneath, and thus thrusts itself forward. The head has the appearance of being composed of two segments; the hinder part is very broad (almost equalling that of the segment in which it is inserted), terminated on each side anteriorly by an angle, and separated from the fore part, which is narrow, by an elevated ridge; the jaws (mandibles) are short and very stout and strong; the antennæ are scarcely visible; the palpi are small. The first segment of the abdomen, or that next the head, is protected by a shield above of a horn-like substance.

The pupæ are what is termed incomplete, that is, when the external organs (such as the wing-cases, antennæ, legs, &c.) are each inclosed in a separate and distinct sheath, and "consequently not closely applied to the body, but have their form for the most part clearly distinguishable." The antennæ, which have been before described as being very long in the perfect insect, are bent backwards, and lie along the back of the pupa until they reach the apex of the body; they are then recurved and extend along the under side, and if very long they are again recurved, so that they, as well as all the other parts, lie close to the body.

The *Cerambycidæ* in the perfect state frequent flowers, especially the *Umbelliferæ*; the large species are often found on the trunks of trees. Different individuals of the same species vary extremely in size, a circumstance frequently observed in those insects whose larvæ feed on wood, and arising most probably from the degree of moisture or dryness of the food.

M. Latreille restricts the genus *Cerambyx* to those species which have an unequal or rough thorax, usually spinous or tuberculated, and dilated in the middle at the sides, with the third, fourth, and fifth joints of the antennæ evidently thicker than the following ones, and the remaining joints abruptly longer and thinner.

C. heros affords an example of this genus: it is about an inch and a half in length; of an elongate form, attenuated posteriorly; black; elytra with the apex pitchy, or brown; the thorax is rough and shining, and has a spine on each side. This species, together with another belonging to the same genus (*C. cerdo*), has been found in England, but it is extremely rare; in the warm and temperate parts of Europe it is common. The larva perforates the oak, and according to Latreille is perhaps the Cossus of the ancients.

The genus *Cerambyx* of Mr. Stephens and most of the British entomologists is synonymous with that of *Callichchroma* of Latreille, whereas the characters given by him for *Cerambyx* agree with those of *Hamaticherus* of English authors.

The Musk-Beetle, which is very common in the south of England on old pollard willows, will serve to illustrate the genus *Cerambyx* of Stephens's 'Illustrations of British Entomology.' It is about an inch and a half in length, of an elongate and somewhat linear form; its colour is usually bright green, sometimes blue: the under part of the body is bluish.

This insect emits a very strong and agreeable odour, which is not unlike attar of roses. It certainly bears no resemblance to musk, though those who gave it the name of Musk-Beetle appear to have thought that it did.

CERAMBYX. [CERAMBYCIDÆ.]

CERAMIACEÆ. [ALGÆ.]

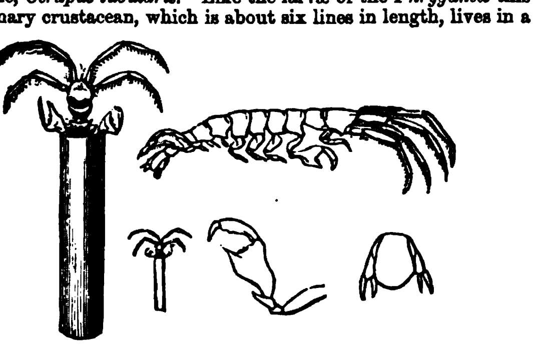
CERA'MIUS, a genus of Hymenopterous Insects belonging to the section *Diploptera* (Latreille). This genus is arranged by Latreille next to the True Wasps. It is readily distinguished by the superior wings being flat (not folded as in the wasps) and having only two cubital cells; the labial palpi are longer than the maxillæ. [VESPIDÆ.]

CERAPTERUS. [PAUSSIDÆ.]

CE'RAPUS, a genus of Amphipodous Crustaceans forming the sixth division of the third section of the order *Amphipoda* (Latreille), according to Desmarest. The following are the characters of this division:—All four antennæ very great and strong, and nearly of the same length; the upper with four joints, the lower or lateral ones with five.

Say first established this genus, which has the antennæ hairy, and performing in some sort the office of limbs, herein corresponding in a degree to the lower antennæ of the *Corophia* of Latreille. Feet of the first pair small, and terminated by a simple short nail; those of the second pair on the contrary very large, having a large, flat, triangular manus provided with a biarticulated thumb, corresponding to a well-developed point which represents the immoveable finger in the ordinary crustaceans; those of the three succeeding pairs moderate and monodactylous, and the four last longer, more slender, and directed backwards and upwards. Body long, linear, demicylindrical, composed of twelve segments, the last of which is flattened into the form of an oval plate furnished on each side with a small bifurcated appendage at the extremity. Head terminated by a very small rostrum. Eyes projecting.

Example, *Cerapus tubularis*. Like the larvæ of the *Phryganeæ* this extraordinary crustacean, which is about six lines in length, lives in a



Cerapus tubularis.

small cylindrical tube, which is considered to be that of a *Tubularia*, exposing only the head, the four large antennæ, and the two first pairs of feet. The species occurs in abundance in the sea near Egg Harbour in the United States, in the midst of *Sertulariæ*, which are supposed to form its principal food. (*Journal of the Academy of Nat. Sci. of Philadelphia*, vol. i. p. 49, pl. 4.)

CERASITE, a native Chloride of Lead. It has a white, yellowish, or reddish colour, is nearly opaque, and has a pearly lustre. Its specific gravity is 7 to 7·1. It consists of lead 83, and chlorine 14. It is found in the Mendip Hills, Somersetshire.

CERASTES. [VIPERIDÆ.]

CERA'STIUM (from κέρας, a horn), a genus of plants belonging to the natural order *Caryophyllaceæ*. It has a 5-parted calyx, 5 petals, all bifid; stamens 10, 5, or 4; styles 5 or 4; the capsules tubular, opening at the end, with 10 teeth. This is an extensive genus, containing species which are common weeds in the temperate climates of most parts of the world. Don enumerates 82 species; of these 9 are British.

C. alpinum, Alpine Mouse-Ear Chickweed, has a hairy ascending stem, the leaves ovate, ovate-oblong, or lanceolate; the flowers few; the sepals bluntish, with membranous margins; bracts herbaceous, their margins often narrowly membranous; the capsules, at length, twice as long as the calyx. This plant is a native of the Pyrenees, the mountainous parts of Wales and Scotland, and of Melville Island. It is subject to great variations, and a number of varieties have been described by Brown, Bentham, and other botanists.

C. glomeratum has ovate leaves, acute lanceolate sepals, with a narrow membranous margin, and, as well as the herbaceous bracts, hairy throughout; the capsule cylindrical, ascending, twice as long as the calyx; fruit-stalks about as long as the calyx. This is a common plant in fields and on banks, flowering from April to September. The other British species are *C. triviale*, common in fields; *C. semidecandrum*, found in dry places: *C. atrovirens*, inhabiting sandy places and rocks near the sea; *C. pumilum*, found only near Croydon in Surrey; *C. tetrandrum*, found at Tynemouth and Shetland; *C. latifolium*, a rare plant; and *C. arvense*, abundant in chalky and gravelly places.

A few of the species, as *C. tomentosum*, *C. grandiflorum*, and *C. Dahunicum* are worth cultivating as border flowers. *C. latifolium*, *C. alpinum*, and *C. glaciale* are adapted for growing on rock-work, or in small pots, when they should be placed in a mixture of loam, sand, and peat. They require the same general treatment as most hardy plants. The annual species may be propagated by sowing seed in an open border in the spring; the perennial, by dividing the plants at the root.

(Don, *Gardener's Dictionary;* Babington, *Manual.*)

CE'RASUS, a genus of plants belonging to the Amygdaloous division of the natural order *Rosaceæ*, and including the Common Cherry among its species. It is hardly different from *Prunus*, there being little or nothing to distinguish it beyond its leaves when young being folded flat instead of being rolled up. Botanists seem however pretty well agreed in looking upon the Cherries as a genus distinct from Plums, and we follow their example. The species may be divided into the True Cherries, the Bird-Cherries, and the Cherry-Laurels.

Section I. True Cherries. Flowers growing in Umbels or singly, or occasionally in short Corymbs; usually appearing earlier than the Leaves.

1. *C. Avium* (*Prunus Avium*, Linn.), the Wild Cherry. Flowers appearing with the leaves, which are pale and rather downy underneath. Branches when young weak and spreading. Fruit roundish, with a soft flesh and an austere juice. A native of the woods of Europe and the west of Asia; and in a cultivated form common in gardens. In this country it occurs as far to the north as Ross-shire, where it exists in the form of a dwarf bush propagating itself rapidly by the roots. The wood is remarkable for the large size of its medullary processes, which give its longitudinal section a bright satiny lustre, and render it well suited for ornamental cabinet work. In this respect it is much superior to the *C. vulgaris*. When growing in gravelly or sharp sandy situations with a dry bottom, which are the only localities where it thrives, it acquires a very considerable size, occasional specimens being spoken of as much as 80 feet and more in height; it is however more commonly seen in the state of coppice wood. To this species we presume all the weeping or weak-branched cultivated cherries with an acid juice are to be referred either as genuine varieties or hybrid forms; such are the Merise or Merisier, Morello, Kentish and All Saint, or Overflowering Cherry, which last is often made into a species by systematic writers, and called *C. semperflorens*. Some of the varieties, especially the Double-Flowered French, as it is commonly called, the Double Merisier of the French, are remarkable for their elegance and beauty. *C. Avium* is the *Cerasus sylvestris* of Ray; and the *C. marasca*, or Marasche Cherry, of Dalmatia, from which maraschino is prepared, has no specific marks to distinguish it.

2. *C. vulgaris* (*Prunus Cerasus*, Linn.), the Common Cherry. Flowers appearing earlier than the leaves, which are light green and smooth underneath. Branches when young stiff and erect. Fruit roundish or heartshaped, succulent, more or less firm, and sugary. Found wild in the woods of Asia Minor, where it acquires a very large size. Walsh speaks of it as being still common along the northern coast of Asia Minor, whence the 'original cherry' was brought to Europe. One variety is chiefly seen in gardens, the other grows in woods in the interior, particularly on the banks of the Sakari, the ancient Sangarius. The trees attain a gigantic size; they are ascended by perpendicular ladders suspended from the lowest branches. Walsh measured one of them 5 feet in circumference (?), 40 feet to the origin of the lowest branches, and from 90 to 100 feet in full height; this large tree was loaded with delicious, fine, transparent, amber-coloured fruit. Dr. Royle considers the cherry wild in Cashmere. It was introduced into Europe by the Romans under Lucullus, about half a century before the birth of Christ, and has ever since formed one of the most esteemed varietes of dessert fruit. It differs from the genuine form of *C. Avium* in the characters above assigned to it, as also in its wood having such small medullary processes that nothing like a satiny appearance in it is produced, whatever the direction be in which it is cut; hence its grain is plain, and it is but ill suited for cabinet-makers' work. It is to be presumed that this exotic species is the origin of the sweet large cherries called Bigarreaus, Guignes, and the like, to which must undoubtedly be added the Tartarian Cherries of the English gardens. That the two species now enumerated were really distinct in the beginning we have little doubt; but long cultivation and their intermixture by hybridising, either intentional or accidental, have so confused them that the gardens are filled with intermediate races, and their limits are lost sight of.

It is here that the *C. juliana* and *Duracina* of modern botanists have to be referred; while their *C. caproniana*, or acid succulent cherries, are probably hybrids. [CHERRY.] For a full account of these species see Loudon's 'Arboretum Britannicum.'

3. *C. chamæcerasus*, the Ground-Cherry. Flowers in umbels, either with the leaves or earlier. Leaves obovate-lanceolate, shining, crenated, quite smooth, with few or no glands. Fruit spherical, acid, with stalks longer than the leaves. A dwarf species, never rising above 3 or 4 feet high, and in the gardens usually budded on the common cherry at the height of 5 or 6 feet from the ground. It is not ornamental, and is seldom seen. Its native situations are stony, rocky, mountainous places, about the skirts of woods and in hedges in the eastern parts of Europe and west of Asia; it is common in Lower Austria and Hungary. Gmelin met with it in Siberia, and Ledebour in the Kirghis Desert, near Karkaraly, in the Altai.

4. *C. nigra*, the Black American Cherry. Flowers in sessile umbels, appearing before the leaves; light pink. Leaves obovate-oblong or

obovate-lanceolate, often cuspidate, somewhat doubly serrated, with or without two glands at the base, slightly rugose. Segments of the calyx toothed. Native of the northern states of the North American Union, and extending into Canada and Newfoundland. It forms rather a handsome tree, with its loose umbels of pinkish flowers. The fruit is as large as a moderately-sized cherry.

5. *C. Pennsylvanica*, Pennsylvanian Cherry. Flowers in sessile umbels, appearing along with the leaves. Leaves ovate or oval, sharp-pointed, smooth, and rather shining, with minute unequal toothings. Segments of the calyx toothless. A native of the more northern parts of North America, especially in Canada, where it is common. It forms a small tree, very like *C. nigra* in some respects, but differing from that species in its much smaller colourless flower and smooth rather shining leaves, which never acquire the obovate figure so common in *C. nigra*. The fruit is that of a bird-cherry, and is said to be sweet. *C. borealis* is considered by Sir William Hooker as being identical with this. It is represented in the southern states of the American Union by *C. umbellata*, which appears to differ chiefly in having spinous branches, more finely serrated leaves, and downy calyxes.

6. *C. serrulata*, the Fine-Toothed Cherry. Leaves oblong-lanceolate, obtuse at the base, tapering to the point, bordered with fine bristle-pointed teeth, thin, and not shining. A native of China, and only known in our gardens with double flowers. These are exceedingly delicate and beautiful, but they appear at so early a season as to be liable to injury from the spring frosts.

7. *C. pseudocerasus*, the Chinese Cherry. Flowers in hairy loose corymbs, appearing before the leaves, with a long hairy tube to the calyx. Leaves ovate or obovate, cuspidate, doubly serrated, slightly downy on the veins. A Chinese species, probably from the northern provinces of that great empire. It bears a small pale-red sweet fruit, which is more readily forced than that of the Common Cherry.

8. *C. depressa*, the Sand-Cherry. Flowers appearing a little earlier than the leaves, or about the same time, in small compact umbels. Leaves obovate-lanceolate, serrated, glaucous on the under side, bluish-green and somewhat shining on the upper. Fruit mucronate. A small bush resembling a dwarf almond, covered with profusion of small white flowers in May, and afterwards with small, black, bitter, shining, sharp-pointed fruit. It is found in Canada and the northern part of the United States.

9. *C. prostrata*, the Spreading Cherry. Flowers solitary, or few in a cluster, appearing along with the leaves, than which they are shorter. Leaves roundish-ovate, loosely hairy beneath, deeply and simply serrated. Calyx-tube oblong, segments downy inside. A small prostrate bush, found on the sea-coast of Candia, and on the mountains of Dalmatia and Asia Minor.

10. *C. Japonica*, the Dwarf-Almond. Leaves ovate-lanceolate, very much tapering to the point, finely serrated, slightly downy beneath, very rugose. Flowers appearing a little before the leaves in small dense clusters. Calyx smooth, bell-shaped, with the segments as long as the tube. A native of Japan, and long known in our gardens as the Double Dwarf-Almond, one of the most beautiful objects that appear in the month of March.

Section II. Bird-Cherries. Flowers growing in long Racemes, appearing with or later than the Leaves. Leaves deciduous.

11. *C. Mahaleb*, the Perfumed Cherry. Leaves roundish ovate, deciduous, glaucous on the underside, simply serrated. Flowers in somewhat corymbose racemes not much longer than the leaves. A shrub or small tree, remarkable for the powerful and agreeable odour of its flowers. It is a native of rocks in the Tyrol, Dalmatia, Carniolia, and Hungary, spreading into Asia till it acquires its most eastern limits in the woods and hedges of the southern parts of the Crimea. It is not a particularly ornamental plant, and though perfectly hardy is seldom seen in our gardens. The fruit is black, and nauseously bitter.

12. *C. Padus* (*Prunus Padus*, Linn.), the Common Bird-Cherry. Leaves oblong, cuspidate, rugose, simply serrated, deciduous. Flowers in racemes much longer than the leaves. A common species, wild in the woods and hedges of the middle parts of Europe, less common in the south, and occurring on the mountains of Caucasus and the Altaï. It is readily known by its deciduous rugose leaves, long racemes of white flowers, and round bitter fruit, which is however agreeable enough to birds. It is a native of Great Britain.

13. *C. Virginiana*, the Choke-Cherry. Leaves ovate or oblong-lanceolate, acuminate, serrated, flat, very smooth, shining, deciduous. Racemes long, cylindrical, lateral. In all systematic books are named two American Bird-Cherries, *C. Virginiana* and *C. serotina*, to each of which are assigned characters that comprehend so little of a discriminative nature that we find it impracticable to ascertain whether two species have really been before the writers on these subjects, or whether they have not distinguished under different names specimens of one and the same species. *C. Virginiana* with the above characters forms a large tree, according to Michaux, in the southern states, attaining from 80 to 100 feet in height. It is the Tawquoy-Meenahtik of the Crees, according to Sir John Richardson, rising on the sandy plains of the Saskatchewan to 20 feet, but extending as far north as the Great Slave Lake (62° N. lat.), where it attains the height of 5 feet only. Its fruit is not very edible in a recent state, but when dried and bruised it forms an esteemed addition to pemmican. Elliott adds that its timber is among the best in the United States for cabinet-makers' work. In this country it forms rather a graceful though roundish headed tree from 20 to 30 feet high, and its shining though deciduous leaves give it almost the appearance of an evergreen.

14. *C. serotina*, the Late Bird-Cherry. Leaves obovate-lanceolate, acute, serrated, channeled, very shining, deciduous. Racemes long, cylindrical, lateral. What is thus designated in this place is a plant with something of the aspect of a Portugal Laurel, and as it flowers later than the last its fruit is not usually ripened in this climate. It is principally distinguished by its leaves being more obovate, never flat, but always half-folded up, and with a more shining surface.

15. *C. Capollim*, Mexican Bird-Cherry. Leaves ovate-lanceolate, acuminate, serrated, flat, shining, deciduous. Racemes terminal. A native of the mountains of Mexico.

Section III. Laurel-Cherries. Flowers growing in long Racemes, appearing with the Leaves. Leaves evergreen.

16. *C. Caroliniana*, the Carolina Laurel-Cherry. Leaves oblong-lanceolate, acute, serrated, and entire, evergreen. Racemes lateral, much shorter than the leaves. It is a native of Carolina, and a very uncommon species in the collections of this country. It is said to be one of the most ornamental of the trees of Carolina. Its leaves are very poisonous.

17. *C. lauro-cerasus*, the Common or Broad-Leaved Laurel (cherry). Leaves oblong-lanceolate, remotely serrated, somewhat convex, pale green, evergreen. Racemes shorter than the leaves. This valuable and common evergreen, which now gives half their richness to the varied pleasure-grounds of Great Britain; which is so hardy that no frost seems to affect it; which is equally capable of resisting the greatest heat and drought of summer, and which will flourish either in the most exposed or the most shaded situations; is a native of the country near Trebizond in Asia Minor, and was sent from Constantinople to Ecluse in the year 1576 by the imperial ambassador Ungnad. Ecluse gives an interesting account of the difficulty he had in establishing the first plant, which must have been transmitted at no small charge; for it is stated to have been six feet high, with a stem as thick as a man's arm. (Clausii, 'Historia Plantarum,' p. 5.) A variegated and a barren-leaved variety are known in gardens, but the original kind is the only one worth cultivating as an object of ornament. It is multiplied in the nurseries by layering, cuttings, and seeds. This species is remarkable for the abundance of hydrocyanic acid secreted in its leaves.

18. *C. Lusitanica*, the Portugal Laurel (cherry). Leaves ovate-lanceolate, acuminate, concave, dark green, glandless, shining, evergreen. Racemes lateral, longer than the leaves. A native of Portugal, and also found in the Canaries, where it is called Hixa, acquiring a height of 60 or 70 feet. According to some the Hixa is a distinct species; Mr. Barker Webb found that plant on the Serra de Gerez in Portugal of the height just stated, while the true *C. Lusitanica* was not above 18 or 20 feet high. This is less hardy than the preceding; it is less easy to transplant, and will not grow so well under other trees; nevertheless it is one of the most useful of our naturalised evergreens. It produces fruit in abundance in England, from which it is readily propagated.

CERA'TINA, a genus of Hymenopterous Insects of the section *Mellifera* and family *Apidæ*. It has the following characters:—Exterior palpi 6-jointed, interior 2-jointed; antennæ inserted in a little fossula, and terminated almost in an elongated club; mandibles sulcated, and tridentate at the apex; abdomen somewhat ovate, elongate, narrower towards the base, and destitute of a ventral scopa.

This genus is included in the section *Apis* (xx. *d.* 2 *a.*) of Kirby's 'Monographia Apum Angliæ.'

C. cærulæa (*Apis cyanea*, Kir.), a little bee, which is very uncommon in this country, and found during the autumn in the flowers of the *Jacobææ*, will serve as an illustration of this genus. It is about a quarter of an inch in length, of a bluish-green colour, and very smooth and shining; the fore part of the head in the male is white.

Spinola states that the female *Ceratina* selects the dead branches of the bramble and likewise those of the sweet briar, and with her mandibles excavates the pith, till a cylindrical burrow of considerable length is formed; this is then divided generally into eight or nine cells, by partitions formed of the pith which was dislodged, mixed with a glutinous secretion. In each cell, as it is formed, an egg is deposited; it is then furnished with a portion of honey, which serves for the food of the larva when disclosed. The account is given under the name of *Ceratina albilabris*, which is said to be synonymous with the one above mentioned. He also says that the insect is common in the south of Europe.

(*Annales du Muséum d'Histoire Naturelle*, vol. x.)

CERATI'TES, a subdivision of the *Ammonitidæ*, as proposed by Haan. It is peculiar to the Muschelkalk. [GONIATITES.]

CERATO'NIA, a genus of Apetalous plants belonging to the natural order *Leguminosæ*. *C. Siliqua*, St. John's Bread, or the Carob-Tree, is a remarkable plant, found wild in all the countries skirting the Mediterranean, especially in the Levant. At Malta it is almost the only tree that grows, relieving the irksomeness of the white stone inclosures by its dark foliage. The pods contain a sweet nutritious pulp, and are sometimes seen in the fruiterers' shops in London; they are a common article of food in the countries where the tree grows wild. Pliny calls it *Siliqua prædulcis*. "At the present day it is sent from Palestine to Alexandria in ship-loads and from thence

Carob-Tree (*Ceratonia Siliqua*).

across the Mediterranean, and as far as Constantinople, where it is sold in all the shops. The pulp resembles manna in taste and consistence, and is sometimes used as sugar to preserve other substances. But the circumstance that has rendered it famous is the controversy whether it was not the real food of St. John in the wilderness. Some of the fathers assert that the ἀκρίδες, or locusts, of St. John were some vegetable substance; and the μέλι ἄγριον, wild honey, the saccharine matter of this pod. It is certain that the plant grows in great abundance in the wilderness of Palestine, where its produce is at this day used for food. It is called by the Arabs kharoob." (Walsh.) The Spaniards call it Algaroba, and give its pods to horses. The seeds, which are nearly of the weight of a carat, have been thought to have been the origin of that ancient money-weight.

CERATOPHRYS. [AMPHIBIA.]

CERATOPHYLLA'CEÆ, *Hornworts*, the Ceratophyllum Tribe, a small and obscure group of plants comprehending the single genus *Ceratophyllum*, probably a mere section of *Urticaceæ*, with the structure and habit of that natural order modified by the submersed situation in which the species live. It has also been supposed to have relations with *Coniferæ*, *Haloragaceæ*, and *Naiadaceæ*. They are aquatic plants, with cellular leaves split into capillary divisions, with monœcious flowers, a many-parted inferior calyx, several stamens, a 1-celled ovary with a pendulous ovule, and a seed whose embryo has four cotyledons surrounding a highly developed many-leaved plumula. *Ceratophyllum submersum* and *C. demersum* inhabit ditches in this country. Four other species are described. Schleiden says there is but one species.

CERATOPHYTA. [POLYZOA.]

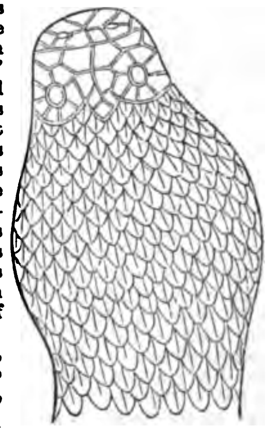
CE'RBERA, a genus of plants belonging to the natural order *Apocynaceæ*, contains among other poisonous species that from which the Tanghin poison of Madagascar is procured. The genus *Cerbera* is known by the calyx being leafy, the corolla funnel-shaped, with a clavate tube, and five scales on its orifice, the stamens sessile just below the orifice of the tube, and a 1- or 2-seeded drupe, with a fibrous woody stone.

C. Tanghin, the Tanghin, is described as a tree with lanceolate alternate leaves, of a leathery texture, pale-pink flowers arranged in corymbose panicles, with a crimson star-like blotch at the orifice of the tube, and an oval drupe as large as a peach, of a green colour stained with purple, and not unlike some sorts of mango. The following interesting account of the plant is given by Mr. Telfair:—The kernel of the fruit must be a very powerful poison: it is not much larger than an almond, and yet is sufficient to destroy above twenty persons. Radama, the late king of Madagascar, abolished the use of it as an ordeal. Whether the custom has been revived by the new government I know not. It was with great difficulty that the chieftains could be persuaded to admit of the abolition of an usage which had existed from time immemorial, and whose unerring efficacy in the detection and punishment of crime had never been questioned, until Mr. Hasty, our government agent, had acquired such an influence with Radama and his court as to admit of the exposure of its fallacy. But this was the work of years; and although Radama was at length himself convinced that nothing could be more unjust than the continuance of the practice, he dared not so far shock the prejudices of his people as to order that it should cease. Even the chief performers in the ceremony, the Skids, as they are called at Tanararissoo, who unite in their own persons the offices of priests and physicians, and who administer the poisonous kernel to the victims, never doubt its power of revealing guilt or clearing innocence. The last occasion on which it was practised in Radama's reign, and of which he availed himself to effect its discontinuance, personally regarded his court and attendants. The king was affected with a complaint of the liver, for which the skid prescribed some inefficacious remedies, and as the disease became worse Mr. Hasty gave him some calomel in doses which he had found by experience to relieve himself under similar symptoms. The disease disappeared, but ptyalism was produced, and alarmed the king's family, who believed that he was poisoned, and insisted that all his immediate attendants should be put to the ordeal of the tanghin; and the royal skid was most earnest in pressing to have it performed, although he himself from his rank and place was among the first to whom it would be administered. In vain the king protested that he felt himself cured, and that the indisposition and soreness of the mouth was caused by the medicines that had relieved him, and which would pass off in a few days. The skid insisted, the ministers and principal chieftains joined with the family in requiring the ordeal, to which the king in spite of his convictions was compelled to consent; but at the same time he made it a condition that this should be the last exhibition of the kind, and he bewailed the necessity which deprived him of so many attached dependants whose fate he had predicted, while he protested his conviction of their innocence.

The king's servants, including the skid, were more than twenty in number; they were shut up at night separately, and not allowed to taste food; the next morning they were brought out in procession and paraded before the assembled people; the presiding skid had the tanghin fruit in readiness; after some prayers and superstitious evolutions he took out the kernel, which he placed on a smooth stone, and with another stone broke down part of it into a soft white mass like powdered almonds. The victims were then brought separately forward, each was questioned as to his guilt, and if he denied, his arms were tied behind, and he was placed on his knees before the skid, who put a portion of the pounded kernel on his tongue and compelled him to swallow it. Thus the kernel was shared among all the king's personal servants. On some of the individuals the poison began to operate in half an hour or less. The skid takes particular notice how they fall, whether on the face, to the right or left hand, or on the back, each position indicating a different shade of guilt. Convulsions generally come on accompanied with efforts to vomit. Those whose stomachs reject the dose at an early period usually recover. On this occasion there were only two individuals with whom this was the case. The others were thrown in a state of insensibility into a hole, and every person present at the ceremony was obliged to throw a stone over them, so that their burial was quickly completed. The king's skid was one of the first that fell. Those that recover are supposed to bear a charmed life ever after, and are respected as the peculiar favourites of the gods. ('Botanical Magazine,' fol. 2968.)

The plant which yields the Tanghin has been called by Du Petit Thomas *Tanghinia venenifera*. *C. Manghas* is a native of Singapore and some of the adjacent islands. The seeds are emetic and poisonous, whilst the milky sap is purgative. The leaves and bark are used as a substitute for senna.

CE'RBERUS, a genus of Snakes, established by Cuvier in his division of the great genus *Coluber*. In Dr. Gray's arrangement of the Snakes of the British Museum, it is placed amongst the *Hydridæ*. The *Cerberi* like the *Pythons*, next to which they are placed in the 'Règne Animal,' have nearly the whole of the head covered with small scales, and plates only between and before the eyes; but they are without the hooks or nails near the vent. Cuvier further says that they have also sometimes simple plates at the base of the tail, but observes that whilst he has seen this arrangement in one individual, he has remarked others of the same species which had them all double; a proof in his opinion of the small importance of the character.



Head of *Cerberus*.

C. cinereus (*Coluber Cerberus*, Daudin), the Karoo Bokadam. Russell, who gives the native name above stated, thus describes the species:—

"Abdominal scuta 144, subcaudal squamæ 59. The head somewhat broader than the neck, yet appears small in proportion to the trunk; a little convex above, compressed on the sides, and projecting into a short, obtuse, or subtruncate snout, on which the eyes and nostrils are situated. The snout is covered with small laminæ of various forms; the rest of the head with small suborbicular carinated scales. The mouth not large, the jaws nearly of equal length. The teeth close set, regular, small, reflex; a marginal and two palatal rows in the upper jaw. The eyes vertical, small, orbicular, protuberant, each situated in the centre of a remarkable circle of small triangular laminæ. The nostrils very small, vertical, near to each other, and close to the apex of the rostrum.

The Karoo Bokadam (*Cerberus cinereus*).

"The trunk thick, round, covered with large carinated, broad-oval, imbricate scales. The length 3 feet 4½ inches; thickness near the head about 3 inches; the middle of the trunk 4½ inches. The tail measures only 8 inches, is a little compressed, tapers moderately, and terminates in an obtuse point.

"Part of the head is almost black; the colour of the trunk and tail a very dark gray; the throat, belly, and under part of the tail are of a dusky yellow; but the colour of the scuta seemed to have been changed by the spirits."

Dr. Russell further observes that his specimen from which our figure is taken was sent from Ganjam in July, 1788, and that he never saw one alive. He adds that notwithstanding its suspicious appearance, the want of poison organs shows that the snake is not formidable.

C. acutus, the Bornean Bokadam, is a native of Borneo.

C. unicolor, the Philippine Bokadam, is a native of the Philippines.

C. Australis, the Australian Bokadam, is a native of Australia.

CERCARIA. [ENTOZOA. *See* SUPPLEMENT.]

CERCERIS. [HYMENOPTERA.]

CERCIS, a genus of plants belonging to the natural order *Leguminosæ*. *C. siliquastrum*, the Judas-Tree, so called from the tradition that it was upon a plant of it, near Jerusalem, that the betrayer of our Saviour hanged himself, is a leguminous tree common on the shores of Asia Minor and in all the East. Dr. Walsh speaks of it as abounding in the Levant at the present day, clothing the shores of the Bosporus and the sides of Mount Libanus. It is very beautiful in all its stages. Very early in spring flowers of a bright pale red burst out before any leaf appears, not only from every part of the branches but from the trunk, piercing the thick strong bark nearly down to the root in a very remarkable manner, and it is for this reason called Red Bud. These buds are gathered and used with other raw vegetables by the Greeks and Turks in salads, to which they give an agreeable colour and taste. It is very common in England, where it proves quite hardy, but it does not flower well unless in a very sheltered situation, or when trained to a wall. There is a pale almost white-flowered variety, and also an American species (*C. Canadensis*), but neither is worth cultivation.

CERCOCEBUS. [SIMIADÆ; GUENONS.]

CERCOMYS. [RODENTIA; HYSTRICIDÆ.]

CERCOPITHECUS. [SIMIADÆ; GUENONS.]

CEREBELLUM. [BRAIN.]

CEREBRUM. [BRAIN.]

CERE'OLITE, a native hydro-silicate of Magnesia and Alumina. It occurs in globules, in Wacke, or Toadstone, and appears to result from its decomposition.

CEREOPSIS, a genus of Birds established by Latham, and placed by him (1802) among the Waders (*Grallatores*); and (in 1824) next to the Swimmers—*Palmipedes* (*Anseres*, Linn.). The characters of this bird, which Mr. Bennett says has been observed by nearly all the navigators who had visited the south coast of Australia and its neighbouring islands from 1792 downwards, are as follows:—

Bill short, elevated, obtuse, covered by a broadly expanded cere, except at the extremity, which is somewhat vaulted and truncated. Nostrils large, situated about the middle of the bill, and open. Feet with tarsi (shanks) longer than the middle toe, and bare of feathers a little way above the knees; great toe articulated to the posterior part of the tarsus; anterior toes palmated, and furnished with membranes deeply notched or cut out as it were so as to appear scarcely to reach beyond the half of their length; nails long and strong; wings ample; wing-coverts nearly as long as the quills; first quill a little shorter than the succeeding ones. Tail feathers sixteen.

C. Novæ Hollandiæ, the Cereopsis Goose, is about the size of the common goose and nearly of the same carriage, with the exception of the length of the legs. Temminck gives the length at from 2½ feet to 3 feet. We select Mr. Bennett's description:—"A broad patch on the top of the head is of a dull white, and the rest of the plumage of a dingy gray, deeper on the upper than on the under parts, having the extremity of each of the feathers of the back margined with a lighter band, and most of the wing-coverts and secondary quill-feathers marked with rounded dusky spots of from two to four lines in diameter. On the feathers of the back and shoulders the spots are much larger, assume an angular or semilunar form, and approach more nearly the general colour of the plumage. The quill-feathers both of the wings and tail are dusky black throughout the greater part of their extent. The naked extremity of the bill is black; the broadly expanded cere of a light straw or lemon colour; the irides light-hazel; the naked part of the legs reddish-orange; and the toes, together with their web and claws, and a streak passing for some little distance up the fore part of the leg, black."

Mr. Yarrell having examined one that died in the Zoological Gardens, Regent's Park, states that its trunk was much shorter than that of the true geese, and more triangular in its shape. The pectoral muscles were large and dark-coloured. The trachea was of large but nearly uniform calibre, without convolution, and attached in its descent to the right side of the neck, as in the heron and bittern. In the form of its bone of divarication and bronchiæ, it most resembled the same part in the geese. The muscles of voice were two pairs; one pair attached to the shafts of the os furcatorium, the other to the inner lateral surface of the sternum. The lobes of the liver were of large size, morbidly dark in colour; their substance broke down under the finger on the slightest pressure. The stomach, a true gizzard, was of small size as compared with the bulk of the bird. The first duplicature of intestine was 6 inches in length, at the returning portion of which the biliary and pancreatic ducts entered; from thence to the origin of the cæca 4 feet 6 inches; the cæca 9 inches each; the colon and rectum together 5 inches; the whole length of the intestines was 7 feet 5 inches. The stomach and intestinal viscera were loaded with fat.

With regard to its habits Mr. Bennett says—"It is true that the limited opportunities that have occurred of observing it in a state of nature have precluded the possibility of obtaining a complete history of its habits and mode of life; but the accounts furnished by various writers lead directly to the inference that it resembles the wild geese of the northern hemisphere as closely in these particulars as in general conformation. We cannot state with certainty whether it is equally migratory; but Captain Flinders, who found it at one period of the year so abundant on Goose Island as fully to justify the appellation, adds that it was by no means so numerous at a different season, and this fact necessarily implies at least a partial change of locality. In its manners it appears that it is by no means so shy as our northern geese, a circumstance which probably depends on the little disturbance that it has hitherto met with in its native haunts. Labillardière tells us that many of those first seen by him suffered themselves to be taken with the hand; but the rest becoming apprised of their danger speedily took to flight. Considerable numbers were taken by the crew of Captain Flinders's vessel, both at Lucky Bay and Goose Island, by

Cereopsis Goose (*Cereopsis Novæ Hollandiæ*).

knocking them down with sticks, and some of them were secured alive. According to M. Bailly, those seen by him at Preservation Island evinced so little shyness, and suffered themselves to be approached so readily, that his boat's crew were enabled to procure without any trouble a sufficient quantity to victual them during their stay. The flesh of these geese, as they are called, is described by Bass as being excellent. D'Entrecasteaux considered it much more delicate than that of the European goose; and Flinders adds that on Preservation Island it formed the best repasts of his men.

"It would seem that this bird does not often leave the coast to visit the interior of the country, for M. Riche, who was lost by his companions for more than two days at Espérance Bay, never met with it in the course of his wanderings in search of them. M. Bailly states that on Preservation Island it takes up its abode on the grassy declivities; and Captain Flinders found it on Goose Island, amongst the grass and on the shore: 'It feeds,' he says, 'upon grass, and rarely takes to the water.' Its usual weight is from 7 to 10 lbs. According to Mr. Bass it has a deep, hoarse, clanging, and though a short yet an inflected voice; and to the accuracy of this observation we can ourselves bear testimony."

This bird has lived and bred in the Gardens of the Zoological Society in Regent's Park, where there are at present several living specimens. Our drawing is from a pair with a brood hatched in the Gardens.

CE'REUS, a genus of plants belonging to the natural order *Cactaceæ*. It is characterised by its sepals being very numerous, imbricate, adnate to the base of the ovarium, united into an elongated tube, outer ones shorter and like a calyx, middle ones longer and coloured, innermost ones petaloid; the style multifid at the apex; the berry areolate, tubercular, or scaly from the remains of the sepals. The species are fleshy grotesque shrubs, with a woody axis and soft interior. They possess angles which are vertical and covered with bundles of spines. The flowers are large, arising from the angles of the spines. They are called Torch-Thistles.

C. senilis, the Old Man Torch-Thistle, is an erect plant, having a stem with 20-25 vertical ribs, covered with fascicles of bristles, each fascicle containing from 15-20 radiating hair-formed curled bristles. Its long gray bristles give it the appearance of the head of an old gray-haired man. It is a native of Mexico.

C. flagelliformis, the Creeping Cereus, has prostrate stems with about 10 angles. It is very common in our gardens, and its trailing stems require the support of trellis-work. It bears an abundance of beautiful red and pink flowers. It is a native of South America, though now naturalised in Asia and Africa.

C. grandiflorus, the Night-Flowering Cereus, has rooting stems, with 5 or 6 angles and fascicles of bristles, with 5-8 in each fascicle. It is a native of the West India Islands, and is found in many parts of the mainland of South America. This plant when cultivated produces very large beautiful sweet-scented flowers. They are however of short duration, remaining open not more than six hours. They generally begin to open between seven and eight o'clock in the evening, and are fully expanded by eleven or twelve, and before the next morning they are quite faded.

C. speciosissimus is an erect plant, 3-4 angled, the angles toothed, the prickles subulate, straight, rising from a white tomentum. It is a native of Mexico, but is very commonly cultivated in our gardens, on account of its large flowers, which are of a beautiful scarlet, the inner petals having a violaceous colour. Nearly 100 species of this beautiful genus of plants have been described, and a fine collection of them exists in the Royal Gardens at Kew. They are of easy culture, and require the same general treatment as the order to which they belong. [CACTACEÆ.]

CE'RIA, a genus of Dipterous Insects belonging to the family *Syrphidæ*. It has the following characters:—Head longer than the thorax; antennæ longer than the head, inserted on a petiole, the second and third joints forming an oval mass; stylet terminal and short; abdomen cylindrical; submarginal nervure of the wings much bent, and throwing out a rudiment of another nervure.

Five species of this genus are known; the colouring is black and yellow, which, together with an elongated and somewhat ovate form of body, gives them a resemblance to wasps. Only one has been discovered in England, and that is extremely rare—it is the *Ceria conopsoides*, and is about half an inch long; black, front of the head yellow in the male, black and yellow in the female; petiole of the antennæ elongated and yellow beneath; sides of the thorax with yellow spots; scutellum yellow, with the apex black; the second, third, and fourth segments of the abdomen, with their margin, of the same calour; legs yellow; exterior margin of the wings brown. It is also found in France. It appears not to have been found abundant anywhere.

CERITHIUM. [ENTOMOSTOMATA.]

CERIUM, a metal not found pure in nature. It occurs in several minerals, of which the following are the most remarkable —

1. *Cerite*, found near Riddarhittan, in Sweden. It occurs amorphous. Its colour is pale dull red, sometimes grayish, and its streak is white; its lustre is resinous, slightly translucent, and sufficiently hard to give sparks with steel, or 5·5. Specific gravity, 4·912.

According to Hisinger it consists of—

Silica	18
Peroxide of Cerium	68·59
Peroxide of Iron	2
Lime	1·25
Water and Carbonic Acid	9·6—99·44

In the opinion of Dr. Thomson it is a hydrous silicated peroxide of Cerium.

2. *Cerine*, found as above, occurs massive and in imperfect crystals. Colour brownish-black, streak brownish-gray, opaque, with an imperfect metallic lustre. Hardness 5·5 to 6·0. Specific gravity, 4·173 Composition according to Berzelius:—

Silica	30·07
Oxide of Cerium	28·19
Oxide of Iron	20·7
Oxide of Copper	0·87
Alumina	11·07
Lime	9·12
Volatile Matter	0·4
	100·42

3. *Allanite*, found at Alluk, East Greenland. It occurs massive, and crystallised in the form of a doubly oblique prism. Fracture imperfect conchoidal. It is opaque, with an imperfect metallic lustre. Colour brownish-black, streak greenish-gray. Hardness, 6·0. Specific gravity, 4. It is composed, according to Stromeyer, of—

Silica	33·021
Protoxide of Cerium	21·6
Protoxide of Iron	15·101
Protoxide of Manganese	0·404
Alumina	15·226
Lime	11·08
Water	3.
	99·432

4. *Monazite*, found near Slatoust, Russia; also in the United States, where it occurs in small brown crystals, disseminated through mica-slate; at Norwich, Connecticut; at Chester, Connecticut; and York Town, New York. It is brittle, has a hardness of 5, and specific gravity of 4·8 to 5·1. It is composed of—

Oxide of Cerium	26·00
Oxide of Lanthanum	23·04
Thorina	17·95
Phosphoric Acid	28·05
Oxide of Tin	2·01
Protoxide of Manganese	1·09
Lime	1·07
	99·21

5. *Cryptolite* is a phosphate of the Oxide of Cerium in minute prisms. It is found with the apatite of Arendal, Norway. It has a pale wine-yellow colour. It has a specific gravity of 4·6.

Orthite is another mineral with Cerium [ORTHITE]; so also are *Yttrocerite* [YTTRIUM] and *Pyrochlore* [PYROCHLORE].

CERNUA, a genus of Fishes belonging to the section *Acanthopterygii* and the family *Percidæ*. It includes the Ruffe or Pope, a British fish, which has also been named *Acerina vulgaris* and *Perca Cernua*. The generic character of *Acerina*, as given by Yarrell in his 'British Fishes,' is as follows:—"Dorsal fin single, elongated, the rays of the first portion spinous, the others flexible; branchiostegous rays seven; teeth very small, uniform, numerous; head without scales; suborbital bone and pre-operculum indented; operculum ending in a single point.

In *Acerina vulgaris*, the Ruffe or Pope, the prevailing colour of the upper part of the body and head is a light olive-brown, passing into a yellowish-brown on the sides, and becoming almost silvery-white on the belly. The lateral line prominent and strongly marked. Small brown spots are disseminated over the back, dorsal fin, and tail, assuming on the latter, from their arrangement, the appearance of bars; pectoral, ventral, and anal fins, pale-brown. This fish is an inhabitant of fresh waters, and closely allied to the perch. It was first described by Dr. Caius, who called it *Aspredo*, being a translation of our word Ruffe (rough), which is applied to this fish on account of the harsh feel of its denticulated scales. It is common in all the rivers of England, especially the Thames, the Isis, and Cam, and is found in the colder parts of the European continent. It is like the perch in its habits. (Yarrell, *British Fishes*.)

CERO'COMA, a genus of Coleopterous Insects, belonging to the family *Cantharidæ* (Latreille). It has the following characters:—Antennæ short, 9-jointed, the basal joint as long as the two following; the second and next joints in succession are short and gradually increase in width to the apex of the antennæ; the terminal joint forms a distinct ovate knob; palpi moderate, all the joints of nearly equal width—such are the characters of the females. The males have the antennæ short, thick, and the joints extremely irregular in shape and size; those towards the base are uncommonly large, the terminal joint forms a large flattened knob, the joints immediately adjoining are the smallest; the palpi are also very much developed, the basal joints being very large. The head and thorax are rounded at the sides, and of about equal width; the elytra are narrow, somewhat linear, elongate, and soft.

The species of this genus are remarkable for the extraordinary antennæ of the males. They are European, and make their appearance during the summer months, frequently in great numbers in the same spot. They are found on flowers, particularly those of the wild chamomile, &c.

C. Schæfferi is about half an inch in length, and of a bright golden green above, or bluish; the legs and antennæ are yellow. In the female the base of the thighs and the tarsi are black. The colour of this species and the texture of its wings closely resemble that of the common Blister Beetle. The general form of the body is not very dissimilar: it is of a smaller size. This species is common in France.

CEROPILES. [POMPILUS.]

CERO'XYLON, a genus of plants belonging to the natural order of Palmæ. *C. Andicola*, the Wax-Palm of South America, is one of the most remarkable plants in the large natural order to which it belongs. It is a species with pinnated leaves and panicled polygamous flowers. Its calyx consists of three small scales; the petals are also three, but much larger and sharp-pointed. The stamens are numerous, with very short filaments. The fruit is a little round drupe, with a single seed of the same figure.

Wax-Palm (*Ceroxylon Andicola*).

This plant has received from the American Spaniards the name of Palma de Cera, or Wax-Palm, on account of the abundance of that substance yielded by the stem. It grows, according to Bonpland, in that part of the Andes which separates the valley of the Magdalena from that of the river Cauca, in 4° 35′ N. lat. Below the snow-capped mountains called Tolima, San Juan, and Quindiu, especially the last, the *Ceroxylon* grows in all its grandeur, elevating its majestic trunk, coated with a thick incrustation of wax, to the height of 180 feet among the most rugged precipices of the wild region which it inhabits. Unlike the greater part of the palm-tribe, this species avoids the heat of tropical plains, and seems incapable of existing except in regions where the temperature is lowered by elevation in the air and the contiguity of perpetual snow. It is said to make its first appearance on the sides of the Quindiu, at a height equal to that of the Puy de Dome or the passage of Mont Cenis; this is higher than the region of Cinchonas, and so cool that Humboldt does not estimate the mean temperature of the year higher at the utmost than 65° or 68° Fahr., which is at least 17 degrees lower than the mean temperature of palm countries. It does not extend over more than 15 or 20 leagues of country altogether. Its roots are fibrous and very numerous, the main root being thicker than the stem itself. The trunk is distinctly marked by rings caused by the fall of the leaves, which are from 18 to 20 feet long. The spaces between the rings are pale yellow, and smooth like the stems of a reed, and covered with a thick coating of wax and resin. This substance, melted with a third of fat, makes excellent candles. Vauquelin ascertained that this vegetable matter consists of two-thirds resin and one-third wax, which is only a little more brittle than bees-wax. The only parallel among palms to this property of exuding wax occurs in a Brazilian palm with palmated leaves, called Carnauba.

CERTHIA. [CERTHIADÆ.]

CERTHIADÆ, the Creeper Family, a family of birds placed by Mr. Vigors under his order *Scansores*, or Climbing Birds. "The genus *Certhia*," writes that author ('Linn. Trans.,' vol. xiv. p. 461), "as originally instituted by Linnæus, contained, besides the true *Certhia* and its congeners, which form the extreme family of the preceding tribe (*Picidæ*), all those birds whose slender and gradually curved bills and delicate formation of body, added to their practice of employing their tongues in taking their food, indicated a strong affinity to each other, and which have since been particularised by authors under the various names of *Nectarinia*, *Cinnyris*, *Drepanis*, &c. To the group thus known and described by the Swedish naturalist, later ornithologists, who have strictly followed his steps, have added another, discovered since his time in Australasia, similar in habits and manners, and now distinguished by the generic title of *Meliphaga*. The whole of the birds, however, thus united by close affinities, and as such generally brought together by systematic writers into one conterminous series, are decidedly divisible into two distinct groups, naturally arranging themselves under different subdivisions of the order. The family of *Certhiadæ* live upon animal food; while the remaining genera of the Linnæan *Certhia* subsist chiefly upon vegetable juices. The tongues of each, though similar in being more or less extensible, and in being the medium through which they are supplied with food, are equally distinct as the nature of the food itself. Those of the former are sharp and of a spear-like form, as if to transfix the insects which are their prey; while those of the latter are divided into tubular filaments, which appear exclusively adapted to the purposes of suction. In other particulars they exhibit an equal difference. The *Certhiadæ* climb, and their feet are of a conformable structure; but the feet of the suctorial birds are not only in general unsuited to that purpose, but they become gradually weaker, and of less use as they come nearer the type of the tribe, where they are so short and slightly formed as to be serviceable only in perching, when the bird is at rest. . . . . The two groups of the Linnæan *Certhia* are disposed in the separate departments to which the distinct nature of their food and habits more immediately unites them; while at the same time, by their forming the extremes of their respective tribes, and touching each other at the corresponding points of the circles in which they are arranged, their obvious affinities are preserved inviolate.

"In addition," continues Mr. Vigors, "to *Dendrocolaptes*, and the true *Certhia* of the present day, the family before us consists of a variety of genera which are strongly united by their corresponding habits. Among these, *Climacteris*, Temm., and *Orthonyx*, Temm., preserve the strong shafts of the tail-feathers, which are carried on to them from the true *Pici*. This construction gradually disappears in the remaining groups of the family; but the strong hind toe, and the tongue more or less extensile, and serving to spear their prey, is still conspicuous. Among such groups we may particularise the *Tichodroma*, Ill., and *Upupa*, Linn., together with the Linnæan *Sitta*, and the conterminous form of *Xenops*, Ill. Here also may be associated the *Opetiorhynchus* and *Anabates* of M. Temminck, as also the *Oxyrhynchus* of the same author. The genus may be observed to be connected with those groups of the present family which are united with the genus *Yunx* of the preceding; it is a perfect Wryneck, as justly asserted by M. Temminck, with a Creeper's foot."

Mr. Swainson ('Fauna Boreali-Americana,' vol. ii.) places the genus *Troglodytes* (Wrens) among the *Certhiadæ*, which family he also places under the *Scansores*.

Cuvier, the Prince of Canino, and Lesson, arrange the *Certhiadæ* under the *Tenuirostres*.

The character of the Family is as follows:—Bill sometimes very much curved, sometimes but little, sometimes nearly straight, rounded, slightly compressed, pointed; tongue simple, cartilaginous at the extremity; tail-feathers generally worn at the end. (Lesson.) The following are the genera enumerated by Lesson:—

Certhia. Bill moderately long, more or less curved, triangular, compressed, slender, pointed; nostrils basal, partially closed by a membrane; wings short, fourth quill longest; tail-feathers stiff, a little curved, pointed at the end.

C. familiaris (Linn.). The Creeper, Common Creeper, Tree-Creeper and Tree-Climber, *C. familiaris* (Linn.), is, according to Belon and others, the Κέρθιος of Aristotle (book ix. 17). It is Le Grimpereau of the French; Picchio Piccolo, Picchietto, Rampichino, and Piccio Rampichino, of the Italians; Baumlaufer, Kleinere Grau-Specht, or Kleinste Baum-Häcker of the Germans, Krypare of the 'Fauna Suecica;' and the Grepianog of the ancient British.

It has the bill about half an inch long, slender, and curved; head and neck above streaked with black and yellowish-brown; a white line above each eye; irides hazel; back, rump, and scapulars approaching to tawny; quills dusky, tipped and edged with white or light brown; coverts dusky-brown and yellowish-white, producing a variegated appearance; a yellowish-white bar across the wing;

breast and belly silvery-white; tail-feathers twelve, tawny-brown; length rather more than 5 inches; weight about 2 drachms (Montagu), Pennant says 5 drachms.

Creeper (*Certhia familiaris*).

The Creeper is a most restless and active little bird, ever on the alert, and climbing up and about the trunks and branches of trees intent on picking up its insect food. Though comparatively common, and a constant resident in Britain, it is not easily seen, for its activity in shifting its position makes it very difficult to follow it with the eye. At one instant it is before the spectator and the next is hidden from his view by the intervening trunk or branch, to the opposite side of which it has passed in a moment. The form of the tail and organisation of the feet are beautiful adaptations for this sort of rapid locomotion. Its note is monotonous, and often repeated.

It builds its nest in the hole or behind the bark of decayed trees, formed of dry grass and the inner part of the bark, lined with small feathers, in which six or eight eggs are deposited. While the female sits on these she is regularly fed by the male bird.

It is found in Great Britain and the continent of Europe. Pennant says that it migrates to Italy in September and October. Latham states that it is found in various parts of Germany and elsewhere on the Continent, and is also said to inhabit North America. This is confirmed by the Prince of Canino, who, in his 'Specchio Comparativo,' notes it as common and permanent near Rome, and rare near Philadelphia.

Temminck is of opinion that the *C. brachydactyla* of Brehm is identical with *C. familiaris.*

Tichodroma (*Petrodroma*, Vieill.). Bill longer than the head, triangular at the base, slightly bent, rounded, entire, and depressed at the point; nostrils horizontal; tail-feathers nearly equal, with ordinary shafts; wings long; fourth, fifth, and sixth quill the longest; *T. muraria*, C. Bonap.; *T. phœnicoptera*, Temm.; *C. muraria*, Linn. This bird is the Grimpereau de Muraille, Pic de Muraille, Ternier, Eschelette, and Echelette, of the French; Picchio Muraiolo and Picchio di Muro of the Italians; Mauer Baumlaufer of the Germans; and Wall-Creeper of Latham.

The summit of the head is of a deep ash-colour; nape, back, and scapulars bright ash; throat and front of the neck deep black; lower parts blackish-ash; coverts of the wings and upper part of the exterior barbs of the quills bright red; extremity of the alar quills black—these quills have two large white spots disposed upon the interior barbs; tail black, terminated with white and ash; bill, iris, and feet black; length 6 inches 6 lines. Such is Temminck's description of the male in its nuptial or spring dress.

The female, according to the same author, has the summit of the head of the same bright ash as the back; the throat and front of the neck white, slightly tinged with ash; and the rest of the plumage like that of the male.

It is a native of the south of Europe. Tolerably abundant in Spain and Italy, always on the most elevated rocks, and very rare in the mountains of moderate height. Never found in the north, according to Temminck. The bird is common in Provence; and the Prince of Canino notes it as permanent and rather rare near Rome, where it may however be seen creeping on the outward walls of St. Peter's. It is not a British bird, at least it has never been recorded as such.

Temminck says that what the Creeper does upon trees the Wall-Creeper does against the vertical faces of rocks, on which it sticks firmly (se cramponnent fortement), without however mounting and descending by creeping. Clefts and crevices of rocks and the walls of old edifices are its favourite haunts, and sometimes, but very rarely,

Wall-Creeper (*Tichodroma muraria*).

the trunks of trees. It feeds on insects, their larvæ, and pupæ, and is particularly fond of spiders and their eggs. Belon has figured his example clinging to a pillar with a spider in its bill. The nest is made in clefts of the most inaccessible rocks, and in the crevices of ruins at a great height.

The bird moults twice a year. It is in the spring only that the male has the black on the throat, and this ornament disappears before the other feathers fall. The females moult also twice, but without changing colour, which makes it impossible to distinguish the sexes after pairing and breeding time. The young may be distinguished from their parents before their first moult, but in winter no difference is observable. (Temminck.)

Dendrocolaptes (*Dendrocopus*, Vieill.) Bill long or moderate, compressed laterally, rather strong, convex, straight or curved, or only curved towards the extremity, pointed; nostrils lateral, round, open; tongue short and cartilaginous; third, fourth, and fifth quills the longest; tail-feathers stiff, pointed; hind toe shortest; claws very much curved, channeled.

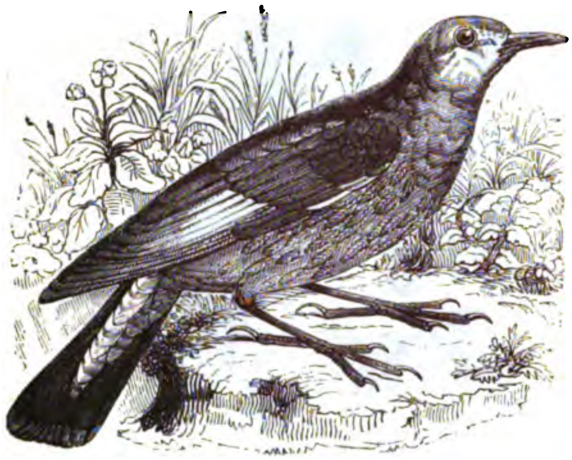
D. procurvus (Temm.), *D. trochilorostris* (Wied), is the size of the blackbird. Bill strongly curved, and nearly 20 lines long; tail graduated, and each feather terminated by a stiff point; general colour cinnamon, passing into dirty ruddy gray on the head and belly; there are numerous white spots on the head and neck. It is a native of Brazil.

Dendrocolaptes procurvus.

Climacteris. Bill short, weak, very much compressed throughout its length, but little curved, oval-shaped; mandibles equal, pointed; nostrils basal, lateral, covered by a naked membrane; feet robust; tarsi of the length of the middle toe, which as well as the hallux are extraordinarily long; claws large and curved, channeled on the sides, subulate, very much hooked; external toe united up to the second articulation, the internal toe as far as the first; lateral toes very unequal; wings moderate; first quill short, second shorter than the third; which last and the fourth are the longest.- (Temminck.)

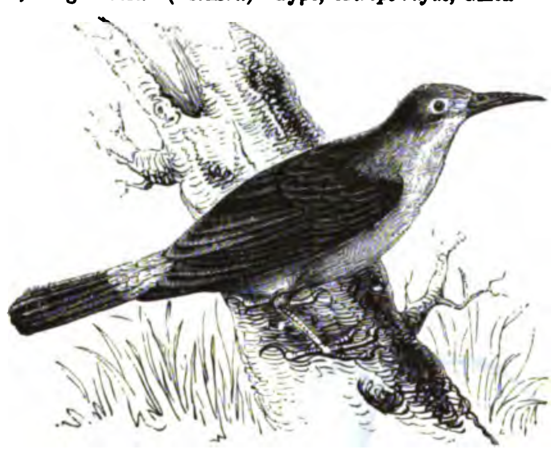
C. Picumnus. The summit of the head is deep gray; nape and neck bright gray; wings and two middle feathers of the tail brown; a large nankeen-coloured band passes nearly through the middle of the quills; tail-feathers black, except at their origin and extremity; throat and cheeks dirty white; breast gray; feathers of the lower parts white in the middle, bordered with brown; lower coverts of the tail Isabella-colour, marked with transverse brown spots; length 6 inches 6 lines. (Temm.) Locality, Timor, Celebes, and the north coast of Australia.

This genus bears a strong relation to the Soui-mangas.



Climacteris Picumnus.

Furnarius (*Opetiorhynchos*), Temm., *Figulus*, Spix. Bill shorter than the head, as wide as it is high, compressed laterally, but little curved, entire, pointed; tongue moderate, straight, worn at the point; wings feeble. (Vieillot.) Type, *Merops rufus*, Gmel.



Furnarius rufus.

F. fuliginosus, Lesson (*C. antarctica*, Garnot).

"The genus *Furnarius*," writes M. Lesson, "was established by M. Vieillot for the reception of some small birds of Paraguay, the most celebrated among which have been placed among the Thrushes, the Creepers, the Bee-Eaters, and the *Promeropidæ*. The most anciently known, the Fournier of Buenos Ayres (*Merops rufus*. Gmel.; *Figulus albogularis*, Spix), is often noticed on account of the manner in which it constructs its nest, namely, in the form of an oven ('four'), whence comes its name. On this point we know nothing of the habits of the Fournier Brun, which lives in South America, and which approaches much in other respects to *Merops rufus*, figured by Commerson under the name of *Hornero Bonariensium* and of *Turdus furnifaber*, and which is said to be an object of veneration at La Plata. As it ought to be, the genus *Furnarius* should only contain the three species indicated by D'Azara, and that which we add under the name of *Furnarius fuliginosus*.

"This bird is five inches and a half in length; the bill is eight lines long, the tarsi an inch, and the tail two inches eight lines. The bill is slightly compressed, convex above, with the upper mandible slightly curved, entire, and exceeding the lower one; the tail is nearly rectilinear, composed of twelve feathers; the legs are feathered down to the tarsi, which are slender, elongated, with large but little apparent scutella; the middle toe is longest, the two outside ones nearly equal in length, and the external toe is united with the middle toe at its base; the claw of the posterior toe is double the length of the anterior toes, which are very much compressed at the sides, curved, and pointed. The entire plumage of the bird is a clear fuliginous brown, spread equally over all the parts of the body, the neck alone exhibiting yellow and brown ill-defined striæ; the under side of the tail is of a bright gray-brown; a yellow band of deeper tint occupies the middle of the great quills, and forms a kind of scarf when the bird is in flight; the extremity of the quills is a little deeper than the rest of the plumage, and their external border is a shade brighter." (Lesson.)

The *F. fuliginosus* inhabits the Falkland Islands. It lives upon the beach, where its familiarity and fearless disposition permits approach till it may be almost touched with the hand. Its sombre plumage has caused it to be mentioned under the name of Merle in the narratives of some voyages. Pernetty, who sojourned at the Falklands, thus describes it: "This bird is so tame that it will almost fly upon the finger; in less than half an hour I killed ten with a small switch, and almost without changing my position. It scratches in the goëmons (fucus) which the sea throws upon the beach, and there eats worms and small shrimps, which they call sea-fleas (puces de mer)." "Its flight is short. When disturbed it contents itself with flying two or three paces farther off. Its habits are solitary." (Lesson.)

Cœreba. [NECTARINIDÆ.]

Dicœum. Bill pointed, bent, of the length of the head, depressed and widened at the base.

The species forming this genus, instituted by Cuvier, are small, oriental, have more or less of scarlet in their plumage, and differ from the true *Certhiæ*, inasmuch as their tails are not worn, nor do they creep. It is questionable whether they do not belong to the *Nectarinidæ*; but their position will principally depend upon their habits and the form of their tongue. Cuvier places the genus next to Le Fournier (*Merops rufus*) and under *Nectarinia*.

Dicæum erythronotus.

CERTHILAUDA. [ALAUDINÆ.]

CERUSE, a name for White Lead. [LEAD.]

CERVANTE'SIA, a name given by Ruiz and Pavon to a genus of plants, in honour of their immortal countryman Cervantes. One of the species, *C. tomentosa*, is a native of Peru, and yields seeds which are eaten in the same manner as almonds in Europe, or the Quandang Nut (*Fusanus acuminatus*), another Santalaceous plant, in Australia.

CERVICOBRANCHIATA, an order of *Mollusca*, in De Blainville's arrangement, including the genera *Patella*, *Fissurella*, &c. [PATELLIDÆ; FISSURELLIDÆ.]

CERVIDÆ, or CERVINA, a tribe or family of Ruminating *Mammalia*, embracing the animals popularly known as Deer. They belong to that division of the *Ruminantia*, or *Ungulata*, whose horns are deciduous, and covered when young with a deciduous hairy skin, or entirely wanting. The *Cervina*, which include the genus *Cervus* of Linnæus, are characterised by the absence of cutting teeth in the upper jaws; by the horns being deciduous, and often wanting in the females; the tarsus hairy on the hinder side; the false hoofs distinct.

Various arrangements of this tribe have been approved. The following remarks from the 'Catalogue of the Specimens of the Mammalia in the British Museum' will be the best introduction to the system followed in this article:—

"Dr. J. E. Gray, in the 'Proceedings of the Zoological Society' (1836, 67), proposed to arrange the species of Deer into three sections, according to the positions of certain tufts of hair on the hind legs, thus:—1, a tuft of hair below the middle of the outside of the metatarsus; 2, a tuft of hair above the middle of the outside of the metatarsus; and 3, with a tuft of hair on the inside of the hock. Dr. Sundevall, in his 'Pecora,' has adopted these divisions. These tufts have the advantage of being found in all ages and in both sexes; so that they can be consulted when the horns are deficient.

"M. Pucheran ('Dict. Univer. Hist. Nat.' iii. 314, 1843) divides the Deer as follows:—

"*A.* With flat horns. 1. *C. Dama* (and var. *mauricus*). *B.* With round horns. *a.* With more than two andouilleres:—1. *C. Virginianus.* 2. *C. Duvaucellii.* 3. *C. Wallichii.* 4. *C. Elaphus.* 5. *C. Wapiti.* 6. *C. macrotis.* 7. *C. macrurus.* 8. *C. occidentalis.* 9. *C. Elaphoides.* *b.* With only two andouilleres:—10. *C. Hippelaphus.* 11. *C. Aristotelis.* 12. *C. equinus.* 13. *C. marianus.* 14. *C. Peronii.* 15. *C. unicolor.* 16. *C. Axis.* 17. *C. porcinus.* 18. *C. nudipalpebra.* 19. *C. Leschenaultii.* 20. *C. Capreolus.* 21. *C. Mexicanus.* 22. *C. paludosus.* 23. *C. campestris.* *c.* Cerfs Daguets:—24. *C. nemorivagus.* 25. *C. rufus.*

"This essay is a mere compilation without any examination.

"M. Pucheran, in his 'Monographie des Espèces du Genre Cerf' ('Comptes Rendus Acad. Sci.,' 1849, ii. 775), divides the tribe *Cerviens* into four genera:—1. *Alces;* 2. *Tarandus;* 3. *Cervulus;* and 4. *Cervus.*

"Since the publication of Cuvier's Essay on Deer ('Ossemens Fossiles,' iv.), where he exhibited the development of the horns of several species; and in which he described several species from the study of the horns alone, many zoologists have almost entirely depended on the horns for the character of the species; and Mr. Hamilton Smith has been induced to separate some species on the study of a single horn. But the facilities which menageries have afforded of studying these animals, and watching the variations which the horns of the species present, have shown that several most distinct but allied species, as the Stag of Canada and India, have horns so similar that it is impossible to distinguish them by their horns. On the other hand, they have shown that animals of the same herd, or even family, and sometimes even the same specimen, under different circumstances, in succeeding years, have produced horns so unlike one another in size and form that they might have been considered, if their history was not known, as horns of very different species. These observations, and the examination of the different cargoes of foreign horn which are imported for the uses of the cutler—each cargo of which is generally collected in a single locality, and therefore would most probably belong to a single species peculiar to the district—have proved to me that the horns afford a much better character to separate the species into groups than to distinguish the allied species from one another.

"Colonel Hamilton Smith, in his monograph of the genus, separated them into genera according to the form of the horns.

"In the 'Proceedings of the Zoological Society' for 1836 I drew attention to the glands on the hind legs, as affording very good characters to arrange the genera proposed by Colonel Smith into natural groups; which in most particulars agreed with the geographical distribution of the species.

"Dr. Sundevall, in his 'Essay on Pecora,' has availed himself of the characters suggested in my paper, and has also pointed out some other external characters, such as the form and extent of the muffle, which afford good characters, and which I firmly believe are much more important for the distinction of the genera and species than those derived from the form of the skull, or the modifications of the teeth, or the form and size of the horns; as they are not like those parts so liable to alteration from age, local circumstances, and other changes during the growth of the animal; and the characters derived from these parts can be seen in the females as well as males, which is not the case with the horns, as they can only be observed in the male sex.

"These examinations have shown that the form and extent of the muffle, the position and presence of glands on the hind legs, the general form of the horns, and the kind of hair which forms the fur, taken together, afford the best characters for the arrangement of the species into natural genera, and these genera into groups. And I believe that the progress of zoology, and the natural arrangement and affinities of animals, are best promoted by the general study of all the parts of the animal taken together, rather than confining one's attention to any set of characters, and believing them as much more important than the others."

At the same time that we agree with the general principles on which Dr. Gray proposes his arrangement, we would draw especial attention to the very interesting nature and history of the development of the horns of this family of animals.

In the Museum of the Royal College of Surgeons ('Physiological Series,' No. 179) will be found a section of part of the os frontis and of the base of a Fallow-Deer's horn (*Cervus Dama*), the growth of which is nearly completed. It shows the horn to be a continuation of bone from the outer table of the skull, and the velvet-like covering of the horn to be equally continuous with the integuments of the head. It shows also the burr or pearl which has been formed round the base of the horn, and illustrates the effects of this part on the growth of the horn.

In the formation of the burr, which is the last part of the process, and takes place rapidly, the osseous tubercles of which it is composed are projected outwards, and by their pressure induce absorption of the vascular external covering; and increasing at the same time laterally, they enclose and compress the blood-vessels: thus in a short space of time the circulation is entirely obstructed, and consequently the whole of that once very vascular and sensible tegument loses its vitality, dries, shrinks, and peels off, leaving the horn a naked insensible weapon. In one of the branches (the brow antler) in this preparation, the whole of the vessels appear to have been thus obliterated; in the other a slight degree of vascularity remains, and one of the large external arterial branches is still uncompressed ('Catalogue, Physiol. Series,' vol. i.). The beautiful preparations illustrative of the process are numbered 163 to 187, both inclusive.

The rapidity with which this firm mass of bone is secreted is worthy of note. The budding horns of a male Wapiti were several inches high in ten days from their first appearance; a month afterwards there was an interval of two feet between them, measuring from branch to branch.

It is in the spring generally that the reproduction of the horn is begun. From the place whence the old horn had been separated and cast, and which at first is apt to bleed, but soon is skinned over with a fine film, the new horn sprouts. At this time there is a strong determination of blood to the head, great in proportion to the demand for such an enormous and ultimately solid secretion. The vessels from the roots swell, the vascular horn pushes up, protected by a delicate and soft covering. In this its early stage it is nearly cylindrical, and the quantity of animal heat which it contains may be in some degree imagined by gently grasping it with the hand. Gradually the antlers appear; the whole 'head,' to use the sporting term, is developed, and becomes of the firmest solidity; the animal feels its powers, and proceeds to rub off the drying and decaying 'velvet,' which may be seen at this period hanging from the horn in ragged strips, against trees and other resisting bodies, leaving at last the magnificent ornament and weapon with only the traces on its now hard surface of the blood-vessels which had produced it. Then it is that the deer, conscious of his strength, comes forth in all his grandeur, ready to do battle with any creature, even man himself, who may dare to invade his haunts. Fierce fights ensue, and the strongest male reigns paramount. The rutting season dies away, spring returns, the antlers are shed, again to be regenerated in time for the season of love.

In the Common Stag or Red Deer (*Cervus Elaphus*), the shedding of the horns takes place about the end of February or during March. The Fallow-Deer sheds his horns from about the middle of April to the first weeks of May.

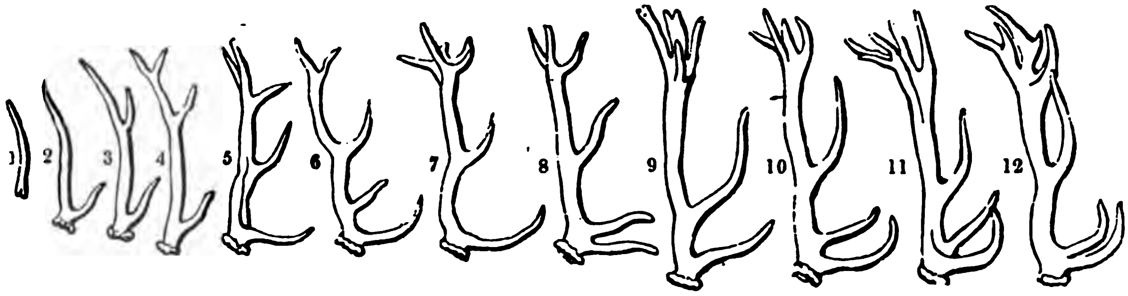
For the production of these annually regenerated bony masses nature has provided with her usual care. "We find it a common principle in the animal machine," says John Hunter, "that every part increases in some degree according to the action required. Thus we find muscles increase in size when much exercised; vessels become larger in proportion to the necessity of supply, as for instance in the gravid uterus. The external carotids in the stag also, when his horns are growing, are much larger than at any other time; and I have observed that in inflammation the vessels become larger, more blood passes, and there appears to be more actions taking place; but the nerves do not seem to undergo any change. The nerves of the gravid uterus are the same as when it is in a natural state; neither do the branches of the fifth and seventh pair of nerves in the stag become larger." (Hunter, 'On the Blood.')

But it must not be supposed that the antlers reach their full amplitude in the first years of the male deer's life. In the Stag or Red Deer the horns of the male do not appear till its second year, and the first which is shed (*fig.* 1, Series *A*) is straight and single, like a small thrust-sword or dagger, whence the young male is termed Daguet by the French. The next horn has generally but one antler, as in *fig.* 2; but it has sometimes two, and even three (*figs.* 3, 4, which are horns of stags in their third year). The third horn has three or four antlers, and sometimes as many as five or six, which are also the numbers of the fourth (*figs.* 5, 6). Up to this time the young male is called a Young Stag—Jeune Cerf. The fifth horn bears five or six antlers of the degree of development indicated in *figs.* 6, 7, or 8. In this stage the animal is called by the French Cerf de Dix Cors jeunement. The sixth horn, which the stag sheds at about seven years of age, is that which bestows upon the stag the appellation of Cerf de Dix Cors.

The proportional length, direction, and curvature of the antlers vary; and it often happens that there is one more or less on the one side than on the other. Independently of the number of antlers, the horns become larger, the superficial furrows more marked, the burr is more projecting, and the prominences of the frontal sinus which support the horns become shorter and wider every year. By such signs is the age of old stags, or those of from eight years upwards, determined; for after the seventh year the number of the antlers is regulated by no fixed rule. They are multiplied towards the summit of the beam, where they are conjoined into a kind of crown or palmation (*figs.* 9, 10, 11, 12). The oldest heads do not in general present more than 10 or 12 antlers (Tines, in Scotch); but some have been seen that bore the enormous number of 33. Such was the noble Cerf à 66 Cors, killed by the first king of Prussia, and presented by that monarch to Augustus I., elector of Saxony and king of Poland. This noble head is said to be still preserved at Moritzburg.

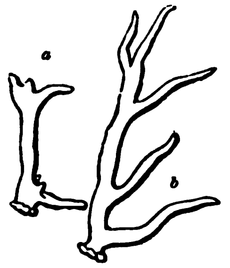
In all gradations of age after the appearance of the antlers, the second antler is more or less approximated to the first or brow antler (Maître Andouiller of the French, a name given to it because it is the largest).

Series *A.*



Horns of Stag (*Cervus Elaphus*). Left Horns.

The sympathy between that part of the system which regulates the development of the horns in the Deer-Tribe and the organs of generation is most remarkable. For instance, if a stag is castrated when his horns are in a state of perfection they will, it is affirmed, never be shed; if the operation is performed when the head is bare, the horns, it is said, will never be regenerated; and if it is done when secretion is actually going on, a stunted ill-formed permanent horn is the result, more or less developed, according to the period at which the animal is emasculated. Any disturbance of the system generally produces a corresponding deterioration in the horn. In the subjoined cut, *fig. a* represents the horn of a deer (*Cervus Canadensis*) produced



a, Horn of Deer produced under unfavourable circumstances; *b*, horn of same Deer produced under more favourable circumstances.

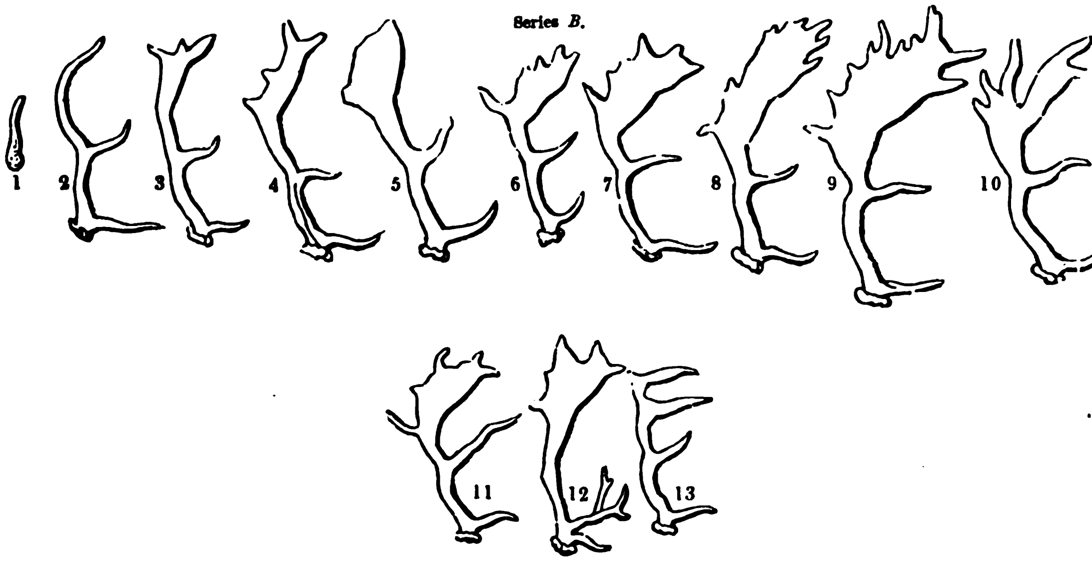
during a voyage from America; and *b* a horn subsequently developed in the French Menagerie by the same individual, which afterwards produced a head of surprising dimensions.

The same system of development which we have observed in the horn with branching antlers is in great measure to be traced in the other leading form of horn, namely, the palmated horn. Taking the horn of the Fallow-Deer (*Cervus Dama*) as an example of the latter, we find the horn first put forth by the buck at two years old (when he is called a Pricket), a simple shaft, slightly curved, the concavity turned forwards (*fig.* 1, Series *B*); this curvature the horns retain throughout. The second year there are two antlers directed forwards (*fig.* 2), and (*figs.* 5, 6, 7, 8). Sometimes one or two of these dentelations form true recurrent antlers (*figs.* 6, 8). *Figs.* 8 and 9 are horns of the fourth growth, and it will be seen that they begin to be divided above. In the following years the palm is irregularly and variously divided (*figs.* 10, 11, 12, 13), so that the horns of old bucks are very frequently oddly shaped, and hardly to be recognised. With still more advanced

Horns of a Fallow-Deer (*Cervus Dama*) that were not shed at the usual time in consequence of the castration of the animal. From the Museum of the College of Surgeons.

age they continue to dwindle. Cuvier, from whom this account and the figures of the growth of the deer's horn are taken, says that it

Series *B.*



Horns of Fallow-Deer (*Cervus Dama*). Left Horns.

the summit of the horn in some cases begins to spread into a palm (*figs.* 3, 4), which afterwards increases, throwing out a greater or less number of dentelations on its posterior and superior border is asserted that these palmated horns of the buck finish by putting on the simple appearance of the horn first developed (daguet); and states that he in fact possessed the head of a fallow-deer which had only simple horns, and whose teeth were ground down to the very roots by long use.

The reproduction of the horns is annual in the Deer of temperate and cold climates; but it has been supposed that some of the species inhabiting hot climates do not cast them every year. The palmated horn seems to be more especially given to those deer which inhabit the northern latitudes; and Colonel Smith is of opinion that it is a provision to enable the animals to remove the snow from their food.

The dental formula of the deer is, generally speaking, the same as in the giraffes, goats, antelopes, sheep, oxen, &c.; namely,

Incisors, $\frac{0}{8}$; Canines, $\frac{0-0}{0-0}$; Molars, $\frac{6-6}{6-6}=32$.

Of the molars, both in the upper and lower jaws, six are true and six false. In the upper jaw the three first molars are bordered by a thick crest on their internal surface; the three next have all the characters of the molars in the dromedaries. [CAMELUS.] In the lower jaw the first incisor is the longest, the second and the third rather decrease, and the fourth is very small; all have cutting edges. The two first false molars are simple; the third has a process or heel at its posterior part, and the three others do not differ from those of the upper jaw. In the formula given above the canines are noted as absent; but this general rule is not without exception, some of the species presenting canines similar to those of the Musks (*Moschus*) in the upper jaw. The Muntjak has these teeth largely developed.

The Deer-Tribe possess the Lachrymal Sinus, or, as it is often termed, the Suborbital Sinus (Larmiers of the French, Tear-Pits of the English, Crumen of others), even more universally than the Antelopes. [ANTILOPEÆ.]

The late Mr. Bennett was of opinion that the use of the lachrymal sinus, which has long remained a problem to zoologists, must be referred to sexual relations. In support of this opinion he has referred to the condition of this organ in some old Indian Deer formerly in the possession of the Zoological Society in the Gardens in Regent's Park.

Professor Owen at one time conceived it possible that the secretion of these glands, when rubbed upon projecting bodies, might serve to direct individuals of the same species to each other. He endeavoured to test the probability of this supposition by preparing a tabular view of the relations between the habits and habitats of the several species of Antelopes and their suborbital, maxillary, post-auditory, and inguinal glands, in order to be able to compare the presence and degrees of development of these glands with the gregarious and other habits of the Antelope-Tribe. He has stated however that it was evident from this table that there is no relation between the gregarious habits of the Antelopes which frequent the plains and the presence of the suborbital and maxillary sinuses; since these, besides being altogether wanting in some of the gregarious species, are present in many of the solitary frequenters of rocky mountainous districts. The supposition therefore that the secretion might serve, when left on shrubs or stones, to direct a straggler to the general herd, falls to the ground. ('Zool. Proc.,' 1836.)

The osteological structure of the Deer-Tribe is such as would be expected when it was necessary that the bony framework should exhibit a union of lightness and strength necessary for an animal whose life is to depend on its agility and defensive powers.

The *Cervidæ* are widely spread, and seem capable of being so modified as to withstand the extremes of heat and cold.

The following arrangement of the Deer is proposed by Dr. J. E. Gray:

A. The Deer of the Snowy Regions have a very broad muzzle, entirely covered with hair. The horns are expanded and palmate; and the fawns are not spotted.

a. The Alcine Deer have no basal anterior snag to the horns, and a small bald muffle between the nostrils, as the genus *Alces*.

b. The Rangerine Deer have a large basal anterior snag to the horns close on the crown or burr, and no muffle, as *Tarandus*.

B. The Deer of the Temperate or Warmer Regions have a tapering muzzle ending in a bald muffle. The fawns, and sometimes the adults, are spotted.

c. The Elaphine Deer have a distinct anterior basal snag to the horns, the muffle broad, and separated from the lip by a hairy band; and the tuft of hair on the outside of the hind leg, above the middle of the metatarsus, as *Cervus* and *Dama*.

d. The Rusine Deer have a distinct anterior basal snag to the horns; the muffle very high, and not separate from the edge of the lips; and the tuft of hair on the outside of the hind leg, above the middle of the metatarsus, as *Rucervus*, *Panolia*, *Rusa*, *Axis*, *Hyelaphus*, and *Cervulus*.

e. The Capreoline Deer have no basal anterior snag to the horns, the first branch being some distance above the burr; the crumen (and pit in the skull) generally small, as *Capreolus*, *Cariacus*, *Blastocerus*, *Furcifer*, *Coassus*, and *Pudu*.

The Alcine and Rangerine Deer are confined to the northern part of both continents; the Elaphine and Rusine Deer to the Eastern World (the latter almost exclusively to the warmer part of Asia); all the Capreoline Deer are peculiar to America. The only exception to these rules are—the Wapiti Deer of the Elaphine group is found in Northern America, and the Roe-Buck and Ahu of the Capreoline group are found in Europe and Northern Asia.

The following is an arrangement of the genera and species of the tribe *Cervina* of Gray:—

Sub-Tribe 1. ALCEÆ.
- Genus, *Alces*.
  - 1. *A. Malchis*, the Elk.

Sub-Tribe 2. RANGERINÆ.
- Genus, *Tarandus*.
  - 2. *T. Rangifer*, the Caribou or Rein-Deer.

Sub-Tribe 3. ELAPHINÆ.
- Genus, *Cervus*.
  - 3. *C. Canadensis*, the Wapiti.
  - 4. *C. Elaphus*, the Stag.
  - 5. *C. Barbarus*, the Barbary Deer.
  - 6. *C. Wallichii*, the Bara Singa.
  - 7. *C. affinis*, the Saul-Forest Stag.
  - 8. *C. Sika*, the Sika.
- Genus, *Dama*.
  - 9. *D. vulgaris*, the Fallow-Deer.

Sub-Tribe 4. RUSINÆ.
- Genus, *Panolia*.
  - 10. *P. Eldii*, the Sungnai.
- Genus, *Rucervus*.
  - 11. *R. Duvaucellii*, the Bahrainga.
- Genus, *Rusa*.
  - 12. *R. Aristotelis*, the Samboo.
  - 13. *R. Dimorphe*, the Spotted Rusa.
  - 14. *R. Hippelaphus*, the Mijangan Banjoe.
  - 15. *R. equinus*, the Samboe.
  - 16. *R. Peronii*, the Smaller Rusa.
  - 17. *R. Philippinus*, the Philippine Rusa.
  - 18. *R. lepida*, the Sundevall Rusa.
- Genus, *Axis*.
  - 19. *A. maculata*, the Axis.
  - 20. *A. pseudaxis*, the Spotted Axis.
- Genus, *Hyelaphus*.
  - 21. *H. porcinus*, the Lugna Para.
- Genus, *Cervulus*.
  - 22. *C. vaginalis*, the Kijang.
  - 23. *C. moschatus*, the Kegan.
  - 24. *C. Reevesii*, the Chinese Muntjak.

Sub-Tribe 5. CAPREOLINÆ.
- Genus, *Capreolus*.
  - 25. *C. Capræa*, the Roe-Buck.
  - 26. *C. Pygargus*, the Ahu.
- Genus, *Blastocerus*.
  - 27. *B. paludosus*, the Guazupuco.
  - 28. *B. campestris*, the Mazame.
- Genus, *Furcifer*.
  - 29. *F. Antisiensis*, the Taruah.
  - 30. *F. Huamel*, the Guemul.
- Genus, *Cariacus*.
  - 31. *C. Virginianus*, the American Deer.
  - 32. *C. Mexicanus*, the Mexican Deer.
  - 33. *C. leucurus*, the White-Tailed Deer.
  - 34. *C. nemoralis*, the Cariacou Deer.
  - 35. *C. punctulatus*, the Californian Roe.
  - 36. *C. Lewisii*, the Black-Tailed Deer.
  - 37. *C. macrotis*, the Mule-Deer.
- Genus, *Coassus*.
  - 38. *C. nemorivagus*, the Gauzu-viva.
  - 39. *C. rufus*, the Cuguacu-ete.
  - 40. *C. superciliaris*, the Eye-Browed Brocket.
  - 41. *C. auritus*, the Large-Eared Brocket.
- Genus, *Pudu*.
  - 42. *P. humilis*, the Venada.

In selecting a few of these animals for description we shall follow the above arrangement:—

1. *Alces Malchis*, the Elk or Moose. This animal is the *Alces Antiquorum* of Rüppell; *Cervus Alces* of Linnæus; Moose Deer, Moose or Elk, American Black Elk, Flat-Horned Elk, of English writers; the Eland and Orignal of Buffon and others; Elch of the Germans; Loss of the Russians; *Alces* of Cæsar; *Alce* of Pliny.

"This animal is the largest of the genus, being higher at the shoulders than the horse; its horns weigh sometimes near 50 lbs. Accordingly, to bear this heavy weight its neck is short and strong, taking away much of the elegance of proportion so generally predominant in the deer. But when it is asserted that the elk wants beauty or majesty, the opinion can be entertained by those who have seen the female only, the young, or the mere stuffed specimens; for us, who have had the opportunity of viewing the animal in all the glory of its full-grown horns, amid the scenery of his own wilderness, no animal could appear more majestic or more imposing. It is however the aggregate of his appearance which produces this effect; for when the proportions of its structure are considered in detail they certainly will seem destitute of the harmony of parts which in the imagination produces the feeling of beauty. The head measuring above two feet in length is narrow and clumsily shaped by the swelling upon the upper part of the nose and nostrils; the eye is proportionably small, and sunk; the ears long, hairy, and asinine; the neck and withers are surmounted by a heavy mane; and the throat furnished with long coarse hair, and in younger specimens encumbered with a pendulous gland: these give altogether an uncouth character to this part of the animal. Its body however is round, compact, and short; the tail not more than four inches long; and the legs, though very long, are remarkably clean and firm; this length of limbs and the overhanging lips have caused the ancients to fancy that it grazed walking backwards. The hair of the animal is coarse and angular, breaking if bent. Its movements are rather heavy, and the shoulders being higher than the croup, it does not gallop, but shuffles or ambles along, its joints cracking at every step, with a sound heard to some distance. Increasing its speed, the hind feet straddle to avoid treading on its fore heels, tossing the head and shoulders like a horse about to break from a trot to a gallop. It does not leap, but steps without effort over a fallen tree, a gate, or a split fence. During its progress it holds the nose up, so as to lay the horns horizontally back. This attitude prevents its seeing the ground distinctly; and as the weight is carried very high upon the elevated legs it is said sometimes to trip by treading on its fore heels, or otherwise, and occasionally to give itself a heavy fall. It is probably owing to this occurrence that the elk was believed by the ancients to have frequent attacks of epilepsy, and to be obliged to smell its hoof before it could recover; hence the Teutonic name of Elend (miserable), and the reputation especially of the fore hoofs as a specific against the disease." (Smith.) The Elk is an inhabitant of woods in the northern parts of both continents.

In 'A perfect Description of Virginia' (small 4to. 1649), we find it thus written: "The elkes are as great as oxen, their horns six foot wide, and have two calves at a time." Hearne remarks that the horns of the Moose occasionally exceed 60 lbs., and that their texture is harder than that of any other deer-horns to be found in the Fur Countries. Lawson ('Nat. Hist. of Carolina') says, "The elk is a monster of the venison sort. His skin is used almost in the same nature as the buffelo's (bison's). Some take him for the red deer of America, but he is not; for if brought and kept in company with one of that sort, he will never couple. . . . . His horns exceed (in weight) all creatures which the New World affords." Richardson states that he has been informed that the males sometimes attain a weight of eleven or twelve hundred pounds.

"The flesh of the moose is very good, though the grain is but coarse, and it is much tougher than any other kind of venison. The nose is most excellent, as is also the tongue, though by no means so fat and delicate as that of the common deer (rein-deer). The fat of the intestines is hard like suet; but all the external fat is soft like that of a breast of mutton, and when put into a bladder is as fine as marrow. In this they differ from all the other species of deer, of which the external fat is as hard as that of the kidnies." (Hearne.) In the 'Perfect Description of Virginia,' above quoted, it is stated that the "skins make good buffe, and the flesh as good as beefe." Lawson, though he speaks of the good qualities of the skin, does not seem to have so high an opinion of the flesh. "His flesh," says Lawson, "is not so sweet as the lesser deers." Richardson remarks that the flesh of the moose is more relished by the Indians and residents in the Fur Countries than that of any other animal, and principally, he believes, on account of the soft fat. In his opinion, corroborating the old book above quoted, the flesh bears a greater resemblance in its flavour to beef than to venison.

The same author describes the dung of the animal as being in the form of brown oval pellets, and such were the droppings from the individuals kept at the Gardens of the Zoological Society in the Regent's Park. "The skins," Sir John Richardson observes, "when properly dressed, make a soft, thick, pliable leather, excellently adapted for mocasins, or other articles of winter clothing. The Dog-Ribs," he adds, "excel in the art of dressing the skins, which is done in the following manner:—They are first scraped to an equal thickness throughout, and the hair taken off by a scraper, made of the shin-bone of a deer, split longitudinally; they are then repeatedly moistened and rubbed, after being smeared with the brains of the animal, until they acquire a soft spongy feel; and lastly, they are suspended over a fire made of rotten wood until they are well impregnated with the smoke. The last-mentioned process imparts a peculiar odour to the leather, and has the effect of preventing it from becoming so hard after being wet as it would otherwise do." ('Fauna Boreali-Americana.')

"Du Pratz," writes Sir John Richardson, "informs us that in his time moose-deer were found as far south as the Ohio, and Denys says that they were once plentiful on the island of Cape Breton, though at the time he wrote they had been extirpated. At present, according to Dr. Godman, they are not known in the State of Maine, but they exist in considerable numbers in the neighbourhood of the Bay of Fundy. They frequent the woody tracts in the Fur Countries to their most northern limit. Several were seen on Captain Franklin's expedition at the mouth of the Mackenzie River, feeding on the willows, which owing to the rich alluvial deposits on that great river extend to the shores of the Arctic Sea in lat. 69°. Farther to the eastward, towards the Coppermine River, they are not found in a higher latitude than 65°, on account of the scarcity on the Barren Grounds of the aspen and willow, which constitute their food. I have not been able to ascertain whether they occupy the whole width of the continent or not. Mackenzie saw them high up on the eastern declivity of the Rocky Mountains near the sources of the Elk River, but I suspect that they are rarely, if ever, found to the westward of the Mountains. Authors mention that the moose generally form small herds in Canada.

The Elk or Moose (*Alces Malchis*).

"In the more northern parts the moose-deer is quite a solitary animal, more than one being very seldom seen at a time, unless during the rutting season, or when the female is accompanied by her fawns. It has the sense of hearing in very great perfection and is the most shy and wary of all the deer-species, and on this account the art of moose-hunting is looked upon as the greatest of an Indian's acquirements, particularly by the Crees, who take to themselves the credit of being able to instruct the hunters of every other tribe. The skill of a moose-hunter is most tried in the early part of the winter; for during the summer the moose, as well as other animals, are so much tormented by musquitoes that they become regardless of the approach of man. In the winter the hunter tracks the moose by its foot-marks in the snow, and it is necessary that he should keep constantly to leeward of the chase and make his advances with the utmost caution, for the rustling of a withered leaf or the cracking of a rotten twig is sufficient to alarm the watchful beast. The difficulty of approach is increased by a habit which the moose-deer has of making daily a sharp turn in its route, and choosing a place of repose so near some part of its path that it can hear the least noise made by one that attempts to track it. To avoid this the judicious hunter, instead of walking in the animal's footsteps, forms his judgment from the appearance of the country of the direction it is likely to have taken, and makes a circuit to leeward until he again finds the track. This manœuvre is repeated until he discovers, by the softness of the snow in the foot-marks and other signs, that he is very near the chase. He then disencumbers himself of everything that might embarrass his motions, and makes his approach in the most cautious manner. If he gets close to the animal's lair without being seen, it is usual for him to break a small twig, which alarming the moose, it instantly starts up, but not fully aware of the danger squats on its hams and voids its urine preparatory to setting off. In this posture it presents the fairest mark, and the hunter's shot seldom fails to take effect in a mortal part. In the rutting season the bucks lay aside their timidity, and attack every animal that comes in their way, and even conquer their fear of man himself. The hunters then bring them within gun-shot by scraping on the blade-bone of a deer and by whistling, which, deceiving the male, he blindly hastens to the spot to assail his supposed rival. If the hunter fails in giving it a mortal wound as it approaches, he shelters himself from its fury behind a tree, and I have heard of several instances in which the enraged animal has completely stripped the bark from the trunk of a large tree by striking with its fore feet."

With respect to the food of the Moose the same traveller says, "Their legs are so long, and their necks so short, that they cannot graze on the level ground like other animals, but are obliged to browse on the tops of large plants and the leaves of trees in the summer, and in winter they always feed on the tops of willows and the small branches of the birch-tree, on which account they are never found during that season but in such places as can afford them a plentiful supply of their favourite food; and although they have no fore teeth in the upper jaw, yet I have often seen willows and small birch-trees cropped by them in the same manner as if they had been cut by a gardener's shears, though some of them were not smaller than a common pipe-stem. They seem particularly partial to red willows" (*Cornus alba*). To the eastward of the Rocky Mountains the evergreen leaves of the *Waltheria Shallon* form, according to Lewis and Clark, a favourite part of the food of the moose-deer.

Mr. Lloyd ('Field Sports of the North of Europe,' vol. ii.) observes that the Elk was at one time numerous in most parts of Sweden and Norway; but owing to the increased population and other causes it is now only to be met with in particular districts. In Scania, he adds, the most southern province of Sweden, where elks once abounded, none are now to be found.

M. Nilsson states that the Elk cannot endure so cold a climate as the stag, 64° of latitude being the extreme limit at which it is met with in the Scandinavian peninsula.

Mr. Lloyd states that the period of gestation is about nine months, and that the female brings forth about the middle of May from one to three young ones; but it is seldom that she has more than two. At this period the mother retires alone to the wildest recesses of the forest. After a lapse of two or three days, the fawns, which are of a light brown colour, have sufficient strength to follow their dam everywhere; they keep with her until they are in their third year, when she leaves them to shift for themselves.

Mr. Lloyd thus describes the habits and uses of the European Elk:—"The elk is a long-lived animal; he does not attain to his full growth until after his fourteenth year. At least so it is to be presumed, as up to that period his horns, which are of a flat form, are annually provided with an additional branch. He sheds his horns about the month of February in each year. The female elk, unlike the rein-deer of that sex, has no horns. The horns of the young male elk are perceptible nine months after its birth: for the first year they are cylindrical and short; the second year they are about a foot in length, but not branched; the third year two points are discernible; the fourth year three; the fifth year they are full grown in length. From that time forward they yearly increase in breadth and in the number of branches until there are as many as fourteen on each horn.

"By nature the elk is timorous, and he usually flies at the sight of man. In the rutting season, however, like other animals of the deer kind, he is at times rather dangerous. His weapons are his horns and hoofs; he strikes so forcibly with the latter as to annihilate a wolf or other large animal at a single blow. It is said that when the elk is incensed, the hair on his neck bristles up like the mane of a lion, which gives him a wild and frightful appearance.

"The usual pace of the elk is a high shambling trot, and his strides are immense, but I have known him when frightened to go at a tremendous gallop. In passing through thick woods he carries his horns horizontally, to prevent them from being entangled in the branches. From the formation of his hoofs he makes a great clattering, like the rein-deer when in rapid motion. In the summer season the elk usually resorts to morasses and low situations; for, like other animals of the deer kind, he frequently takes to the water in warm weather; he is an admirable swimmer. In the winter time he retires to the more sheltered parts of the forest, where willow, ash, &c. are to be found; as from the small boughs of these trees he obtains his sustenance during that period of the year. In the summer and autumn the elk is often to be met with in small herds, but in the winter there are seldom more than two or three in company. At the latter season indeed he is frequently alone.

"The flesh of the elk, whether fresh or smoked, is very excellent; the young are particularly delicious. According to Mr. Nilsson, it resembles in taste that of the stag. The tongue and the nose are thought to be great delicacies in Scandinavia as well as in America. Great virtue was once placed in the hoof of that animal, as parings of it were supposed to be a specific against the falling sickness and other disorders; but this idle notion must by this time, I should think, be nearly exploded. The skin is convertible to many purposes, and is very valuable. Mr. Greiff says:—'It is not long since that a regiment was clothed with waistcoats made from the hides of those animals, which were so thick that a ball could scarcely penetrate them.' He adds further, that 'when made into breeches, a pair of them among the peasantry of former days went as a legacy for several generations.'

"The elk is easily domesticated: several instances have come to my knowledge. I had a fawn in my own possession a year ago, but from want of proper nurture it died. Formerly these animals were made use of in Sweden to draw sledges, but owing, as it was said, to their speed frequently accelerating the escape of people who had been guilty of murders, or other crimes, the use of them was prohibited under great penalties. Though I apprehend those ordinances if not abrogated are obsolete, I am not aware that the elk is ever made use of in that kingdom at the present day, either to draw a sledge or for other domestic purposes.

"In Sweden, as I have observed, it is contrary to law at this particular time to kill the elk at any season of the year: this is not the case in Norway; for in that country as I have just shown, these animals may be destroyed with certain limitations as to numbers, from the 1st of July to the 1st of November inclusive. The penalty however for killing an elk out of season in Norway is very much heavier than in Sweden; it amounts indeed, including legal expenses, &c., to about 20*l.*, which is no inconsiderable sum in that kingdom." (Lloyd, 'Northern Field Sports,' vol. ii. p. 329 et seq.)

2. *Tarandus Rangifer* (Bonaparte), the Rein-Deer. This animal has a multitude of synonyms. It is the *Cervus Tarandus*, Linnæus; *Cervus Rangifer*, Ray; *Cervus Grœnlandicus*, Brisson; *Cervus coronatus*, Geoffroy; *Rangifer Tarandus*, Gray; *Cervus palmatus*, Johnston; *Tarandus*, Pliny; *Rangifer*, Gesner; the Rein-Deer, Caribou, and Greenland Buck of English writers; Renthier, Renhirsch of the Germans; Renne of Buffon; Carrebœuf of the French Canadians; and Oleen of the Russians. Several varieties have been recognised; amongst others, a small variety which goes by the following names:—

1. Woodland Caribou.
2. Great Caribou of the Rocky Mountains.
3. Labrador or Polar Caribou.
4. Siberian Rein-Deer.
5. Newfoundland Caribou.

On this animal Dr. J. E. Gray observes that it "varies exceedingly in size. In the British Museum there are specimens varying from 41 to 50 inches high at the withers."

Richardson observes, "There are two well-marked and permanent varieties of Caribou that inhabit the Fur Countries: one of them (Woodland Caribou) confined to the woody and more southern district; and the other (Barren-Ground Caribou) retiring to the woods only in the winter, but passing the summer on the coast of the Arctic Seas, or on the Barren Grounds so often mentioned in this work." ('Faun. Bor.-Amer.,' p. 299.)

The large Siberian variety is ridden on by the Tungusians. They also use them for draught, as the Laplanders do the smaller variety.

They have a large variety in Newfoundland, nearly as large as a heifer. They have very large and heavy horns. There are some horns of this variety in the British Museum. Dr. Middendorf informed Dr. J. E. Gray that the horns of the large Siberian variety were as large as and greatly resembled the horns from Newfoundland in the Museum collection.

Pallas observes, "Americæ forte continuo, gregatim verno tempore per glacies admigrant, paulo diversi à Siberiâ urguibinis et verosimillime Americani." ('Zool. Ross. Asiat.' i. 208.)

In winter the hair of the Rein-Deer is long, thick, gray-brown; neck, rump, belly, ring round the hoof, and end of nose, white. In summer the same animal has short dark sooty-brown hair, with the parts which are white in winter being rather paler gray-brown.

The tame Rhendeer, or Rein-Deer, of the Laplanders, is, according to Hoffberg ('Amœn. Acad.,' vol. iv.), at the end of his back an ell and a half high, and his length, from horns to tail, is two ells, whilst from the navel to the back-bone he measures three-quarters of an ell. On casting his coat his hair is at first brownish-yellow, but as the dog-days approach it becomes whiter, till it is at last almost entirely white. Round the eye the colour is always black. The longest hair is under the neck; the mouth, tail, and parts near the latter are white, and the feet, at the insertion of the hoof, are surrounded with a white ring. The hair of the body is so thick that the skin cannot be seen when it is put aside, for it stands erect, as in other animals of the same genus, but is much thicker. When the hair is cast it does not come away with the root, but breaks at the base.

The horns are cylindrical, with a short branch behind, compressed at the top and palmated with many segments, beginning to curve back in the middle, and an ell and a quarter long. A single branch sometimes, but seldom two, springs from each horn in front, very near the base, frequently equalling the length of the head, compressed at the top and branched. The distance between the tips equals the length.

The horns of the female are like those of the male, but less, more slender, and not so much branched. She has four true paps and two false ones.

The horns grow in the usual manner, and during the early part of their growth are extremely sensible, and suffer from the clouds of gnats (*Culex pipiens*) that form one of the persecutions of both deer and owner. About autumn, before rutting time, they have become hard, and the velvet is rubbed off. Towards the end of November the male loses his horns, but the female retains hers till she brings forth; if barren, she drops them in the beginning of November. The wild animal grows to a much larger size than those which are tamed.

Geographical Distribution.—Northern Europe, Asia, and America. Captain James Clark Ross, in the Appendix to Sir John Ross's 'Last Voyage,' says that although this animal was seen in great numbers on the isthmus of Boothia, only one individual was killed in the course of their late voyage. It was a fine buck, of larger size than ordinary, and weighed 250 lbs.; the average of those killed at Spitzbergen and Melville Island did not exceed half that weight. The does arrive about the middle of April, the bucks nearly a month later; and herds of several hundreds were seen about the isthmus towards the end of May. Although they migrate towards the middle of September to milder climes, yet stragglers are occasionally seen in the winter. They are indeed spread, as Mr. Bennett observes, "abundantly through all the habitable parts of the arctic regions and the neighbouring countries, extending in the New Continent to a much lower latitude than in the Old, and passing still farther south on all the principal mountain chains. In America the southern limit of the

Heads of two old buck Caribou of the Barren Grounds. From Sir John Richardson's cuts taken from Captain Back's drawings.

Rein-Deer across nearly the whole continent appears to be about the parallel of Quebec; but the animal is most numerous between 63° and 66° N. lat. Passing westward it is said to be unknown in the islands interposed between America and Asia, but is again abundant in Kamtchatka, throughout nearly the whole of Siberia, in Northern Russia, Sweden, and Norway, and more especially in Finmark and Lapland. In these latter countries the numbers of the few wild herds that still exist are suffering a constant diminution, every art being put in practice by the hardy natives to reclaim and domesticate an animal which constitutes their sole property, the source of all their comforts, and the very means of their existence; without which their land would actually be, as at a first glance it seems, a bleak and uninhabitable desert. According to M. Cuvier, the Baltic forms in Europe its southern limit; in Asia however it extends along the Ural chain to the foot of the Caucasus; and we have the authority of a passage in Cæsar's 'Commentaries,' which can scarcely apply to any other animal, for its having existed in his day in the Hercynian Forest. The boundaries of this immense tract of woodland are certainly not very well defined; but this location would imply, at all events, a more southern European habitat than any that is at present known. Again, crossing the ocean, we find the Rein-Deer at Spitzbergen, in Greenland, and in Newfoundland; but it has been said by Pennant, and this has been repeated by Sir John Richardson, in his valuable zoology of the Fur Countries of North America, not to be known in Iceland. This statement, which was scarcely true at the time when Pennant wrote, is not by any means correct as refers to the present day. About eighty years since, as we learn from Van Troil's 'Letters on Iceland,' thirteen of these animals were imported from Norway, ten of which dying on the passage, only three were landed. These were turned out into the mountains, and have since multiplied to such an extent in the interior and unfrequented parts of the country that their progeny was estimated by Count Trampe, the governor, in 1809, the period of Dr. Hooker's visit, at no less than 5000 head. Herds of forty, sixty, or even a hundred individuals, are said, both by Dr. Hooker and by Sir George Mackenzie, who visited the island in the following summer, to be not uncommon in the mountains. They are however of little use to the inhabitants, who have made no attempts to domesticate them, and are too poor to purchase powder and ball for their destruction. It does not appear indeed that they are much sought after, the cow and the sheep thriving extremely well upon the island, and supplying the place of the deer in almost every respect. We may add, that according to Mr. (Sir Arthur) Brooke, an importation of six bucks and twenty-four does took place in 1777, about seven years after the period of the first introduction of the animal into Iceland." ('Gardens and Menagerie of the Zoological Society,' vol. i.)

The size of the Rein-Deer, widely spread as it is, varies very much according to the accidents of climate; and if authors are to be credited their weight ranges from 60 to 400 lbs. The latter is probably an exaggeration, but it is evident that the weight increases in proportion to the proximity of the animal to the Pole. According to Sir John Richardson, the bucks of the variety called the Barren-Ground Caribou weigh, exclusive of the offal, when in good condition, from 90 to 130 lbs., whilst he describes the Woodland Caribou as much larger; and Captain (Sir John) Franklin makes the weight of the latter from 200 to 240 lbs. The buck killed on the isthmus of Boothia was, as we have seen, 250 lbs.; while the average of three killed at Spitzbergen and on Melville Island did not exceed half that weight. The Rein-Deer of Norway and Sweden are diminutive when compared with those of Finmark and Lapland, which in their turn yield to those of Spitzbergen; and these again fall short of the more Polar races. The sledge-deer of the Laplanders are small when compared with those reared by the Tungusians of the north of Asia, who ride upon them.

The food of the Rein-Deer varies with the seasons and the climate. Lapland, says Hoffberg, in the memoir above quoted, is divided into two tracks, called the alpine and woodland country. Those immense mountains called in Sweden Fjellen divide that country from Norway, extending towards the White Sea as far as Russia, and are frequently more than twelve miles in breadth. The other, called the woodland division, lies to the east of this, and differs from the neighbouring provinces of Norway by its soil, which is exceedingly stony and barren, being covered with one continued tract of wood, of old pine-trees. This tract has a very singular appearance. The trees above are covered over with great quantities of a black hanging lichen, growing in filaments resembling locks of hair, while the ground beneath appears like snow, being totally covered with white lichens. Between this wood and the Alps lies a region called the Woodland, or Desert Lapmarc, of 30 or 40 miles in breadth, of the most savage and horrid appearance, consisting of scattered uncultivated woods and continued plains of dry barren sand mixed with vast lakes and mountains. When the mosses on part of this desert tract have been burnt, either by lightning or any accidental fire, the barren soil immediately produces the white lichen which covers the lower parts of the Alps. The Rein-Deer in summer seek their highest parts, and there dwell amidst their storms and snows, not to fly the heat of the lower regions, but to avoid the gnat and gad-fly. In winter these intensely cold mountains, whose tops reach high into the atmosphere, can no longer support them, and they are obliged to return to the desert, and subsist upon the lichens. Of these its principal food is the rein-deer lichen. There are, says Hoffberg, two varieties of this; the first is called *Lichen sylvestris*, which is extremely common in the barren deserts of Lapland, and more particularly in its sandy and gravelly fields, which it whitens over like snow; its vast marshes, full of tussocks of turf, and its dry rocks are quite grown over by it. The second variety of this plant, which is less frequent than the former, is named the Alpine; this grows to a greater height, with its branches matted together: it has this name because when those mountains are cleared of their wood the whole surface of the earth is covered with it; yet it is seldom to be found on their tops. When the woods become too luxuriant the Laplander sets fire to them, as experience has taught him that when the vegetables are thus destroyed, the lichen takes root in the barren soil and multiplies with facility; though it requires an interval of eight or ten years before it comes to a proper height. The Laplander esteems himself opulent who has extensive deserts producing this plant exuberantly. When it whitens over his fields he is under no necessity of gathering in a crop of hay against the approach of winter, as the Rein-Deer eats no dried vegetable, unless perhaps the River Horsetail (*Equisetum fluviatile*). They root for this lichen under the snow like swine in a pasture; their foreheads, nose, and feet are guarded with a hard skin closely attached to those parts that they may not be hurt by the icy crust which covers the surface of the snow. The very strong shoes which the Laplander esteems so much are made of those parts of the hide. It sometimes happens (but very rarely) that the winter sets in with great rains, which the frost immediately congeals; the surface of the earth is covered with a coat of ice before the snow falls, and the lichen is entirely encrusted and buried in it: thus the Rein-Deer is sometimes starved, and a famine attacks the Laplanders. In such an exigence they have no other resource than that of felling old fir-trees grown over with the hairy liverworts. These afford but a very inadequate supply even for a small herd, but the greater part of a large one, in such a case, is sure to perish with hunger. In the summer, when the Rein-Deer ranges upon the Alps, a number of plants afford it food. Hagstrom states that it refuses to eat 46 species, the names of which he gives. Richardson states that the Barren-Ground Caribou, which resort to the coasts of the Arctic Sea in summer, retire in winter to the woods lying between 63° and 66° N. lat., where they feed on the *Usneæ*, *Alectoriæ*, and other lichens which hang from the trees and on the long grass of the swamps. About the end of April, when the partial melting of the snow has softened the *Cetrariæ*, *Corniculariæ*, and *Cenomyces*, which clothe the Barren Grounds like a carpet, they make short excursions from the woods, but return to them when the weather is frosty. In May the females proceed towards the sea-coast, and towards the end of June the males are in full march in the same direction. At that period the sun has dried up the lichens on the Barren Grounds, and the Caribou frequent the moist pastures which cover the bottoms of the narrow valleys on the coasts and islands of the Arctic Sea, where they graze on the sprouting *Carices*, and on the withered grass or hay of the preceding year, which is at that period still standing and retaining part of its sap. Their spring journey is performed partly on the snow, and partly, after the snow has disappeared, on the ice covering the rivers and lakes, which have in general a northerly direction. Soon after their arrival on the coast the females drop their young; they commence their return to the south in September, and reach the vicinity of the woods towards the end of October, where they are joined by the males. This journey takes place after the snow has fallen, and they scrape it away with their feet to procure the lichens, which are then tender and pulpy, being preserved moist and unfrozen by the heat still remaining in the earth. Except in the rutting season, the bulk of the males and females live separately; the former retire deeper into the woods in the winter, whilst herds of the pregnant does stay on the skirts of the Barren Grounds, and proceed to the coast very early in the spring. Captain (Sir William) Parry saw deer on Melville peninsula as late as the 23rd of September, and the females with their fawns made their first appearance on the 22nd of April. The males in general do not go so far north as the females. On the coast of Hudson's Bay the Barren-Ground Caribou migrate farther south than those on the Coppermine River or Mackenzie River, but none of them go to the southward of the Churchill. The lichens on which the Caribou principally feed whilst on the Barren Grounds are *Cornicularia tristis*, *C. divergens*, and *C. ochrileuca*, *Cetraria nivalis*, *C. cucullata*, and *C. Islandica*, and *Cenomyce rangiferina*. ('Fauna Boreali-Americana.') In the isthmus of Boothia the Rein-Deer does arrived about the middle of April, the bucks nearly a month later; and herds of several hundreds were seen about the isthmus towards the end of May. Numbers of the fawns, which at that period are in a very weak state, are killed by the natives, who hunt them with their dogs; and the does themselves often fall victims to their attachment to their offspring. Captain James Ross states that the Rein-Deer feeds on the *Usneæ*, *Alectoriæ*, *Cetrariæ*, and other lichens in the early part of spring; but as the summer advances the young and tender grass fattens them so quickly that in August they have been killed with several inches thick of fat on their haunches. In this state the meat is equal to the finest English venison, but is most tasteless and insipid when in poor condition. (Appendix to Sir John Ross's 'Last Voyage.')

The Caribou travel in herds varying in number from eight or ten to two or three hundred; their daily excursions being generally towards the quarter from which the wind blows. The Indians kill them with bows and arrows or guns, sometimes approaching by means of a disguise, sometimes taking advantage of rocks or other shelter, and always greatly assisted by the curiosity and unsuspecting nature of the deer themselves. They also take the Rein-Deer in snares, or spear them as they are crossing rivers or lakes. The Esquimaux take them in traps ingeniously formed of ice and snow. A single family of Indians will sometimes destroy two or three hundred in a few weeks; and in many cases they are killed for the sake of their tongues alone. The reader will find a graphic account of the Esquimaux method of taking them in Captain Lyon's 'Private Journal,' p. 336; and a description of the deer found in use among the Chepewyans (Chippeways), in Hearne. Sir John Franklin relates the ingenious methods pursued by the Copper Indians and Dog-Ribs. Captain James Ross remarks that the natives of Boothia seldom hunt the Rein-Deer in the spring, and then the bow and arrow is the only mode of killing it; but in the autumn, as the animals return from the north in fine condition, they are destroyed in great numbers by parties of the natives driving them into the water, whilst others in canoes kill them with spears at their leisure.

Utility to Man.—To the Laplander particularly the Rein-Deer is all in all. According to Hoffberg, the mountaineer very often possesses three or four hundred or even a thousand head; the woodman very rarely above one hundred. As a domestic animal, yielding a quantity of the most delicious food, and occupying the place of the cow and the ox, it is invaluable. As a beast of burden its importance is equally great, and its organisation is adapted to the icy wastes, over which it forms the Laplander's sole medium of communication, no less than that of the camel is framed for those arid deserts which without the latter animal would be impassable. The weight which it can draw when harnessed to a sledge is said to be 300 lbs.; but 240 lbs. form the general limit of the burden. The tales told of its swiftness, when thus employed, would appear almost incredible if not so well attested as they are. In a race of three deer with light sledges started by Pictet, who went to the north of Lapland in 1769 to observe the transit of Venus, the first performed 3089 ft. 8 in. and $\frac{28}{100}$ in two minutes, making a rate of nearly 19 English miles an hour; the second went over the same ground in three minutes, and the last in three minutes twenty-six seconds. One is recorded to have drawn an officer with important dispatches, in 1699, 800 English miles in forty-eight hours; and the portrait of the poor deer, which fell dead at the end of its wonderful journey, is still preserved in the palace of Drottningholm in Sweden. Journeys of 150 miles in nineteen hours are said not to be uncommon.

To the natives of North America the Rein-Deer is only known as a beast of chase, but it is a most important one: there is hardly a part of the animal which is not made available to some useful purpose. Clothing made of the skin is, according to Richardson, so impervious to the cold, that, with the addition of a blanket of the same material, any one so clothed may bivouack on the snow with safety in the most intense cold of an arctic winter's night. The venison, when in high condition, has several inches of fat on the haunches, and is said to equal that of the fallow-deer in our best British parks; the tongue and some of the tripe are reckoned most delicious morsels. Pemmican is formed by pouring one-third part of melted fat over the pounded meat and incorporating them well together. The Esquimaux and Greenlanders consider the stomach or paunch, with its contents, a great delicacy, and Captain James Ross says that those contents form the only vegetable food which the natives of Boothia ever taste. (Richardson's 'Fauna Boreali-Americana.')

Rein-Deer (*Tarandus Rangifer*).

Highly excellent as an article of food, and useful domestically as this animal is, we do not think that it can ever be introduced with much success into the British Islands. Not that there would be much difficulty about the food for the deer; it is space that is wanting. A long succession of generations would be required before the migratory habits of the Rein-Deer could be got rid of, and possessing as we do the best venison, and the finest breed of horned cattle and horses, there seems no very good reason for repeating the experiments which have already been tried and have failed.

3. *Cervus Canadensis*, the Wapiti. This animal is the Wapiti Stag of Pennant, 'Arctic Zool.'; Wewaskiss of Hearne; Waskeesews, or Red-Deer, of Hutchins; Red-Deer of Umfreville; the Elk of Lewis and Clark; the American Elk of Bewick; Wapiti of Barton and Warden; Le Wapiti of F. Cuvier; the Wapiti (*C. Strongyloceros*) of Smith; Red Deer of the Hudson's Bay Traders; La Biche of the Canadian Voyageurs; Wawaskeesho, Awaskees, and Moostosh, of the Cree Indians (Richardson). It is also Le Cerf du Canada of Cuvier, who makes it the *C. Canadensis* of Gmelin (Buffon), and *C. Strongyloceros* of Schreber; and Cerf Wapiti of Lesson, who states it to be *C. Wapiti* of Mitchell and *C. major* of Ord. It may be also the Stag of Carolina of Lawson, but he describes it as "not so large as in Europe, but much larger than any fallow-deer;" and he says they are always fat with some delicate herbage that grows on the hills, whereas the modern travellers describe the Wapiti as frequenting the savannahs or the clumps of wood that skirt the plains. There is hardly any doubt that it is the Stag of America (*C. major Americanus*) of Catesby. "This beast," says the author last named, "nearest resembles the European red deer in colour, shape, and form of the horns, though it is a much larger animal and of stronger make. Their horns are not palmated but round, a pair of which weighs upwards of thirty pounds. They usually accompany buffaloes (Bisons), with whom they range in droves in the upper and remote parts of Carolina, where, as well as in our other colonies, they are improperly called Elks. The French in America call this beast the

Canada Stag. In new England it is known by the name of the Gray Moose, to distinguish it from the preceding beast (the True Elk) which they call the Black Moose." Richardson states that it is without doubt the Canada Stag of various authors; but, as F. Cuvier has observed, the want of a pale mark on the rump in Perrault's figure is sufficient to excite a doubt of its being the *C. Canadensis* of that author. Indeed he does not think it at all improbable that this figure is that of the *C. Macrotis*, which may hereafter prove to be an inhabitant of Upper Canada. Dr. J. E. Gray defines it as follows:—Red-brown; rump with a very large pale disc extending far above the base of the tail, and with a black streak on each side of it; male with hair of throat elongated, black with reddish tips.

Geographical Distribution.—Sir John Richardson says that this animal does not extend its range farther to the north than the 56th or 57th parallel of latitude, nor is it found to the eastward of a line drawn from the south end of Lake Winipeg to the Saskatchewan in the 103rd degree of longitude, and thence till it strikes the Elk River in the 111th degree. To the south of Lake Winipeg he thinks it may perhaps exist farther to the eastward. He adds that they are pretty numerous amongst the clumps of wood that skirt the plains of the Saskatchewan, where they live in small families of six or seven individuals, and that they feed on grass, on the young shoots of willows and poplars, and are very fond of the hips of the *Rosa blanda*, which forms much of the underwood in the districts which they frequent.

A small variety is described as a native of the plains of California and the upper parts of the river Missouri. It is very abundant and occurs in large herds.

The height of this animal at the shoulders is 4½ feet, more than a foot exceeding that of the common stag. All the upper parts and the lower jaw are of a somewhat lively yellowish-brown; a black mark from the angle of the mouth along the side of the lower jaw; a brown circle round the eye. The first antlers depressed in the direction of the facial line. Neck mixed red and black, with coarse black hairs descending from it like a dewlap, deeper in colour than the sides. From the shoulders to the hips French gray; a pale yellowish patch on the buttocks, bounded on the thighs by a black line; tail yellowish, 2½ inches long, whereas it is nearly 7 inches in the European Stag. The hair of a mean length on the shoulders, the back, the flanks, the thighs, and the under part of the head; that on the sides and limbs shorter, but the hair is very long on the sides of the head posteriorly and on the neck, particularly below, where they form the kind of dewlap above alluded to. On the posterior and outer aspect of the hind legs there is a brush of tawny hair which surrounds a narrow long horny substance. Ears white within and clothed with tufted hair, externally of the same colour as the neighbouring parts; a naked triangular space round the larger lachrymal sinus near the inner angle of the orbit. Hoofs small. Like the common stag, the Wapiti has a muzzle, upper canine teeth, and a soft tongue. The quality of the hair is brittle and there is a short wool beneath it. Richardson thinks that the Crees give it the name of Stinking Head on account of the large suborbital opening.

Hearne gives the Wapiti a character for stupidity surpassing that of all the deer kind. He says that they frequently make a shrill whistling and quivering noise, not very unlike the braying of an ass. Mr. Drummond, who saw many in his journeys through the plains of the Saskatchewan, informed Sir John Richardson that it does not bell like the English deer. F. Cuvier describes the cry as prolonged and acute, consisting of the successive sounds *a*, *o*, *u* (French), uttered with so much strength as to offend the ear.

The flesh of the Wapiti is coarse, and little prized by the natives, principally on account of the fat being hard like suet. It wants the juiciness of venison, and resembles dry but small grained beef. Its hide, when made into leather after the Indian fashion, is said not to turn hard in drying after being wet, and in that respect to excel moose or rein-deer leather.

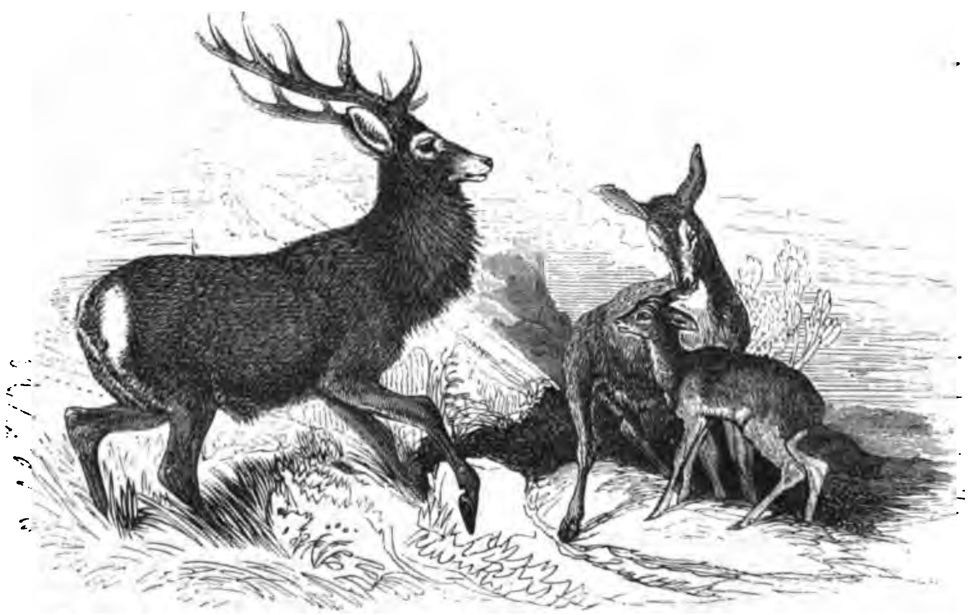
The velvety covering of the horns shrivels and is rubbed off in the month of October, at the commencement of the rutting season, but the horns themselves do not fall until the month of March or April.

The pair shed by 'Monkey' (one of the Wapiti kept by the Zoological Society of London in the Regent's Park), on the 4th March, 1837, weighed 26½ lbs.

Wapiti (*Cervus Canadensis*).

That the Wapiti will live and thrive well and propagate in Great Britain there is now no doubt; but grand as the appearance of the animal is, it is not probable that it will be bred here to any great extent on account of the inferior quality of its venison.

4. *C. Elaphus*, the Stag. It is the Common Stag, or Red Deer, of the English; Carw (Stag), Ewig (Hind), Elain (Young or Calf), of the ancient British; Le Cerf (Stag), La Biche (Hind), Faon (Young or Calf), of the French; Cervio, Cervia, of the Italians; Ciervo, Cierva, of the Spanish; Cervo, Cerva, of the Portuguese; Hirtz, Hirsch (Stag),



Common Stag (*Cervus Elaphus*).

N.B. Mr. Smith makes a sub-genus of the True Stags under the name of *Elaphus*.

Hind (Hind), Hinde Kalb (Calf) of the Germans; Hart (Stag) and Hinde of the Dutch; Hjort, Kronhjort (Stag), and Hind, of the Swedes; Kronhjort, Hind, Kid, or Hind-Kalv, of the Danes; the *Cervus vulgaris*, Linnæus; *C. nobilis*, Klein; *Cervus*, Pliny; *'Ελαφός*, Aristotle; *Cervus Germanicus*, Brisson; *Tragelaphus*, Gesner; *Hippelaphus*, Johnston.

This noble species is a native of the forests of the whole of Europe and Asia where the climate is temperate. In England it is intimately blended with the old oppressive forest laws, which valued the life of a man at less than that of a stag, and with some of our legends of deadly feud: 'Chevy Chace,' for instance. The stag-hounds that formerly roused the deer on the moors of the west of England are at present dispersed, and although in Scotland villages have been depopulated to let it run wild, it is the rifle of the deer-stalker principally that now brings the stag down.

The Red Deer is distinguished by its brown colour. The rump has a pale spot extending rather above the upper surface of the base of the tail. They sometimes attain a great size. Pennant speaks of one that weighed 18 stones Scots, or 314 lbs., exclusive of the entrails, head, and skin. The Prince of Canino has described a Corsican variety as *Cervus Corsicus*. Buffon remarks of this species that he believes its small size depends on a deficiency of nourishment, for when removed to better pastures it becomes even bigger than the Common Stag.

5. *C. Barbarus*, the Barbary Deer, is chiefly distinguished from the Common Stag and the Algerian variety of it by its smaller size, stouter form, and more permanently-spotted fur. It is the Bush-Goat of the Moors, and inhabits the coasts of Barbary.

6. *C. Wallichii*, the Bara Singa, or Morl, is an Indian species. It is also found in Persia, where it is called Maral, Gevezu, or Gookoohee. It is the *Cervus Pygargus* of Hardwicke; also Jesrael, or Tailless Deer, and Red Deer, of India.

7. *C. affinis*, the Saul-Forest Stag, the Stroa or Tibetan Stag of Hodgson, the Bara Singha of the Hindoos. The bones are as heavy and as large as those of the Wapiti.

8. *C. Sika*, the Sika, is of a dark-brown colour, and has rather slender horns. It is a native of Japan.

9. *Dama vulgaris*, the Fallow-Deer. This well-known ornament of our parks is the Hydd (Buck), Hyddes (Doe), Elain (Fawn), of the ancient British; Le Daim (Buck), La Daime (Doe), Faon (Fawn), of the French; Daino (Buck), Damma (Doe), Cerbietto, Cerbietta (Fawn), of the Italians; Gama, Corza (Buck), Venadito (Fawn), of the Spanish; Corza (Buck), Veado (Fawn), of the Portuguese; Damhirsch of the Germans; Dof, Dof-Hjort, of the Swedes; Daae, Dijr, of the Danes; *Dama vulgaris*, Gesner; *Cervus palmatus*, Klein; *Cervus platyceros*, Ray; *Cervus Dama*, Linnæus.

It is not certain whether the common Fallow-Deer is the Πρόξ of Aristotle. Buffon and others are of that opinion; but M. Camus, who seems very well disposed to coincide with such opinion if he could, gives good reasons for doubt. Pennant considers the *Platycerata* of Pliny (book xi. c. 37), and the *Eurycerata* of Oppian ('Cyneg.' lib. ii., lin. 293), to have been our Fallow-Deer.

Pennant, speaking of the two varieties, the spotted and the deep-brown, says, on the authority of Collinson, that they were introduced into this country by James I. from Norway, where he passed some time when he visited his intended bride, Anne of Denmark; and he remarks (citing Llywd), that one of the Welsh names of the animal,

Fallow-Deer (*Dama vulgaris*).

Geifr Danys, or Danish Goat, implies that it was brought from some of the Danish dominions. James, who observed their hardiness, brought them first into Scotland and thence to Enfield Chace and Epping, to be near his favourite palace, Theobalds. When Pennant wrote, they were, according to him, scarcely known in France, but were sometimes found in the north of Europe. In Spain, he observes, they are extremely large; and that they are met with in Greece, the Holy Land, and in China. For the two latter localities he quotes Hasselquist, who says he saw it in Mount Thabor, and Du Halde. Pennant goes on to state that in every country except our own these deer are in a state of nature unconfined by man; but they are, and for some time have been, confined in parks on the Continent as they are in England. In Moldavia and Lithuania they are said to be found wild. Cuvier observes that they have become common in all the countries of Europe, and that they appear to have come originally from Barbary. In a note to his last edition of the 'Règne Animal' he states, that since the publication of the second edition of his 'Ossemens Fossiles' he had received a wild Fallow-Deer (Daim) which had been killed in the woods to the south of Tunis.

Besides the varieties above mentioned, there are many others, as is generally the case with reclaimed or half-reclaimed animals. One variety is milk-white. Pennant remarks that in the old Welsh laws a Fallow-Deer was valued at the price of a cow, or, as some say, a he-goat. This species is represented on the sculptures of Nineveh.

10. *Panolia Eldii*, the Sungnai, is an Indian species.

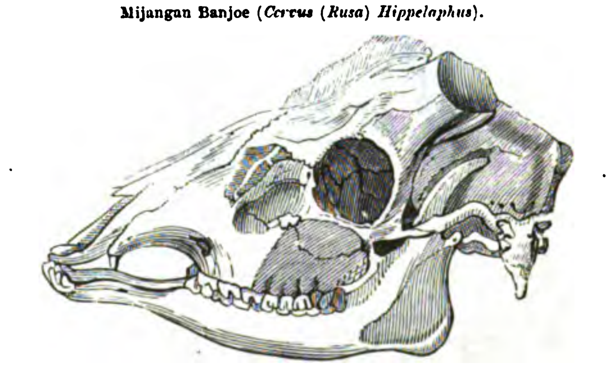
11. *Rucervus Duvaucellii*, the Bahrainga, is another Indian species. It is called the Spotted Deer of the Sunderbunds, and Barara Singha by Hardwicke. It is the *Cervus Elaphoides* of Hodgson. It inhabits reedy marshes and the islands of great rivers, never entering the mountains or forests. The tail is short, with no caudal disc and no heavy mane.

12. *Rusa Aristotelis*, the Samboo. It is the *Cervus Hippelaphus* of Ogilby, *Cervus unicolor* of H. Smith, Cerf de Coromandel of Cuvier, *Cervus Bengalensis* of Schirz, Daim Noir de Bengale of Duvaucell, the Samboo-Deer of Bennett, *Cervus heterocerus* of Hodgson. The last author describes four varieties of this animal. They are natives of various parts of India, and inhabit great forests and the mountains above them. They are not gregarious, and rut and drop their horns in spring.

13. *R. Dimorphe*, the Spotted Rusa, Gerver or Gower. Their colour is red-brown. They are confined to the saul-forests in India.

14. *R. Hippelaphus*, the Mijangan Banjoe. It is the *Cervus Hippelaphus* of Cuvier; Cerf Noir du Bengale, ou Hippelaphe, of F. Cuvier; Cerf d'Eau, ou Mejanganbanjoe, of the Malays of Java,

Mijangan Banjoe (*Cervus* (*Rusa*) *Hippelaphus*).



Skull of *Cervus Hippelaphus*.

according to Duvaucell; Rusa, or Roussaitan (Black Stag), of the Javanese and Sumatrans; *Rusa Hippelaphus*, the Great Rusa, of

Smith; *C. Molluccensis* of Quoy and Gaimard; *C. (Rusa) Timorensis* of Müller.

The size and proportions of this animal are about those of the Common Stag, but its hair is rougher and harder, and when adult that of the upper part of the neck, of the cheeks, and of the throat is long, and forms a sort of beard and mane. In winter its colour is of a grayish-brown more or less deep; in summer it is of a brighter and more golden brown. The croup is a pale yellow, and the tail is brown terminated by rather long hair.

It is a native of Bengal, Sumatra, and the islands of the Indian Archipelago.

This is supposed to be the *Hippelaphus* of Aristotle; but G. Cuvier, who once was of that opinion, seems in the last edition of his 'Règne Animal' to consider that another species, *C. (Rusa) Aristotelis*, Cuvier, living in the north of India, is the animal alluded to by the Greek zoologist.

15. *R. equinus*, the Samboe. It is the *Rusa* of Raffles; the Eland or Elk of the Dutch sportsmen. It inhabits Sumatra and Borneo. It is of a plain brown colour.

16. *R. Peronii*, the Smaller Rusa, is a native of Timor and Lombok, Batchian and Ternate.

17. *R. Philippinus*, the Philippine Rusa, is the *C. Marianus* of Cuvier, the Cerf de Philippine of Desmarest. It is a native of the Philippines.

18. *R. lepida*, the Sundevall Rusa, is a native of Java. It is scarcely as large as a roe-buck.

19. *Axis maculata*, the Axis. It is the *Axis* of Pliny; *C. Axis* of Erxleben; *A. major* of Hodgson, also *A. medius* and *A. minor* of the same author; Cerf Cochon of Buffon; Spotted Axis or Chittra, Langna or Pada, or Spotted Porcine Deer, Thou or Spotted Porcine Axis, *A. medius*, or Spotted Hog-Deer, or Thou Langna of the Tarai, of Hodgson. In size and general form it nearly resembles the common Fallow-Deer. The skin is at all times of a rich fawn-colour spotted with white. Height at the shoulder 2 feet 6 or 7 inches. The distribution of the spots varies in different iudividuals. The ground-colour changes to nearly black along the back; the under parts are snow-white. Flanks, sides, shoulders, hind quarters, and part of the neck spotted as above mentioned. There is a broad dusky spot on the forehead, and a line of the same colour extends along the middle of the nose. The male has no canine teeth, nor has the female any horns; she is generally less in size than the male, and resembles him much in colour, but may be distinguished, it is said, by a white longitudinal line on the flanks. The young resemble the parents.

It is a native of India and the larger islands of the Indian Archipelago; very abundant in Bengal, and on the banks of the Ganges.

The Axis haunts the thick jungles in the vicinity of water, and the British sportsmen hunt it under the name of the Spotted Hog-Deer. It feeds in the night; and is timid, indolent, and mild, excepting when the females have young, and then the male is bold and fierce.

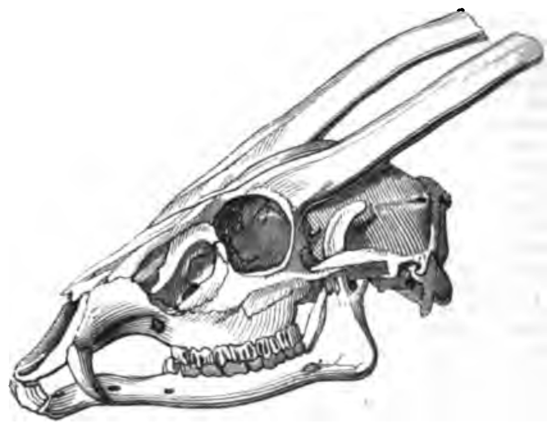
Axis (*Axis maculata*).

The Axis is easily domesticated, and in England has propagated freely in captivity. The species has been kept with success both in menageries and open parks, to both of which its form and colour make it an elegant ornament.

20. *A. pseudaxis*, the Spotted Axis. It is the *C. pseudaxis* of Gervais. It differs from *A. maculata* in having a series of spots in place of an oblique streak on the haunches.

21. *Hydaphus porcinus*, the Lugna Para, or Shgoriah. It is the *C. porcinus* of Sundevall; the *C. niger* of H. Smith; the Porcine Deer of Pennant; the Brown Porcine Axis of Hodgson; *C. Hippelaphus*, var. 3, of Cuvier. This species is easily known from the Axis by being lower on its legs, and having no distinct black dorsal streak, nor white streak on its haunches. The horns are generally short, with only short snags. They live in families, or small herds, on the plains of Hindustan. They are also found in Ceylon. Mr. Ogilby says they do not ascend mountains. The *C. Dodur* of Royle is probably a distinct species. *C. pumilis* of H. Smith is perhaps a variety.

22. *Cervulus vaginalis*, the Kijang or Muntjak. It is the *Cervus Muntjac* of Zimmerman; *Prox Muntjac* of Sundevall; *Cervus plicatus* of Forster; the Ribbed-Faced Deer of Pennant; the Chevreuil des Indes of Allamand.



Skull of Muntjak (*Cervulus vaginalis*).

The height of the Muntjak at the shoulders is about 2 feet 2 inches; head pointed; eyes large, with lachrymal sinuses; ears rather large; tail short and flattened.

In the living animal there are on the face two rough folds of the skin, considerably distended and elevated, about an inch and a half apart above; and following the direction of the prominent part of the forehead they unite below, so as to mark the face with the letter V. In the dried subject the folds are contracted, and three distinct ribs appear, which suggested to Pennant the name of Rib-Faced Deer. General colour reddish-brown above; belly and front of the thighs pure white. The male has large canines in the upper jaw; the female has none, nor has she horns.

Dr. Horsfield, who has given the best account of this animal, states that "the Muntjak selects for its retreat certain districts, to which it forms a peculiar attachment, and which it never voluntarily deserts. Many of these are known as the favourite resort of our animal for several generations. They consist of moderately-elevated grounds, diversified by ridges and valleys, tending towards the acclivities of

Muntjak (*C. vaginalis*).

the more considerable mountains, or approaching the confines of extensive forests. Such districts are by no means uncommon in Java: they are covered with long grass, and shrubs and trees of moderate size, growing in groups or small thickets, and they generally intervene between cultivated tracts and the deep forests. Their vegetation is peculiarly adapted to afford our animal a very abundant supply of nourishment; their surface is covered with long grass (*Saccharum spicatum*), well known to persons who have visited the interior of Java by the name of Allang-Allang, and the groves and thickets abound with *Phyllanthus Emblica*, Linn.: these two plants constitute its principal food. They also produce many species of *Hibiscus*, *Grewia*, *Urena*, and other malvaceous plants, all of which are greedily eaten by the Kijang. . . . The Kijang is impatient of confinement, and is not fitted for the same degree of domestication as the stag. It is however occasionally found in the inclosure of natives and Europeans, but requires a considerable range to live comfortably: it is cleanly in its habits, and delicate in its choice of food. The flesh affords an excellent venison, which is often found on the tables of Europeans. The natives eat the males, and always present them in a conspicuous place in their feasts; but in consequence of some peculiarities in the habits of the females, they have an aversion to them as food."

23. *C. moschatus*, the Kegan or Kakr. It is the *Cervus Moschus* of Desmarest, *C. Ratwa* and *Stylocerος Ratwa* of Hodgson, *Prox Ratwa* of Sundevall, *P. albipes* of Wagner, *P. stylocerος* of Wagner, the Musk-Deer of Nepaul; the Jungle Sheep.

It is of a bright reddish-yellow colour, with the chin and gullet whitish. The hair is not ringed as in the following species.

The Ratwa are natives of India, where they live in forests, in the mountains, or at their bases. They live six or eight together. The horns fall in May. The females have bristly tufts ending in a knot instead of a horn.

24. *C. Reevesii*, the Chinese Muntjak, is of a grayish-brown colour, with short pale ringed hair. It is a native of China. Dr. J. E. Gray says ('Brit. Mus. Cat.'):—"The Earl of Derby has these three kinds (the three last species) at Knowsley, but they breed together, and it has hence become impossible to discriminate the males from the original species."

25. *Capreolus Capræa*, the Roe-Buck. This animal is probably the Δορκὰς of Aristotle; *Iorcas* and *Dorcas* of Oppian; *Caprea* of Pliny (xi. 37); *Caprea*, *Capreolus*, *Dorcas*, of Gesner; *Capreolus* of Ray and of Sibbald; *Cervus Capreolus* of Linnæus; *C. minimus* of Klein; Iwrch (male), Iyrchell (female), of the ancient British; Le Chevreuil of the French; Capriolo of the Italians; Zorlito, Cabronzillo Montes, of the Spanish; Cabra Montes of the Portuguese; Rehbock (male), Rehgees, of the Germans; Radiur, Rabock, of the Swedes; Raaedijr, Raaebuk, of the Danes.

Its length is about 3 feet 9 inches; height before about 2 feet 3 inches; behind, 2 feet 7 inches. Weight from about 50 to 60 lbs. Length of horns from 8 to 9 inches; they are erect, round, and divided into three branches above; their lower part is deeply furrowed longitudinally. Those of a young buck in its second year are simple; in the third year a branch appears; the head is complete in the fourth year. In the winter the hair on the body is long, the lower part of each hair is ash-coloured, there is a narrow bar of black near the end, and the tip is yellow. On the face the hair is black tipped with yellow. The ears are long, of a pale yellow on the inside, and covered with long hair. In summer the coat is short and smooth, and of a bright reddish colour. The chest, belly, legs, and inside of the thighs, are yellowish-white; the rump is pure white, and the tail very short. On the outside of the hind legs, below the joint, is a tuft of long hair.

"The Roe-Buck was formerly very common in Wales, in the north of England, and in Scotland, but at present the species no longer exists in any part of Great Britain, except in the Scottish Highlands." Such is the locality given by Pennant when he wrote; and he adds that, according to Dr. Mouffett, it was found in Wales as late as the reign of Queen Elizabeth, and in great plenty in the Cheviot Hills, according to Leland, in that of Henry the VIII. That at one time the Roe inhabited the southern parts of the kingdom is clear, if the information given to the editor of the last edition of the 'British Zoology' is correct, for that states the discovery of seven or eight horns of the Roe in the peat beds near Romsey, in Hampshire, together with the complete head of a beaver, with the teeth entire. In Ireland the animal is not known. They are frequent in France, and are found in Italy, Sweden, Norway, and Siberia. Pennant, who gives these localities, says that the first that are met with in Great Britain are in the woods on the south side of Loch Rannoch, in Perthshire; the last in those of Langwal, in Caithness; but that they are most numerous in the beautiful forests of Invercauld, in the midst of the Grampians. They are still comparatively plentiful in Scotland. Sir James Carnegie had a battue, in which forty were killed. Sir William Jardine states, that south of the Forth they are now very rare, one or two wilder parks only possessing a few; but frequent traces of their former abundance are found in the border counties, remains and skeletons being almost yearly disinterred from most of the larger peat mosses. The same author speaks of its frequency in many European countries, Germany, Silesia, &c. ("Naturalist's Library,' Mammalia, vol. iii.)

The Roe does not keep in herds, but only congregates in families in the lower coverts and less wild woods. The female goes with young five months, and produces two fawns at a birth, and these she conceals from the buck. They are said to live twelve or fifteen years, and to be able to reproduce the species at the age of eighteen months.

Pennant observes that it is a tender animal, and quotes Buffon, who says that in the hard winter of 1709 the breed was almost extinguished in Burgundy, and many years passed before it was restored again. It is generally killed—either in the covert or by the sportsman, who waits outside while the copse or wood is driven—with shot. It falls very readily, and often without being apparently severely struck; we have heard instances of their being knocked over with comparatively small shot. As soon as it is down the throat is cut, and the animal is hung up by the hind legs on the fork of some tree to bleed.

Roe-Buck (*Capreolus Dorcas*).

Herbage and tender shoots of underwood are the food of the Roe in the summer. They are said to be very fond of the *Rubus saxatilis*, called in the Highlands the Roe-Buck Berry. In winter, when the ground is covered with snow, they browse on the tender branches of the fir and the birch. (Pennant.)

The flesh is delicate food when well killed, and the horns are used for handles of carving-knives, &c.

Pennant states that in the old Welsh laws a roe-buck was valued at the same price as a she-goat.

26. *C. Pygargus*, the Ahu. It is the *Cervus Pygargus* of Pallas, *Cervus Ahu* of Griffith, the Siaga of the Tartars, Dikaja Kosa of the Russians, Tailless Roe and Tailless Deer of Pennant and Shaw. It is a native of Central Asia.

27. *Blastocerus paludosus*, the Guazupuco. It is the *Cervus Mexicanus* of Goldfuss, *C. dichotomus* of Illiger. It is a native of South America.

28. *B. campestris*, the Mazame or Guazuti. It is the *Cervus bezoarticus* of Linnæus, *C. campestris* of F. Cuvier, *C. leucogaster* of Goldfuss, the Biche de Pampas of Cuvier. It is a native of South America in Northern Patagonia. It is exceedingly abundant, in small herds, throughout the countries bordering the Plata. Mr. Darwin describes the odour of the buck as quite overpowering, from its disagreeable character.

29. *Furcifer Antisiensis*, the Tarush or Taruga, is a native of South America, in the Bolivian Alps.

30. *F. Huamel*, the Guemul. It is the *Auchenia Huamel* of H. Smith, the *Camelus Equinus* of Leuckart, *Cervecus Andicus* of Lesson, the Cloven-Footed Horse of Shaw. It is a native of the east coast of South America.

31. *Cariacus Virginianus*, the American Deer. It is the *Dama Virginiana* of Ray, *Cervus Virginianus* of Gmelin, *C. Strongylocerος* of Schreber, the Virginian and Mexican Deer of Pennant, the Cerf de la Louisiane of Cuvier, the Cariacou of Buffon. The tail of this animal, like the rest of its body, is fulvous, above the tip it is black, but beneath white, and is carried erect when running. They inhabit the Oregon, and are found to be most numerous near the coast of the Pacific Ocean. Their range on that coast is up to 15° N. latitude. At the Umqua, in latitude 43° they give place to the Black-Tailed Deer. "We believe that the same species of deer inhabits all the timbered or partially timbered country between the coast of the Atlantic and Pacific Oceans." (Gray.)

32. *C. Mexicanus*, the Mexican Deer. Tail fulvous gray. Not well known. Inhabits Mexico.

33. *C. leucurus*, the White-Tailed Deer. It is the *Cervus leucurus* of Douglass, *C. campestris* of F. Cuvier. Various writers on America have called it by the following names: Roe-Buck (Dobbs), the Fallow or Virginian Deer (Cook's Third Voyage); the Long-Tailed Jumping Deer (Umfreville); Deer with small horns and long tail (Gass.); Long-Tailed Red Deer, Small Deer of Pacific, Common Red Deer, and Common Fallow-Deer with long tails (Lewis and Clark); Jumping Deer (Hudson's Bay Traders); Chevreuil (Canadian Voyageurs); Mowitch (Cree Indians).

This species is not found on the east side of the Rocky Mountains farther north than latitude 54° N., nor is it found in that parallel east of 105° W. longitude. Mr. Douglass says, "it is the most common deer in the district adjoining the river Columbia, more especially on the fertile prairies of the Cowalidoke and Multnornah rivers, within 100 miles of the Pacific Ocean."

34. *C. nemoralis*, the Cariacou Deer. It is the Cerf Blanc or Cerf des Paletuviers of Cuvier, Chevreuil d'Amérique of Daubenton, Biche des Savannes of Buffon. It is a native of the shores of the Mexican Gulf and of Guyana. (Baillon.)

35. *C. punctulatus*, the Californian Roe. Dr. J. E. Gray says, "There is a female of this species in the Zoological Gardens; it is much smaller and darker than *C. Virginianus*, and it differs in the hair being dark, with a distinct yellow subterminal band. It is a native of Columbia, and at best a doubtful species."

36. *C. Lewisii*, the Black-Tailed Deer. It is the *Cervus Lewisii* of Peale. A native of California between the Columbia River and the Umqua. It is seldom seen east of the Cascade Mountains. It never elevates its tail in running, and viewed from behind shows two narrow white lines of hair, instead of the large white and elevated tail of the Virginian Deer.

37. *C macrotis*, the Mule-Deer. It is rather larger than *C. Virginianus*, having more the general aspect of the Wapiti. It is destitute of the black submaxillary marks of *C. Lewisii* and *C. Virginianus*. It is most abundant on the eastern slope of the Rocky Mountains, and delights in rocky hills covered with cedars and fir-trees.

38. *Coassus nemorivagus*, the Gauzu-viva. It is the *Cervus Nemorum* of Desmarest, *C. simplicicornis* of Illiger, *C. margivorus* of Schrank. This delicate little deer is only 26 inches in length. Its aspect is said to approach that of the sheep. The lachrymal sinus is said to be nearly imperceptible.

Gauzu-viva (*Coassus nemorivagus*).

The lower part of the head and lips whitish. Space round the eyes, inside of fore legs, and from lower part of breast to buttocks whitish-cinnamon. Neck and all the other parts brownish, approaching to grayish, each hair being tipped with white. Horns short. It is a native of the Brazils.

Cuguacu-ete (*Coassus rufus*).

39. *C. rufus*, the Cuguacu-ete or Pita. It is the *Cervus rufus* of F. Cuvier, *C. dolichurus* of Wagner, *Subulus Americanus* of J. Brookes, *Subulo rufus* of H. Smith.

Its height is about 29 inches; general colour reddish-brown; inside of ears (hairs short), space round the lips, lower part of head and tail, hind part of belly, buttocks, and inside of fore legs to knees, whitish. Females without horns. Nearly of the same reddish tint, with a white spot above the nose and on the upper lip.

It lives in the low moist woods of South America, in large herds, and as ten females are seen for one male, it is supposed that their appearance gave currency to the report of a form of deer on the New Continent without horns. They are very fleet only for the first burst, for they are soon run down by dogs, and are sometimes captured by the lasso and balls.

40. *C. superciliaris*, the Eye-Browed Brocket, differs chiefly from the two last in the form of the muffle, and in the presence of a white streak over the eyes. It is a native of the Brazils.

41. *C. auritus*, the Large-Eared Brocket. It is also a native of the Brazils.

42. *Pudu humilis*, the Venada. It is the *Cervus humilis* of Bennett; *Capra Pudu*, Molina; *Antilocapra Pudu*, Lesson; *Antilope Dicranocerus Temamazama*, H. Smith; *Cervus Macatlchicheltic*, Seba; Mazame of Hernandez. It is a native of Chili.

Fossil Cervidæ.

The remains of Deer are sufficiently numerous in beds of the third period of the Tertiary Series and in caverns. Thus, in the cave at Kirkdale, Dr. Buckland found evidences of at least three species, the smallest being very nearly of the size and form of a fallow-deer, the largest agreeing in size with the elk, but differing in form; and a third, of intermediate size, approaching that of a large stag or red-deer. The skeletons of animals found in the recent shell-marls of Scotland, according to Sir C. Lyell, all belong to species which now inhabit or are known to have been indigenous in Scotland. Several hundred, he observes, have been procured within the last century from five or six small lakes in Forfarshire, where shell-marl has been worked. Those of the Stag (*Cervus Elaphus*) are stated to be the most numerous; and if the others be arranged in the order of their relative abundance they will follow, according to Sir C. Lyell, nearly thus:— Ox, boar, horse, dog, hare, fox, wolf, and cat. The beaver, he adds, seems very rare; but it has been found in the shell-marl of Loch Marlie in Perthshire, and in the parish of Edrom in Berwickshire.

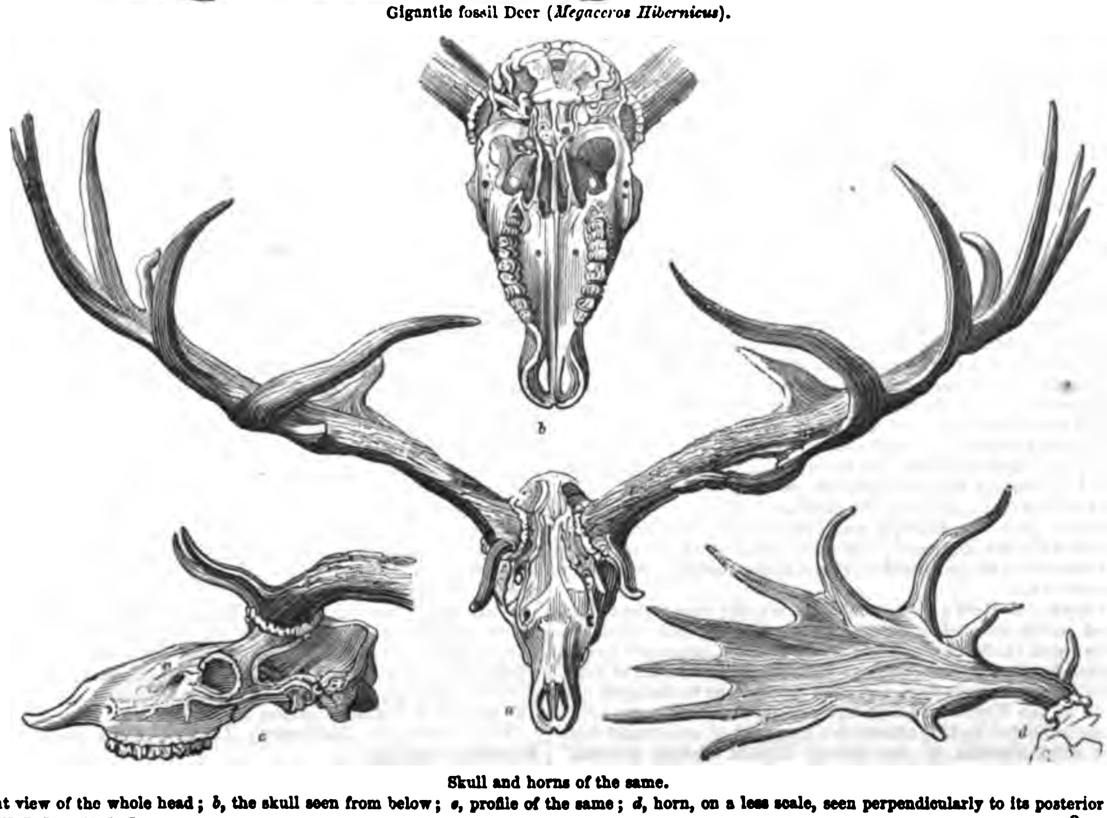
The most remarkable of the Fossil *Cervidæ* found in the British Islands is the *Megaceros Hibernicus*, the gigantic Irish Deer. This animal has been called by various names, of which the following are the most common:—*Cervus platyceros altissimus*, Large Irish Deer, Molyneux; *Cervus fossilis*, Goldfuss; Cerf à Bois Gigantesque, Cuvier; the Fossil Elk of Ireland, Parkinson; *Cervus Hibernus*, Desmarest; *Cervus megaceros*, Hart; Fossil Dama of Ireland, Hamilton Smith.

Dr. Molyneux, to whom we owe the first account of the remains of this animal, supposed it to be the American Moose. On this point Professor Owen says, "The great extinct Irish Deer surpassed the largest Wapiti or Elk in size, and much exceeded them in the dimensions of the antlers. The pair first described and figured in the 'Philosophical Transactions' measured 10 feet 10 inches in a straight line from the extreme tip of the right to that of the left antler; the length of each antler, from the burr to the extreme tip in a straight line, was 5 feet 2 inches, and the breadth of the expanded part, or palm, was 1 foot 10½ inches. Dr. Molyneux, after giving the dimensions of the fossil head and its noble attire, says—'Doubtless all the rest of the parts of the body answered these in due proportion,' and he infers the amount of the superiority of the great Irish Deer over the 'fairest buck' accordingly."

"Recent discoveries of the entire skeleton of the Megaceros however have shown that the proportions of the trunk and limbs to the vast antlers were not the same with which we are familiar in the existing Deer best provided with these weapons, but that the antlers were both absolutely and relatively larger in the great extinct species. This in fact constitutes one of its best characteristics, and involves other differences in the form and proportions of its osseous framework. One of the modifications in the skeleton of Megaceros, which relates to the vast weight of the head and neck, is the stronger proportions of its limbs; and another and more striking character is the great size of the vertebræ of the neck, which form the column immediately supporting the head and its massive appendages. The extent of these modifications may be appreciated by the following dimensions of the skeleton of the Megaceros and of that of the Great American Moose (*Alces palmata* and *Americana*):—

	Megaceros.			Alces.		
	Ft.	In.	Lin.	Ft.	In.	Lin.
Length of the trunk from the 1st rib to the end of the ischium	6	3	3	5	0	0
Height from the ground to the top of the longest dorsal spine	6	0	0	5	6	0
Length of the fore-leg from the top of the scapula in a straight line	5	7	0	5	4	6
Length of hind leg from the head of the femur in a straight line	4	9	3	4	10	9
Circumference of fourth cervical vertebra . .	1	10	0	1	0	0
Span of antlers between the extreme tips . . .	9	0	0	4	0	0"

Gigantic fossil Deer (*Megaceros Hibernicus*).



Skull and horns of the same.

a, Front view of the whole head; *b*, the skull seen from below; *c*, profile of the same; *d*, horn, on a less scale, seen perpendicularly to its posterior surface.

The weight of the skull and antlers of the *Megaceros* in the Museum of the College of Surgeons in London is 76 lbs., whilst another exists in Dublin which weighs 87 lbs. The average weight of the skull, without the horns or lower jaw, is 5¼ lbs. From this fact we may form some idea of the enormous size of the antlers, which seem to have obeyed the same periodical law as those of all existing deer. When it is recollected that all the matter of these antlers must have been drawn from the blood carried to the head by the carotid arteries in the course of a few months, our wonder may well be excited at the special activity of the capillary circulation of these parts.

The question has been somewhat eagerly discussed, as to whether the *Megaceros* existed within the historical period. On this point Professor Owen has the following remarks :—

"Is there any evidence, it may be asked, that the *Megaceros* co-existed with the human race, or that its extinction was the result of man's hostility? Dr. Molyneux ('Phil. Trans.,' xix. p. 490) says that its extinction in Ireland has occurred 'so many ages past, as there remains among us not the least record in writing, or any manner of tradition, that makes so much as mention of its name; as that most laborious inquirer into the pretended ancient but certainly fabulous history of this country, Mr. Roger O'Flaherty, the author of 'Ogygia,' has lately informed me.'

"The term Shelch, in the romance of the 'Niebelungen,' written in the 13th century, and there applied to one of the beasts slain in a great hunt a few hundred years before that time in Germany, has been cited by Goldfuss, and subsequently by other naturalists, as probably signifying the *Megaceros*, just as the Halb-Wolf of the same 'Lied' has been conjectured to be the Hyæna.

"The total silence of Cæsar and Tacitus respecting such remarkable animals, renders their existence and subsequent extirpation by the savage natives a matter of the highest improbability; and it has been well observed by Dr. Buckland, that 'the authority of the same romance would equally establish the actual existence of giants, dwarfs, and pigmies, of magic turn-caps—the using of which would make the wearer become invisible—and of fire-dragons, whose blood rendered the skin of him who bathed in it of a horny consistence, which no sword or other weapon could penetrate.'

"Some appearances in the bones themselves of the *Megaceros*, and perhaps an undue confidence in the vague statements of their discovery with remains of the existing deer, hog, and sheep, in peat-bogs, have led to the opinion that the Gigantic Deer existed within the time of man. Dr. Hart cites the fact of the discovery of a human body in gravel, under eleven feet of peat, soaked in the bog-water, which was in good preservation, and completely clothed in antique garments of hair, which it had been conjectured might be that of our fossil animal. But if any *Megaceros* had perished, and left its body under the like circumstances, its hide and hair ought equally to have been preserved. Except however the solitary instance of fat or adipocire in the shaft of one of the bones discovered by Archdeacon Maunsell, not a particle of the soft parts of the animal seems ever to have been found. Dr. Hart conceives that 'more conclusive evidence on this question is derived from the appearance exhibited by a rib, in which he discovered an oval opening near its lower edge, with the margin depressed on the outer, and raised on the inner surface, round which there is an irregular effusion of callus. This opening,' he says, 'appears evidently to have been produced by a sharp-pointed instrument which did not penetrate so deep as to cause the animal's death, but which probably remained fixed in the opening for some length of time afterwards; in fact, such an effect as would be produced by the head of an arrow remaining in a wound after the shaft was broken off.' (Op. cit., p. 29.)

"But a conical arrow-head, with a base one inch in diameter, sticking in a rib, with its point in the chest, must have pierced the contiguous viscera, and rankling there have excited rapid and fatal inflammation. The evidence of the healing process in the bone would rather show that the instrument which pierced the rib had not been left there to impede the operations of the 'vis medicatrix naturæ.' A formidable branch of the formidable antler is as well suited to inflict such a wound as the hypothetical arrow; and if the combative instincts of the rutting stag rightly indicate the circumstances under which the wound of the *Megaceros* was inflicted, they would be those which best accord with the actual evidence of recovery from it."

Although the remains of this animal have been found principally in Ireland, they have also been dug up in the Isle of Man, in Scotland, and found in several of the ossiferous caverns of England. This discovery is interesting, as from the position in which the remains of the *Megaceros* have been found, it establishes the comtemporaneity of this animal with the Mammoth, Rhinoceros, and other extinct *Mammalia* of the period of the formation of the newest tertiary fresh-water fossiliferous strata.

In the cavern of Kent's Hole, near Torquay, the base of an antler, fossil, and partly gnawed, has been found. It does not belong to *Megaceros*; and Professor Owen has referred it to a genus and species which he calls *Strongyloceros Spelæus*, Gigantic Round-Antlered Deer. "If the trunk and limbs bore the same proportions to the head and antlers as in the Wapiti and Red Deer, as most probably they did, the species indicated by this remarkable fragment of antler must have been the most gigantic of our extinct English Cervine animals." (Owen.)

Besides these, the remains of *C. Elaphus*, the Red Deer, *C. Tarandus*, the Rein-Deer, *Dama vulgaris*, the Fallow-Deer, *Capreolus Capræa*, the Roe-Buck, have all been found in various parts of the British Islands. Amongst the bones found in Kirkdale are those of a small deer, which Professor Owen calls *Cervus Bucklandi*.

Remains of Deer occur in other ossiferous caverns besides those of Great Britain, as in the Muggendorf caverns, the Grotte d'Echenoz, and that on the banks of the Meuse, at Chockier; as well as in the osseous breccias of Gibraltar, Cette, Nice, Corsica, and Antibes. M. Bertrand de Doue found, among the bones entombed in and beneath volcanic matter near St. Privat d'Allier (Velay), a large proportion of remains, referrible to at least four undetermined species of *Cervi*, in company with *Rhinoceros leptorhinus* and *Hyæna spelæa*; and M. Robert extracted from the ferruginous beds at Cussac (Haute-Loire) the bones of seven species of deer (to two of which he assigns the names of *Cervus Solilhacus*, and *C. dama Polignacus*), accompanied by the bones of the antelope, *Bos Urus* and *B. Velaunus*, two species of horse, *Elephas primigenius*, *Rhinoceros leptorhinus*, and *Tapir Arvernensis*. Among the fossil species enumerated we find, under section *a*, *Cervus giganteus*, *C. euryceros*, and *C. Americanus*; under section β*, *C. Guettardi*; and under β** *C. Hibernus* and *C. Somonensis*.

Captain P. Cautley, in his paper 'On the Remains of Mammalia found in the Sewalik Mountains, at the southern foot of the Himalayas, between the Sutluj and the Ganges,' enumerates, among the fine collection of bones found by him, those of the elk and several varieties of deer. In the district between the Jumna and the Ganges he obtained the remains of more species of deer than one in the marl or clay conglomerate, described as consisting of fragments of indurated clay, cemented by clay, sand, and carbonate of lime. Professor Kaup discovered the bones of the following deer :—*Cervus anocerus*, *C. trigonocerus*, *C. dicranocerus*, and *C. curtocerus*—in the sand resting upon the calcaire grossier in Rhenish Hesse, in company with *Dinotherium*, &c. &c. Deer therefore may be considered to have existed in the second and third tertiary periods, namely, the Miocene and Pliocene periods of Lyell. [*See* SUPPLEMENT.]

CERVUS. [CERVIDÆ.]

CESTRA'CEÆ, or CESTRI'NÆ, a natural order of plants belonging to the class of Monopetalous Exogens. It is nearly related to *Solanaceæ*, and is sometimes made to form a tribe of that order. It has the following characters:—Limb of corolla plicate, valvate or induplicate in æstivation; calyx 5-toothed; corolla funnel-shaped, 5-lobed, regular; tube elongated, limb usually spreading; stamens 5; anthers dehiscing lengthwise; ovarium seated on a cupulate disc; pericarp capsular or baccate; placentas adnate to the dissepiment; embryo nearly straight, with a cylindrical radicle, and roundish leafy cotyledons. It embraces the genera *Cestrum*, *Dunalia*, *Meyenia*, *Dartus*, *Vestia*, *Lessea*, *Fabiana*, *Laureria*, *Lamarkia*. In the second edition of the 'Natural System,' Dr. Lindley recognises the order *Cestraceæ*, and adds, "I do not attempt to characterise this assemblage of plants, being uncertain what its real peculiarity is. According to Schlechtendahl, it has all the characters of *Solanaceæ*, except that the embryo is nearly straight, and the cotyledons foliaceous. To this however it is possible that the valvate æstivation of the corolla ought to be added; but I am by no means sure that the species of *Periphragmos* of the 'Flora Peruviana,' with winged seeds, ought not to be included, although, as they have an imbricated æstivation, and a tricarpellary fruit, they are placed in *Polemoniaceæ*. These plants, which are very different from those of Jussieu's *Cantuas*, especially *C. quercifolia*, have much the habit of *Lycium* as well as *Vestia*. If they really do belong to *Polemoniaceæ*, they must be considered a connecting link between that order and *Cestraceæ*." The genera then recognised by Lindley were, *Cestrum*, *Vestia*, *Lessea*, *Fabiana*. In the 'Vegetable Kingdom,' Dr. Lindley has dropped the order *Cestraceæ*.

The genus *Cestrum* has a tubular calyx, terete, very short, obsoletely 5-toothed; corolla funnel-shaped, with a long slender cylindrical tube; a roundish throat and a flat limb, with ovate equal segments; filaments the length of the tube; anthers inclosed, being roundish, 2-celled, many seeded. *C. venenatum* is a large woody bush which grows at the Cape of Good Hope, in Houtinqua Land, and elsewhere. The flowers are arranged in axillary clusters; the corolla has a reddish tube and a white limb, and emits a perfume resembling Jasmine flowers. A decoction of the bark reduced to an extract by evaporation is employed by the Hottentots to poison their arrows. It is said to be a speedy poison, and is also employed to destroy wild beasts by mixing with their food. *C. macrophyllum* and *C. noctuum* have similar properties. *C. Hediunda* and *C. lamifolium* are febrifuge, and are applied extensively as astringents in Peru. About 50 species of *Cestrum* have been described. They are all of them natives of North and South America, and the West India Islands, and are known by the common name of Bastard Jasmines. They are easily cultivated, and will grow in any rich light soil, and are easily propagated by cuttings, which should be placed under a hand-glass in heat. The species of the allied genera require the same treatment.

(Don, *Gardener's Dictionary*; Lindley, *Flora Medica*; Lindley, *Vegetable Kingdom*.)

CESTRACION. [SQUALIDÆ.] CESTRUM. [CESTRACEÆ.]

CESTUM. [ACALEPHÆ.]

CETACEA, an order of Aquatic Mammals with fin-like anterior extremities, the posterior extremities being absent, or rather, having their place supplied by a large horizontal caudal fin or tail; without an external ear, without hair on their external integument, and the cervical bones so compressed as to leave the animal without any outward appearance of a neck. This order comprises the Whales, the largest animated forms in existence. Some of the genera composing it are phytophagous, or plant-eaters; others are zoophagous, or animal-eaters.

The Cetaceous Mammals, whose abode is either in the sea or the great rivers, resemble Fishes so closely in external appearance, that it is hardly to be wondered at that not only the vulgar, but even some of the earlier zoologists, looked upon them as belonging to that class. This notion is kept alive to the present day in the announcements of the comparative success of those ships which are employed in the Whale Fishery; for not only is it conveyed by that general term for the capture of whales, but by statements that one ship has arrived with three fish, another with four fish, a third with one fish, &c.

If we turn to the Sacred Scriptures we find the Hebrew words Than and Thannin, which have been translated by the words Κῆτος (the word used by Æneas Gazæus to designate the fish out of whose belly Hercules is said to have escaped after having been swallowed) and 'whale.' Lycophron terms the marine animal that so disposed of Hercules when he was shipwrecked, κάρχαρος κύων, a shark.

The Septuagint translates the Hebrew words above noticed, τὰ κήτη τὰ μέγαλα, in the 21st verse of the first chapter of Genesis. The same Greek word is used in the 17th verse of the first chapter of Jonah. In the book of Job (vii. 12), and in that of Ezekiel (xxxii. 2), the translation uses the term δράκων. In Matthew (xii. 40), where the swallowing up of Jonah is alluded to, κῆτος is employed.

In Barker's 'Bible' (1615) the passage in Genesis is translated, "Then God created the great whales," much the same as it stands in the version now read in our churches, "And God created great whales."

The other passages are translated in Barker's 'Bible' as follows:—Jonah (i. 17), "Now the Lord had prepared a great fish to swallow up Jonah: and Jonah was in the belly of the fish three days and three nights:"—Job (vii. 12), "Am I a sea or a whale fish, that thou keepest me in ward?"—Ezekiel (xxxii. 2), "Thou art like a lyon of the nations, and art as a dragon in the sea;" in a note 'or whale' is added:—Matthew (xii. 40), "For as Jonas was three days and three nights in the whale's belly," &c.

In the version now used in our churches the passage in Jonah is verbatim the same as in Barker; that in Job is thus rendered, "Am I a sea, or a whale, that thou settest a watch over me?"—that in Ezekiel, "Thou art like a young lion of the nations, and thou art as a whale in the seas:"—that in Matthew is identical with the passage in Barker.

These are merely cited as examples: there are other passages in the Old Testament in which the words whale and κῆτος occur in the English and Greek versions. It would be beside the present question to enter into the discussion whether the whale was meant, or a crocodile, as some will have it, in the verses above quoted; it is sufficient for our purpose to show the commonly received opinion that a whale was a fish

In the Index to Pliny's 'Natural History' we find the Whales treated as Fishes, "Balænarum Piscium Consideratio," "Balæna piscis," &c.; but in the work itself the *Balæna* and *Physeter* are noticed as *Beluæ*, and a fair account is given of their spouting and general habits. The 7th chapter of his ninth book, indeed, is headed "An spirent pisces, an dormiant;" but in that chapter he expressly states that neither whales nor dolphins (balænis nec delphinis) have gills, but breathe by means of fistulæ, or blow-holes, which appertain to the lungs.

Aristotle, whose great zoological work Pliny had closely studied, was certainly aware of the broad distinction between the Whales and Dolphins (the position of whose blow-holes he mentions), and Fishes.

Gesner separated the Whales from the Fishes, including them in a distinct order of marine animals. Aldrovandi separated them also, though they appear in the same volume, the title of which is 'De Piscibus Libri V.: De Cetis Liber Unus.' Johnston gives them a separate chapter at the head of his book 'De Piscibus.'

Ray, in his 'Synopsis Methodica Piscium' (1713), observes that the term 'fish' is extended, even by the learned of our country, to the bloodless aquatics, as they were then termed, *Exanguia aquatica*, such as *Crustacea*, *Testacea*, and *Mollia*, or Shellless Mollusks. On the other hand, some, he remarks, not only exclude those *Exanguia aquatica*, but also the *Cetacea* ("Cetaceum genus, seu Belluæ Marinæ"), contending that no other animals can justly be termed fishes except those which breathe by means of gills, and have but one ventricle to the heart. With these last Ray agrees, and expresses his own opinion, that, if we speak properly and philosophically, the name of Fish should be restricted to such last-mentioned animals only, and points out the absence of any relationship of the "Pisces Cetacei dicti" with the true fishes; adding, that with the exception of the place where they spend their lives, the external figure of their body, their hairless skin, and their natatory progression, the *Cetacea* have hardly anything in common with the true fishes, but in other respects agree with the viviparous quadrupeds.

Nevertheless, that he may avoid dissent from received opinions and the appearance of paradox, Ray declares that he will not innovate, but consider the Cetaceous Animals as Fishes; and he proceeds to define what a fish is, thus: An aquatic animal having blood, wanting feet, swimming with fins, covered either with scales or with a naked, smooth, hairless skin, passing its life in the waters, and never voluntarily leaving it for the dry land.

The Cetaceous Fishes, or *Belluæ Marinæ*, form his first section, and are immediately followed by the Cartilaginous Fishes, called Σελάχη by Aristotle. Of the Cetaceans he says, that they breathe, like quadrupeds, by means of lungs, copulate, bring forth their young alive, and nourish them with their milk, and in the structure and use of all their internal parts agree with those animals.

The following are the genera enumerated by Ray:—

Balæna (2 species); *Cete* (1); *Orca* (2, but one not clearly defined); *Albus; Monoceros; Delphinus; Phocæna.* And he divides the *Cetacei generis Pisces, seu Balænæ*, into two great groups—the Toothed and Toothless; the latter having horny laminæ in the upper jaw.

The Toothed Whales are subdivided into those which have teeth in both jaws, and those which have teeth in the lower jaw; and there are further subdivisions depending on the absence or presence of the back-fin and the shape of the teeth.

The Toothless or Whalebone Whales are subdivided also with reference to the absence or presence of the back-fin, the presence of a blow-hole, or the employment of nostrils in respiration, the presence of plaits on the belly, and the width of the lower jaw.

Linnæus, in his last edition of the 'Systema Naturæ' (1766), defines the fulcra, or props, of his *Mammalia* to be 4 feet, with the exception of those Mammals which are merely aquatic, "in quibus pedes posteriores in caudâ pinnam compedes;" in other words, in which the posterior limbs are manacled or conjoined, so as to form a tail-fin.

The seven orders of *Mammalia* in this system are divided into three sections:—1, *Unguiculata;* 2, *Ungulata;* 3, *Mutica.* The seventh and last order, *Cete*, is the only one belonging to the section *Mutica.*

The following is the Linnæan definition of the last-named order:—

Pectoral fins in lieu of feet, and feet conjoined into a horizontal flattened fin in lieu of a tail. No claws. Teeth cartilaginous. Nose often a frontal pipe. Food, mollusks, fishes. Locality, the ocean.

Linnæus then declares that he has separated these Cetaceans from the Fishes, and associated them with the Mammals, on account of their warm bilocular heart, their lungs, their moveable eyelids, their hollow ears, "penem intrantem feminam mammis lactantem," and this, to use his own expressive words, "ex lege naturæ jure meritoque."

Here then we find the decisive step taken, with the unflinching firmness of a master mind, relying upon the philosophical principles that demanded the separation, and no longer yielding to popular prejudice by calling that a fish which he knew to be a mammiferous animal. Some parts of his definition—not much of it—may be open to criticism, as where he designates the teeth as cartilaginous, a term probably used to comprehend both the horny laminæ of the Whalebone Whales and the true teeth of the other Cetaceans; but the broad line of distinction is unassailable, and will ever remain so.

The order *Cete* is thus summarily defined by its great founder:—Spiracles upon the head. Pectoral fins and horizontal caudal fin without claws.

Genera:—*Monodon, Balæna, Physeter, Delphinus.*

This, the last order of the Linnæan *Mammalia*, is immediately preceded by the *Belluæ.*

For Lacépède's arrangement, see his 'Histoire Naturelle, &c. Des Cétacés,' 4to., Paris, 1804.

The Cétacés form Cuvier's ninth and last order of Mammifères, the Ruminants (*Pecora*, Linn.) being the eighth.

Cuvier defines the Cetaceans to be mammiferous animals without posterior feet. Their trunk, he states, continues itself with a thick tail, which a cartilaginous horizontal fin terminates; and their head is joined to the trunk by a neck so short and thick that no narrowing or constriction of the part is perceptible, and composed of cervical vertebræ, which are very delicate, and in part conjoined or soldered together. Their anterior extremities have the first bones shortened, and the succeeding bones flattened and enveloped in a tendinous membrane, which reduces them to true fins. This gives nearly entirely the external form of the fishes, except that these last have the tail-fin vertical. The Cetaceans therefore remain constantly in the water; but as they respire by means of lungs, they are obliged to come frequently to the surface for air. Their warm blood—their ears open externally, although with very small apertures—their viviparous generation, the teats by means of which they suckle their young, and all the details of their anatomy, sufficiently distinguish them, Cuvier observes, from the fishes.

The same great zoologist remarks that their brain is large, and its hemispheres well developed; the petrous bone, or that portion of the cranium which contains the internal ear, is separated from the rest of the head, and only adheres thereto by ligaments. There is no external ear, nor are there any hairs upon their bodies. The form of their tail obliges them to move it from above downwards for their progressive motion, and aids them greatly in raising themselves in the water.

To the genera which up to Cuvier's time naturalists had reckoned among the *Cetacea*, he adds those which had formerly been confounded with the Walruses, and which form his first family, namely,—

The Herbivorous Cetaceans.

The teeth of these have a flat crown, which, Cuvier remarks, determines their mode of life, leading them often to leave the water to creep and feed on the bank: these have two teats on the breast, and hairy moustaches; two circumstances, he observes, which when they have been seen from a distance, with their heads raised vertically out of the water, have given them some resemblance to women or men, and have probably given origin to the stories of some travellers who pretend that they have seen Tritons and Syrens. Although in the cranium the bony nostrils open upwards, they are only pierced in the skin at the end of the muzzle. Their stomach is divided into four pouches, two of which are lateral; and they have a great cæcum.

Cuvier divides the Herbivorous *Cetacea* into—

1st, The Lamantins, or rather Manatees (*Manatus*, Cuv.); 2nd, the Dugongs, Lacép. (*Halicore*, Ill.); 3rd, the Stellères, Cuv. (*Rytina*, Ill.).

Cuvier's second family of this order consists of—

The Ordinary Cetaceans.

These are distinguished from the preceding by the singular apparatus which has procured for them the French name of Souffleurs, or Blowers. As they take, together with their prey, says Cuvier, large volumes of water into their very spacious mouth, there was a necessity for some outlet to get rid of it; it passes across the nostrils by means of a particular disposition of the velum palati, and is collected in a sac placed at the external orifice of the cavity of the nose, whence it is driven out with violence by the compression of powerful muscles by a narrow aperture pierced at the top of the head. Thus it is, adds Cuvier, that they produce those jets d'eau which cause them to be seen from afar by voyagers.

He further observes that their nostrils, incessantly traversed by floods of salt water, could not be lined with a membrane sufficiently delicate for the perception of odours. The whales therefore are without those projecting laminæ which are to be found in other animals; the olfactory nerve is wanting in many, and if any of them enjoy the sense of smelling they must have it very much obliterated. Their larynx, of pyramidal form, penetrates into the back nostrils for the reception of the air, and for the purpose of conducting it to the lungs, without any necessity on the part of the animal to lift its head and mouth out of the water: there are no projecting laminæ in their glottis, and their voice must be reduced to simple bellowings. They have no vestige of hair, but their body is covered with a smooth skin, under which lies the thick blubber abounding in oil, and the principal object for which they are sought. Their teats are near the anus, and they are unable to seize anything with their fins. Their stomach has five, and sometimes as many as seven, distinct pouches. In lieu of a single spleen they have many small and globular ones; those which have teeth have them conical, and similar to each other. They do not masticate their food, but swallow it rapidly. Two small bones, suspended in the flesh near the anus, are the only vestiges of posterior extremities. Many have on the back a vertical fin of a tendinous substance, but not sustained by bone. Their flattened eyes have a thick and solid sclerotic; their tongue has only smooth and soft integuments.

Cuvier divides this group into two small tribes: 1, those whose head bears the ordinary proportion to the body; and 2, those which have the head disproportionately great.

1st Tribe.

Genera:—1. *Delphinus*, Linn., with the sub-genera *Delphinus*, Cuv.; *Phocæna*, Cuv.; *Delphinapterus*, Lacép.; and *Hyperoodon*, Lacép.

2. *Monodon*, Linn.

2nd Tribe.

These Cetaceans have the head so large, that it is either a third or one-half of the length of the body; but neither the cranium nor the brain participates in this disproportion, which is entirely due to an enormous development of the bones of the face.

Genera:—1. *Physeter*, Linn. (the true Cachalots); with the sub-genus *Physeter*, Lacép. (Cachalots with a dorsal fin).

2. *Balæna*, Linn. (Whalebone Whales); with the sub-genera containing the *Balænopteræ* of Lacépède: namely, the *Balænopteræ* with a smooth belly; and the *Balænopteræ* with a plaited belly, commonly termed Rorquals. ('Règne Animal.')

The following synopsis of the families of *Cetacea* is taken from the 'Catalogue of the British Museum,' by Dr. J. E. Gray.

Sub-Order CETE.

Skin smooth, bald. Teats 2, inguinal. Limbs clawless. Fore-limbs fin-shaped; hinder united, forming a forked horizontal tail. Nostrils enlarged into blowers. Carnivorous.

Family 1st. BALÆNIDÆ.

Nostrils 2, separate, longitudinal. Palate with baleen. Jaw toothless. Head very large.

Genus I. *Balæna*.

Species 1. *B. mysticetus*, Right Whale.
2. *B. marginata*, Western Australian Whale.
3. *B. australis*, Cape Whale.
4. *B. Japonica*, Japan Whale.
5. *B. antarctica*, New Zealand Whale.
6. *B. gibbosa*, Scrag-Whale.

Genus II. *Megaptera*, Humpbacked Whales.

Species 7. *M. longimana*, Johnston's Hump-Backed Whale.
8. *M. Americana*, Bermuda Hump-Back.
9. *M. Poeskop*, Cape Hump-Back.
10. *M. Kuzira*, the Kuzira.

Genus III. *Balænoptera*.

Species 11. *B. rostrata*, Pike-Whale.

Genus IV. *Physalus*.

Species 12. *P. Antiquorum*, Razor-Back.
13. *P. Boops*.
14. *P. Sibbaldii*.
15. *P. fasciatus*, Peruvian Finner.
16. *P. Iwasi*, Japan Finner.
17. *P. antarcticus*.
18. *P. Brasiliensis*.
19. *P. australis*, Southern Finner.

Family 2nd. CATODONTIDÆ, or PHYSETERIDÆ.

Nostrils 2, separate, longitudinal. Palate smooth. Lower jaw toothed. Head very large.

Genus I. *Catodon*, Spermaceti Whales.

Species 20. *C. macrocephalus*, Northern Sperm-Whale.
21. *C. Colueti*, Mexican Sperm-Whale.
22. *C. polycyphus*, South Sea Sperm-Whale.

Genus II. *Kogia*, Short-Headed Whales.

Species 23. *K. breviceps*, Short-Headed Whale.

Genus III. *Physeter*.

Species 24. *P. Tursio*, the Black Fish.

Family 3rd. DELPHINIDÆ (DOLPHINS).

Nostrils united, lunate, transverse. Palate smooth. Jaws toothed, rarely deciduous. Head moderate.

Genus I. *Hyperoodon*.

Species 25. *H. Butzkopf*, Bottle-Head.
26. *H. rostratum*, Beaked Hyperoodon.
27. *H. Doumetii*, Corsican Hyperoodon.
28. *H. Desmarestii*, Desmarest's Hyperoodon.
29. *H. latifrons*.

Genus II. *Ziphius*.

Species 30. *Z. Sowerbiensis*.
31. *Z. Sechellensis*, Sechelle Ziphius.

Genus III. *Delphinorhynchus*.

Species 32. *D. micropterus*, Blainville's Whale.

Genus IV. *Monodon*.

Species 33. *M. monoceros*, the Narwhal.

Genus V. *Beluga*.

Species 34. *B. Catodon*, Northern Beluga.
35. *B. Kingii*, Australian Beluga.

Genus VI. *Neomeris*.

Species 36. *N. Phocænoides*, Neomeris.

Genus VII. *Phocæna*.

Species 37. *P. communis*, Common Porpoise.

Genus VIII. *Grampus*.

Species 38. *G. Cuvieri*, Cuvier's Grampus.
39. *G. Rissoanus*, Risso's Grampus.
40. *G. Richardsonii*.
41. *G. Sakamata*.

Genus IX. *Globiocephalus*.

Species 42. *G. Svineval*, Pilot-Whale.
43. *G. intermedius*, the Black Fish.
44. *G. affinis*, Smaller Pilot-Whale.
45. *G. Sieboldii*, Naiso Gota.
46. *G. macrorhynchus*, South-Sea Black Fish.

Genus X. *Orca*.

Species 47. *O. gladiator*, Killer.
48. *O. crassidens*, Lincolnshire Killer.
49. *O. Capensis*, Cape Killer.
50. *O. intermedia*, Small Killer.

Genus XI. *Lagenorhynchus*.

Species 51. *L. leucopleurus*, White-Sided Bottlenose.
52. *L. albirostris*, White-Beaked Bottlenose.
53. *L. Electra*, the Electra.
54. *L. cæruleo albus*.
55. *L. Asia*, the Asia.
56. *L. acutus*, Eschricht's Dolphin.
57. *L. clanculus*.
58. *L. Thicolea*.

Genus XII. *Delphinapterus.*
Species 59. *D. Peronii*, Peron's Dolphin.
60. *D. borealis.*
Genus XIII. *Delphinus.*
Species 61. *D. Heavisidii*, Hastated Dolphin.
62. *D. obscurus*, Dusky Dolphin.
63. *D. compressicauda*, Compressed-Tailed Dolphin.
64. *D. Tursio*, Bottlenose Dolphin.
65. *D. Abusalam*, the Abusalam.
66. *D. Eutropia*, the Eutropia.
67. *D. Eurynome*, the Eurynome.
68. *D. Metis*, the Metis.
69. *D. Cymodoce*, the Cymodoce.
70. *D. Doris*, the Doris.
71. *D. frenatus*, Bridled Dolphin.
72. *D. Clymene.*
73. *D. Styx*, the Styx.
74. *D. Euphrosyne*, the Euphrosyne.
75. *D. Alope*, the Alope.
76. *D. microbrachium.*
77. *D. dubius.*
78. *D. loriger.*
79. *D. Delphis*, the Dolphin.
80. *D. Janira*, the Janira.
81. *D. Novæ Zealandiæ*, New Zealand Dolphin.
82. *D. Forsteri*, Forster's Dolphin.
83. *D. Sao*, the Sao.
84. *D. longirostris*, Cape Dolphin.
85. *D. microps*, Small-Headed Dolphin.
Genus XIV. *Steno.*
Species 86. *S. Malayanus*, Malay Dolphin.
87. *S. frontatus*, Fronted Dolphin.
88. *S. compressus*, Narrow-Beaked Dolphin.
89. *S. attenuatus*, Slender-Beaked Dolphin.
90. *S. fuscus*, Cuban Steno.
91. *S. rostratus*, Beaked Dolphin.
Genus XV. *Pontoporia.*
Species 92. *P. Blainvillii*, the Pontoporia.
Genus XVI. *Inia.*
Species 93. *I. Geoffroyii*, the Inia.
Genus XVII. *Platanista.*
Species 94. *P. Gangetica*, the Sou Sou.

Sub-Order SIRENIA.

Skin rather hairy. Whiskers rigid. Limbs clawed. Teats 2, pectoral. Nostrils 2, apical. Herbivorous.

Family MANATIDÆ.

Grinders none, or flat crowned. Front of jaws covered with horn.
Genus XVIII. *Manatus.*
Species 95. *M. australis*, the Manatee.
96. *M. Senegalensis*, the Lamantin.
Genus XIX. *Halicore.*
Species 97. *H. Dugong*, Indian Dugong.
98. *H. Tabernaculi.*
99. *H. australis.*
Genus XX. *Rytina.*
Species 100. *R. gigas*, Morskaia Korova.

The following is M. F. Cuvier's arrangement of the *Cetacea*, to which, and that of Baron Cuvier, we shall principally refer when speaking of the anatomy of these creatures.

Tribe 1.

PHYTOPHAGA (Vegetable-feeding).

Teeth of different kinds; molars with flattened crowns, corresponding to the vegetable nature of their food. Mammæ two, pectoral. Lips provided with stiff bristles. External nostrils always two, situated at the extremity or upper part of the rostrum, which is obtuse.

Genera: *Manatus*, Cuv.; *Halicore*, Cuv.; *Rytina*, Ill.

Tribe 2.

ZOOPHAGA (Animal-feeding).

Teeth of one kind or wanting, not adapted for mastication. Mammæ two, pudendal. External nostrils double or single, situated on the top of the head.

A. With the head of moderate size.

Family *Delphinidæ.*

Teeth in both jaws, all of simple structure, and, generally, conical form. No cæcum.

Genera: *Delphinorhynchus*; *Delphinus*; *Inia*; *Phocæna.*

M. F. Cuvier is of opinion that the following genera seem to form the types of as many distinct families of Zoophagous Cetaceans.

Genera: *Monodon*; *Hyperoodon*; *Platanista.*

B. With the head of immoderate size, equalling one-third the length of the body.

Family 1. *Catodontidæ.*

Teeth numerous, conical, but developed only in the lower jaw. External nostrils or blow-holes confluent. No cæcum.

Genera: *Catodon*; *Physeter.*

Family 2. *Balænidæ.*

No teeth; their place supplied by the plates of baleen, or whalebone, attached to the upper jaw. Blow-holes distinct. A cæcum.

Genera: *Balænoptera*; *Balæna.* ('Histoire Naturelle des Cétacés,' &c.)

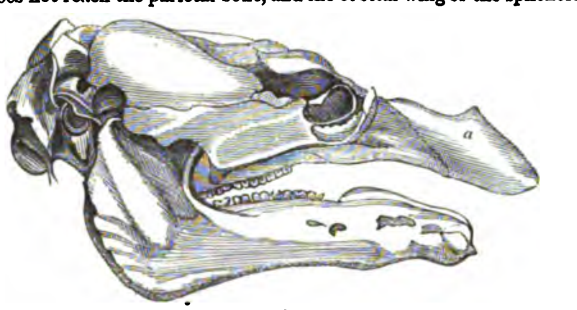
On the arrangement and remarks of the two Cuviers, Dr. J. E. Gray makes the following criticism. After referring to Lacépède's classification, he says:—

"Cuvier, dissatisfied with this state of things, in his 'Ossemens Fossiles' examined the various documents and consulted the authorities which had been used by Lacépède; but he appears to have undertaken the work with a predisposition to reduce the number of species which his predecessor had described to the smallest number. Thus, he concludes that there are only eleven species of Dolphins, one Narwhal, one Hyperoodon, one Cachalot or Sperm-Whale; and he appears to think there are only two Whalebone Whales—the Right Whale and the Finner. To make this reduction: First, he believes that the Hump-Backed Whale of Dudley is only a whale that has lost its fin, not recognising that the Cape Rorqual, which he afterwards described from the fine skeleton now shown in the inner court of the Paris Museum is one of this kind. Secondly, that the Black Fish and the Sperm-Whale are the same species, an error which must have arisen from his not having observed that Sibbald had figured the former, for he accuses Sibbald of twice describing the Sperm-Whale; and when he came to Schreiber's copy of Sibbald's figure, he thinks the figure represents a dolphin which had lost its upper teeth, overlooking the peculiar form and posterior position of the dorsal fin, and the shape of the head, which is unlike that of any known dolphin. This mistake is important, as it vitiates the greater part of Cuvier's criticism on the writings of Sibbald, Artedi, and others, on these animals. Unfortunately these views have been very generally adopted without re-examination. But in making these remarks, it is not with the least desire to underrate the great obligation we owe to Cuvier for the papers above referred to; for it is to him that we are indebted for having placed the examination of the whales on its right footing, and for directing our inquiries into the only safe course on these animals which only fall in our way at distant periods, and generally under very disadvantageous circumstances for accurate examination and study.

"M. F. Cuvier's 'Cetacea' (Paris, 1836) is little more than an expansion of his brother's essays, with a compiled account of the species; but he has consulted with greater attention the works of Sibbald and Dudley; has some doubts about the finned Cachalots being the same as the Sperm-Whale (p. 475), but at length gives up the subject. He has found that the Hump-Backed Whale is evidently a Rorqual (p. 305), but does not record it as a species, nor recognise it as the Cape Rorqual, nor as Dr. Johnston's Whale: the latter he incorrectly considers the same as *B. Physalus.* He combines together as one species Quoy's Short-Finned Rorqual of the Falkland Islands, with Lalande's Long-Finned Whale of the Cape (p. 352). He is in great doubt about the hump of the Cachalots (p. 279): his remarks on that subject, and on the Cachalots of Sibbald, show how dangerous it is for a naturalist to speculate beyond the facts before him."

Before giving any account of the natural history of the species of Whales, we shall make some remarks on their general structure and organisation. First we shall speak of the structure of the skeleton in the

Phytophagous Cetaceans—of which the Lamantin, or Manatee, is an example. The nasal bones in the skull of the Manatee are very small, almond-shaped, separated from each other, and let in on each side in a notch of the frontal bone. The result of this conformation is a very large aperture of the bony nostrils. The rest of the bones of the nose are nevertheless replaced by cartilages, so that in the living animal the opening of the nostrils is, as ordinarily, at the end of the muzzle. The intermaxillary bones carry no teeth in the adult, nor at any period of life, except during the first days of embryonic existence; they are notwithstanding very much extended longitudinally, and they re-ascend along the edge of the nostrils to above the region of the eye. The orbits are very much advanced and very projecting. The suborbital hole is pierced in the re-entering angle formed by the projecting frame of the orbit with the anterior part of the maxillary bone, so that it is not perceptible when the cranium is seen in profile. This projection of the orbit causes the distance between the lower external border of the zygomatic portion of the intermaxillary bone and the teeth to be greater than the width of the palate. The frontal bones, whose anterior branches are much separated, in order that they may embrace the aperture of the nostrils and form the walls of the orbits, give off each an obtuse postorbital apophysis. The cheek-bone extends throughout the lower half of the orbit on the orbital apophysis of the maxillary bone, and thus borders the whole of the orbit anteriorly; it gives off a postorbital inferior apophysis. A very small lachrymal bone is let in at the anterior angle between the frontal, the jugal, and the maxillary, which intervenes at this point between the lachrymal and the jugal bones. A little lower down, in a depression, is pierced the large suborbital hole, which is thus carried farther backward than the edge of the orbit, and cannot give place to any canal. The dental part of the maxillary is more inward than the orbit, so that the interior part of the wall of this cavity is formed by a flat advancement of that bone. The zygomatic apophysis of the temporal bone is thicker than in any other animal, but the rest of the bone is moderate; it contributes to form the sides of the occipital crest, and leaves above, between it and the superior and lateral occipitals, a space which permits the petrous bone to be seen. The two crests which limit the temporal fossa above run in a nearly parallel direction, and do not unite in a single line, as in the greater part of the *Carnivora*. In the adult there is only a single unequal parietal bone, which enters largely into the temple; but in the fœtus there are two, completely separated by a double interparietal; these four bones however speedily unite, not only with each other, but, what is singular, with the upper occipital, even before the other parts of the occipital are united. The plane of the occipital is inclined from before backwards, and from above downwards, and the occipital crest makes an obtuse angle; there is no vestige of a mastoid apophysis. Below, the intermaxillaries form the point of the muzzle, occupying nearly the fourth of the palate, and surrounding a large incisive hole, which is single, because they have no internal apophysis. Very young Manatees have a small tooth in each of their intermaxillaries, thus completing, Cuvier observes, their analogy with the Dugongs. He observed this in the fœtus, but he remarks that the tooth disappears at a very early period. The jaws commence a little behind the suborbital hole, which, from the disposition of the orbits, is found nearly at their level. The palatine bones advance in a narrow and obtuse point, occupying nearly a fourth of the palate, and contribute to the formation of two large pterygoid wings, whose body is in other respects almost entirely sphenoidal, and does not separate itself from the body of the posterior sphenoid even in the fœtus. The temporal alæ of the sphenoid remain distinct much longer. The palatine bone shows itself in the temple by a narrow tongue-shaped process, between the maxillary on one side and the anterior sphenoid and the frontal on the other; but its continuity is partially hidden by the dental portion of the maxillary bone, which is continued backwards to the wing of the sphenoid, which it touches without articulation. The anterior sphenoid also only shows itself in the temple by a narrow tongue-shaped process, but much shorter than that of the palatine. It does not reach the parietal bone, and the orbital wing of the sphenoid



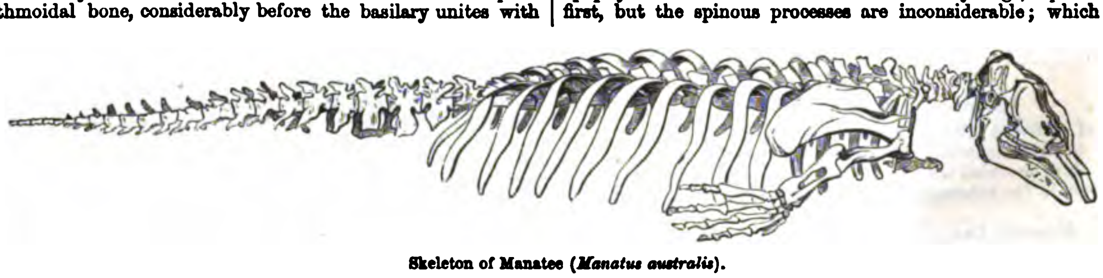
Skull of Manatee (*Manatus australis*).

touches the frontal. The body of the basilary bone and that of the two sphenoids are conjoined with each other and with the cribriform plate of the ethmoidal bone, considerably before the basilary unites with

nearly flat sufaces, as in all the *Herbivora*. The ascending ramus is very wide, and its posterior angle rounded. The coronoid apophysis is directed forwards, and truncated nearly into a hatchet-shape. The region of the symphysis is thick and elongated anteriorly. The whole portion that supports the gum is perforated with small holes. The holes for the exit of the lower maxillary are very large. The lateral and dental portions of the lower jaw are very large and rounded.

The shoulder-blade is nearly semi-elliptical; its lower line being almost straight, and answering to the great axis of the ellipse: the spine occupies only the anterior half of the bone. Its greatest projection is near its root; it is prolonged forwards into a pointed acromion, which ascends a little obliqtely, and which has the air of terminating by an articular facet. There are no clavicles. A strong blunt tubercle occupies the place of the coracoid process. The humeral surface is a little higher than it is wide, and very concave. The upper part of the humerus is also very convex; its external tuberosity is very projecting. The bicipital groove is not deep, but there remains a deep canal between the internal tuberosity and the articular head; the deltoidean crest is but little marked. The lower head is a rather oblique simple pulley, ascending at the internal edge. Its width is not greater than its antero-posterior diameter. The internal condyle projects much more than the other backwards. The ulna and radius, which are rather short in proportion to their stoutness, and still more so with reference to the size of the animal, are joined together by their two extremities. Their upper articulation corresponds to the pulley of the humerus; the head of the radius is wider than it is high, and, even when not conjoined, is incapable of executing rotation; in which circumstance the Manatee differs still more widely from the Seals, to approximate itself to the *Herbivora*. The radius has below, at its external surface, two pointed crests. There are only six carpal bones; the pisiform bone is wanting, and the trapezium and trapezoid are united into a single bone, which is articulated at once with the metacarpal bone of the thumb and of the fore finger. The analogue of the os magnum responds to those of the fore and middle fingers. The unciform bone responds to the middle, ring, and little fingers, which last articulates itself at the same time with the cuneiform bone of the first row. Each of these bones has also in the Manatee its particular character. The pisiform bone, Cuvier observes, is also wanting in the Dolphins, and is very small in the Seals and Sloths, whilst it is very long in the animals which make much use of their fore feet for seizing or progression. The metacarpal bones are flat above and carinated below; that of the thumb, which has no phalanges to support, terminates in a point; the others are enlarged at their lower extremity. That of the little finger is longer and the most enlarged of all. The ring-finger, on the contrary, is that which has the longest phalanges; but those of the little finger are flatter and wider. All the articular surfaces of the phalanges are rather full, and must possess but little mobility.

There are only 6 cervical vertebræ, all very short. The annular portion of the third, the fourth, and the fifth is incomplete. The transverse apophyses of the fourth, fifth, and sixth are pierced with a hole; they are all simple. There are 16 ribs and 16 dorsal vertebræ; the spinous apophyses of which last are moderately elevated and inclined backwards. Counting from the sixth dorsal, there is on the ventral surface of their body a small sharp crest. The two succeeding vertebræ may be called lumbar, and then there would be 22 caudal. Thus there are in all 46 vertebræ. Under the joint of the first eleven caudal vertebræ are articulated small chevron bones, as in the greater part of quadrupeds which have a powerful tail. The transverse apophyses of the vertebræ of the tail are very large, especially in the first, but the spinous processes are inconsiderable; which accords,



Skeleton of Manatee (*Manatus australis*).

the lateral occipitals. The area of the section of the cranium is nearly half of that of the face; it is singularly high, especially before, in proportion to its length. The frontal bones are there nearly vertical; the cribriform plates are found below the anterior surface; they are small, not much pierced with holes, and scarcely sunk. The crista galli is prolonged more backwards than they are. There is no sella; the whole base is united; the median fossæ hardly depressed. The analogous hole of the spheno-palatine is large, and entirely in the palatine bone. The optical foramen is small and in the form of a canal; the spheno-orbital, which comprises also the rotundum, is rather large and of an oval form; the foramen ovale is a notch of the border of the posterior sphenoid, completed by the tympanic bone; the condyloidean foramen is very small. and forms a notch in the lateral occipital. The articulation of the lower jaw is formed by

Cuvier remarks, with the depressed form of the tail-fin, to prove that the Manatee swims by a vertical movement of the tail. The ribs are singularly stout and thick; their two edges are rounded, and they are as convex internally as externally.

The connections of the bones of the skull of the Dugong, &c. are, Cuvier observes, nearly the same as in the Manatee. To change, he adds, the head of the latter to that of the Dugong, it would suffice to render more convex and elongate the intermaxillary bones to make room for the tusks, and to curve the symphysis of the lower jaw downwards so as to make it conform to the inflection of the upper jaw. The muzzle would then assume the form that it has in the Dugong, and the nostrils would be raised as they are in that animal. In a word, says Cuvier, one might say that a Manatee is only a Dugong whose tusks are not developed.

The enormous development of the intermaxillary bones of the Dugong carries up the aperture of the bony nostrils much higher than in the Manatee, and it is situated at the superior part of the head in the middle of its length and directed upwards, its form being a large oval as in the Manatee of Senegal. The whole skull, and particularly

Skull of Dugong (*Halicore Dugong*).

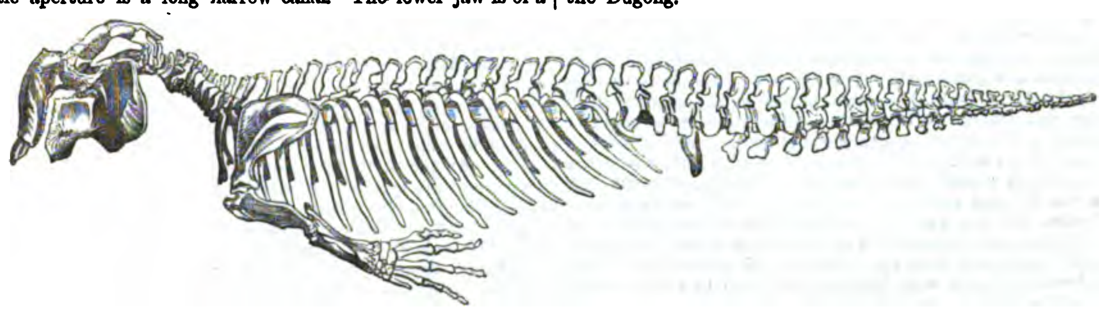
the frontal bones, are for the same reason much shorter in proportion than in the Manatee. The branches of the frontal bone which form the upper part of the orbit are more delicate and more rugose. The maxillary portion which serves as a floor for the orbit is narrower; the jugal bone in turning to form the anterior and inferior edge of the orbit is more compressed and directed more downwards. There is also a lachrymal bone in the anterior angle more considerable than in the Manatee, but equally without any hole. The zygomatic apophysis of the temporal bone is more delicate and more compressed. The connections of the bones of the cranium are the same, but at the inferior surface the basilary bone is united with the lateral occipitals rather than with the posterior sphenoid. A very great solution of continuity is seen in the bottom of the orbit and of the temple, and establishes in the skeleton an extensive communication between these two fossæ and that of the nostrils; it is intercepted between the maxillary, the frontal, the anterior sphenoid, and the palatine bones. The continuity of the temporal portion of the palatine with the rest of the bone is not here concealed, as in the Manatee, by a production of the maxillary bone. The occiput is narrower and its crest less marked than in the Manatee; the frame of the tympanum is also narrower and more delicate, but the bone of the ear is disposed nearly in the same way, and is let in between the same bones. There also remains in the skeleton a large empty space between that bone, the basilary, and the anterior sphenoid. Within the cranium there is no bony tentorium; the cribriform fossa is reduced to two simple depressions very much separated from each other, and which terminate anteriorly by two or three small holes. There is no sella Turcica. The optic aperture is a long narrow canal. The lower jaw is of a height corresponding with the curvature and length of the intermaxillary bones. This part shows in the adult the remains of three or four alveoli on each side.

The atlas is very similar to that of the Manatee; the axis the same. The five other cervical vertebræ are very delicate, but not conjoined. There are 18 dorsal vertebræ, the spinous apophyses of which are arranged nearly in a straight line. Counting from the ninth, the ribs do not attach their head between two vertebræ, but only to the same vertebra, to the transverse apophysis of which they are articulated. The ribs are not nearly so stout as in the Manatee, but, notwithstanding, the first are still very thick and have their edges blunt. After the 18 dorsal vertebræ come 27, and perhaps more, whose spinous apophyses diminish progressively. In the lumbar vertebræ the transverse apophyses are very long; afterwards they diminish by degrees on the sides of the tail, and again become rather longer at its extremity, apparently for the support of the tail-fin. It would seem that the first three only belong to the loins. The fourth has towards its extremity a facet, which is probably destined for the attachment of the pelvic bones, which last are well marked in the Dugong. They are two long slender bones, which have some resemblance in form to the clavicles of man. There are V-shaped bones articulated under the interval of the vertebræ after that which comes beyond the pelvis. They diminish by degrees, and seem to terminate altogether under the last fourth of the tail.

The shoulder-blade, as in the Manatee, has its anterior angle rounded, the posterior angle sharp, and carried well backwards; the posterior border very oblique and slightly concave. Its spine is projecting, its acromion pointed, but much less elongated than in the Manatee. The coracoid process is much more pointed than in that animal, and directed forwards and a little inwards. The humerus is much stouter and shorter than in the Manatee; its deltoid crest projects more, and it forms with the great tuberosity a rhomboidal protuberance. The bones of the fore-arm are rather longer in proportion than those of the Manatee, but their form is the same, and they are equally conjoined at their two extremities. There are only four carpal bones; two of which are in the first row, one for the radius, the other for the ulna; and two in the second, the first of which supports the metacarpals of the thumb and fore finger, and the second those of the middle and ring-finger. That of the little finger bears upon the second bone of the second row, and upon that of the first. The thumb, as in the Manatee, is reduced to a pointed metacarpal. The other fingers have the ordinary number of phalanges, the last of which are compressed and obtuse. ('Ossemens Fossiles.')

Professor Owen, in his 'Anatomy of the Dugong' ('Zool. Proc.,' 1838), remarks that after the excellent and elaborate descriptions of the osteology of that animal by Cuvier, Rüppell, and others, but little remains to be said on the subject. The bones, Professor Owen observes, are chiefly remarkable, as in the Manatee, for their dense texture and the non-development of medullary cavities in them. This reptile-like condition of the skeleton is, he adds, further exemplified in the loose connection of the bones of the head. The bones are not loaded with oil as in the true *Cetacea*. All the specimens examined by the Professor presented 7 cervical and 19 costal vertebræ, corresponding to the 19 pairs of ribs; but the number of the remaining vertebræ exceeded that ascribed to the Dugong by Home and Cuvier, there being at least 30, making in all 55. Rüppell assigns to the *Halicore tabernaculi* 7 cervical, 19 dorsal, 3 lumbar, 3 pelvic, and 27 caudal vertebræ; in all 59. Professor Owen found, as Rüppell also describes, that the first four pairs of ribs reached the sternum through the medium of cartilages; all the others terminated freely in the mass of abdominal muscles: the tenth to the fifteenth Professor Owen found the longest, and the last the shortest.

The Professor points out that the affinity of the Dugong to the *Pachydermata* is here again illustrated by the great number of the ribs. The lower jaw is, he observes, articulated to the cranium by a true synovial capsule, reflected over cartilaginous surfaces, and not, as in the Carnivorous *Cetacea*, by a coarse and oily ligamentous substance. In treating of the rudimental pelvic bones of the Dugong, he remarks that in the true *Cetacea* the parts analogous to the ischia are alone present, and that those bones serve a similar purpose in the Dugong.



Skeleton of Dugong (*Halicore Dugong*).

Zoophagous Cetaceans.—The skull in the Dolphins is very much elevated, very short and very convex behind. The occipital crest surrounds the top of the head, and descends on each side on the middle of the temporal crests, which are directed much more backward than it is. This large and occipital surface is formed by the occipital, the interparietal, and parietal bones, which early unite into one piece. The parietal bones descend on each side into the temple between the temporal and the frontal bones, and they there reach the posterior sphenoid bone. In front and above, the parietals terminate behind the occipital crest, and the maxillaries approaching on their side, what appears of the occipital bone externally only represents a very narrow band, which traverses the skull from right to left, and seems to dilate at each extremity to form the wall of each orbit; but on raising the maxillary and nearly the whole of the anterior surface of the cranium, the frontal bone will show itself much larger than it appears to be externally. The nasal bones are two rounded tubercles let into two fossæ of the middle of the frontal, and in front of which the nostrils are sunk vertically. The posterior and vertical surface of these nostrils is formed by the cribriform plate of the ethmoid bone, but it has very few holes—three or four, sometimes less. The rest of the internal contour of the nostrils belongs to the maxillaries. Their septum is the vomer, which is united to the ethmoid bone as ordinarily. The maxillaries, after forming the long muzzle, and arriving in the neighbourhood of the orbits, enlarge, and cover with a wide and dilated band the ceiling which the frontal bone gives to those cavities, and the whole anterior surface of the frontal bone, with the exception of the small band, which they suffer to appear along the occipital crest. They also touch the bones of the nose. The two intermaxillaries form the external and anterior border of the nasal aperture, and descend upon and between the two maxillaries up to the point of the muzzle, where they even show themselves below; but the maxillaries are seen a little between them, above, near the nostrils.

But the frontal bone does not entirely form the lower surface of the ceiling of the orbit; the anterior part is formed by a flat and irregular bone, covered above, like the frontal, by the maxillary; this, which is the jugal bone, gives off from its anterior angle a slender and long apophysis, which is directed backwards, and proceeds to articulate itself to the zygomatic apophysis of the temporal bone: this delicate filament is the sole bony limit of the orbit below. The zygomatic apophysis of the temporal bone unites itself to the postorbital apophysis of the frontal, in order to limit the orbit backwards; whence it happens that the whole zygomatic arch properly so called appertains to the temporal bone, which last extends but little into the temple, and terminates at the temporal crest, so that it does not appear in the occiput. Below, the lateral occipital and the basilary bones produce projecting plates, which, uniting to the continuation of the pterygoidean ala and to a lamina of the temporal bone, compose a sort of vault, under which are suspended by ligaments the petrous and tympanic bones, which are promptly conjoined into one piece. The parietal bone, after having passed behind the temporal, forms a part of this vault. The temporal bone itself therefore seems to be almost foreign to the composition of the cranium, only serving to stop some small holes remaining in the parietal. This, Cuvier observes, is the commencement of the separation which it undergoes in the inferior classes. The part of these crests which borders the basilary region on each side makes this region resemble a wide canal. At the bottom of the orbit are seen the two sphenoids placed as ordinarily—the posterior touching the temporal, the parietal, and the frontal; the anterior touching the posterior, the frontal, and the internal pterygoid apophysis: but the great peculiarity is the form of the back nostrils. The maxillaries being prolonged into a flattened muzzle, and the teeth terminating in front of the orbit, the maxillary is not on the floor nor on the anterior or lateral walls of that cavity, but at its ceiling, as is also the jugal bone: it completes the internal border of this ceiling. From the entire posterior contour of the lower surface or palatine of these maxillary bones rises a sort of quadrangular pyramid, whose base is traversed vertically by the nostrils, and in which the rest of the space is hollow, or contained between two laminæ open behind. These form a sort of double walls, which surround the posterior aperture of the nostrils. They are composed of the palatines and the pterygoid internal apophyses. Each palatine is folded back on itself in an irregular ring to form the base of this double wall, and the ceiling is completed by the maxillary to which it is articulated. The internal pterygoid apophysis is only recurved in the form of S. One of its curvatures articulates itself externally to the palatine to prolong the lower and external wall; the other unites to the other arch of the palatine, and afterwards continues on the anterior sphenoid to articulate itself to the vomer, and thus complete the internal part of this enclosure of the back nostril; whence it results, that the entire border of the back nostril, except the vomer, belongs, as in the Ant-Eaters, to the internal pterygoid apophysis. The great sinus intercepted between the two walls of this border is a peculiarity in the Dolphin: this internal pterygoid always remains distinct. The posterior sphenoid is conjoined with the basilary much sooner than to the anterior sphenoid: Cuvier even found it conjoined in some fœtuses before any of the other bones. This nearly absolute derangement of the bones has, Cuvier observes, much changed the direction of the holes. In place of the incisive hole there is a long canal, which proceeds between the two maxillaries and the two intermaxillaries, from the end of the muzzle to the nostrils, near which it bifurcates. The suborbital hole is to be sought in the ceiling of the orbit, where it represents a cavity open below, from which proceed in different directions canals which go to open on the superior surface of the maxillaries and intermaxillaries, not below but above and opposite to the orbit. Cuvier could find neither lachrymal bone nor hole. In a hollow in front of the orbit, between the maxillary, the vomer, and a point of the palatine bone, is a small hole which ascends in the nostril and represents the spheno-palatine. To respond to the pterygo-palatine, Cuvier could only perceive a small hole on the junction of the palatine to the maxillary in the palate, which enters the sinus placed on each side of the posterior nostrils. The optic hole is moderate and in the anterior sphenoid as ordinarily. The spheno-orbital hole between the two sphenoids also performs the office of the round hole. There is an oval hole in the posterior sphenoid, and more internally in the same bone a hole for a vessel. An aperture between the temporal, the lateral occipital, the basilary, and the posterior sphenoid gives passage to the nerves of the ear to go to the petrous bone. In front of it, and very near, is the carotidean hole. In the basilary bone, and in a notch of the borders of this vault of the ear, is the condyloidean hole, which is very small. It is the posterior border of this vault which occupies the place of the mastoid apophysis.

Internally the cerebral cavity is very remarkable, inasmuch as its height surpasses its length. The floor is very compact. The sella is but slightly marked. The cerebellar fossæ are the most hollowed; there is often a very projecting bony tentorium in its middle; the falx is always bony backwards, but it has no crest, and some small holes are scarcely perceptible in the cribriform plate. The petrous and tympanic bones are not joined to the cranium by any suture, and are not even inclosed, but only suspended by ligaments under the sort of vault above noticed. They unite at an early period into a single bone of the ear. The occipital condyles are large, but project little. The hole, directed entirely in the line of the head, is nearly circular.

Cuvier remarks that complete symmetry is never found in the skulls of Dolphins; the two nostrils, the two nasal bones, and the adjacent parts, never appeared to him equal, as in other mammiferous animals; and this, he observes, conducts us to the extreme inequality of those parts in the Cachalots.

The various species of Dolphins differ from each other in the relative length and width of the muzzle, the number of teeth, and the divers convexities or concavities of their parts, the palate, &c. Cuvier points out these variations in the species, and particularly notices the Dolphin of the Ganges (Susuk) as the most extraordinary in the structure of its cranium.

Skull of Porpesse.

In the common Dolphin the seven cervical vertebræ are united in a single body, and so they are in the Porpesse; but this is not universally the case, for in the Dolphin of the Ganges, for instance, the cervical vertebræ are as distinct as in any quadruped. But where they are anchylosed, as in the common Dolphin, the atlas is fully developed, and has sufficiently strong, transverse, conic apophyses. The body of the axis is very delicate; but its spinous apophysis, anchylosed to the atlas, is also well marked. The four succeeding vertebræ are, to use Cuvier's expression, as thin as paper, and their annular part unites above to the lower surface of the spine of the axis. The seventh cervical has some volume and rather strong distinct apophyses. The dorsal vertebræ are 13 in number, and there are 13 ribs. The first three ribs only have a head and a tubercle, and are articulated on the body of two vertebræ and on the extremity of the transverse apophysis of one of them. The ten succeeding ribs are only articulated to the extremity of the transverse apophysis. The last cervical and the first six dorsal have their articular apophyses united to each other by horizontal surfaces, the anterior of which is above. At the sixth they begin to become oblique; at the seventh they are nearly vertical. Commencing with the fourth, the transverse apophysis gives off a small point from its anterior border. This point approaches the anterior articular apophysis, and becomes blended with it at the seventh; afterwards these points form the only articular apophysis; those of one vertebra embracing the lower part of the spinous apophysis of the preceding vertebra. Towards the twenty-second vertebra or the second lumbar they no longer reach it; but they remain irregularly marked far upon the tail. The transverse apophyses of the lumbar region are very long, and the spinous very high. On the tail they are shortened; the spinous are widened; and the transverse are directed rather forwards. They disappear at the forty-ninth vertebra, and the spinous at the fifty-first or fifty-second. The V-shaped bones (hæmapophyses of Professor Owen) of the under part of the tail commence under the thirty-eighth. The body of the vertebræ are round, rather angular below; more compressed and thicker in the region of the back; shorter in the lumbar region and in that of the tail, where they present a kind of carination below. The anterior and posterior epiphyses remain a long time distinct. The sternum is composed of three bones; the first, very wide, is notched in front, and gives off on each side between the first and second rib a sharp point directed backwards. There is a hole in the middle. The second is simply rectangular. Between the first and it the second rib is articulated; the third rib is attached between the second and third bone, which receives on its sides the fourth, and towards its point the fifth and sixth, which is the last true rib. The sternal parts of the ribs are all ossified.

The shoulder-blade is fan-shaped, with the external surface slightly concave, and its spinal border forming the segment of a circle: the two other borders are slightly concave and nearly equal; the anterior is bifurcated, and thus presents two edges—one external, the other nearer the ribs. The external gives off a flat apophysis directed forwards, and enlarged at its extremity, which represents the acromion. The other border, which is the true anterior border, gives off also, but close to the articular surface, a flat apophysis, less than the acromion, descending a little and equally enlarged at the end: this is the coracoid process. The humerus is very short and stout. On the anterior part of its upper extremity or head is a tuberosity as large as itself: the lower head is enlarged and compressed from before backwards, and does not terminate in a facet that may be termed articular, but unites by synchondrosis with the radius and ulna: these two bones are short and compressed. The radius is in front and the largest, and its form is nearly rectangular: the ulna is behind and narrower. Its posterior border is concave, and it forms at its upper extremity a projecting angle, which is the only vestige of the olecranon. The carpal bones are flat, angular, and together form a sort of pavement. There are three in the first row, the anterior of which responds to the radius, the posterior to the ulna, and the intermediate one to both radius and ulna. In the second row there are four, the anterior of which is the smallest. Under this anterior bone, which may be also taken for a metacarpal, is a pointed bone which is the sole vestige of a thumb. The next bone, which is the fore finger, is composed of nine joints, which must represent its metacarpal, its phalanges, and their epiphyses: there are seven in the third finger and four in the fourth; the fifth is reduced to a single very small tubercle.

In the Narwhals the skull resembles that of the Dolphins, and especially the head of the *Beluga*, in structure; but instead of the numerous teeth ranged along the maxillaries presented by the Dolphins generally, there is but one on each side, directed forwards and implanted in an alveolus common to the maxillary and intermaxillary bones. Very rarely indeed are these teeth symmetrical; and nearly always one of the two remains inclosed in its alveolus, whilst the other grows to a length of ten or twelve feet. The muzzle, and more especially the intermaxillary bones, are more widened than in the Dolphins. The intermaxillaries ascend near to the bones of the nose. The holes with which the maxillaries are pierced in their widened part, and which occupy the place of the suborbital holes, are large

Skull and Teeth of Narwhal (*Monodon monoceros*), seen from below. Owen.

and numerous. The notch which separates this widened part from the muzzle is small, and the upper part of the orbit projects but little. The nasal are very small, and the left nostril is smaller than the other.

The number of vertebræ, according to Scoresby, are—7 cervical, 12 dorsal, and 35 lumbar or caudal—54 in all. The spinal canal is said to cease at the forty-first. The spinous apophyses begin to diminish at the thirty-fourth, and disappear at the thirty eighth. The V-shaped bones commence between the thirtieth and the thirty-first, and terminate between the forty-second and forty-third. There are six pairs of true ribs and six false, all rather slender. The bones of the anterior extremity appear to bear a close resemblance to those of the Porpesse, except that the bones are more equal, as might be expected from the roundness of the Narwhal's flipper.

In the Hyperoodons the skull differs almost entirely in form from those belonging to the Dolphins. From the maxillaries, which are pointed in front and widened towards the base of the muzzle, rises on each of their lateral borders a large vertical crest, rounded above, descending obliquely forwards and more rapidly backwards, where it falls again nearly above the postorbital apophysis. Still more backwards, the maxillary bone, continuing to cover the frontal bone, ascends vertically with it and with the occipital, to form on the back part of the head a transverse occipital crest, which is very elevated and very thick, so that on the skull of the animal there are three of these great crests: the occipital crest behind, and the two maxillary crests on the sides, which are separated from the first by a wide and deep notch. They do not approximate above, nor do they form a vault, as in the Dolphin of the Ganges, but simply a sort of lateral walls. The intermaxillaries, placed as ordinarily between the maxillaries, ascend with them to the nostrils, and passing by the side of them, raise themselves above, so that they take part in the formation of the posterior crest elevated upon the occiput. The two nasal bones, which, as well as the nostrils, are very unequal, are placed at the anterior surface of this occipital crest, and are raised to its summit. In other respects the connections of the bones are nearly the same as in the Dolphins.

The zygomatic apophysis of the temporal bone is thick, without being as long as in the Dolphin of the Ganges; the orbit is as wide as in the ordinary Dolphins, and bounded in like manner below by a slender stem given off by the jugal bone. The parietal bones show themselves but very little in the temporal fossa, which is itself not much extended in height. Below, the palate is slightly carinated, indicating an approximation to the *Balænæ*. The lateral furrows observable in the common Dolphin are absent. The pterygoideans occupy a very great length in the back-nostrils, and much diminish the portion which the palatine bones fill in front. The vomer shows itself at two points of the lower surface, between the pterygoideans and the palatines, and between the maxillaries and intermaxillaries. The occiput is higher than it is wide. The lower jaw has not the symphysis longer than in the ordinary species of the Dolphins.

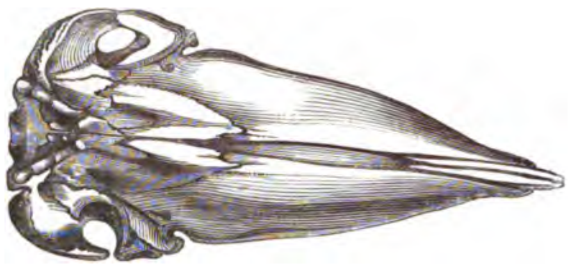
The seven cervical vertebræ are all anchylosed together; there are thirty-eight other vertebræ, nine of which carry the ribs. At the twenty-second the V-shaped bones which characterise the first caudal commence, so that seventeen caudal vetebræ may be counted. There are six of these V-shaped bones; and the superior spinous apophyses cease on the ninth caudal. The five first ribs only are articulated to the sternum, and there are only four false ribs on each side. The sternum is composed of three bones, the first square, notched in front and behind; the second square also, and notched in front; the third oblong and notched behind.

The shoulder-blade has the spinal border more extended in proportion and more rectilinear than in the Dolphins, the anterior angle more pointed, the acromion directed rather downwards, and the coracoid process a little in the opposite direction. The bones of the arm and fore-arm are a little less shortened than in the Dolphins. ('Ossemens Fossiles.')

The skull of the Cachalots bears a nearer resemblance to that of the Dolphins than to that of any other Cetaceans. The immense muzzle, notwithstanding its prodigious extent, is, like that of the Dolphin, formed by the maxillaries on the sides, the intermaxillaries towards the mesial line, and the vomer on that line. The intermaxillaries reach beyond the other bones to form the anterior point; they ascend on the two sides of the nostrils and the nasal bones, and raise themselves to form that species of wall which elevates itself perpendicularly and circularly on the back of the head, but that of the right side is carried higher than that of the left. The vomer shows itself between them in considerable width, especially at the upper part; it is hollowed into a semicanal throughout its length. The nostrils are pierced at the foot of this sort of wall at the root of the vomer, and between the raised and ascending parts of the two intermaxillaries. Their direction is oblique from below upwards, and from behind forwards. They are excessively unequal, and that on the right side is not a fourth of the size of that on the left. The nasal bones are also very unequal. Both ascend between the intermaxillaries against the foot of the semicircular wall which is raised upon the cranium, but they only rise to the level of the left intermaxillary. The right nasal bone is not only larger than the other, but it also descends lower between the two nostrils, articulating itself upon the root of the vomer, and giving to that part an irregular crest which reposes a little obliquely on the left nostril, which, as before observed, is the longest.

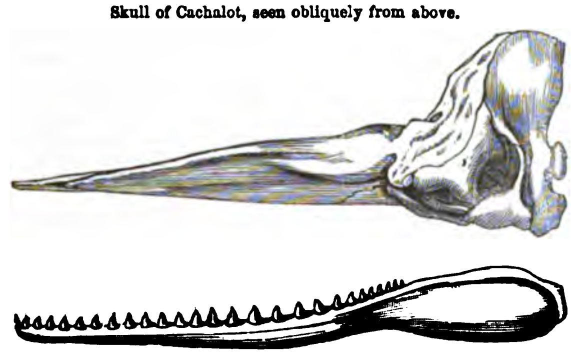
The direction of the vomer and amplitude of the left nostril indicate a direction of the membranous canal of the nostrils and the whole spouting apparatus towards the same side, and explain, Cuvier observes, the fact observed by mariners, namely, that the Cachalots throw their spoutings towards the left side.

The maxillaries do not join each other in front of the semicircular wall; and leave exposed between them an irregular and considerable part of the frontal bone, which goes behind them, and directing itself laterally, proceeds to form, as in the Dolphins, the principal part of the ceiling of the orbit. The maxillary makes its anterior angle, in front of which the border of the maxillary has a deep notch, and at its upper surface, opposite to that notch, is the great hole which occupies the place of the suborbital, but which, Cuvier remarks, should here be called supra-orbital. The posterior angle of the orbit is occupied by the point of the zygomatic apophysis of the temporal bone; but it does not quite join the postorbital apophysis of the frontal bone, so that the edge of the orbit is open at this point. The lower part of the orbit is formed by a stout and cylindrical jugal bone, whose anterior part dilates itself into an oblong lamina which partially closes the orbit in front. The temporal fossa is very deep, rounded, but not distinguished by a crest from the rest of the occiput: a little of the parietal bone is perceptible between the temporal and the frontal bones. The squamous portion of the temporal bone is not extensive, its zygomatic portion is in the shape of a stout and short cone; proceeding to the orbit it alone forms the arch as in the Dolphins. The occipital bone is vertical and forms the whole posterior



Skull of Cachalot, seen from below.

Skull of Cachalot, seen obliquely from above.



Profile of Skull of Cachalot and under jaw.

Skull of Cachalot, seen from behind.

surface of the semicircular wall which surrounds the skull behind. The occipital hole is nearly at the lower third of its height. The lower border of the occipital bone is divided on each side by a notch into two lobes, the external of which represents the mastoid apophysis.

The lower part of the skull, allowing for the difference of proportion of the parts, much resembles the lower portion of that of the Dolphins. The region behind the nostrils is very much shortened in comparison of that which is anterior to them, and of which the enormous muzzle forms the greatest portion. The result of this conformation is that the basilary and posterior sphenoid are very short; that the anterior sphenoid, as in the Large-Muzzled Dolphins, only shows itself below in a notch of the vomer, and appears very little towards the temple between the palatine, the pterygoidean, and the temporal ala of the posterior sphenoid; and that the pterygoideans extend on their lateral and posterior part, nearly to the posterior portion of the basilary bone. The jugal bone on its anterior part lines below a great portion of the vault of the orbit, and proceeds to touch behind the points of the two sphenoids. Their anterior border is not double, as in the Dolphins. The bone of the ear bears a great resemblance to that of the Dolphins, but the tympanic bone is less elongated and less lobated backwards.

Of the cervical vertebræ of the Cachalot the atlas alone is distinct; the six others are anchylosed into a single mass by the bodies and spinous apophyses; but the number may be made out by the sides where very delicate laminæ interpose between the holes where the nerves pass out. There are 14 pairs of ribs and 14 dorsal vertebræ (perhaps a fifteenth), and 35 others. The dorsal vertebræ have their transverse apophyses short; their anterior articular apophyses are turned inwards, and embrace the posterior, which look outwards. The spinous processes are less elevated and wide from before backwards. The two last carry the ribs only on the extremity of their transverse apophyses, and not on a facet of their body. On the succeeding vertebræ the spinous apophyses rise, become oblique, and wider at their summit than at their base. The articulars ascend gradually to their anterior borders, as in the Dolphins: the spinous apophyses shortening by degrees, the articular apophyses arrive at their summit on the tail, and finally disappear. The spinous apophyses disappear also on the last caudal vertebræ. The transverse apophyses are at first simple tubercles of the articular apophyses: they do not take the form of distinct apophyses till the three last dorsal vertebræ, and afterwards continue on the lumbar and caudal, but always remaining of moderate length, and not dilating at their extremity. The lower part of the body of the vertebræ, counting from the fourth lumbar, is strongly carinated. The V-shaped bones do not commence before the twenty-first after the dorsal vertebræ. They are at first rather long, and more so than the spinous apophyses to which they correspond; but afterwards they are a little shortened. The vertebræ which carry them have their lower carination divided into two truncated ridges, each at the two extremities, so as to form facets for the V-shaped bones, which always articulate between two vertebræ. The caudal vertebræ still remain very large up to the six or seven last, which diminish rapidly, losing their different eminences: thus the greatest portion of the spine is nearly much of a size.

The shoulder-blade is concave externally, convex on the side of the ribs, and narrower than in the other Cetaceans: its spinal border is not two-thirds of its height. Its anterior border becomes double below the middle of its height, and gives off from its external ridge a great acromion, more projecting anteriorly than the shoulder-blade is at this point, and enlarged at its extremity. The internal border gives off near the articular head a coracoid apophysis, which projects less than the acromion, and terminates in a point. The humerus is very short and stout, and has at its anterior border a crest, terminated towards the lower part by a hook which represents the deltoidal crest. The ulna is anchylosed early to the humerus, even before the epiphysis of this last is united. The olecranian apophysis projects very much, and curves towards the wrist. ('Ossemens Fossiles.')

Balænidæ, or Whalebone Whales.—The skull of the Rorqual (*Balænoptera*) is more approximated to that of the Dolphins than the skull of the *Balænæ*, properly so called. The immense maxillary bones are disposed below, in form of a reversed roof or a keel, to the two sides of which the baleen, or whalebone, is attached. The vomer is shown between them in nearly the mesial line of the keel. Above, the two intermaxillaries, placed parallel between the two maxillaries, leave between them a vacant space, which is continued above, or rather backwards, with the very large aperture of the nostrils, which is in the form of an elongated oval; and, contrary to the other Cetaceans, preserves, as in the whole of the *Balænæ*, a symmetrical form. The nasal bones, which are short, but notched or festooned anteriorly, and not in form of tubercles, form the upper border of this aperture. The maxillary does not cover the frontal bone, except by a narrow apophysis on the two sides of the nasal bones. The whole portion of the frontal bone which goes on each side to form the orbit is exposed, but the parietal bones cover the upper part of the temporal fossa to the sides of the apophysis of the maxillary bone, which shows itself between the frontal and the bones of the nose. The occipital bone advances between them, and covers the middle of the frontal to near the bones of the nose; so that at the base of the nose the frontal does not show itself externally. There are two temporal crests projecting greatly outwards, commencing at the sides of the nose, and between which the skull is flat, or even slightly concave, and descends slowly towards the occipital hole, which is at the extremity of this plane. The occipital crest comes near the base of the nasal bones, traversing from one temporal crest to the other. On the middle of this occipital surface is a slightly projecting longitudinal ridge.

The jugal bone is curved into a portion of a circle, and forms the lower border of the orbit, coming from the zygomatic apophysis of the maxillary bone, which abuts at the anterior angle on the temporal apophysis, which abuts on the posterior angle. The jugal bone is not dilated at its extremity as in the Dolphin. The frontal on one side touches the maxillary, and on the other the temporal bones, by its ante- and post-orbital apophyses, and forms by itself the whole ceiling of the orbit, without being doubled above by the maxillary; but on the contrary it is below, on its anterior portion, that in front of the orbit, and moreover is bordered there anteriorly by the lateral lamina of the maxillary bone, which is, with reference to the frontal, in an inverse position from that which it holds in the Dolphins. It is by this lamina that the maxillary bone abuts on the anterior angle of the orbit, and articulates itself with the anterior and enlarged extremity of the jugal bone; but what is very remarkable is, that at this point, between the frontal and the maxillary, and, so to speak, at their very articulation, a peculiar bone, in form of a lamina, occupies nearly half the length of that suture, and which perhaps is the analogue of the lachrymal bone. The whole of the zygomatic arch, properly so called, which is very large, belongs to the temporal bone. The frame of the orbit is closed on all sides; its ceiling is very large and concave above. The palatine bones are prolonged below the keel of the maxillaries. The posterior nostrils are very near the occipital hole. They have at each angle a tuberosity formed by the pterygoidean bone, which has little longitudinal extent, and only surrounds the nostrils on the external side and a little above and below, but without forming a sinus or double border there, as in the Dolphins. The basilary region, which is very short, is also hollowed into a canal, as in them, and has on each side the bones of the ear, which are very small in proportion, and of oval form, and equally convex in their inferior surface. In front of the basilary bone, and between the pterygoidean bones, may be seen the body of the posterior sphenoid. The glenoid face of the temporal bone is nearly vertical, and looks forwards; that which makes the articular surface of the lower jaw is in some sort the truncature of the extremity of the bone. This jaw is an arch externally convex, compressed, slightly trenchant above and below. It has a coronoid apophysis in form of an obtuse angle, and a tuberosity a little more backwards.

Cuvier points out certain differences between the skulls of the Rorquals of the Cape, the Mediterranean, and the North Sea, for which we must refer the reader to his 'Ossemens Fossiles.'

Balæna.—To form the idea of a *Balæna*, properly so called, Cuvier states that we must figure to ourselves the muzzle of the Rorqual narrowed, elongated, compressed laterally, and arched from before backwards, nearly in a quarter of a circle. It is, he observes, in the space which this curvature leaves, that the plates of baleen, or whalebone, which adhere by their upper and wide extremity to the sides of the keel which the muzzle forms below, and descend obliquely outwards by their lower and pointed extremity towards the lower jaw, are lodged. It is precisely because this curvature gives them more space in the *Balænæ*, properly so called, that they are longer in those whales than in the Rorquals, in which last the nearly straight muzzle leaves them little room.

It results from this lateral compression of the muzzle that the intermaxillary bones are not horizontally between but vertically upon the maxillaries: the upper plane of these last is itself nearly vertical, except in the lateral branch, which borders the frontal before, to proceed with it upon the orbit. This transverse portion of the frontal bone is narrower from before backwards than in the Rorqual. The occipital bone is convex throughout its upper portion, less oblique than in the Rorqual, and semi-oval. The temporal bone remains transverse, and its zygomatic portion hardly curves forwards at all. The nasal bones are rhomboidal, and not triangular as in the Rorqual. Below, the palatine and pterygoidean bones are thrown still more back, and are shorter, and the sphenoid bone is more concealed than in the Rorqual. The maxillary bone has a deep notch at its lower and posterior border. The glenoid surface of the temporal bone is much less vertical than in the Rorqual, so that the lower jawbone rises a little to offer its articular convex surface. This disposition, joined to the absence of a coronoid apophysis, may serve to distinguish it from the lower jaw of the Rorqual.

In the Rorqual of the Cape, Cuvier found the atlas distinct from the axis; this last is anchylosed by the upper part of its ring, which has no spinous apophysis, with the corresponding part of the third cervical. This last and the four others do not unite: they are of some thickness. The transverse apophyses are double in the first three, as in the axis; one superior is given off from the annular portion below the articular apophysis, the other from the lower part of the body; none of these apophyses are directed forwards. The lower are shortened from the axis to the fourth vertical and are wanting in the succeeding ones. The upper apophyses are longest on the axis and on the third; afterwards they are equal, and form a series with the transverse apophyses which carry the ribs. There are 7 cervical vertebræ, 14 dorsal vertebræ and as many pairs of ribs, and 31 other vertebræ to the end of the tail—52 in all. The second, third, and fourth ribs only have heads, and seem hardly able to reach the body of the vertebræ. The others only reach the extremities of the transverse apophyses, which go on lengthening to the lumbar region. They are longer than they are wide, and dilate at the end, as in the Greenland Whale. They thus continue to the thirteenth lumbar, where they begin to shorten, but still widen to the fifteenth or sixteenth, where they disappear. The spinous apophyses begin to show themselves on the third cervical. They remain small on the neck, and begin to be elongated and compressed on the first dorsals. They form a nearly equal series; wider on the middle of the back, narrower, but always moderately elevated, on the lumbar region, and shortening by degrees on the tail. They vanish on the last twelve, and the annular portion disappears two vertebræ after the spinous apophyses. The facets of the articular apophyses look inwards as far as the eleventh, where they begin to open outwards. They do not rise, and finally form, towards the fourteenth or fifteenth, with the spinous (which is always shortened), a trilobated prominence. The pelvis in the French skeleton is attached under the ninth lumbar vertebra. At the eleventh the V-shaped bones commence. The first is still formed of two separate bones. They re-divide anew behind. The lower part of the lumbar and caudal vertebræ is hardly marked by a slight carination. Commencing from the fifteenth vertebra after the dorsal, the body of each is pierced on both sides, above and below, with a large hole for the vessels. These holes do not diminsh on the last caudal, though they are much smaller, so that they each represent two cylinders set back to back, pierced in their axis.

The single bone of the sternum was square, deeply forked posteriorly, and with a point at its external border.

The shoulder-blade of the Cape Rorqual is, Cuvier remarks, entirely different from that of the *Balæna;* it is wider than it is long, semicircular on the spinal side, with a single anterior border, a single prominence (the acromion) towards the lower third, and a tubercle near the articulation, which is the coracoid apophysis. The humerus is still stouter in proportion than that of the *Balæna*, but the bones of the fore-arm are much more elongated. The fin is also much more pointed. There are only four well-marked fingers, which, not counting the metatarsals, have the following joints:—the index two, the middle and ring-finger seven each, and the little finger three: all the fingers are terminated by a cartilaginous dilatation.

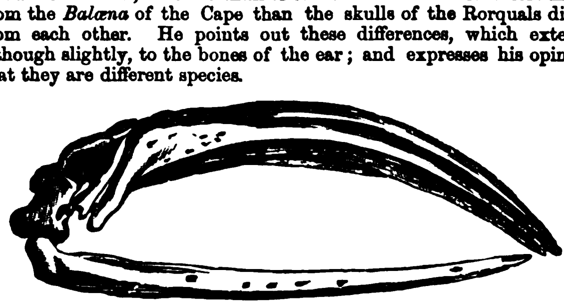
The bone of the ear in the *Balænæ* differs from that of the Dolphins in the enormous thickness of the tympanic bone, especially on the internal side. The tympanic bone is a little more closed in front, but leaves between it and the petrous bone on the internal side a solution of continuity wider and longer in proportion. It is not bilobated backwards. The petrous bone is of very irregular form, and very rugged; it gives off two great and stout apophyses, also very rugged, one of which, posterior and a little superior, articulated to a corresponding apophysis of the tympanic bone, is inserted between the temporal and lateral occipital; and the other, anterior and inferior, is articulated by squamous suture with the temporal

Skull of Greenland Whale, with lower jaw, seen from above.

Skull of Greenland Whale, seen from below.

portion, which descends to furnish articulation with the lower jaw. The ear-bones in all the Cetaceans are four in number, as in the *Mammalia*, and the malleus is anchylosed to the frame of the tympanum, which, Cuvier observes, is the more singular, inasmuch as it is not deprived of its muscles.

Cuvier remarks, that the skull of the Greenland Whale differs more from the *Balæna* of the Cape than the skulls of the Rorquals differ from each other. He points out these differences, which extend, although slightly, to the bones of the ear; and expresses his opinion that they are different species.



Skull of Greenland Whale, with lower jaw, profile.

In the great Cape *Balæna*, according to Cuvier, the atlas, the axis, and the five other cervical vertebræ are united together by their bodies. All their spinous apophyses are anchylosed into a single crest. The atlas and axis unite besides by their upper transverse apophyses, which are wide and strong: their lower transverse apophyses, which are equally long and strong, are anchylosed to each other and to that of the third, which is more slender. The next four cervicals have only delicate transverse apophyses, of which the third, fourth, and fifth are anchylosed together. The last also has only one upper transverse apophysis, but longer, stronger, free, and directed forwards. Cuvier remarks that this division of the apophyses into upper and lower responds to the two branches separated by a canal, which are seen in those of ordinary mammals. The transverse apophyses of the first dorsal are directed also forwards, and are long and a little stronger than at the last cervical; they commence increasing in bulk, and shortening at the fourth dorsal. The succeeding take a more transverse direction, and are enlarged at the end, to the tenth inclusive. Counting from the eleventh, they again begin to elongate to the seventeenth; they then diminish insensibly to the thirty-fourth, where they disappear. They are throughout longer than in the Cachalot, and enlarged towards the end, the contrary of which is manifested in that genus. There are fifteen pairs of ribs; the last four pairs and the first two do not reach the body of the vertebra, and are only attached to its transverse apophysis. The first pair is flattened and extremely wide, especially at the sternal extremity. The last three are slender and short. After the fifteen dorsal vertebræ come twenty-seven others. The V-shaped bones commence between the eleventh and twelfth; they are small compared with those of the Cachalot, and disappear after the twenty-sixth. The eleven or twelve last vertebræ have no longer any eminences. The last of all are nearly quadrangular, and are each pierced with two vertical holes. The spinous apophyses form a tolerably uniform series of moderate height, all inclined forwards; they begin to diminish on the tail. The anterior articular apophyses are not elevated, remain at the same height, and preserve the same dimensions. They widen on the tail where they have no articulation to furnish, and the last five or six, nearly equal to the corresponding spinous apophyses, form with them on their vertebræ a trilobated prominence.

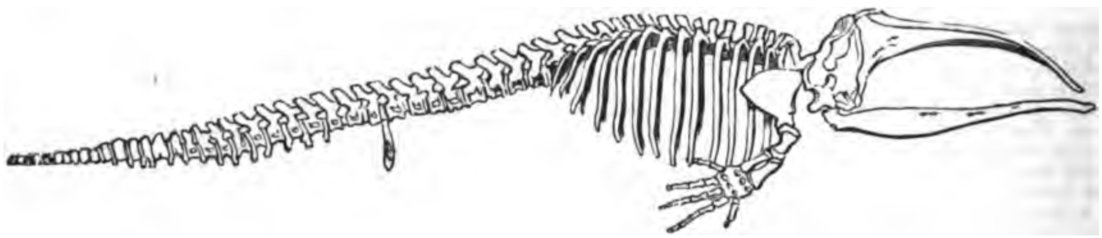
The single bone of the sternum was oblong, widest in front, and carried on each side an articular facet for a rib.

The shoulder-blade is nearly flat; one can scarcely perceive a slight concave curvature: it is nearly fan-shaped, and less wide than high. Its anterior border is simple, and has only a single projecting apophysis, which from its position is probably the acromion. Its articular head is much wider in proportion than in the Cachalot. The humerus is stout and short, scarcely twice as long as it is thick. Its tuberosity does not reach beyond the head in front; this last is hemispherical, and nearly parallel to the axis. The lower head is divided into two slightly inclined planes for the ulna and radius, which two bones are compressed; the ulna is the narrowest, especially in its middle. Its upper head is slightly oblique at its axis, and the olecranon ascends a little instead of recurving into a hook, as in the Cachalot. The radius enlarges below, so as to be there two-thirds of its length; above it is not more than a third. There are four carpal bones in the first row, of which the ulnar bone, which responds to the pisiform, forms a projection externally: there are only three in the second. The metatarsals are in length only double their width. The thumb has two phalanges, the ring-finger four, the little finger three; and all are terminated by a cartilaginous dilatation. A wide and short fin obliquely rounded is the result. ('Ossemens Fossiles.')

The pelvis in the Cetaceans is, as we have seen, only rudimentary; but it may be necessary here to give a summary of the modification of the bones and their connection with the skeleton in the different groups.

In the Dugong it consists of two pairs of bones joined two and two, and end to end, by a cartilage: to the vertebræ this apparatus is attached by a cartilage also.

The construction of this part varies in the true Zoophagous Cetaceans. Two small long bones lodged in the flesh, one on each side of the anus, form the pelvic rudiments in the Dolphins. In the great whales, the Mysticete, or Whalebone Whale, for example, at the extremity of each of the bones, regarded by comparative anatomists as ilia, a second, which is smaller and curved, is articulated. The convexity of this last bone is external, and may be considered as a pubis or ischium.



Skeleton of Mysticete, or Whalebone Whale.

Digestive Organs.—Phytophagous Cataceans.—The teeth (molars) of the Manatees are ridged doubly or trebly, the root distinct from the crown: here the resemblance to the pachyderms, Tapir and Hippopotamus for instance, is very strong. The molars of the Dugongs are elliptical, without true fangs, and with two slight furrows on the unworn crown, which disappear with age. In the upper jaw are two tusks. In the *Rytinæ* there are no molars; but there is in lieu of them a horny plate in the middle of each jaw. The tongue is short, and can hardly be endowed with much motion. The form of the os hyoides is simple: anchylosis between the body and posterior cornua soon supervenes; but the latter send no ligament to the thyroid cartilage. The anterior cornua remain generally cartilaginous, and are the medium of union between the body, or basi-hyal, and the large and long styloid processes.

Professor Owen states that the opening of the larynx is chiefly defended, during the submarine mastication of the vegetable food of the Dugong, by the extreme contraction of the faucial aperture, which resembles that of the *Capybara*. No pyramidal larynx traverses it, as in the true *Cetacea*. Two large parotid glands are situated immediately behind the large ascending ramus of the lower jaw. A thick layer of simple follicular glands is developed above the membrane of the palate, and a glandular stratum is situated between the mucous and muscular coats of the lower part of the œsophagus. Professor Owen states that a similar but more developed glandular structure is present in the œsophagus of the Ray. He then observes that the stomach of the Dugong presents, as Sir Everard Home had justly observed, some of the peculiarities met with in the Whale Tribe, the Peccari and Hippopotamus, and the Beaver: like that of the first it is divided into distinct compartments; like the second and third it has pouches superadded to and communicating with it; and like the last it is provided with a remarkable glandular apparatus near the cardia. These modifications, the Professor remarks, obviously harmonise with the difficult digestibility and low-organised matter of the food of the Dugong. "Yet," says he, "it is a fact that would not have been à priori expected, that in the Carnivorous *Cetacea* the stomach is even more complicated than in the Herbivorous species, and presents a closer resemblance to the ruminant stomach; it is divided, for example, into a greater number of receptacles, and has the first cavity like the rumen lined with cuticle; while in the Dugong, on the contrary, the stomach is properly divided into two parts only (of which the second much more resembles intestine), and both are lined with a mucous membrane." After a luminous detailed account of the stomach, Professor Owen observes that it would seem that a cæcum—and he minutely describes that of the Dugong—is present in all the Herbivorous *Cetacea*: for Steller notices it as of large size and sacculated in the Northern Manatee (*Stellerus*); and Daubenton has given a figure of the bifid cæcum in the Southern Manatee (*Manatus Americanus*). It is interesting, he adds, to find that a caput coli (the situation and structure of which in the Dugong he describes) is present in the true *Cetacea*, as the *Balænidæ*, which subsist on animal food of the lowest organised kind. The whole of the alimentary canal and the individual differences presented by the three specimens having been elaborately detailed, Professor Owen proceeds to point out that the Dugong with respect to the biliary organs deviates in a marked degree from the ordinary *Cetacea*, in the presence of a well-developed gall-bladder, an organ which Daubenton also found in the Manatee. But the presence of the gall-bladder is not, the Professor observes, constant in the Herbivorous *Cetacea*; for in the Northern Manatee, according to Steller, it is wanting, and its absence seems to be compensated by the enormous width of the ductus communis choledochus, which would admit the five fingers united. The secretion of the pancreas was carried by from twenty to thirty ducts, each about two lines in diameter, to a very wide common excretory canal, which terminates below, but on the same prominence with the cystic duct, at a much greater relative distance from the pylorus than in the true *Cetacea*. In one of the Dugongs dissected by Professor Owen were two small accessory spleens in addition to the larger rounded one, but in the other specimens the last alone was present. ('Zool. Proc.,' 1838.)

Zoophagous Cetaceans.—The teeth of the Dolphins are generally simple and conical or compressed. They are present in both jaws; their number varies, and they not unfrequently lie hid in the gums in a rudimentary state. Those of the Cachalots are simple, of a long ovoid recurved shape, and placed in the lower jaw only. The Mysticetes, or Whalebone Whales, are without true teeth; in lieu of which, transverse horny plates of baleen, or whalebone, as it is commonly termed, grow from the palate. These plates on their internal edges are fringed with loose beards, and among these the small marine animals which form their food are entangled as in the meshes of a net.

The stomachs of the Zoophagous Cetaceans are very complicated: the number of these in various species, and in different individuals of the same species, has been variously given by different authors. Some have stated the number in the common Dolphin and Porpesse at three, others at four, others at five, others at six. F. Cuvier considers it as certain that these numerical differences proceed simply from the manner in which the organ is viewed. Professor Owen was unable to distinguish more than four compartments in the stomach of the Porpesse. In general the spouting whales have no cæcum; but a trace of it has been found in the Platanist, and it actually exists in the Piked and Whalebone Whales.

John Hunter pointed out the considerable degree of uniformity present in the liver of this tribe, observing that in shape it resembles that of man, but that it is not so thick at the base nor so sharp at the lower edge, and probably not so firm in the texture. The right lobe is the largest and thickest. There is no gall-bladder. The same distinguished comparative anatomist describes the pancreas as a very long flat body, having its left end attached to the right side of the first cavity of the stomach: it passes, he adds, across the spine at the foot of the mesentery, and near to the pylorus joins the hollow curve of the duodenum, along which it is continued and adheres to the intestine, its duct entering that of the liver near the termination of the gut. In the Piked Whale the spleen is single and small; in the Porpesse it is subdivided into several distinct portions.

There is an interesting series of preparations illustrative of the anatomy of the *Cetacea* in the museum of the College of Surgeons, and well deserving the attention of the student of comparative anatomy. One of these preparations, No. 323, is a perpendicular section of several plates of whalebone, with the intermediate substance and vascular nidus, from the upper jaw of a young specimen of the Great Whale (*Balæna mysticetus*, Linn.). The disposition and relative proportions of the plates of whalebone are here shown; from which disposition it results, that only the fringed extremity of the whalebone plates are visible from the inside of the mouth of the whale; the whole concavity of the palate appearing to be beset with coarse rigid hairs or bristles, which explains the passage in Aristotle ('Hist Anim.' iii. 12), who, speaking of the Great Whale ('μυστίκητος, or, as Bekker reads it, ὁ μῦς τὸ κῆτος), says, "The Mysticete has no teeth in its mouth, but hairs like hog's bristles."

Circulating System.—Phytophagous Cetaceans.—The three Dugongs dissected by Professor Owen presented the same remarkable extent of separation of the two ventricles of the heart described by Sir Everard Home and Sir Stamford Raffles in the individuals examined by them, and observed by Rüppell in the Dugong of the Red Sea (*Halicore Tabernaculi*). Daubenton appears to be the first who noticed this condition of the heart, in his dissection of the fœtus of the Manatee. Steller also described it in the genus which bears his name; but in that animal the apical cleft of the heart extended upwards only one-third of the way towards the base, whereas in the Dugong it reaches half-way towards the base.

Professor Owen found the foramen ovale completely closed, and the ductus arteriosus reduced to a thick ligamentous cord, permeable for a short distance by an eye-probe from the aorta, where a crescentic slit still represented the original communication. He states that in the smoothness and evenness of their exterior and their general form the auricles of the Dugong resemble those of the Turtle (*Chelone*), and that the appendix can hardly be said to exist in either. The right auricle is larger than the left. The primary branches from the arches of the aorta correspond in each specimen with Sir Everard Home's figure and description. There was only one superior cava, not two, as in the Elephant; and the pulmonary veins terminated in the left auricle by a common trunk an inch in length.

As no mention had been made in the anatomical descriptions of the Herbivorous Cetaceans by Daubenton, Steller, Cuvier, Raffles, and Home, respecting the existence or otherwise of the extraordinary intercostal and intervertebral arterial plexuses present in the true *Cetacea*, Professor Owen carefully followed out this part of the dissection, but could detect no trace of this very striking modification. Here again, he observes, in enunciating a general anatomical proposition regarding Cuvier's *Cetacea*, the Herbivorous species must be exceptionally cited apart.

Zoophagous Cetaceans.—Professor Owen remarks that the Carnivorous Cetaceans do not participate in the structure of the heart above described with the Herbivorous section.

The following is John Hunter's description of the heart of the Whale:—

"The heart is inclosed in its pericardium, which is attached by a broad surface to the diaphragm, as in the human body. It is composed of four cavities—two auricles and two ventricles: it is more flat than in the quadruped, and adapted to the shape of the chest. The auricles have more fasciculi, and then pass more across the cavity from side to side, than in many other animals; besides being very muscular they are very elastic, for being stretched they contract again very considerably. There is nothing uncommon or particular in the structure of the ventricles, in the valves of the ventricles, or in that of the arteries. The general structure of the arteries resembles that of other animals; and where parts are nearly similar, the distribution is likewise similar. The aorta forms its usual curve, and sends off the carotid and subclavian arteries. The veins, I believe, have nothing particular in their structure, excepting in parts requiring a peculiarity, as in the folds of the skin on the breast in the Piked Whale, where their elasticity was to be increased."

This assertion respecting the veins is not stated very positively, and we shall presently see that there is a peculiarity in their structure.

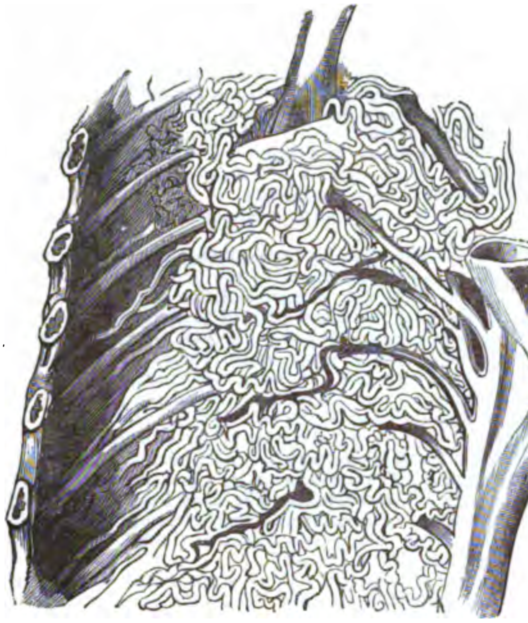
The same great physiologist well observes, that in our examination of particular parts, the size of which is generally regulated by that of the whole animal, if we have only been accustomed to see them in those which are small or middle sized, we behold them with astonishment in animals so far exceeding the common bulk as the Whale. "Thus," says Hunter, "the heart and aorta of the Spermaceti Whale appeared prodigious, being too large to be contained in a wide tub, the aorta measuring a foot in diameter. When we consider these as applied to the circulation, and figure to ourselves that probably 10 or 15 gallons of blood are thrown out at one stroke, and moved with an immense velocity through a tube of a foot diameter, the whole idea fills the mind with wonder."

But the most remarkable modification of the arterial system in the Whales remains to be noticed. This consists in an almost infinite circumvolution of arteries, forming a plexus of vessels filled with oxygenated blood, situated under the pleura and between the ribs, on each side of the spine. This intercostal plexus, or rete mirabile, is the apparatus which enables the whale to remain under water for more than an hour.

M. Breschet read a paper to the French Academy of Sciences in 1834, which bears the following title: 'Histoire Anatomique et Physiologique d'un Organe de Nature vasculaire *découvert* dans les Cétacés, etc.' M. Breschet has however no claims to the discovery of this organ. It was indicated and described long ago by Tyson in his 'Anatomy of a Porpesse,' but he was not aware of the use of it, and considered it as a glandulous body. Hunter was the first who determined its exact nature, and showed that it was a reservoir of arterial or aërated blood.

After noticing the general structure of the arteries as above mentioned, and stating that the aorta forms its usual curve, sending off the carotid and subclavian arteries, Hunter proceeds as follows:—

"Animals of this tribe, as has been observed, have a greater proportion of blood than any other known, and there are many arteries apparently intended as reservoirs, where a large quantity of arterial blood seemed to be required in a part, and vascularity could not be the only object. Thus we find that the intercostal arteries divide into a vast number of branches, which run in a serpentine course between the pleura, ribs, and their muscles, making a thick substance, somewhat similar to the spermatic artery in the Bull. These vessels, everywhere lining the sides of the thorax, pass in between the ribs near their articulation, and also behind the ligamentous attachment of the ribs, and anastomose with each other. The medulla spinalis is surrounded with a net-work of arteries in the same manner, more especially where it comes out from the brain, where a thick substance is formed by their ramifications and convolutions; and these vessels most probably anastomose with those of the thorax. The subclavian artery in the Piked Whale, before it passes over the first rib, sends down into the chest arteries which assist in forming the plexus on the inside of the ribs. I am not certain but the internal mammary arteries contribute to form the anterior part of this plexus. The motion of the blood in such cases must be very slow; the use of which we do not readily see. The descending aorta sends off the intercostals which are very large, and gives branches to this plexus; and when it has reached the abdomen it sends off, as in the quadruped, the different branches to the viscera and the lumbar arteries, which are likewise very large, for the supply of that vast mass of muscles which moves the tail."



Arterial Plexus in the Dolphins. Breschet.

With regard to the veins, Professor Owen points out that they are remarkable not only for their great capacity, which Hunter noticed, but also for their number and the immense plexuses which they form in different parts of the body, and above all for the almost total absence of valves. Tyson, he observes, has given a figure of the extensive venous plexus situated on the membrane investing the psoas muscles, and these have recently occupied the attention of Breschet and Von Baer. The inferior and superior venæ cavæ are not brought into communication by the vena azygos, as in other *Mammalia;* such veins in the usual situation in the chest would have been subject to compression between the arterial plexuses and the lungs. The venæ azygos are therefore represented by two venous trunks situated in the interior of the vertebral canal, where they receive the intercostal and lumbar veins, and finally communicate with the superior cava by means of a short single large trunk, which penetrates the parietes of the posterior and right side of the chest. Professor Owen concludes this interesting note to Hunter's 'Animal Economy' by clearing up the difficulty, which must have occurred to most, of accounting for the fact of so enormous an animal as the great whale being killed by such puny instruments as the harpoon and lance. "The non-valvular structure of the veins in the *Cetacea*," says the Professor, "and the pressure of the sea-water at the depths to which they retreat when harpooned, explain the profuse and deadly hæmorrhage which follows a wound that in other *Mammalia* would be by no means fatal."

Respiratory System.—Phytophagous Cetaceans.—Professor Owen states that the peculiar form, structure, and position of the lungs have been so accurately described and figured by Raffles, Home, and Rüppell, that he has only to observe the close agreement with these accounts which the structure of the parts presented in the three Dugongs dissected by him. Daubenton and Humboldt, he remarks, describe and figure a precisely similar condition of the respiratory apparatus in the Manatee. Steller, he adds, describes the same extension of the lungs in the *Rytina*, and compares it with the lungs in the Bird, but without their fixation in the parietes of the chest, so characteristic of that class. Professor Owen is of opinion that the Chelonian reptiles perhaps offer a closer resemblance to the Herbivorous *Cetacea* in this respect; and he notices it as worthy of remark, that the air-cells of the lungs are larger in the Dugong than in any other mammals. In the Carnivorous *Cetacea*, the air-cells, he observes, are remarkably minute, and the lungs more compactly shaped and lodged in a shorter thorax.

"Existing," continues Professor Owen, "as both the Herbivorous and Carnivorous *Cetacea* do, under such peculiar circumstances—as air-breathing animals constantly dwelling in an element the access of which to the lungs would be immediately fatal—it might be supposed that the mechanism of the larynx, or entry to the air-passage, would be similarly modified in all the species, in order to meet the contingencies of their aquatic existence. But we can as little predicate a community of organisation in the structure of this part, as of the circulating or digestive system in the *Cetacea* of Cuvier. The Dugong and the Dolphin present, in fact, the two extremes in the Mammiferous class, in the development of the epiglottis, which is one of the chief internal characteristics of that class. In the true *Cetacea* and the *Delphinidæ* in particular, it is remarkable for its great length, and in the Dugong it can hardly be said to exist at all."

Professor Owen, after giving a minute and accurate account of the larynx, thus proceeds:—

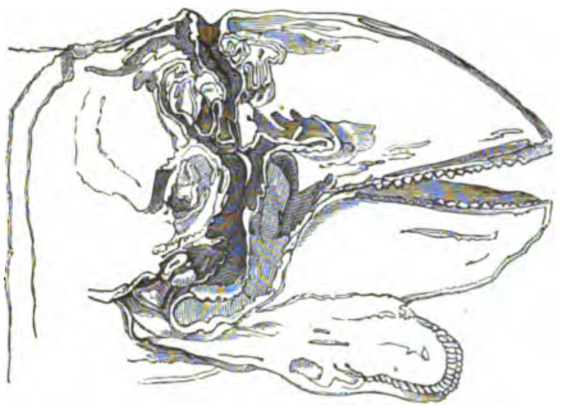
"Amongst the true *Cetacea*, we have observed that it is those which subsist on the lowest organised animal substance, as the *Balænidæ*, which approach the nearest to the herbivorous species, in having the additional complexity of the cæcum; and it is interesting to find that the same affinity is manifested in the structure of the larynx. The epiglottis and arytenoid cartilages, for example, are relatively shorter in the *Balænoptera* than in *Delphinus;* and as Mr. Hunter has observed, they are connected together by the membranes of the larynx only at their base; and not wrapped together or surrounded by that membrane as far as the apices, as in the Dolphins. In the *Balænoptera* also, the apices of these cartilages are not expanded, as in the Dolphins, but diminished to an obtuse extremity. These points of resemblance to the condition of the larynx in the Dugong and Manatee are carried still further in the Mysticete Whale, at least in the fœtus dissected by me, and in which both the epiglottis and arytenoid cartilages were relatively much shorter, and the thyroid cartilage larger and more convex than in the Piked Whale (*Balænoptera*). The thyroid cartilage is however a single piece in both genera of *Balænidæ*, though deeply notched above and below; and the larynx presents several interesting individual peculiarities, which however the minute and accurate descriptions and illustrations of this organ, in both the *Balænoptera* and *Balænæ*, published by Professor G. Sandifort, preclude the necessity of further dwelling upon."

The diaphragm, lungs, bronchi, and trachea present in the Zoophagous Cetaceans secondary modifications only, but important differences are exhibited in the nostrils, which serve to conduct the air from the atmosphere to the lungs. The necessity for the act of spouting seems to have led to the obliteration of the organ of smelling, and to the formation of a new organ especially destined to fulfil that act. Although this organ has only been studied thoroughly in the Dolphins, the probability is, that the apparatus in all the Zoophagous Cetaceans is the same.

If, says Baron Cuvier, we trace the œsophagus upwards, we find that when it arrives opposite the pharynx it appears to divide into two passages, one of which is continued onwards to the mouth, while the other ascends to the nose. Mucous glands and fleshy fibres, which constitute several muscles, surround the last-mentioned passage. Some of these are longitudinal, and arise from the circumference of the posterior orifice of the bony nostrils, and descend along that canal to the pharynx and its sides; the others, which are annular, appear to be a continuation of the proper muscles of the pharynx. The larynx rises into this passage in a pyramidal form, and the annular fibres have the power of constricting it. Mucous follicles, which pour out their secretion by conspicuous excretory orifices, prevail in this part. When the lining of the nasal passage has reached the vomer, it becomes of a peculiar texture, thin, smooth, and black, is apparently destitute of vessels and nerves, and very dry. A fleshy valve closes the two bony nasal canals at the upper or external orifice. It is formed of two semicircles attached to the anterior edge of that orifice, which it shuts by the agency of a very strong muscle lodged above the intermaxillary bones. To open it, there is a necessity for some foreign body to press against it from below; and when it is closed, it debars all communication between the nasal passages and the cavities above them, which cavities are two large membranous pouches formed by dark mucous skin, and very much wrinkled when empty; but when distended, they become of an oval shape, which in the Porpesse is about as large as a common wine-glass. These two pouches lie beneath the integument in front of the nostrils, and communicate with an intermediate space immediately above those nasal organs, whose external orifice is a transverse semilunar slit. Strong fleshy fibres expand and cover the whole upper surface of this apparatus, radiating from the entire circumference of the cranium, uniting above the two pouches, and adapted for compressing them forcibly. Now we will suppose that the Cetacean has taken into its mouth water which it wishes to eject: it first sets the tongue and jaws in motion as if it were about to swallow the water; but, shutting its pharynx, it forces the water to ascend into the nasal passages, where the annular fibres above mentioned accelerate its progress till it raises the valves and distends the membranous pouches above. The water, when once in the pouches, can be there retained till the animal wishes to spout. When that wish is present, the Cetacean closes the valve, and so prevents the descent of the water into the nasal passages, and forcibly compresses the pouches by means of the muscular expansion which overspreads them. The water, compelled then to escape by the narrow semilunar aperture, is projected to a height which corresponds to the amount of the pressure applied.

In the case of the Spermaceti Whale, it appears that the animal occupies about a seventh of its time in breathing; and when it rises after long intervals, an enormous column of air must rush into the lungs and aërate a vast quantity of blood for the reservoir described by Hunter. In ordinary mammals, man and the quadrupeds for instance, respiration is momentarily going on, and enough air only is inhaled to oxygenate the blood requisite for a few pulsations.

The spout-hole is simple in the Dolphins, and situated, as seen in the cut, towards the top of the head: the same simplicity exists in that of the Cachalots, but it is situated at the upper extremity of the snout. In the Whalebone Whales it is double, opening towards the summit of the head, as in the Dolphins, in a crescentic form whose convexity is sometimes anterior and sometimes posterior.



Vertical section, exhibiting the tongue, larynx, and nostrils of the Porpesse. ('Catalogue of the Physiological Series' (Mus. Coll. Chir.), vol. ii. pl. 29, p. 163.)

Uropoietic System.—Professor Owen observes, that if we were acquainted with the structure of the urinary organs of the Herbivorous *Cetacea*, as it is exemplified in the Dugong alone, we should have to establish as marked a distinction in this respect between them and the true *Cetacea* as in the preceding organic systems. Instead of the numerous and minute lobuli or renules into which the kidney is subdivided in the Dolphins and Whales, it presents in the Dugong a simple compact form with an unbroken external surface; the tubuli uriniferi terminate upon two lateral series of eleven mammillæ, which project into a single elongated cavity or pelvis, from which the ureter is continued. In the Northern Manatee however, Steller, whose accuracy Professor Owen justly notices, describes the kidney as being subdivided like that of the Seal and Sea-Otter. A similar lobulated structure is also ascribed by John Hunter, in his paper on Whales, in 'Phil. Trans.' (1787), to the Manatee, including it, with the Seal and White Bear, among the animals occasionally inhabiting the water. Daubenton, in his anatomical description of the *Manatus Americanus*, merely notices the kidneys as oblong, and placed opposite to each other; nor does his figure give any indication of lobulated structure; neither does Sir Everard Home mention such structure in his Anatomy of the Manatee in 'Phil. Trans.' (1821). This want of uniformity in the structure of the kidney in the Herbivorous *Cetacea* is however, Professor Owen adds, of less moment with reference to their natural affinities; since in the Pachyderms we find some species, as the Rhinoceros, and though in a less degree, the Elephant, presenting a subdivided kidney; while others, as the Tapir and Hog, have it entire.

In the fœtus of the Dolphin, according to Müller, the lobules of the kidney consist principally of convoluted uriniferous ducts, extending from the apex to the circumference of the lobule; the intertwinings of the tubuli are greatest in the intercortical portion. It is a curious fact, Professor Owen remarks, that the supra-renal gland in the Porpesse presents a certain resemblance to the kidney in its lobulated exterior; but, he adds, the analogy extends no farther, for on making a section of this part it was found to consist of the usual continuous compact substance.

Generative System.—John Hunter remarks that the organs of generation of this order of animals come in both sexes nearer in form to those of the Ruminants than of any others; and this similarity is particularly remarkable in the female; in the male their situation varies on account of the modification of the external form of the body.

The female organs in the *Rytina* have been described by Steller; and Sir Everard Home has given an account of those of the Dugong. ('Phil. Trans.,' 1820.)

Hunter, in his paper on Whales has entered particularly into the structure of those of the Zoophagous Cetaceans. The period of uterine gestation does not appear to be certainly known; the number of young is generally considered not to exceed one, there being but two nipples; the glands for the secretion of milk are two, one on each side of the mesial line of the belly at its lower part. The milk is very rich, like that of a cow to which cream has been added.

Professor Owen remarks, that much stress has been recently laid on the supposed existence which the muscles surrounding the mammary gland afford in the act of suckling, by compressing the gland and ejaculating the milk accumulated in the dilated receptacle or reservoir; but he observes that, considering how great the pressure of the surrounding water must be upon the extended surface of the mammary gland, it may readily be conceived, that when the nipple is grasped by the mouth of the young, and the pressure removed from it by the retraction of the tongue, the milk will be expelled in a copious stream by means of the surrounding pressure alone, independently of muscular aid. The Professor adds, that the intimate structure of the mammary gland in the Zoophagous *Cetacea* is essentially the same as in the *Ornithorhynchus*, being composed of an innumerable quantity of cæcal tubes; these are however shorter than in the *Ornithorhynchus*, and their glandular parietes are firmer; they are well shown in the figure of the mammary gland in a young Piked Whale (*Balænoptera rostrata*) given by Müller in his seventeenth plate, fig. 2., and according to that author present, after the *Ornithorhynchus*, the simplest structure of the mammary gland in the entire mammiferous series of animals.

Brain, Nervous System, and Senses.—The brain is well formed. In the Porpesse and the common Dolphin it has been stated to be as highly developed as in any mammiferous quadruped. In the greater whales there is reason for supposing that the ratio of the weight of the brain to that of the body is $\frac{1}{3000}$. In the smaller Cetaceans it is not diminished to a proportionate size, as its extraordinary development in the Dolphin testifies.

Smell.—Hunter observes that in many of the Whale Tribe there is no organ of smell at all, and in those which have such an organ, it is not that of a fish, therefore probably not calculated to smell water. It becomes difficult therefore, he remarks, to account for the manner in which such animals smell the water; and why the others should not have had such an organ, which seems to be peculiar to the large and small Whalebone Whales (*Balæna mysticetus* and *Balænoptera rostrata*); the organ, in those which have it, he adds, is extremely small, when compared with that of other animals, as well as the nerve which is to receive the impression.

Taste.—The complicated and indeed delicate structure of the tongue in the Phytophagous Cetaceans indicates that they must enjoy the sense of taste, although the tongue is capable of but slight motion.

But it has been doubted whether the Zoophagous Cetaceans are endowed with a special organ for the enjoyment of this sense. No fossulate nor conical papillæ are present in the tongue of the Dolphin or of the Porpesse; slight elevations, the middle of which appears to be perforated, are only perceptible, and the fringed edges would seem to lead to the notion that their object is more intended for furthering the sensations of touch.

John Hunter states that the tongue, which is the organ of taste, is also endowed with the sense of touch. He found the tongue in the Porpesse and Grampus firm in texture, composed of muscle and fat, pointed and serrated on its edges like that of a hog. In the Spermaceti Whale, he says, it was almost like a feather-bed. In the Piked Whale it was but gently raised, hardly having any lateral edges, and its tip projecting but little, yet like every other tongue, composed or muscle and fat. He supposes that the tongue of the large Whalebone Whale rises in the mouth considerably; the two jaws in the middle being kept at such a distance on account of the whalebone, so that the space between, when the mouth is shut, must be filled with the tongue.

Sight.—The eye in the Herbivorous Cetaceans only is provided with a nictitating membrane, or lateral lid; that of the Zoophagous or Spouting Cetaceans has no lachrymal glands, but the lids are furnished with glands for a mucous secretion adapted for lubricating the sclerotic coat.

John Hunter states that the eye in this tribe is constructed upon nearly the same principle as that of the quadrupeds, differing however in some circumstances, by which it is probably better adapted to see in the medium through which the light is to pass. It is upon the whole small for the size of the animal. The lids have but little motion, and consist not of loose cellular membrane, as in common quadrupeds, but rather of the common adipose membrane of the body; the connection however of their circumference with the common integuments is loose, the cellular membrane being less loaded with oil, which allows of a slight fold being made upon the surrounding parts in opening the eyelids. This is not to an equal degree, he adds, in them all, being less so in the Porpesse than in the Piked Whale. A detailed account of the anatomy of the eye in whales will be found in Hunter's paper.

Hearing.—There is no external concha, but the ear is constructed much upon the same principle as in the quadruped; there are however certain differences which the reader will find set forth in Hunter's paper. The sense seems to be fairly developed, and whale-fishers experience no small difficulty from the warning given by both eye and ear. It has however been stated that the Greenland Whale, though not without a nice sense of hearing, remains insensible to the report of a cannon.

Touch.—The sensation of touch must be lively, though it is a commonly received opinion that the common Dolphin, notwithstanding its delicate epidermis, is not very sensible to tactile impressions. Messrs. Breschet and Roussel de Vauzème distinguish the following constituents in the skin of the Cetaceans:—1. Derm, or corium, a dense fibrous cellular texture, which contains and protects all the other parts of the skin. 2. The papillary bodies, consisting of papillæ covered by the derm. 3. The sudorific apparatus, consisting of soft, elastic, spiral canals, which extend through the entire thickness of the derm, and open in the intervals of the papillæ by an orifice, closed generally by a small epidermic valve. 4. The inhalent apparatus, 5. The mucous apparatus. 6. The colorific apparatus.

According to Hunter, the reticular network containing the blubber, which is described by him as fine in the Porpesse, Spermaceti, and large Whalebone Whale (*Balæna*), and coarse in the Grampus and small Whalebone Whale (*Balænoptera*), forms part of the skin.

In giving some illustrations of this large family we shall follow the arrangement of Dr. J. E. Gray as indicated above.

The following is a synopsis of the character of the genera of the first family *Balænidæ*:—

a. Dorsal fin none. Belly smooth. Baleen elongate, slender.
 1. *Balæna.*
b. Dorsal fin distinct. Belly plaited. Baleen broad, short.
 2. *Megaptera.* Pectoral fins elongate. Dorsal fin low.
 3. *Balænoptera.* Pectoral fins moderate. Dorsal fin falcate, ⅔ length from nose. Vertebræ 54 or 64.

It is in the genus *Balæna* that the baleen, or whalebone, is most highly developed. John Hunter describes this extremely elastic animal substance as being of the same nature as horn, a term which he uses to express what constitutes hair, nails, claws, feathers, &c. It consists, he remarks, of thin plates of some breadth and in some of very considerable length, their breadth and length in some degree corresponding to one another; when longest they are commonly the broadest, but not always so. The plates differ in size in different parts of the same mouth, more especially in the large Whalebone Whale. "They are placed," continues Hunter, "in several rows, encompassing the outer skirts of the upper jaw, similar to teeth in other animals. They stand parallel to each other, having one edge towards the circumference of the mouth, the other towards the centre or cavity. They are placed near together in the Piked Whale, not being a quarter of an inch asunder, where at the greatest distance, yet differing in this respect in different parts of the same mouth; but in the Great Whale the distances are more considerable. The outer row is composed of the longest plates; and these are in proportion to the different distances between the two jaws, some being 14 or 15 feet long and 12 or 15 inches broad; but towards the anterior and posterior parts of the mouth they are very short, they rise for half a foot or more, nearly of equal breadths, and afterwards shelve off from their inner side until they come near to a point at the outer: the exterior of the inner rows are the longest, corresponding to the termination of the declivity of the outer, and become shorter and shorter till they hardly rise above the gum. The inner rows are closer than the outer, and rise almost perpendicularly from the gum, being longitudinally straight, and have less of the declivity than the outer. The plates of the outer row laterally are not quite flat, but make a serpentine line; more especially in the Piked Whale the outer edge is thicker than the inner. All round the line made by their outer edges runs a small white bead, which is formed along with the whalebone, and wears down with it. The smaller plates are nearly of an equal thickness upon both edges. In all of them the termination is in a kind of hair, as if the plate was split into innumerable small parts, the exterior being the longest and strongest. The two sides of the mouth composed of these rows meet nearly in a point at the tip of the jaw, and spread or recede laterally from each other as they pass back; and at their posterior ends in the Piked Whale they make a sweep inwards, and come very near each other, just before the opening of the œsophagus. In the Piked Whale there were above 300 in the outer rows on each side of the mouth. Each layer terminates in an oblique surface, which obliquity inclines to the roof of the mouth, answering to the gradual diminution of their length; so that the whole surface, composed of these terminations, forms one plane, rising gradually from the roof of the mouth: from this obliquity of the edge of the outer row we may in some measure judge of the extent of the whole base, but not exactly, as it makes a hollow curve, which increases the base. The whole surface resembles the skin of an animal covered with strong hair, under which surface the tongue must immediately lie when the mouth is shut; it is of a light-brown colour in the Piked Whale, and is darker in the Large Whale. In the Piked Whale, when the mouth is shut, the projecting whalebone remains entirely on the inside of the lower jaw, the two jaws meeting everywhere along their surface; but how this is effected in the Large Whale I do not certainly know, the horizontal plane made by the lower jaw being straight, as in the Piked Whale; but the upper jaw being an arch cannot be hid by the lower. I suppose therefore that a broad upper lip, meeting as low as the lower jaw, covers the whole of the outer edges of the exterior rows. The whalebone is continually wearing down, and renewing in the same proportion, except that when the animal is growing it is renewed faster and in proportion to the growth. The formation of the whalebone is extremely curious, being in one respect similar to that of hair, horns, spurs, &c.; but it has besides another mode of growth and decay equally singular. These plates form upon a vascular substance, not immediately adhering to the lower jaw-bone, but having a more dense substance between, which is also vascular. This substance, which may be called the nidus of the whalebone, sends out (the above) thin broad processes, answering to each plate, on which the plate is formed, as the cock's spur or the bull's horn, on the bony core, or a tooth on its pulp; so that each plate is necessarily hollow at its growing end, the first part of the growth taking place on the inside of this hollow. Besides this mode of growth, which is common to all such substances, it receives additional layers on the outside, which are formed from the above-mentioned vascular substance extended along the surface of the jaw. This part also forms upon it a semi-horny substance between each plate, which is very white, rises with the whalebone, and becomes even with the outer edge of the jaw, and the termination of its outer part forms the bead above mentioned. This intermediate substance fills up the spaces between the plates as high as the jaws, acts as abutments to the whalebone, or is similar to the alveolar processes of the teeth, keeping them firm in their places. As both the whalebone and the intermediate substance are constantly growing, and as we must suppose a determined length necessary, a regular mode of decay must be established, not depending entirely on chance, or the use it is put to. In its growth three parts appear to be formed: one from the rising core, which is the centre; a second on the outside; and a third being the intermediate substance. These appear to have three stages of duration; for that which forms on the core, I believe, makes the hair, and that on the outside makes principally the plate of whalebone. This, when got a certain length, breaks off, leaving the hair projecting, becoming at the termination very brittle; and the third or intermediate substance, by the time it rises as high as the edge of the skin of the jaw, decays and softens away like the old cuticle of the sole of the foot when steeped in water. The use of whalebone, I should believe, is principally for the retention of the food till swallowed; and I suppose the fish they catch are small when compared with the size of the mouth." (Hunter 'On Whales.')

View of the inside of the jaws of a fœtal *Balænoptera*, showing the arrangement of the Whalebone. (Owen, 'Odontography.')

The following notes by Dr. J. E. Gray contain the result of the most recent observations on this curious production in the *Cetacea*:—

"The baleen, or whalebone, has generally been considered as the teeth of the whale; but this must be a mistake, for Mr. Knox observes: 'In the fœtal *B. mysticetus* 60 to 70 dental pulps were found on each side of each jaw, making the whole number amount to from 260 to 300. The preparation (No. 56) exhibits a portion of this gum with 12 pulps. Had these pulps been confined to the upper jaw, and corresponded to the number of baleen plates, it would have formed a strong analogy between the baleen and teeth; but the number of baleen plates in the whale greatly exceeds the number of dental pulps; and the lower jaw, which contained an equal number of pulps with the upper, has neither teeth nor baleen in the adult whale. Their presence therefore in the fœtal *Mysticetus* forms one of the most beautiful illustrations of the unity of organisation in the animal economy. The teeth in the *Balæna* never cut the gum, but become gradually re-absorbed into the system; the very cavity in which the gums were lodged disappears; whilst, to suit the purposes of nature, the integumentary system furnishes the baleen, which is evidently a modified form of hair and cuticle.' (Knox, 'Cat. Whales,' 22.) Professor Eschricht has shown also that the fœtus of *Megaptera Boops* ('Danish Trans.,' xi. t. 4, 1845) has numerous teeth on the edge of the jaw, though they are never developed. I am inclined to regard the baleen as a peculiar development of hair in the palates of these animals, and somewhat analogous to the hair found in the palates of the genus *Lepus.*

"From the examination I have been able to make of the baleen of *Balænoptera rostrata*, and of different masses of small blades of *Balæna australis*, it would appear as if there was, at least in these two species, two series of baleen on each side of the palate; the external series being formed of large triangular blades placed at a certain distance apart; and the internal, in *Balænoptera rostrata*, formed of smaller, much thinner, triangular pieces, placed much closer together, and forming a very dense screening apparatus; and in *Balæna australis* the inner series is formed of numerous separate narrow strips of whalebone, each ending in a pencil of hairs, which vary in size from that of small twine to that of tape, half an inch wide: these are placed behind the others, and gradually increase in size from the innermost to the broad external series.

"The baleen, or whalebone, affords good characters for the separation of this family into sections. Mr. Knox ('Cat. Prep. Whale,') gives the best account of the development, position, and distinction between the baleen of the whales of the North Sea which has come under my observation; and it agrees with the observations I had made on the subject before I could procure his pamphlet.

"In *Balæna maximus*, Knox (*Physalus Antiquorum*), 314 external or labial plates (baleen) were counted on each side. Towards each extremity these plates degenerate into bristles, and admit of being counted with difficulty. Towards the mesial line the baleen as a mass diminishes gradually in depth, giving the whole palatine surface an elegant arched form. The 314 external or labial plates do not extend to the whole extent in a transverse direction, but a system of numerous small and narrow plates succeeds the external ones. For each external plate twelve (internal) smaller ones could be easily counted; so that the number of plates which could be counted, and not including the bristly terminations towards the snout, pharynx, and mesial line, stands thus: external or labial plates 314; internal small plates, corresponding to each external one, 12; total number of baleen plates 3768. The longest plate of baleen is placed about the centre of each of the sides, and measured 26 inches in length, and 15 inches in breadth. The substance when recent is highly elastic and very heavy: the whole weighed nearly two tons.

"It is short or long according to the species of whale, being modified entirely by the more or less arched form of the upper jaw. Mr. F. Knox first pointed out this curious and important fact. The usual conclusion come to by all persons was, that the size of the whale corresponded to the length of the bone or baleen. Now, this is only good with regard to one species of whale, and not at all to the whole group of Whalebone Whales. (Knox, 'Cat. Prep. Whale,' 8.)

"In *Balæna minimus*, Knox (*Balænoptera rostrata*), 307 external or labial (baleen) plates can be counted on each side. Towards each extremity these plates degenerate into fine bristles, which were not counted. The plates hang perfectly parallel with each other, and from their closeness and fringed lingual aspect must act as a very perfect filter in collecting the minute molluscous animals, and at the same time enable the whale to eject the water. The food of the whale is still a much disputed point. It is now generally admitted that the *Mysticetus* lives only on small *Medusæ*, shrimps, &c., but that the other species of Whalebone Whale devour inconceivable quantities of fish; for instance, M. Desmoulins states that '600 great cod and an immensity (probably as many thousands) of pilchards have been found in the stomach of a single Rorqual.'

"Mr. F. Knox, in dissecting the *Balæna maximus*, saw no cavity in the course of the viscera which could have contained six cod of ordinary size; that of *B. minimus* was empty, although the Frith of Forth, particularly at and above Queensferry, abounds at all seasons with herrings and other fishes and their fry. The want of teeth by no means renders it impossible that the *Balæna* with baleen can live on large fishes; but the extreme narrowness of the gullet (that of *B. maximus* barely allowed the passage of the closed human hand, and that of *B. minimus* was certainly narrower than that of an ordinary sized cow), added to the want of teeth and the want of proper authenticated information on the subject, are strong arguments in favour of the hypothesis that they do not. (Knox, 'Cat. Prep. Whale,' 16.)

"The thickness of the plate of baleen depends on the number of bristles. In the baleen of *B. maximus* there are 506 bristles in the thickness of the plate, and by a rude enumeration there appeared to be at least 130 bristles in each inch. The whole breadth of the plate being 5¾ inches gives us 747 bristles entering into its composition. These bristles are matted together to the extent of 11 inches on the external and 5 inches on the internal margins by a substance like minute laminæ or scales, and which may be seen by the aid of a microscope to invest the free bristles at the fringed extremity of the plate. We have often observed the facility with which some baleen can be split up, and were struck with the fact that the baleen of *B. maximus* would not split. The removal of the external lamina in the plate under description shows the cause of this: about 6½ inches from the root of the plate, many of the bristles have deviated from their direct parallel inclination, and become intimately twisted and interwoven with each other. It has been attempted to prove the age of the whale from an examination of the baleen, in the same manner as we judge of the age of cattle by certain annulated markings on the horns. On the plate before us we can distinctly perceive numerous transverse lines crossing the course of the bristles at right angles. If these transverse lines indicate a periodical check to the growth of the baleen, then the age of the *B. maximus* would be 800 to 900 years old, that being the number of transverse lines on the longest plate of baleen. (Knox, 'Cat. Prep. Whale,' 9.)

"The whalebone of the smooth-bodied whales without any back fins (*Balæna*) is elongate, much longer than broad at the base, and gradually attenuated, and edged with a fringe of equal lengthened fine soft bristles. The baleen is internally formed of a thin layer of fibres, covered on each side with a thick coat of 'enamel;' when dry and out of the mouth the blades are flat.

"The whalebone of the plaited-bellied whale with a bunch (*Megaptera*) or a dorsal fin (*Balænoptera*) is short, broad, triangular, not much longer than broad at the base, and rapidly attenuated; and is edged with a series (sometimes rather crowded) of elongate rigid unequal bristle-like fibres, which become much thicker and more rigid near and at the tip. The baleen is internally formed of a more or less thick layer of thick fibres, covered on each side with a thin layer of enamel, and when dry and out of the palate they are curled up and somewhat spirally twisted.

"The baleen of the *Balæna* is alone designated Whalebone (or rather Whale-Fin, as it is usually called) in commerce. The baleen of the other genera of this family is called Finner-Fin or Humpback-Fin. The wholesale dealers in baleen, in the 'London Directory,' are called Whale-Fin Merchants, and whalebone occurs under the name of Whale-Fin in the 'Price-Current.' In the 'London New Price-Current,' for 1843, the South Sea Whale-Fin varied during that year from 200*l.* to 305*l.* per ton, and there is no price named for Greenland Whale-Fin. (McCulloch, 'Com. Dict.' i. 1344.)

"The baleen was formerly thought to be the tail of the animal. (Blackstone, 'Commen.' i. 233, quoted by McCulloch, 'Com. Dict.' 1344."

Balæna mysticetus (the Right Whale). It is the *B. Grœnlandica* of Linnæus; *B. vulgaris* of Brisson; *B. Rondeletii* of Willughby; the Right, Whalebone, Common, or Greenland Whale of English writers. One variety is called the Nord Kapper or Nord Caper, another the Rock-Nosed Whale.

Description.—Colour velvet-black, gray, and white, with a yellow tinge. Back, greater portion of the upper jaw, part of the lower, fins, and tail, black; lips, fore part of lower jaw, sometimes a little of the upper, and a portion of the abdomen, white; eyelids, junction of the tail with the body, part of the axilla of the flippers, &c., gray. The older the whale, the more white and gray is there upon it; some are piebald all over. The surface of the body is rather furrowed. The head is very large, forming nearly a third of the whole bulk, the under part, the outline of which is given by the jaw-bone, flat. The lips inclose the cavity of the mouth; the upper jaw is bent down at its edges like a boat upside down, so as to shut in the front and upper parts of the cavity. On the most elevated part of the head are situated the blow-holes, two longitudinal apertures like the holes in the belly of a violin, and from 8 to 12 inches long. The baleen is very long, ranging from 9 to 12 feet. There are upwards of three hundred of these plates of whalebone on each side of the jaw, enclosing the tongue between their lower extremities, and themselves covered by the lower lip. The body is thickest a little behind the flippers, near the middle of its whole length, whence it gradually tapers conically towards the tail, and slightly towards the head. There is no dorsal fin. The flippers, about 9 feet long and 5 feet broad, are placed about two feet behind the angle of the mouth, and cannot be raised above a horizontal position. The horizontal tail is flat and semilunar, indented in the middle; the two lobes somewhat pointed and turned a little backwards. The eyes, not much larger than those of an ox, have a white iris, and are situated on the sides of the head about a foot obliquely above and behind the angle of the mouth. The sense of sight appears to be acute in the water, but not above it. The size of this whale has been supposed to have been greatly exaggerated by old statements. Eighty and 100 feet were mentioned as a frequent length, and many accounts more than doubled that measurement. At present 65 or 70 feet appear to be the extreme length of a full grown Mysticete. The Rev. Dr. Scoresby, who has elucidated the history of this whale as satisfactorily as Mr. Beale has that of the Sperm-Whale, and who was personally concerned in the capture of 322, found not one that exceeded 60 feet. It should be remembered however, in criticising old accounts, that the great persecution which these animals have long undergone and still undergo, while it reduces their numbers, is very unfavourable to longevity.

The habitat usually assigned to this whale is most extensive: thus, M. Lesson states that it inhabits all the seas of the globe, especially the two poles; but it is not improbable that the Whalebone Whale or Black Whale of the South Seas (*Balæna australis*, Desmoulins, *B. antarctica*, Less.), which has every appearance of being distinct, and moreover of being infested with parasitical cirrhipedes (*Tubicinella*, *Coronula*, &c.) of different species from those which infest the Greenland Whale, has been mistaken for the last named cetacean. Multitudes of the Southern *Balæna* were seen by Captain James Ross, R.N., in very high southern latitudes during his last expedition.

This species seems to hear acutely any noise made in the water, such as splashing, &c. in calm weather; but a sound produced in the air, a loud shout for instance, when the whale is only at the distance of a ship's length, is disregarded. The usual rate of swimming seldom exceeds four miles an hour, but they will descend when harpooned at a velocity of seven or eight miles an hour, and one of these whales when alarmed can sink in five or six seconds far beyond the reach of a human enemy. The Mysticete seldom remains at the surface to breathe longer than two minutes, during which period it blows eight or nine times. It then descends for five or ten minutes; sometimes, when on its feed, for fifteen or twenty minutes. Though Dr. Scoresby states that it has no voice, it makes, he observes, a loud noise in blowing. The spout is ejected some yards high, and has the appearance of a puff of smoke at a distance. They blow strongest, densest, and loudest when alarmed, or after a long stay under water.

A very considerable portion of the feeding-grounds is occupied by what is termed 'green water,' which swarms with minute life, and has been carefully examined and described by Dr. Scoresby. The smallness of the gullet is only fitted for swallowing small animals, such as the *Clio borealis*, numerous specimens of which (the 'Whale's Food' of the Greenland Whalers) will be found in the preparation No. 323 A of the Physiological Series of the Museum of the Royal College of Surgeons in London. This small mollusk is said to constitute the chief support of the Mysticete, and the structure and disposition of the whalebone-plates explain how these or any other small species of animal are retained in the capacious mouth of their devourer, while the water taken in along with them drains through the interstices of the plates. When the Mysticete feeds, it swims rapidly below the surface with open jaws; a stream of water enters them, and with it myriads of small marine animals; the water finds an outlet at the sides, but the thick internal hairy apparatus of the whalebone does not permit one of these animals to escape.

Nine or ten months is supposed to be the period of utero-gestation, and the mother is so attached to her young one, or 'sucker,' as it is termed, that it is often struck as a snare to the affectionate parent, for she will not leave it, and falls a victim to her maternal love. Dr. Scoresby relates instances of this kind which cannot be perused, much less witnessed, without great pain by any person of ordinary humanity. Such a mode of capture seems hardly justifiable, whilst it must be ruinous to future prospects.

This species is generally found alone or in pairs, excepting when many individuals are attracted to some abundant feeding-ground or to a desired locality, such as the vicinity of icebergs.

To the Esquimaux and the Greenlander this species is all in all. They eat the flesh and fat with indescribable relish. The membranes of the abdomen serve them for clothing, and the thin transparent peritoneum admits light through the windows of their huts whilst it keeps out the weather. The bones are made into props for their tents, or aid in the formation of their boats, and supply them with harpoons and spears for the capture of the seal and greater sea-birds. The sinews, divided into filaments, are used as thread for sewing their dress, &c. Some have stated that pickled and boiled blubber is palatable, and that the tail, first parboiled and then fried, is agreeable eating. The flesh of the young whale is said to be by no means indifferent food. To civilised nations, the oil made from its fat or blubber, and the whalebone, have long made it a great commercial object. [FISHERIES, in ARTS AND SC. DIV.]

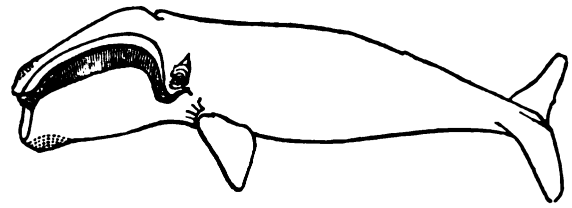
Greenland Whale (*Balæna mysticetus*).

B. marginata, the Western-Australian Whale, has very long and slender baleen, with a rather broad black edge on the outer or straight side. From the character of the baleen Dr. Gray considers this a distinct species.

B. australis, the Cape Whale. It is the Right Whale of South Sea Whalers, the Southern Whalebone Whale of Nunn, the Common Black Whale of Sir James Ross. It inhabits the South Seas, and is of a uniform black colour.

B. Japonica, the Japan Whale. It is an inhabitant of the coasts of Japan, which it visits periodically. Its head is covered with barnacles. Only the baleen has been seen in England. The species has been described from Chinese drawings.

B. antarctica, the New Zealand Whale. A species described by Dr. J. E. Gray as *B. Antipodarum*, from a very accurate drawing of a specimen taken in Jackson's Bay, New Zealand. It is the Tuku Peru of the natives. The specimen was 60 feet in length. The following cut is reduced from Dr. Gray's plate.



New Zealand Whale (*Balæna Antipodarum*). Gray.

B. gibbosa, the Scrag-Whale, is regarded as a species by Dr. J. E. Gray. It is an inhabitant of the Atlantic Ocean. "It is near akin to the Finback, but instead of a fin upon its back, the ridge of the after part of its back is scragged with half-a-dozen knobs or knuckles." (Dudley.)

The remaining genera of the *Balænidæ* have either fins or humps on their backs, and are called Finners and Hump-Backs.

The genus *Megaptera* includes the Hump-Backed Whales. They are easily known from the Finners in being shorter and more robust, the skull nearly one-fourth the entire length, the head wider between the eyes, the mouth larger, the lip warty, and the nose large and rounded; the plaits of the belly and throat are broad. The skull is intermediate between that of *Balæna* and *Balænoptera*.

M. longimana, Johnston's Hump-Backed Whale. It was described by Dr. Johnston from a specimen cast ashore at Newcastle. It is an inhabitant of the North Sea, and has been taken at the mouth of the Maas. It is the *Balæna longimana* of Rudolphi, and the *Balæna Boops*, or Keporkak, of Eschricht, who says it is the most common whale in the Greenland seas.

M. Americana, the Bermuda Hump-Back, is of a black colour, with a white belly, and has its head covered with tubercles. It is the *Balæna nodosa* of Bonnaterre. It is found at Bermuda from March to the end of May, when it departs. The baleen of this whale is extensively imported from Bermuda.

M. Poeskop, the Poeskop, or Cape Hump-Back. It is the Rorqual du Cap of Cuvier, the *B. Lalandii* of Fischer, and *B. Capensis* of Andrew Smith; the Hump-Backed Whale of Ross's 'Antarctic Voyage.' It is an inhabitant of the seas of the Cape of Good Hope.

M. Kuzira, the Kuzira. It inhabits the Japanese seas.

Balænoptera rostrata, the Pike-Whale. It is the *Balæna rostrata*, Müller; *Rorqualus rostratus*, Dekay; *Balænoptera microcephala*, Brandt; *Rorqualus Boops*, F. Cuvier. It is of a black colour, underneath of a reddish white. It inhabits the North Sea, and has been found in New York Bay, at Valognes in France, and a specimen was taken in the Thames at Deptford.

Physalus Antiquorum, the Razor-Back. It is the *Balæna Antiquorum* of Fischer, and probably the Great Northern Rorqual of Knox and Jardine; the Rorqual de la Mediterranée of Cuvier. It is of a slate-gray colour, whitish beneath. The baleen is slate-coloured, the under edge blackish, the inner edge pale-streaked. It is an inhabitant of the North Sea, and is sometimes found on the coasts of Great Britain. There is a skeleton at Black Gang Chine in the Isle of Wight 75 feet long. It was taken in 1842. A specimen was taken at Berwick in 1831. There is a skeleton of one also at Plymouth 74½ feet long. This animal was found floating in Plymouth Sound on the 2nd of October 1831. It is stated to have been 102 feet long and 75 feet in circumference. This specimen was taken round the country in three caravans. Dr. J. E. Gray refers the skeleton of the whale now in the Edinburgh Botanic Gardens to this species. It was 80 feet long, and was taken off North Berwick in 1833.

P. (*Rorqualus*) *Boops* of Gray has been taken off the coast of Wales. The length of the specimen in the British Museum is 38 feet; the head is 9 feet long, the vertebræ are 60 in number, and there are 15 pairs of single ribs. It was taken in 1846, and was mentioned in the papers of the day as a Spermaceti Whale.

P. (*Rorqualus*) *Sibbaldii*. A specimen of this species exists in the museum at Hull. It is 50 feet long.

P. fasciatus, the Peruvian Finner, described by Tschudi, has been found on the coasts of Peru.

P. Iwasi, the Japan Finner. It is very rare; one was cast ashore at Kii in 1760. It was 25 feet long.

P. antarcticus, named from the baleen of a New Zealand species by Dr. J. E. Gray.

P. Brasiliensis, the Bahia Finner. Named from baleen; brought from Bahia.

P. australis, Southern Finner, inhabits the seas of the Falkland Islands.

The family of CATODONTIDÆ includes the Toothed Whales. The genera are as follows:—

Catodon. Dorsal hump rounded. Blowers on front of truncated head. Skull elongate.

Kogia. Dorsal hump. Blowers (?). Skull short, broad.

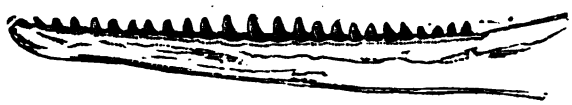
Physeter. Dorsal fin falcate. Blower on back of forehead. Skull elongate.

There has been much discussion about the genera and species of this family. We shall however follow the 'British Museum Catalogue,' adding the more common synonyms of the species.

Catodon macrocephalus, Northern Sperm-Whale. This is the *Physeter macrocephalus* of Linnæus; the Sperm-Whale, the Spermaceti Whale, the Blunt-Headed Cachalot of English writers. It is the *Physeter Trumpo* of Bonnaterre; the *Catodon Trumpo* of Gerard; the *Physeter gibbus* of Schreber; *Cetus macrocephalus* of Oken.

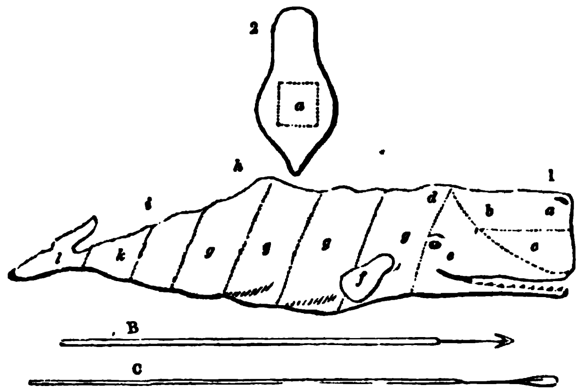
The colour of this animal is black, becoming whitish below.

The subjoined cut of the jaw is from F. Cuvier, who gives it from the skeleton in the Paris Museum, and is confined to the lower jaw only; from which it may be inferred, that in the French specimen there is no appearance of teeth in the upper jaw: in the lower there are 27 on each side=54.



Teeth of Cachalot.

To render the following description more intelligible we prefix a cut from Mr. Beale's work on the Sperm-Whale, which is by far the most accurate published figure extant of the Spermaceti Whale.



Spermaceti Whale (*Catodon macrocephalus*).

1, Outline of the entire form; 2, anterior aspect of the head; *a*, nostril, or spout-hole; *b*, situation of the case; *c*, the junk; *d*, bunch of the neck; *e*, eye; *f*, fin; *g*, spiral strips or blanket pieces; *h*, the hump; *i*, the ridge; *k*, the small; *l*, the tail or flukes.

B, a harpoon. C, a lance.

a, in fig. 2: the lines forming the square are intended to represent the flat anterior part of the head.

The head presents a very thick blunt extremity, constituting about a third of the whole length of the animal; at its junction with the body is a large protuberance on the back called 'the bunch of the neck.' Immediately behind this is the thickest part of the body, which from thence gradually tapers off to the tail, but it does not become much smaller for about another third of the whole length, when 'the small' or tail commences; and at this point also, on the back, is a large pyramidal prominence called 'the hump,' from which a series of smaller processes run half way down the 'small' or tail, constituting what the whalers term the 'ridge.' The body then contracts so much as to become finally not thicker than that of a man, and terminates by expanding on the sides into the 'flukes' or tail, forming a large triangular horizontal fin with a slight notch or depression posteriorly between the flukes, which are about 6 or 8 feet in length, and from 12 to 14 feet in breadth in the largest males or 'bulls.' The chest and belly are narrower than the broadest part of the back, and taper off evenly towards the tail; the depth of the head and body is, in all parts except the tail, greater than the width. The head, viewed in front, presents a broad somewhat flattened surface, rounded and contracted above, considerably expanded on the sides, and gradually contracted below, resembling in some degree the cutwater of a ship. The slit of the single blowing-hole or nostril is about 12 inches in length. In the right side of the nose is the 'case,' a cavity for the purpose of secreting and containing an oily fluid, which after death concretes into a granulated yellowish substance: this is the Spermaceti. In the case of a large whale there is not unfrequently a ton, or more than ten barrels of spermaceti. Beneath the case and nostril is the elastic 'junk,' formed of dense cellular tissue, strengthened by strong tendinous fibres, and infiltrated with very fine sperm-oil and spermaceti. The mouth extends nearly the whole length of the head. Both the jaws, especially the lower, are contracted in front to a very narrow point; and when the mouth is closed the lower jaw is received within a sort of cartilaginous lip, or projection of the upper one: but principally in front; for, farther back at the sides, and towards the angle of the mouth, both jaws are furnished with tolerably well-developed lips. The tongue is small and white. The throat is capacious enough to give passage to the body of a man, presenting a strong contrast to the contracted gullet of the Greenland Whale. Throughout, the mouth is lined with a pearly white membrane. The eyes are small in proportion to the size of the animal, and are furnished with eyelids, the lower of which is most moveable. At a short distance behind the eyes are the external openings of the ears, sufficiently large to admit a small quill. Not far from the posterior angle of the mouth are the swimming-paws or fins, which are not much used in progression, but probably more as balances, and occasionally in supporting the young.

Mr. Beale gives the following as the dimensions of a Sperm-Whale of the largest size, or about 84 feet in length:—Depth of head from 8 to 9 feet; breadth from 5 to 6 feet; depth of body seldom exceeding 12 or 14 feet; circumference seldom exceeding 36 feet; swimming-paws about 6 feet long and 3 feet broad.

The skin is smooth, but occasionally in old whales wrinkled. The general colour is very dark, deepest on the upper part of the head, back, and flukes, in which situation it is sometimes black; on the sides it gradually assumes a lighter tint, and on the breast becomes silvery-gray. In different individuals there is however every variety of shade, and some are piebald. Old 'bulls' have generally a portion of gray on the nose, immediately above the fore-part of the upper jaw, when they are said to be 'gray-headed.' The 'black skin' in young whales is about three-eighths of an inch thick; in old ones it is not more than one-eighth. Immediately beneath the black skin is the blubber or fat, termed the 'blanket,' of a light yellowish colour, producing when melted the sperm-oil.

The bulk of the head is, as we have seen, made up of a membranous 'case,' containing a thin oil of much less specific gravity than water; below which again is the 'junk,' which, although heavier than the spermaceti, is still lighter than the element in which the whale moves; consequently, observes Mr. Beale, the head taken as a whole is lighter specifically than any other part of the body, and will always have a tendency to rise at least so far above the surface as to elevate the nostril or blow-hole sufficiently for all purposes of respiration; and more than this, a very slight effort on the part of the whale would only be necessary to raise the whole of the anterior flat surface of the nose out of the water. At very regular intervals of time the snout emerges, and from the extremity of the nose the spout is thrown up, and at a distance appears thick, low, bushy, and white. It is formed of the expired air forcibly ejected through the blow-hole, and acquires its white colour from minute particles of water previously lodged in the chink or fissure of the nostril, and also from the condensation of the aqueous vapour thrown off by the lungs. The spout, says Mr. Beale in continuation, is projected at an angle of 136 degrees, in a slow and continuous manner for about three minutes, and may be seen from the mast-head in favourable weather at the distance of four or five miles. When the whale is alarmed, or 'gallied,' the spout is thrown much higher with great rapidity, and differs much from its usual appearance. Immediately after each spout the nose sinks beneath the water, scarcely a second intervening for the act of inspiration, which must consequently be performed very quickly, the air rushing into the chest with astonishing velocity; there is however no sound caused by inspiration, and very little by expiration in this species: in short, nothing of that loud noise called the 'drawback' in the Finback and other whales. Ten seconds is occupied by a large bull sperm whale in making one inspiration and one expiration: during six of these the nostril is beneath the water. At each breathing-time the whale makes from 60 to 70 expirations, and remains therefore at the surface 10 or 11 minutes. When the breathing-time is over, or, as the whalers term it, he has had his 'spoutings out,' the head sinks slowly, the 'small,' or the part between the 'hump' and 'flukes,' appears above the water, curved, with the convexity upwards; the flukes are then lifted high into the air, and the animal having assumed a straight position, descends perpendicularly to an unknown depth. This last act is called 'peaking the flukes,' and those who are on the look-out call loudly when they see it—'there goes flukes.' The whale continues thus hidden beneath the surface for one hour and ten minutes; some will remain one hour and twenty minutes, and others only for one hour; but these, Mr. Beale says, are rare exceptions. A seventh of the time of this whale is, Mr. Beale makes out, consumed in respiration.

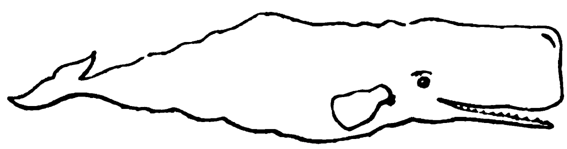
Small fishes are occasionally swallowed in quantities by this whale, and one has been known to eject from its stomach a fish as large as a moderate-sized salmon; but the principal food of the Sperm-Whale appears to consist of squids or cuttle-fishes. [SEPIADÆ.]

This species is gregarious; and the herds called 'schools' are of two kinds, one consisting of females, the other of young males not fully grown. Mr. Beale has seen as many as 500 or 600 in one 'school.' With each female 'school' are from one to three large 'bulls' or 'school-masters,' as they are termed by the whalers. The full-grown males almost always go alone in search of food: they are when alone very incautious and easily killed. It is the smaller, or 'forty-barrel bull,' as he is called, that makes the most desperate resistance. A large whale will yield 80 barrels of oil, and sometimes 100.

Mr. Beale states that the female is smaller than the male, and that she breeds at all seasons, producing generally only one at a time, but sometimes two. Nothing certain appears to be known as to the period of gestation, but F. Cuvier supposes it to be ten months. A fœtal Cachalot, dissected by Mr. Bennett, was 14 feet long and 6 feet in circumference, deep black, mottled with white spots. Its position in the womb was that of a bent bow. According to F. Cuvier, the two brought forth by the Stranded Whale near D'Audierne, were 10 or 11 feet long; and Captain Colnett states that the young Sperm-Whales which he saw in great numbers off the Galapagos Islands were not larger than a small Porpesse. Mr. Beale's own observations coincided with those of Mr. Bennett.

For many other habits of this whale, such as 'breaching,' or leaping clear out of the water and falling back again on its side, so that the breach may be seen in a clear day from the mast-head at a distance of six miles; 'going head out,' a mode of progression which enables it to attain 10 or 12 miles an hour, which Mr. Beale believes to be its greatest velocity; 'lob-tailing,' or lashing the water with its tail; and the vivid descriptions of the dangers and hair-breadth escapes attending its capture, we must refer to Mr. Beale's book, which every one who is anxious for information on this subject should read.

This animal is an inhabitant of the north; it has however been found on the coasts of America, Japan, New Guinea, and Timor. It has been frequently stranded on the British Islands. Twelve males were caught at Walderwich on the Suffolk coast in 1788. There is a skeleton of an adult at Burton-Constable Castle, near Hull, in Yorkshire. It has been taken also near Teignmouth, in Whitstable Bay, and in the Frith of Forth.



The Spermaceti Whale (*Catodon macrocephalus*). Beale.

C. Colneti, the Mexican Sperm-Whale, is an inhabitant of the North Pacific, the South Seas, and equatorial oceans, and often referred to the last species.

C. polycyphus, the South Sea Sperm-Whale, is found in the Southern Ocean, and is also spoken of as the Cachalot, or Sperm-Whale.

Kogia is the generic name given by Dr. J. E. Gray to a form of whale with a shorter head, which has been taken at the Cape of Good Hope. It has been sometimes regarded as the young of the Sperm-Whale.

K. breviceps, the Short-Headed Whale of Gray, is the only species, and has been described from a single skull in the Paris Museum.

Physeter is the generic term applied by Linnæus and many subsequent writers to the Sperm-Whale, but it was originally applied by Artedi to the Black Fish, to which Dr. J. E. Gray has restored it in the 'British Museum Catalogue.'

P. Tursio, the Black Fish of Gray, is the *Physeter microps* and *P. Tursio* of Artedi, and probably the *Delphinus globiceps* or *D. Grampus* of Cuvier. It is of a black colour. The teeth are from 11 to 22 on each side. It is an inhabitant of the North Sea. Two specimens, 52 feet in length, have been taken off the coasts of Scotland, and were described by Sibbald. Of one of the specimens Sibbald observes, "The size of the cranium may be estimated by the fact that four men were seen inside it at one time extracting the brain, which contained several cells or alveoli, like those which bees keep their honey in, and in these were rounded masses of a white substance, which upon examination were proved to be sperm. Some of this substance was also found externally on the head, in some parts to the thickness of two feet."

The family of DELPHINIDÆ, or Dolphins, are more numerous than those of the other *Cetacea*. They are distinguished from the last family by the smaller and more proportionate head; and in those species which have lost their upper teeth at an early age, by there being no regular pits in the gums of the upper jaw for the reception of the teeth of the lower one; and also by the hinder part of the skull not being deeply concave, and surrounded on the sides and behind by a high ridge.

The following is a synopsis of the genera and sub-families of this extensive family:—

A. Jaws tapering; the symphysis of the lower jaw short, not half the length of the jaw. Dorsal fin generally distinct; pectoral fin ovate, acute. Marine.

a. Upper jaw toothless; lower jaw with only one or two teeth (which are often hidden in the gums) on each side. Beak of the skull keeled on each side, the keel being sometimes large, and forming a kind of reflexed wing on each side; head with a short beak. *Hyperoodontina.*

1. *Hyperoodon.* The beak of the upper jaw with a large erect wing-like expansion in front of the blowers; lower jaw with two rudimentary teeth in front.

2. *Ziphius.* Beak of upper jaw keeled on each side; lower jaw broad, bent down in front with large compressed teeth in the middle of each side.

3. *Delphinorhynchus.* Beak of upper jaw keeled on each side; lower jaw nearly straight, with two or three small rudimentary conical teeth in the middle of each side.

b. Upper and lower jaw with few or deciduous teeth. Wings of the maxillary bones expanded and shelving downwards. The beak short, deflexed. Forehead convex. Head rounded, without any beak. *Monoceratina.*

* Lower jaw toothless.

4. *Monodon.* Upper jaw of males with one or two very long projecting spirally-twisted tusks. Dorsal fin none.

** Upper and lower jaw with conical, early deciduous teeth.

5. *Beluga.* Dorsal fin none.

*** Upper and lower jaw with compressed permanent teeth.

6. *Neomeris.* Dorsal none.

7. *Phocæna.* Dorsal triangular, in the middle of the back.

c. Upper and lower jaw with many teeth, rarely deciduous with age. Wings of the jaw-bone horizontally produced over the orbits. *Delphinina.*

* Head rounded in front, not beaked. Nose of skull scarcely so long as the brain-cavity. Dorsal distinct.

8. *Grampus.* Teeth conical, truncated, early deciduous. Intermaxillaries broad. Pectoral ovate.

9. *Globiocephalus.* Teeth conical, deciduous when old. Intermaxillaries very broad. Pectorals narrow, linear.

10. *Orca.* Teeth conical, acute, permanent. Intermaxillaries moderate. Pectorals ovate.

** Head beaked. Nose of skull as long as or longer than brain-cavity.

11. *Lagenorhynchus.* Head shelving in front. Dorsal rather posterior. Nose of skull depressed, expanded.

12. *Delphinapterus.* Head rather convex in front. Dorsal none. Nose of skull rather depressed, convex above.

13. *Delphinus.* Head rather convex in front. Dorsal medial. Nose of skull rather depressed, convex above.

14. *Steno.* Head rather convex in front. Dorsal medial. Nose of skull compressed, higher than broad; symphysis of lower jaw rather elongate.

15. *Pontoporia.* Head rather convex in front. Dorsal medial. Nose of skull rather compressed; high symphysis of lower jaw very long.

B. Jaws much compressed; symphysis of the lower jaw very long. Dorsal none. Teeth in both jaws. Fluviatile.

d. Skull with the maxillary bones simple, expanded over the orbit. Teeth conical. Paddles ovate or oblong. *Iniana.*

16. *Inia.* Teeth rugose; the hinder ones with a rounded tubercle on the inner side.

e. Skull with the maxilliary bones bent up in front of the blowers, and forming a vault. The teeth compressed. The paddles fan-shaped, truncated at the end. *Platanistina.*

17. *Platanista.*

Hyperoodon Butzkopf, the Bottle-Head. It is the Flounder's Head of Dale, in his 'History of Harwich,' where it has been taken. Pennant calls it the Beaked Whale. It inhabits the North Sea.

H. rostratum, the Beaked Hyperoodon, is an inhabitant of the North Sea. It differs from the last species in having the dorsal fin behind the middle of the back. It has been taken in the Thames and the Humber, and skeletons exist in the museums of Edinburgh, Bristol, and Liverpool.

Two other species of Hyperoodon are described by Dr. J. E. Gray, *H. Desmarestii* and *H. latifrons*. The latter is a native of the North Sea, and has been taken on the coast of Lancashire.

Ziphius Sowerbiensis is the *Physeter bidens* of Sowerby, the *Diodon bidens* of Bell. The head of a specimen caught in Scotland is now in the museum at Oxford. Dr. Gray observes that "it belongs to the genus *Ziphius* of Cuvier, before only known in the fossil state; and the examination of the skull has proved the accuracy of these determinations."

Z. Sechellensis, named from a skull in the museum at Paris brought from the Sechelles.

Delphinorhynchus micropterus was first described by De Blainville. It inhabits the seas of the coasts of Europe.

Monodon monoceros, the Narwhal, Unicorn, or Unicorn-Whale. It is the *Monodon microcephalus* and *Narwhalus Andersonianus* of Desmarest. When young it is black, but when old it is whitish marbled. Although it has sometimes two tusks, it has more frequently one, from which it derives its name of Unicorn. It inhabits the Northern Ocean, and is not unfrequent on the coast of Scotland.

The use of the tusk has been a matter for discussion. Dr. Scoresby has expressed an opinion that as the end of the tusk is smooth and clean, while the rest of it is rough and dirty, and as a broken tusk was found rubbed and rounded, it may be used to pierce thin ice for the purpose of enabling the animal to respire without the necessity of retreating into open water. Again, he states that his father sent him the contents of a Narwhal's stomach, consisting of several half-digested fishes, with others of which the bones only remained. There were the remains of a cuttle-fish, part of the spine of a flat-fish, probably a small turbot, and a skate almost entire. The last was two feet three inches in length, and one foot eight inches in breadth, comprising the bones of the head, back, and tail, the side-fins, and considerable portions of the muscular substance. It appears, he observes, remarkable that the Narwhal, an animal without teeth, with a small mouth and stiff lips, should be able to catch and swallow so large a fish as a skate, the breadth of which is nearly three times as great as the width of its own mouth. As the animal in which these remains were found had a tusk of seven feet, Dr. Scoresby apprehended that this instrument had been employed in the capture of the fishes on which it had recently fed. It seemed probable to him that the skates had been pierced with the horn and killed before they were devoured; otherwise, he observes, it is difficult to imagine how the Narwhal could have swallowed them, or how a fish of any activity would have permitted itself to be taken, and sucked down the throat of a smooth-mouthed animal without teeth to detain and compress it.

The Narwhal (*Monodon monoceros*).

Narwhals swim with great swiftness. When at the surface for respiration they blow repeatedly with considerable force, and then frequently lie motionless for several minutes with their back and head just above water. Dr. Scoresby describes them as often sporting about his ship, sometimes in bands of about twenty together, often elevating their long tusks and crossing them with each other as if they were fencing. They often uttered a very unusual sound resembling the gurgling of water in the throat, which Dr. Scoresby thinks produced it, as it only occurred when they reared their tusks, with the front of the head and mouth out of the water. Several of them followed the ship, seeming to be attracted by curiosity. As the water was perfectly transparent, they could be seen descending to the keel and playing about the rudder for a considerable time. Sir Joseph Banks stated to Dr. Fleming, who has published a very interesting account of one in the 'Wernerian Transactions,' that a Narwhal stranded on the Lincolnshire coast was found with the whole of its body buried in the mud of the beach, and seemed safely and securely waiting the return of the tide.

The blubber of the Narwhal yields a very superior oil, which, as well as the flesh, is considered a dainty by the Greenlander. It is regarded as the herald of the Mysticete, in whose neighbourhood the former is said generally to be found—perhaps from partaking of the same food. When harpooned it swiftly dives to about 200 fathoms, and on its return to the surface is killed by lances. The Greenlander drives them to fissures in the ice, where they come up to respire, and kills them with harpoons, &c. The ivory of the tusk is considered superior to that of the elephant; it is very dense and hard, very white, is not subject to become yellow, and is susceptible of a high polish. They formerly brought a high price, and many virtues were attributed to them: they still form a valuable article in commerce. The celebrated throne of the Danish kings is stated to be made of the tusks of this animal.

Beluga Catodon, the Northern Beluga. It is the *Cetus bipinnis* of Brisson; *Physeter Catodon* of Linnæus; *Delphinus leucas* of Pallas; *Catodon Sibbaldii* of Fleming; the Beluga, Round-Headed Cachalot, Small Catodon, of English writers; the White Whale, and White Fish, of whalers; and the *Albus Piscis Cetaceus* of Ray. It is known by its white colour. When young however it is black. It is an inhabitant of the North Sea, and has been taken in Scotland. We are informed by Mr. Whittle of the dockyard, Chatham, that one made its appearance in the waters of the Medway in the spring of 1846, advancing daily with the flow of the tide for a month as high as Rochester bridge. It was at last shot near Upnor Castle. It measured 13 feet 1 inch, and was all over of a most delicate primrose yellow colour. The dental formula was $\frac{10-10}{8-8}$.

One of these dolphins haunted the Frith of Forth in the summer of 1815 for nearly three months, passing almost daily upwards, and again retiring with the flood and ebb. It was supposed to be in pursuit of salmon, and after many unsuccessful attempts the salmon-fishers killed it with fire-arms and spears. Mr. Bald of Alloa bought it, and sent it to Professor Jameson: it is now in the Edinburgh Museum, and formed the subject of the interesting observations of Dr. Barclay and Mr. Neil in the 'Transactions of the Wernerian Society.'

Mr. Neil remarks that the shape of this animal is very symmetrical, suggesting the idea of perfect adaptation to rapid progression in the water. "Its head," he observes, "is small and lengthened, and over the forehead there is a thick round cushion of flesh and fat: the body continues to swell as far as the large thick oval flippers, and from that point gradually diminishes to the setting on of the tail, which is powerful, and described as bent under the body in swimming, and propelling the animal with the velocity of an arrow."

In the specimen examined by Mr. Neil the teeth were $\frac{9-9}{6-6}$.

The higher and arctic latitudes appear to be the chosen haunts of the *Beluga*. They abound in Hudson's Bay, Davis's Straits, and on parts of the southern coasts of Asia and America, where they ascend the large rivers. Steller noticed them at Kamtchatka; and in Charlevoix's time they were numerous in the Gulf of St. Lawrence, going with the tide as high as Quebec. Disco Island in Greenland is said to abound with them, nor are they scarce at Spitzbergen. Scoresby did not see them lower than Jan Mayen's Land; he seldom observed them among the ice, but where the water was clearest and smoothest. They are described as not at all shy, but often following the ships, tumbling about the boats in herds of forty or fifty, bespangling the surface with their brilliant whiteness. The whale-fisher seldom disturbs these beautiful creatures, for they are not only difficult to strike on account of their activity, but when stricken the harpoon frequently draws, and if it holds the capture is but of little value. Sir Charles Giesecke speaks of their regular annual visits about November to the west coast of Greenland, where they become a seasonable supply to the natives when other provisions fall short. They arrive in herds with stormy weather and south-west winds, and are taken with harpoons and strong nets. Cod, haddock, flounders, &c., are said to be the usual food of the *Beluga*.

The White Whale (*Beluga Catodon*).

The oil is reported to be of the best, whitest, and finest quality, and of their skins a sort of morocco leather is said to be made, which, though thin, will resist a musket-ball. The internal membranes are used for windows and bed-curtains, and the sinews for thread. The flesh, it is asserted, resembles beef, though somewhat oily. Hans Egede describes both it and the fat as having no bad taste "when it is marinated with vinegar and salt;" and says that it is then as well-flavoured as any pork whatever. He declares the fins also and the tail "pickled or sauced" to be very good eating; so that, according to Hans, "he is very good cheer."

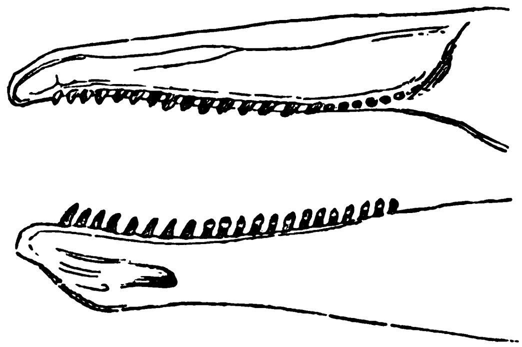
B. Kingii is the representative of the last species in the Southern Hemisphere. It has been taken off the coasts of Australia.

Neomeris Phocænoides is the name given by Dr. J. E. Gray to a species of Dolphin found in the Indian Ocean, the *Delphinus melas* of Temminck.

Phocæna communis, the Common Porpoise, or Porpesse. It is the *Phocæna Rondeletii* of Willughby, *Delphinus Phocæna* of Linnæus. It appears to be the Φώκαινα of Aristotle ('Hist. Anim.' vi. 12). Pennant supposes it to be the *Tursio* of Pliny ('Nat. Hist.' ix. 9), which, according to the Roman naturalist, bears some likeness to the Dolphins, of which he relates so many anecdotes illustrative of their affection for man in the preceding chapter. It is the Porco Pesce of the Italians (whence probably the English name Porpesse); Marsouin of the French; Marsuin and Tumblare of the Swedes; Meerschwein of the Germans; and Llamhidydd of the ancient British. It is the most common of all the *Cetacea* on the British coasts. It is black all over.

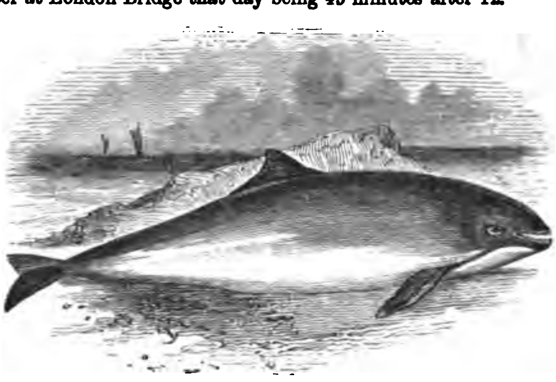
The following is its dental formula:—Molars, $\frac{40 \text{ to } 46}{40 \text{ to } 46} = 80$ to 92.

Porpesses swim in shoals, and drive the mackerel, herrings, and salmon before them, pursuing them up the bays "with the same eagerness," says Pennant, "as a pack of dogs does a hare. In some places they almost darken the sea as they rise above water to take breath: they not only seek for prey near the surface, but often descend to the bottom in search of sand-eels and sea-worms, which they root out of the sand with their noses, in the same manner as the hogs do in the field for their food." In fine weather they leap, roll, and tumble in the manner so well known, principally in the spring and summer, which is supposed to be their rutting season. They go up the rivers in pursuit of the salmon, to which they are a deadly enemy, and other fish; and have been seen high in the Loire, Charente, and Seine in France. It has been remarked that when the Porpesses are gambolling in the spring and summer, they appear heedless and blind to all danger and risk, which, as their brain is highly developed,



Teeth of Porpesse (*Phocæna communis*). F. Cuvier.

strengthens the supposition that they are at such times actuated by the sexual impulse to an extent that lessens their usual wariness. On the 23rd May, 1842, we saw about 10 a.m. two rolling and sporting a little above London Bridge, towards the Surrey shore. They seemed to disregard the numerous steam-vessels which were constantly passing, and to pay no attention to the wherries, some of which went close to them. The man on the look-out in the steamer from whose deck we watched them said that they had been seen between five and six that morning near Southwark Bridge, and that one of them had been hooked with a boat-hook, but had got away. It was blowing fresh from the south-west, and the tide was running up: the time for high water at London Bridge that day being 45 minutes after 12.



The Porpoise, or Porpesse (*Phocæna communis*).

The oil procured from the fat surrounding the body of the Porpoise is of the purest kind, and the skin when carefully tanned and dressed is used for wearing apparel, and for coverings for carriages. The shoals of these creatures on the west coast of Ireland are immense, and might be well worth the attention of the neighbouring population if furnished with boats and proper implements for their capture, and conversion to economic purposes. As an article of food the flesh was anciently esteemed, and considered worthy of the tables of the great. Receipts for dressing it appear in the 'Forme of Cury,' compiled (circ. 1390) by the master cooks of King Richard II. It appears to have been served in 'furmente,' in broth, and roasted, and was evidently used both fresh and salted. Several of them were on the board at the great feast holden at the 'intronazation' of George Neville, archbishop of York, in the reign of Edward IV. In Henry VIII.'s time it continued to be a royal dish, and was in fashion in the reign of Elizabeth. It appears to have been in those days generally presented as a roast with a sauce made of fine white bread-crumbs, mixed with vinegar and sugar. The Common Dolphin (*Delphinus delphis*) was then considered so great a delicacy that, according to Dr. Caius, one which was taken in his day was thought a present worthy of the duke of Norfolk, who distributed it amongst his friends: it was roasted and dressed with the porpesse-sauce last above mentioned. At a later period the Porpesse kept its ground on the table of Roman Catholics on fish-days and during Lent. Nor have modern navigators found it undesirable food. Captain Colnett's people, who fell in with numbers of them off the Mexican coast, mixed their flesh with their salt-pork—making excellent sausages, which formed their ordinary food. Captain Basil Hall speaks with some unction of a dish of porpesse-cutlets, well separated from the investing lard and blubber, which was served at his table with such happy effect that the dish left his cabin empty.

The flesh of the porpesse is the Greenlander's great dainty, and he quaffs its oil as the most delicious of draughts.

Grampus Cuvieri is the *Delphinus griseus* of Cuvier; *Phocæna grisea* of Lesson. It is an inhabitant of the North Sea, and has been taken off the coast of France, and also off the Isle of Wight.

G. Rissoanus. A specimen was taken at Nice, and described by Risso.

G. Richardsonii. Described by Dr. Gray in the Zoology of the Erebus and Terror.

G. Sakamata. Described by Schlegel in 'Fauna Japonica' as *Sakamata Kuzira.* It has been found off the coasts of Japan.

Globiocephalus Svineval, the Pilot-Whale, also known to sailors as the Black Whale, Howling Whale, Social Whale, and Bottle-Head. It is the *Delphinus globiceps* of Cuvier, the Narwal Edente and Petit Cachalot of the French. It is of a black colour, with a white streak from throat to vent. It is a native of the North Sea, and has been taken off the coast of Scotland. A skull in the British Museum measures 28 inches in length.

G. intermedius is the Black Fish of American sailors. It inhabits the coasts of North America.

G. affinis, the Smaller Pilot-Whale. Its locality is unknown. A specimen exists in the museum of the College of Surgeons. It is the *Delphinus melas* of Owen.

G. Sieboldii is a native of the coasts of Japan, where it is called Naiso-Gota.

G. macrorhynchus is the Black Fish of the South Sea whalers. It inhabits the South Seas.

Orca Gladiator, the Killer. It is the *Delphinus Orca* of Linnæus, *Grampus* of Hunter, *Delphinus Grampus*, and Large Grampus, of Owen. It inhabits the North Sea, and has been taken on various parts of the British coasts. There is the skull of one in the Hunterian Collection at the Royal College of Surgeons which was killed at Greenwich in 1793.

O. crassidens is a fossil species. It is described by Professor Owen in the 'British Mammals and Birds' under the name of *Phocæna crassidens.* A skull was found in the fens of Lincolnshire in 1843.

O. Capensis, the Cape Killer, is the *Delphinus globiceps* of Owen. It inhabits the Southern Pacific Ocean.

O. intermedia is a smaller species, described by Dr. Gray in the Zoology of the Erebus and Terror.

Lagenorhynchus leucopleurus, the White-Sided Bottlenose. It is the *Delphinus Tursio* of Knox. It is a native of the North Sea. The skeleton of a specimen taken in the Orkneys is in the museum of the University of Edinburgh.

L. albirostris, White-Beaked Bottlenose. A specimen was taken off the coast of Norfolk in 1846.

L. Electra, the Electra. Described by Dr. Gray in the Zoology of the Erebus and Terror.

L. cæruleo albus. It is an inhabitant of the east coast of South America—Rio de la Plata.

L. Asia. Described by Dr. Gray in the Zoology of the Erebus and Terror. Locality unknown.

L. acutus. It inhabits the North Seas—Faroe Islands.

L. clanculus. Described by Dr. Gray from a skull brought from the Pacific Ocean.

L. Thicolea. Described by Dr. Gray from a skull brought from the west coast of North America.

Delphinapterus Peronii. It is the Right Whale-Porpoise of the whalers. It is black, with the exception of the beak, pectoral fins, and under part of the body, which are white. It is found on the Brazil Bank, off New Guinea, and in the higher southern latitudes. There are two skulls in the museum at Paris. They live in large shoals, and the flesh is esteemed a delicacy.

D. borealis. It inhabits the North Pacific Ocean. It has been described by Peale in the United States Exploring Expedition.

Delphinus. The English name for this genus is Dolphin, but as Dr. J. E. Gray observes:—"Most maritime persons call these animals Bottlenoses, Bottleheads, Flounderheads, Grampuses, Porpoises, Porpesses or Porpusses, sometimes adding Whale to the name. They generally confine the name of Dolphin (most used by landsmen) to the Scomberoid Fish (*Coryphæna*), which changes colour in dying." [CORYPHÆNA.] We subjoin a synopsis of the characters with the localities of the species of this large genus:—

A. Head shortly beaked; nose of skull moderate; triangle or hinder part of beak elongate, produced before the teeth-line; palate flat. Teeth $\frac{24-40}{24-40}$.

† Beak scarcely produced; nose of skull rather depressed, scarcely longer than the brain cavity. Teeth $\frac{24-30}{24-30}$.

1. *Delphinus Heavisidii*, the Hastated Dolphin, inhabits the South Sea—Cape of Good Hope.

2. *D. obscurus*, Dusky Dolphin, inhabits the Southern Ocean—Cape.

3. *D. compressicauda*, the Compressed-Tailed Dolphin, inhabits 4° S. lat., 24° W. long.

†† Beak short; nose of skull rather thick, conical, convex above, half as long as the head.

* Beak of skull rather thick and rather swollen on the sides.

4. *D. Tursio*, Bottlenose Dolphin, inhabits the North Sea.

5. *D. Abusalam* inhabits the Red Sea.
6. *D. Eutropia* inhabits the Pacific Ocean—Chili.
7. *D. Eurynome* inhabits the North Sea.
** Beak of skull rather thick, conical, evenly tapering.
8. *D. Metis*, the Metis. Locality unknown.
9. *D. Cymodoce*, the Cymodoce. Locality not known.
*** Beak of skull slender, cylindrical.
10. *D. Doris*. The Doris. Inhabits —— ?
11. *D. frenatus*, the Bridled Dolphin, inhabits Cape de Verds.

B. Head longly beaked. Nose of skull slender, light, rather depressed, especially in front, much longer than the head. Teeth $\frac{40-60}{40-60}$.

* Skull flattened behind; triangle to the teeth line. Palate flat, not grooved on the side.

12. *D. Clymene*. Locality unknown.
13. *D. Styx*, the Styx, inhabits West Africa.
14. *D. Euphrosyne*, the Euphrosyne, inhabits the North Sea.
15. *D. Alope*, the Alope. Locality unknown.

** Skull roundish; triangle just to the teeth line. Palate with a deep groove on each side, and a high central ridge behind.

† Beak moderate, 1¼ the length of the brain cavity. Teeth $\frac{45}{45}$ or $\frac{50}{50}$.

16. *D. Delphis*, the Dolphin, inhabits the North Sea, Atlantic Ocean. Has been taken on the English coast.
17. *D. Janira*, the Janira, inhabits Newfoundland.
18. *D. Novæ Zealandiæ*, the New Zealand Dolphin, inhabits New Zealand and Cape Gable.
19. *D. Forsteri*, Forster's Dolphin, inhabits the Pacific Ocean between New Caledonia and Norfolk Island.
20. *D. Sao* inhabits Madagascar.

†† Beak of skull twice as long as the brain cavity. Teeth $\frac{55-60}{55-60}$.

21. *D. longirostris*, the Cape Dolphin, inhabits the Southern Ocean.—Cape of Good Hope.

*** Skull round; triangle not reaching to the teeth line. Palate convex, with a very concave line on the hinder part of each side. Beak twice as long as the head. Teeth $\frac{50}{50}$.

22. *D. microps*, the Small-Headed Dolphin, inhabits the coasts of Brazil.

Steno Malayanus. It is the Delphin à Ventre Roux of the Paris Museum, *Delphinus plumbeus* of Cuvier. It is a native of the Indian Ocean.

S. frontatus. It inhabits the Indian Ocean and the Pacific.

S. compressus. Described by Gray in the Zoology of the Erebus and Terror.

S. attenuatus. Found at Cape Horn.

S. fuscus. Described by Gray in the Zoology of the Erebus and Terror. A fœtus was brought from Cuba by Mr. M'Leay.

S. rostratus. It inhabits the North Sea, and has been taken at Holland and at Brest.

Pontoporia Blainvillii. It has been found off Monte Video. A skull is in the museum at Paris. It is described by Freminville as *Delphinus Blainvillii*.

Inia Geoffroyii. A native of Upper Peru or Bolivia—River Moxos. "The specimen," says Gray, "in the Paris Museum, which Desmarest described as *Delphinus Geoffroyii*, is evidently this species."

Platanista Gangetica. It is the Sou Sou of India, the Susu of Buffon, the *Platanista* of Pliny, Dauphine du Gange of Cuvier, *Delphinus Shawensis* of Blainville.

The family MANATIDÆ includes a number of animals, which, although usually referred to *Cetacea*, have relations which have induced some zoologists to propose that they should be placed amongst other orders of *Mammalia*. They differ from the animals we have already considered in being entirely vegetable feeders, and are comprised in the division of Phytophagous Cetaceans of the two Cuviers.

It is not indeed surprising that they should so long have been confounded with the Cetaceans; for their general appearance and horizontal tail, joined to the difficulty of associating them either with the Seals or the Walruses, notwithstanding their aquatic habits, led naturally to their being placed in the same order with the true Zoophagous Whales. But with external form almost all resemblance ceases; and when these Phytophagous Mammals are, as they ought to be, referred to a separate group, there will not be, so far as discovery has hitherto gone, any such animal as a Phytophagous Whale.

"The short and thick neck, fin-like fore legs, want of hind legs, caudal tegumentary fin, smooth, naked, and almost hairless integument, are all modifications of external form by which the Dugongs and Manatees are adapted to play their part in the water: but the kind of part," says Professor Owen, "which they are to play in that element depends on organic characters which mainly, if not exclusively, reveal their true affinities. Now we have seen that the whole of the internal structure in the Herbivorous *Cetacea* differs as widely from that of the Carnivorous *Cetacea* as do their habits: that the amount of variation is as great as well could be in animals of the same class existing in the same great deep. The junction of the Dugongs and Manatees with the true Whales cannot therefore be admitted in a distribution of animals according to their organisation. With much superficial resemblance they have little real or organic resemblance to the Walrus, which exhibits an extreme modification of the amphibious carnivorous type. I conclude therefore that the Dugong and its congeners must either form a group apart, or be joined, as in the classification of M. de Blainville, with the Pachyderms, with which the Herbivorous *Cetacea* have the nearest affinities, and to which they seem to have been more immediately linked by the now lost genus *Dinotherium*."

The following is a synopsis of the genera:—

1. *Manatus*. Tail rounded. Grinders, $\frac{9}{9}$ or $\frac{6}{6}$, tubercular.
2. *Halicore*. Tail forked. Grinders, $\frac{3}{3}$; flat-tipped; upper cutting-teeth produced, tusk-like.

Rytina. Tail forked. Grinders none.

Manatus australis, the Manatee. This is the Lamantin of Buffon; *Trichechus Manatus* of Linnæus; *Manatus Americanus* of Desmarest; Manate del'Orenoque of Humboldt; Lamantin d'Amérique of Cuvier. The terms Manatee and Lamantin are indifferently applied to this and the following species. The present species is of a gray-black colour, and is an inhabitant of the warmer parts of America and its islands.

Cuvier describes the Manatees as having an oblong body terminated by an elongated oval fin; eight molar teeth in each jaw, with a square crown marked by two transverse ridges; neither incisors nor canines in the adult; but in the very young ones two small pointed teeth are found in the intermaxillary bones, which disappear early. The vestiges of nails are observable on the edges of their flippers, which they use dexterously enough in creeping and carrying their young. This has caused these organs to be compared to hands; whence their name Manati, or Manatee.


Teeth of Manatee (*Manatus australis*).

The mammæ of the Manatees and Dugongs are pectoral, and this conformation, joined to the adroit use of their flippers (whose five fingers can be easily distinguished through the investing membranes, four of them being terminated by nails) in progression, nursing their young, &c., have caused them, when seen at a distance with the anterior part of their body out of the water, to be taken for some creature approaching to human shape so nearly (especially as their muzzle is thick set with hairs, giving somewhat of the effect of human hair or a beard), that there can be little doubt that not a few of the tales of Mermen and Mermaids have had their origin with these animals, as well as with Seals and Walruses. Thus the Portuguese and Spaniards give the Manatee a denomination which signifies Woman-Fish; and the Dutch call the Dugong Baardmannetje, or Little Bearded Man. A very little imagination and a memory for only the marvellous portion of the appearance sufficed doubtless to complete the metamorphosis of this half woman or man, half-fish, into a Siren, a Mermaid, or a Merman; and the wild recital of the voyager was treasured up by such writers as Maillet, Lachesnaye-des-Bois, Sachs, Valentyn, and others, who, as Cuvier well observes, have displayed more learning than judgment.

This and the other species of Manatees are called by English sailors the Sea-Cow and the Woman-Fish, and by the French Bœuf Marin and Vache Marine.

The Manatees are gregarious, and generally go in troops. The young are usually placed in the centre of the herd for protection, and on the approach of danger all unite for the common safety. It is alleged that, when one has been struck by a harpoon, its companions will tear out the weapon; and they are so attached to their young that if the calf be taken, the captors are sure of the mother, from the recklessness with which her maternal affection leads her to the place of capture. If the mother be captured, the young follow her to the shore, and fall an easy prey.

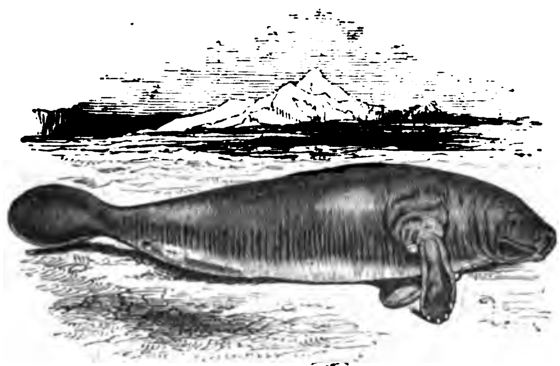
The shallow bays of the Antilles and the quiet creeks of the South American rivers, particularly in Guyana and the Brazils, are the favourite haunts of the Manatee. They were formerly abundant at the mouths of the Orinoco and Amazon, ascending many miles, even into their tributaries and the fresh-water lakes. There, their actions are recorded as being similar in some respects to the whales, such as 'breaching,' or leaping to a considerable height out of the water. The food is entirely vegetable, consisting of subaqueous plants and littoral herbs principally.

The mild innoffensive manners of the Manatee, and the unsuspecting nature of the animal, make it an easy prey to the hunter, who pursues it for the sake of the flesh, which all pronounce to be excellent, both fresh and salted. Hernandez compares it to well fatted pork of pleasant flavour. Others compare it, when roasted, to beef or veal in flavour, and state that when salted it makes excellent sea provision.

It is alleged that formerly they were so plentiful within ten or twelve leagues of Cayenne, that a large boat might be filled with them in a single day, when their flesh was sold in the market at about 3*d.* per lb. But the eagerness with which it was purchased soon reduced the numbers, and made them comparatively scarce.

The capture is generally effected by means of the harpoon. At St. Domingo the hunters approached them in a small boat, and struck them with a large harpoon to which a long stout cord was made fast. The stricken animal made violent efforts to escape, carrying with it the harpoon and cord, to the end of which a cork or piece of light wood to serve as a buoy was attached, and indicated the whereabouts of the Manatee. After a while the hunters took hold of the rope and at last drew the exhausted animal on shore, where it was killed. The sport of Manatee-catching, thus conducted, is described as highly exciting, but the boat is sometimes upset by the struggles of the animal in the shoals.

Manatees have reached Europe. The carcass of one which had been long dead, is recorded to have come on shore at Newhaven in the Frith of Forth, in the autumn of 1785; and Duhamel states that one with its cub was thrown on shore near Dieppe.



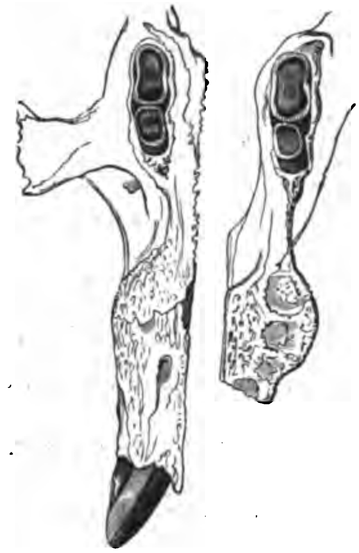
The Manatee (*Manatus australis*).

M. Senegalensis, the Lamantin. This species is a native of the west coast of Africa. It is the *Manatus Senegalensis* of Desmarest; Lamantin of Adanson; Lamantin du Senegal of Daubenton; the Woman-Fish of Purchas; the Round-Tailed Manati of Pennant.

Halicore Dugong, Indian Dugong. It is the *Trichechus Dugong* of Gmelin; *Dugungus Indicus* of Hamilton; Le Dugong des Indes of French writers.

The head of this Dugong is small in proportion to the body, which in general form much resembles that of the Manatee. The large upper lip is thick and obliquely truncated, and the truncated surface, which forms the short and nearly vertical snout, is furnished with soft papillæ and a few bristles. A horny substance covers the lips, the upper of which is very moveable and tumid on the edge; the lower is much smaller, resembling a round or oblong chin. The inside of the cheeks is furnished with strong projecting bristles. The nostrils are situated on the summit of the upper jaw, where it curves downwards, and penetrate obliquely, so that the upper semilunar edge presses upon the lower surface to form a valve capable of being shut at the will of the animal. The eyes are small. The little aperture of the ear is hardly perceptible. The mammæ are placed on the chest, beneath the thick and fleshy flippers or paws, which are rather warty on their anterior edge; but there is no appearance of nails. The tail is broad, and lobated or crescent-shaped. The skin is three-quarters of an inch thick, of a uniform bluish colour, sometimes blotched with white below. Length from 7 to 8 feet.

The attention of Professor Owen was particularly directed to the state of the dentition of the Dugongs of different sexes which he examined, from which it appeared that, as in the Narwhal, the permanent tusks of the female are arrested in their growth, and remain throughout life concealed within the substance of the intermaxillary bones and the alveolar integument. The cavity of the tusks, he states, is in like manner filled up by the secretion of the pulp which retrogrades in the course of its absorption, and hence the tusks are solid, like the corresponding tusks in the female Narwhal, or at least present only a shallow cavity at their expanded and distorted base. He found in one cranium of a male Dugong, in the upper jaw, the deciduous incisors or tusks co-existing with the permanent ones. In the skull of a male which had $\frac{3-3}{2-3}$ molars, the sockets of the deciduous incisors were obliterated, and the points of the permanent ones projected from their sockets. Not more than 20 grinders, 5 on each side of the jaw, appear to be developed in this animal.



Teeth of Dugong (*Halicore Dugong*). F. Cuvier.

"It is obvious," says Professor Owen, "that the different form and condition of the tusks thus observed in the heads of Dugongs of the same size and age, might be regarded as indicating a specific instead of a sexual difference. Dr. Knox inclines to the former opinion; I have however adopted the latter view, not hastily or hypothetically, but as a result of the minute comparison of the forms and proportions of all the crania which have come under my observation."

H. Dugong is an inhabitant of the Indian Ocean.

"The external form of the Dugong," says Professor Owen, "is not so well calculated for moving rapidly through the water as that of the Dolphin and other Carnivorous *Cetacea*, which subsist by a perpetual pursuit of living animals. In these the snout is conical and peculiarly elongated, and in some, as the *Delphinus Gangeticus*, the jaws are produced to an extreme length, so as to give them every advantage in seizing their swift and slippery prey; whilst in the herbiferous Dugong the snout is as remarkable for its obtuse truncate character—a form however which is equally advantageous to it, and well adapted to its habits of browsing upon the *Algæ* and *Fuci* which grow upon the submarine rocks of the Indian seas. As, from the fixed nature of the Dugong's food, the motions of the animal during the time of feeding must relate more immediately to the necessity of coming to the surface to respire, its tail, the principal locomotive organ of ascent and descent, is proportionally greater than in the true *Cetacea*, its breadth being rather more than one-third the length of the whole body. But the most important external differences are seen in the presence of the membrana nictitans, in the anterior position of the nostrils, and in the situation of the mammæ, which are pectoral, or rather axillary, being situated just behind the roots of the flippers: in the female specimen examined, their base was about the size of a shilling, and they projected about half an inch from the surface. A considerable ridge extends along the middle of the upper surface of the posterior part of the back, which is continued upon and terminates in the tail."

The haunts of the Dugong, which does not appear ever to frequent the land or fresh-water, are generally in the sea-shallows, where the water is not more than two or three fathoms.

Sir Stamford Raffles states that during six months four of these animals were secured at Singapore, but that the greatest number is said to be taken during the northern monsoon, when the sea is most calm, near the mouth of the Johore River. They are usually caught by spearing, in which feat the natives are very expert, during the night, when the animals indicate their approach by a snuffing noise which they make at the surface of the water. The first object of the captor is to secure and elevate the tail, when the animal becomes perfectly powerless. Sir Stamford adds, that the Dugongs are seldom caught at Singapore above 8 or 9 feet in length; but how much larger they grow is not ascertained, as when they exceed that size, their superior strength enables them to make their escape.

Leguat, who speaks of them as occurring at the Isle of France in great numbers about 120 years ago, says that they were 20 feet long, but were very easily taken. They fed in flocks like sheep in three or four fathoms' water, and made no attempt at escape when approached. Sometimes they were shot at the end of the musket, sometimes laid hold of and forced on shore. Three or four hundred were met with together, and they were so far from shy that they suffered themselves to be handled, and the fattest were thus selected. The larger ones were avoided, not only on account of the trouble they gave in the capture, but because their flesh was not so good as that of the smaller and younger ones.

The female Dugong produces generally only one young at a birth, and to this the mother bears such strong affection that, if the young is speared, the mother will not depart, but is sure to be taken also. The Malays consider this animal as almost typical of maternal affection. The young utter a short and sharp cry, and are said to shed tears, which are carefully preserved by the common people as a charm, under the notion that they will secure the affections of those whom they love, as they attract the mother to the young Dugong.

The flesh of the Dugong is delicate, and is said to be superior to that of the Buffalo or common Ox. It is considered by the Malays as a royal fish, and the king has a right to all that are taken. Sir Stamford Raffles states that this species afforded much satisfaction on the table, as the flesh proved to be most excellent beef.

H. Tabernaculi, the Dugong of the Red Sea, is considered by Rüppell a distinct species. He gave it its specific name under the impression that it was with the skin of this species that the Jews were directed to veil the Tabernacle. He saw it swimming among the coral banks on the Abyssinian coast near the Dalac Islands. The fishermen harpooned a female, which he dissected, 10 feet long. The Arabs stated that they live in pairs or small families, that they have feeble voices, feed on *Algæ*, and that in February and March bloody battles occur between the males, which attain the length of 18 feet. The female brings forth in November and December. The flesh, teeth, and skin are esteemed by the Arabs.

Dugong (*Halicore Dugong*).

H. australis. It is a native of the north-west coast of Australia. It is the Manate of Dampier and the Whale-Tailed Manate of Pennant. Two upper jaws and three skulls of this species are in the British Museum.

Rytina gigas, the Morskaia Korova. It is the Manate, or *Vacca marina*, *Trichechus Manatus* of Müller; *Rytina Stelleri* of Illiger; *Stellerus borealis* of Desmarest; the Whale-Tailed Manate of Pennant. It is a native of the Arctic Ocean—Behring's Straits. The Sea-Ape of Pennant, *Trichechus Hydropithecus* of Shaw, *Manatus Simia* of Illiger, Dr. Gray suggests may belong to this family, if it is not a Seal.

Fossil Cetacea.

The fossil remains of *Cetacea* have hitherto been found in the Tertiary Formations only. Bones from the Portland Stone which were at first thought to belong to whales proved to belong to the genus *Cetiosaurus* (Owen), the most gigantic of all the fossil reptiles. (Owen, 'Report on British Fossil Reptiles' in 'Trans. Brit. Ass.' 1841.) Dr. Buckland, in his 'Bridgewater Treatise,' remarks that the seas of the Miocene and Pliocene periods were inhabited by marine *Mammalia*, consisting of Whales, Dolphins, Seals, Walrus, and the Lamantin or Manatee, whose existing species are chiefly found near the coasts and mouths of rivers in the torrid zone.

Manatidæ. Cuvier figures and describes the remains of a Manatee differing from the existing species. Specimens were collected from various parts of France, and he states it to be very certain that an animal of the genus *Manatus*, a genus now peculiar to the torrid-zone, inhabited the ancient sea which has covered Europe with its shells, at an epoch posterior to the formation of the chalk, but anterior to that when the gypsum was deposited and the *Palæotherium* with its contemporary genera lived on the soil of France. ('Oss. Foss.')

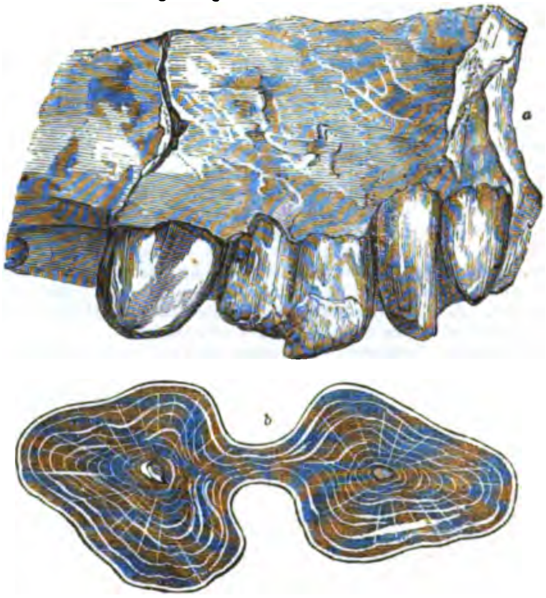
Delphinidæ. Cuvier notices and figures, with an accurate description, the remains of a fossil Dolphin, approaching the Grampus and *Delphinus globiceps*, from Lombardy, the skeleton of which was found nearly entire by M. Cortesi; and another with a very long symphysis of the lower jaw from the department of Landes. Also a fossil Dolphin closely approximating the common Dolphin from the same locality, and another from the Calcaire Grossier of the department of Orne. ('Oss. Foss.')

M. von Meyer refers to these and another (Grateloup, 'Ann. Géner. d. Sc. Phys.' iii., s. 58, t. 36; Taylor, 'Magazine of Nat. Hist.' March, 1830, s. 262), giving the following names:—*Delphinus Cortesii*, *D. macrogenius*, *D. longirostris*. ('Palæologica.')

Monodon. Cuvier collects notices of fossil fragments of the Narwhal from Parkinson and Georgi. He adds that he himself saw a broken piece of a tusk in the Cabinet of Natural History of Lyons which had formerly been in that of Pestalozzi. ('Oss. Foss.') Remains of the *M. monoceros* have been found in the neighbourhood of London and in other parts of England. (Owen, 'Brit. Foss. Mam.')

Ziphius. Cuvier founded this genus, which approximates the Cachalots and Hyperoodons, on crania discovered on the coast of Provence, and disinterred in excavating the docks at Antwerp, and on a fragment in the Paris Museum. On these materials he rests three species, namely—*Ziphius cavirostris*, *Z. planirostris*, and *Z. longirostris*, the remains of which he figures and describes. ('Oss. Foss.')

Zeuglodon. This name was given by Professor Owen to the *Basilosaurus* of Dr. Harlan. It was at first regarded as a reptile by its discoverer, but Professor Owen found that the microscopic characters of the texture of the teeth were strictly of a mammiferous character, and the nature of their investing substance limited the comparison of them with those of the few mammals in which the teeth are devoid of enamel. Among these are the *Edentata*, including the *Megatherium* and its congeners, the Morse, the Dugong, and the Cachalot. It is to the teeth of the Cachalot and Dugong that those of the so-called Basilosaur offer the nearest resemblance; and Professor Owen conceives that its position in the natural system was in the cetaceous order, intermediate between the Cachalot and the herbivorous species. In a paper read before the Geological Society of London, Professor Owen says, "The teeth, in their combination of an exaggerated condition of the conjugate form—which is but indicated in certain teeth of the Dugong, with two distinct fangs, in their oblique position in the jaw, and the irregular interspaces of their alveoli,—present very striking peculiarities; and when to these dental characters we add the remarkable and abrupt contraction of the distal end of the humerus, which is nevertheless provided with an articulating surface for a ginglymoid joint, and its remarkably diminutive size—a cetaceous character, which likewise is here carried to an extreme,—and when we also consider the dense laminated structure of the ribs, and the third exaggeration of a cetaceous structure in the extreme elongation of the body of the caudal vertebræ,—we cannot hesitate in pronouncing the colossal *Zeuglodon* to have been one of the most extraordinary of the *Mammalia* which the revolutions of the globe have blotted out of the number of existing beings."



Teeth of *Zeuglodon*.

a, Portion of upper jaw, containing three teeth, very much reduced; *b*, section of tooth.

In the 'American Journal of Science' for April, 1843, is a 'Notice of the Discovery of a nearly complete Skeleton of the *Zygodon* (*Zeuglodon*) of Owen (*Basilosaurus* of Harlan) in Alabama,' by S. B. Buckley, A.M.

The entire length of the skeleton, including the head, is described as nearly 70 feet, and was imbedded "in a marly limestone soil" on the plantation of Judge Creagh, the same gentleman who had forwarded the bones to Dr. Harlan. This discovery entirely corroborates the conclusions to which Professor Owen came in the memoir above quoted. Bones of this gigantic fossil Cetacean have been also found near the Washita River in Louisiana, and have been seen in Washington County, Mississippi: from thence, Mr. Buckley adds, they have been found in several places as far east as Claiborne, on the Alabama River. The skeleton is now at New York.

Balænidæ.—Balænoptera. Cuvier figures and describes the skeleton of a fossil whale, which he considers to have been a sub-genus of

Balænoptera, or Rorqual, found in Lombardy by M. Cortesi, on the east flank of Monte Pulgnasco (Apennines) in 1806. Cuvier calculates the entire length at 21 feet, French; observing, that if the animal was adult it was a very small Rorqual. Another skeleton of the same species, not more than 12 feet 5 inches long, was also discovered by M. Cortesi in similar beds, and a neighbouring valley near a small stream which falls into the Chiavenna, one of the tributaries of the Po. ('Oss. Foss.')

Balæna. Numerous remains of *Balænæ* have been found in the Tertiary Formations. Cuvier mentions a considerable fragment of the skull of a *Balæna* disinterred in the Rue Dauphine at Paris in 1779. Daubenton came to the conclusion that the whale to which it belonged must have been 100 feet long; but Cuvier, on satisfactory calculations, reduces the length to 60 feet, and states his opinion that it is an unknown species. ('Oss. Foss.') Dr. Mantell detected the remains of *Balæna* in Sussex (Brighton Cliffs). In the Red Crag of Felixstow the tympanic bones of whales are frequent, whilst their bones are so numerous as to constitute a considerable portion of the phosphatic substances which are now dug from this formation under the name of Coprolite. From the form of the tympanic bones, which he calls Cetotolites, Professor Owen has named four species of *Balæna*: *B. affinis*, *B. definita*, *B. gibbosa*, and *B. emarginata*. (Owen, 'Brit. Foss. Mam.')

Phocæna. Professor Owen refers the fossil found in the Lincolnshire fens to this genus, which Dr. Gray places under the genus *Orca*.

Physeteridæ. Teeth of the *Physeter macrocephalus* have been found in the Tertiary Beds of Essex and in other parts of Great Britain. From the section of a tooth found in the Red Crag at Felixstow, Suffolk, Professor Owen proposes to call the animal to which it belonged *Balænodon physaloides*.

(Cuvier, *Ossemens Fossiles*; F. Cuvier, *Histoire Naturelle des Cetacés*; Owen, *Descriptive and Illustrated Catalogue of the Physiological Series in the Museum of the College of Surgeons*; Scoresby, *An Account of the Arctic Regions*; Beale, *Natural History of the Sperm Whale*; Owen, *British Fossil Mammals and Birds*; Dr. J. E. Gray, *Catalogue of the Specimens of Mammalia in the British Museum*, Part I., '*Cetacea*;' *Cyclopedia of Anatomy and Physiology*, article '*Cetacea*.') [See SUPP.]

CETE. [CETACEA.]

CETIOSA'URUS, a genus of large Fossil Saurians adopted by Professor Owen. It occurs in the Oolitic Formations.

CE'TOCIS, De Montfort's generic name for those Belemnites which are plicated at the summits.

CETONI'ADÆ (M'Leay), a family of Coleopterous Insects of the section *Melitophili* (Latreille). The species belonging to this family have the sternum more or less prolonged into an obtuse point, between the second pair of legs; the mentum is emarginated, and never transverse; the terminal lobe of the maxillæ is furnished with a tuft of fine hairs; the labrum is concealed; the antennæ are small and ten-jointed; the basal joints are short; the three terminal joints are comparatively large, placed close together, and form a triphyllous knob. The thorax is generally somewhat triangular, with the anterior part (which would form the apex of the triangle) truncated. The elytra are usually rather straight at the sides, and obtusely rounded at the apex, thus presenting a somewhat square form; their disc is rather flat. A triangular scale is interposed between the base of the thorax and that of the elytra at their outer angles.

The *Cetoniadæ* form one of the most extensive groups of the Beetle Tribe, and nothing can exceed the brilliant colours with which many of them are adorned—in this respect vyeing with, if not surpassing, the *Buprestidæ*.

In the larva and imago states these insects feed upon vegetable substances: the grub or larva of the common Rose-Beetle very much resembles that of the cockchafer; and when about to assume the pupa state incloses itself in a cocoon formed of particles of earth and rotten wood, or any surrounding substances, fastened together by means of a glutinous secretion.

In viewing a large collection of insects of this family it is difficult to say what colours prevail most. In *Cetonia*, the typical genus of the group (in which the scutellum is of moderate size) the colours are generally burnished, and consist for the most part of various shades of green. *Cetonia aurata*, the common Rose-Beetle, affords a good example of this genus. It is about three-quarters of an inch in length, and of a bright green and sometimes copper-like colour, with two white irregular fasciæ towards the latter part of the elytra, and extending from the side inwards: these fasciæ (and several little spots of the same colour which are observable on the elytra) are composed of a number of small scales, which in old specimens are often nearly all rubbed off. This species is too well known to require further description. It is seen very commonly in the south of England, flying about in the sunshine during the months of May and June, frequently settling on roses, the leaves of which it greedily devours; it is also very fond of elder and lilac flowers. If perchance the bark of a tree be wounded so that the sap oozes out, this insect will frequently be observed licking it up, and collecting it by means of the tufts of hair with which the maxillæ are terminated.

Rösel informs us, that he kept one of these insects alive for upwards of three years, during which time he fed it upon fruit and moist white bread.

Cetonia stictica, a small species, about half an inch in length, and of a black colour, with numerous white spots on the thorax and elytra, is said to have been taken in this country. Its occurrence is however so rare, that it is doubted by some if it be truly indigenous. It is common in France and Germany, and is found on thistles.

C. fastuosa, a species which somewhat resembles *Cetonia aurata*, but is of a larger size and without any spots, occurs in the south of France.

CETRARIA, a genus of plants belonging to the family of Lichens. The species have the following characters:—Thallus foliaceous, lobed, and laciniated; on each side smooth and naked; the shields are orbicular, obliquely adnate with the margin of the thallus, the lower portion being free; the disc coloured, plano-concave, with a border formed of the thallus, and inflexed.

C. Islandica, Iceland Moss. It is the *Lichen Islandicus* of older botanists. It has an erect, tufted, olive-brown thallus, paler on one side, laciniated, channeled, and dentato-ciliated; the fertile lacinia very broad. Shields brown, flat, with an elevated border. It grows on the ground in exposed situations in northern countries. The aqueous decoction when cold forms a thick jelly. It has a bitter flavour. It has been employed medicinally. [ICELAND MOSS, in ARTS AND SC. DIV.]

C. nivalis is an allied species growing on mountains in northern countries. It has similar properties to the last.

CEUTORHY'NCHUS, a genus of Coleopterous Insects, of the family *Curculionidæ* (Leach). The species have the antennæ eleven-jointed, seven of which compose the funiculus; the basal joint is as long as the remainder taken together; the club is ovate. Rostrum sometimes long, bent, and filiform, and at others short and straight. Thorax with the fore part much attenuated, with a channel beneath, in which the snout may be deposited. Scutellum minute and hardly apparent; the elytra are rounded at the extremity, and do not entirely cover the abdomen; the extremity of the tibiæ is without spina.

The little insects of which this genus is composed are very numerous, and frequent plants of various sorts; some scarcely exceed a mustard-seed in size. *C. didymus* is abundant on the common stinging nettle, and is about the size of a hemp-seed. It is white beneath, and of a dull brownish black above; the sides of the thorax are white, and the elytra are furnished with two spots of the same colour; the apex of the elytra is also more or less white. When touched, or often when even approached, these little beetles close their snout in a groove on the under part of the body, contract the legs, and allow themselves to roll off the leaves to the ground, where they are with difficulty distinguished from the mould.

CEVADILLA. [CEBADILLA.]

CEYX. [HALCYONIDÆ.]

CHABAZITE, a mineral belonging to the large class of *Aluminates*. It always occurs in the form of attached crystals; never massive or fibrous. The primary form of the crystal is a rhomboid. The colour is white, also yellowish and red. The lustre is vitreous, and it is transparent to translucent. The hardness is 4 to 4·5. The specific gravity is 2·06 to 2·17. It has the following composition:—

Silica	48·4
Alumina	19·3
Lime	8·7
Potash	2·5
Water	21·1
	100·0

This species includes *Gmelinite*, which occurs in small glassy crystals; also *Levyne*, which is found in compound crystals; and *Ledererite*, which has the form of Gmelinite, but differs in containing just one-third the quantity of water. *Phacolite* is another variety. It occurs in the form of small glassy crystals, which are double six-sided pyramids. *Acadiolite* appears to be another variety. It has a red colour, and comes from Nova Scotia. *Herschelite* is another variety. It occurs in small hexagonal tables.

Chabasite is mostly easily distinguished by the nearly cubical form presented by its crystals. From *Analcime* it is distinguished by the intumescence produced by it under the blow-pipe. It is distinguished from *Calc-Spar* by its hardness and its action with acids; from *Fluor-Spar* by its form and cleavage, and by the absence of phosphorescence.

It is found in Trap, Gneiss, and Syenite. In the New World it is found in the Trap of Connecticut, in New Jersey, and New York. *Ledererite* is found in Nova Scotia. *Chabasite* is found in the Faroe Islands, at the Giant's Causeway, Ireland, also in Iceland. *Gmelinite* is found in Antrim, Ireland. *Levyne*, at Glenarm in Ireland; also in Scotland, Iceland, and the Faroe Islands.

CHACMA. [BABOON.]

CHÆRADODIA, a genus of plants belonging to the natural order *Amaryllidaceæ*. One species of this genus, *C. Chilensis*, is called Thekel in Chili. A cold infusion of the leaves is used as a purgative and diuretic medicine by the natives.

CHÆROPHYLLUM, a genus of plants belonging to the natural order *Umbelliferæ*, to the sub-order *Campylospermæ*, and the tribe *Scandicineæ*. It has an obsolete calyx; obcordate petals with an inflexed point; a fruit not beaked; carpels with five equal obtuse ridges; interstices with single vittæ. The species are annual, biennial, or perennial plants with decompound leaves. Many plants formerly placed in this genus are now referred to *Anthriscus*. [ANTHRISCUS.] The *Chærophyllum sylvestre* of Linnæus is now *Anthriscus sylvestris*. It has been used in medicine as a substitute for hemlock. The *Chærophyllum sativum* of Lamarck is the *Anthriscus cerefolium* of Hoffman. It is the garden Chervil of Great Britain, and is used in some places as a pot-herb. Three species of *Chærophyllum* are described by Babington in his 'Manual of British Botany:' *C. temulum* has a rough stem swelling beneath the joints; the leaves bipinnate; the leaflets ovate, oblong, pinnatifid, with obtuse mucronate segments; glabrous petals; styles equalling the stylopode. It is a common plant on hedge-banks in Great Britain, attaining a height of three or four feet. *C. aureum* and *C. aromaticum* have been described as natives of Scotland, but it is very doubtful as to whether they have not both been introduced. (Babington, *Manual of British Botany;* Lindley, *Flora Medica*.)

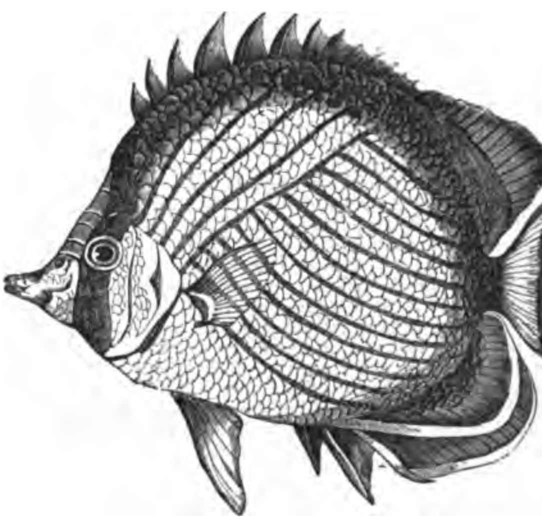
CHÆ'TODON (χαίτη, hair, and ὀδούς, a tooth), a genus of Fishes of the section *Acanthopterygii* and family *Squammipennes*. It has the following characters:—Body compressed; mouth small, furnished with several closely-set rows of long slender bristle-like teeth. The scales (which are usually confined to the body) in this genus extend on to the dorsal and anal fins, so that it is difficult to see where the latter commence.

These fishes abound in the seas of hot climates, frequent rocky shores, and are adorned with beautiful colours. Their most common tints appear to be black and yellow, but brilliant metallic blues and greens of various hues are not unfrequent. Many of the species have a vertical black band in which the eye is placed. In some there are several similar vertical bands on the body; in others the body is spotted or adorned with oblique or longitudinal bands. They have a large air-bladder; their intestines are long and ample; and their cæca are numerous, long, and slender. Their flesh is good eating.

The species are numerous, and have been divided into several subgenera; those to which the name *Chætodon* is now restricted have the body more or less elliptical, the rays of the dorsal fin forming a tolerably uniform curve, the snout more or less produced, and the pre-operculum sometimes furnished with a small tooth.

In some of this section one or more of the soft rays of the dorsal fin are much produced, and form a long filament; and others are distinguished by their having very few spines to the same fin.

Chætodon vagabundus, a species which inhabits the coasts of Ceylon, has the body of a pale yellow colour, with numerous oblique brownish-purple lines; the dorsal fin is blackish, and has 13 spinous rays; the caudal fin, or tail, is yellow, with two black bands; the anal fin is blackish with a yellow curved longitudinal band; its margin is also yellow; a broad black vertical band extends through the eye; and the part anterior to this band, as low down as the eye, is of a pinkish hue with yellow streaks. Its length is from 6 to 12 inches; the scales on the body are large; those on the head are rather small.



Chætodon vagabundus.

The next sub-genus, *Chelmon* (Les Chelmons, Cuv.), is distinguished by the form of the snout, which is much elongated, open at the end only, and formed by a great elongation of the intermaxillary and under-jaw bones.

C. rostratus, a species which inhabits the fresh waters of India, is of a silvery hue and has five brownish bands; the posterior part of the dorsal fin is furnished with a black spot encircled with white.

This fish feeds upon insects, and is remarkable for its mode of procuring them. When it observes a fly or any other insect on a weed or hovering over the water, it ejects a little drop through its tubular snout with such precision as frequently to disable the little animal, so that it falls into the water and is devoured.

In those parts where *C. rostratus* abounds it is frequently kept in vessels of water, and affords much entertainment by the dexterity displayed in shooting at flies which are placed on the vessel for the purpose: it generally approaches to within five or six inches before the drop of water is ejected.

The sub-genus *Heniochus* differs from the true Chætodons in having the anterior spines of the back produced into a long filament, which is sometimes double the length of the body.

Ephippus may be distinguished by the species having the dorsal fin deeply cleft between the spinous and soft portions. The spiny portion, which is scaleless when not erected, is received into a groove formed by the scales of the back.

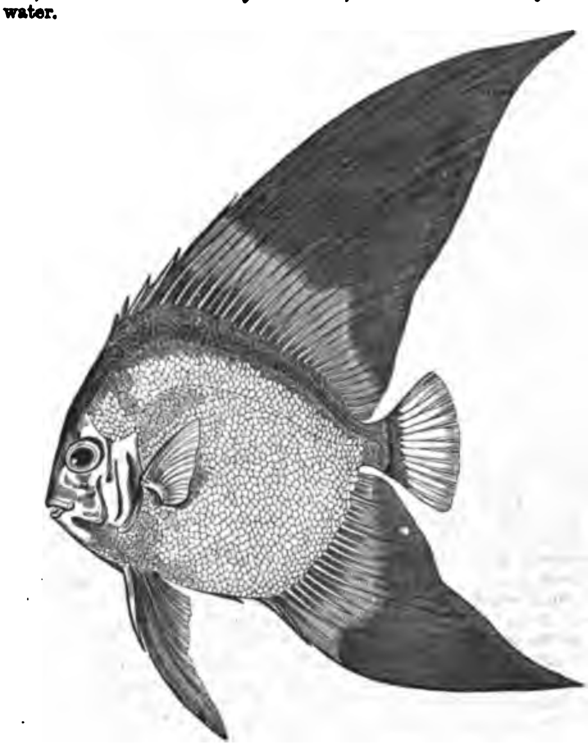
Holocanthus. The species of this sub-genus have a large spine on the angle of the pre-operculum, and most of them have the edge of the same bone serrated: they are found both in the Atlantic and Pacific oceans.

The next subdivision, *Pomacanthus*, has the body of a more elevated form, owing to the sudden rising of the anterior margin of the dorsal fin. The only species known are from the American coasts.

In the last subdivision, *Platax*, the species may be known by the extremely compressed form of the body, the large vertical dorsal fin (which has the anterior spines almost concealed in the membrane), the long ventral fins, and the teeth. Here, in addition to the fine thickly-set teeth, there are some in front which are trenchant, and each of them is divided into three points.

All the species of this section are found in the Indian Ocean. One has been found in a fossil state at Mount Bolca.

Platax vespertilio will afford an example of this section. It is found off the coast of Ceylon, and is of a yellowish colour; the dorsal, anal, and ventral fins are brownish, the back is also mottled with the same colour, and a dark band extends downwards through the eye; the base of the caudal fin is dark brown. This species grows to a large size, and is found in rocky situations, but more commonly in deep water.



Platax vespertilio.

The two species of Chætodons, of which figures are here given, have been selected from Mr. J. W. Bennett's 'Fishes of Ceylon,' a work illustrated by beautiful coloured plates.

(Cuvier, *Règne Animal;* Lacépède, *Histoire Naturelle, &c., des Poissons;* Bloch, *Histoire Naturelle, générale et particulière, des Poissons.*)

CHAFFINCH, the English name for a well-known species of *Fringilla*: Σπίζα of Aristotle and the Greeks; *Fringilla* and *Frigilla* of Gesner and others; Franguello, Frangueglio, Fringuello, and Spincione, of the Italians; Pinson, Pinçon, Grinson, and Quinson, of the French; Fink, or Buch-Fink (Beech-Finch), Edel-Fink, Gemeine-Fink, Schild-Vink, of the Germans, &c.; Fincke and Bofincke of the 'Fauna Suecica;' Asgell-Arian, Winc, of the ancient British; *Fringilla cœlebs* of Linnæus. It has also the following local names in English:—

Spink, Beech-Finch, Pink, Twink, Skelly, Shell-Apple, Horse-Finch, Scobby, Shilfa, Chaffy, Boldie.

As far back as the time of Belon the powerful voice of this bird was remarked:—"On les garde en cage pour les faire chanter, dont le chant est si puissant qu'il en est fascheux" (folio, 1555); and in the small quarto (1557) the following quatrain is printed under the figure of the bird:—

Pour bien pinser lon me nom Pinson,
Qui ay la voix fort haultaine et puissante;
Je hay le chauld, froidure m'est plaisante;
En ce contraire est à tous ma façon.

"The passion for this bird," says Bechstein, in his 'Cage Birds,' "is carried to such an extent in Thuringia, and those which sing well are sought for with so much activity, that scarcely a single chaffinch that warbles tolerably can be found throughout the province. As soon as one arrives from a neighbouring country whose notes appear good, all the bird-catchers are after it, and do not give up the pursuit till they have taken it. This is the reason why the chaffinches in this province are so indifferent songsters; the young ones have only bad masters in the old ones, and they in their turn cannot prove better."

In England however it appears to have been appreciated. The Hon. Daines Barrington, in his paper 'On the Small Birds of Flight' (the bird-catcher's expression), observes that the greatest sum he ever heard given for a song-bird which had not learned to whistle tunes, was five guineas for a Chaffinch that had a particular and uncommon note, under which it was intended to train others. Bechstein says the Thuringians have been known to give a cow for a Chaffinch with a fine voice.

Bechstein, after describing the different notes that express its passions and wants, among which the often-repeated cry, 'fink, fink' (our 'twink'), from which its German name is derived, he considers to be mechanical and involuntary, thus speaks of its powers:—"But what makes it appear to still more advantage among other birds are its clear and trilling tones that seem almost to approach to words; in fact, its warbling is less a song than a kind of battement, to make use of a French word, and is expressed in German by the word schlag (trill), which is used to designate its song as well as the nightingale's. Some chaffinches have two, three, four, even five different battemens, each consisting of several strains, and lasting several minutes. This bird is so great a favourite in Germany that not a single tone of its voice has escaped the experienced ears of our bird-fanciers. They have observed its nicest shades, and are continually endeavouring to improve and perfect it. I confess I am myself one of its warmest admirers; I have constantly around me the best songsters of its species, and if I liked could write a good sized volume on all the details of its music."

The following chaffinch songs, or melodies, are most esteemed in Saxony and Hesse. Some are heard in the woods, but they are rarely sung with a clear and strong voice. If the bird executes well, and adds to the last strain the sound 'fink,' which the German bird-catchers translate by 'amen,' it is of the highest value. "No price," says Bechstein, "will be taken for it:"—

1. The 'Double Trill of the Harz,' in Lower Saxony. 2. The 'Reiter Zong,' or 'Rider's Pull,' first heard among the mineral mountains of Saxony and Voigtland. 3. The 'Wine Song,' with the following subdivisions, namely:—The 'Fine,' or 'Längsfeld Wine Song;' the 'Bad Wine Song' and the 'Sharp Wine Song,' which is subdivided into the 'Common Sharp' and the 'Ruhl Sharp.' 4. The 'Bräutigam,' or 'Bridegroom Song,' also divided into good and bad. 5. The 'Double Trill.' One of these, the 'Double Trill of Iamblach,' is only to be acquired in the house, and is so deep and powerful that it can scarcely be conceived how the larynx of so small a bird can produce such sounds. Bechstein, who makes this observation, adds that a Chaffinch which sings this either alone or with the 'Good Bridegroom's Song' (such as are educated at Iamblach), sells at Waltershausen for eighteen French francs. 6. The 'Gutjar,' or 'Good Year Song,' with two subdivisions. Chaffinches singing this, united to the 'Wine Song' of Ruhl, or the 'Sharp Song,' had become very rare when Bechstein wrote, and fetched high prices. 7. The 'Quakia Song,' formerly much admired. Bechstein says, "I believe I possess the only bird that is now to be found which sings this. To be admired the 'Quakia' must be united with the 'Double Trill.' This my chaffinch sings also." 8. The 'Pithia,' or 'Trewethia,' a very uncommon and agreeable song, never heard but in the depths of the Thuringian mountains.

For the different modes of capturing this pretty bird, so precious when in pefect song to the bird-fancier, its treatment in confinement, the diseases to which it is subject, and their remedies, we must refer the reader to Bechstein's 'Cage and Chamber Birds,' of which there is an English edition published by Bohn (1853).

The following description—and the bird is so common that a more particular one is unnecessary—is from the interesting 'Journal of a Naturalist':—"The male bird is remarkable for the cleanliness and trimness of his plumage, which, without having any great variety or splendour of colouring, is so composed and arranged, and the white on his wings so brilliant, as to render him a very beautiful little creature. The female is as remarkable for the quiet unobtrusive tintings of her dress; and when she lies crouching on her nest, elegantly formed of lichens from the bark of the apple-tree, and faded mosses, she would hardly be perceptible but for her little bright eyes that peep with suspicious vigilance from her covert." Temminck says, that in autumn after the moult, the colours of the plumage of the male are more bright than they are in the spring, because all the feathers of the upper and lower parts are terminated by a clear ash-colour; and, at the season of love, the male bird's dress becomes decked with pure and brilliant colour, without the aid of a second moult, the edges of the barbs being worn away with use, and thus suffering those colours which had been hidden to appear in all their beauty.

Many varieties occur, as pure white, yellowish white, some parts of the body white. The usual colours with a white collar; wings and tail white. Aldrovandus mentions one partly yellowish and partly blackish.

This bird inhabits almost all the countries of Europe; it is permanent in the southern parts, and a regular bird of passage in the greatest number of localities. The Prince of Canino says that it is very common near Rome, and makes its passage in October, when numbers of them are taken for the table among other small birds at Paretajo and Roccolo, but in much the larger proportion, 500 chaffinches being, according to the Prince, captured to every 80 linnets, 65 goldfinches, 30 green grosbeaks or greenfinches, &c., &c. It has been stated and denied, that only the females of this bird are migratory in Europe. On this point Selby observes, "In Northumberland and Scotland this separation takes place about the month of November, and from that period till the return of spring, few females are to be seen, and those few always in distinct societies. The males remain, and are met with, during the winter, in immense flocks, feeding with other granivorous birds in the stubble lands as long as the weather continues mild and the ground free from snow; and resorting, upon the approach of storm, to farm-yards and other places of refuge and supply. This separation of the sexes I am induced to believe takes place in many other species, with respect to their migratory movements, as I have before remarked in the account of the snow-bunting. This appears also to be the case with the woodcock, having observed that the first flight of these birds (which seldom remain longer than a few days to recruit, and then pass southward) consists chiefly of females; whilst, on the contrary, the subsequent and latest flight (which continue with us) are principally composed of males. It has been noticed by several authors that the arrival of the males, in a number of our summer visitants, precedes that of the females by many days; a fact from which we might infer that in such species a similar separation exists between the sexes during their equatorial migration." Knapp ('Journal of a Naturalist') says, "With us (Gloucestershire) the sexes do not separate at any period of the year, the flocks frequenting our barn-doors and homesteads in winter being composed of both. In the northern parts of Europe however the females are said to migrate to milder regions, which induced Linnæus to bestow the name of *Cœlebs* upon this species." White observes upon the vast flocks which he saw near Selborne towards Christmas, all of which were hens. Jenyns says that it collects in flocks at the approach of winter, but makes no mention of the separation of the sexes. In Middlesex we have seen in winter flocks composed mostly of females, but we have also seen both sexes, about Christmas, partaking with other little winged pensioners of the crumbs daily thrown out for their support.

The Chaffinch feeds principally on seeds. We are however compelled to add that they are very injurious to the florist and gardener. "These birds," says Knapp, "make sad havoc with some of our spring flowers; and the polyanthus, in March, in our sheltered borders, is very commonly stripped of all its blossoms by these little plunderers, I suppose to obtain the immature seeds at the base of their tubes. . . . . At this period too they are sad plunderers in our kitchen gardens, and most dexterously draw up our young turnips and radishes as soon as they appear upon the surface of the soil; but after this all depredation ceases, the rest of their days being spent in sportive innocence." Selby says that in summer it feeds much upon insects and larvæ, and that he has witnessed its assiduity, during the autumn, in devouring the females of a large species of aphis, that infests the trunks and stronger branches of the larch and some other kinds of fir. In winter, he adds, grain and other seeds constitute its food.

Like the other finches it builds one of the most beautiful nests, and, as Selby observes, always accordant with the particular colour of its situation. It is variously placed in trees and bushes. In orchards an old apple-tree is a favourite situation. Eggs, four or five, bluish-white, tinged with pink and marked with streaks and spots of purplish-red.

CHAILLETIA'CEÆ, *Chailletiads*, an obscure natural order of Polypetalous Exogens, some of whose species are said to be poisonous. They are very near *Rhamnaceæ*, from which they differ in having the stamens alternate with the petals, and five hypogynous glands. The petals are small scale-like bodies stationed at the orifice of a tubular calyx; the ovary is superior, and two or three celled, the ovules pendulous, the fruit somewhat drupaceous, and the seeds without albumen.

Chaillctia toxicaria is called Ratsbane in Sierra Leone. The order embraces four genera and ten species.

Chailletia pedunculata.

1, an expanded flower; 2, the back of ditto; 3, a petal; 4, stamens; 5, different views of the ovary; 6, different views of the fruit; 7, an embryo.

CHALA'ZA, that part in a seed where the vessels of the raphe pass from the exterior integument or primine, and expand into the secundine. In the common almond it is readily seen by turning the testa inside out and observing that part which corresponds to the apex of the cotyledons. When the foramen of a seed is next the hilum, the chalaza is most conspicuous; but when the foramen is at the apex of a seed, the chalaza will then be in contact with the hilum, with which it must necessarily be then confused.

CHALCEDONY. [AGATE.]

CHA'LCIDES, Daudin's name for a family of Lizards, which, like the Seps-Lizards, are very long and serpent-like; but whose scales, instead of being imbricated or disposed like tiles, are rectangular, and form, like those of the tail in the ordinary lizards, transverse bands which do not intrench upon each other. Some, says Cuvier, have a ridge on each side of the trunk, and the tympanum still very apparent. They approach the *Cordyli*, as the Seps-Lizards approach the *Scinks*, and lead by several relations to the *Sheltopusicks* and *Ophisauri*. The *Chalcides* have four legs, but they are little developed, and the extremities may be considered as in a degree rudimentary; for some of them cannot be said to be furnished with more than one well-formed toe on each foot, though there are traces or rudiments of more. Cuvier thus arranges the family:—

A species with five toes from the East Indies, *Lacerta Seps* of Linnæus.

A species with four toes, *Lacerta tetradactyla* of Lacépède; *Chalcis tetradactyla*. The genus *Tetradactylus* of Merrem; *Saurophis* of Fitzinger.

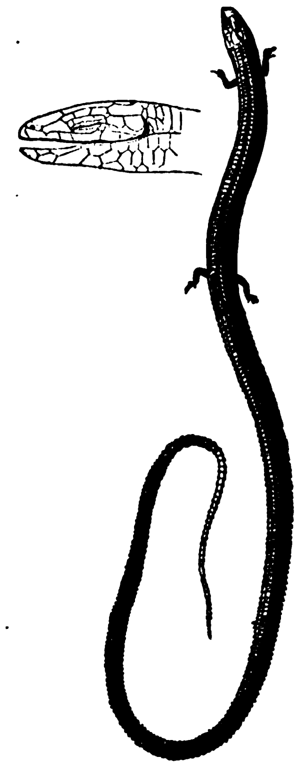
A section which have the tympanum concealed, and leading directly to the *Bimana* (*Chirotes*), and thence to the *Amphisbænæ*. Of these, there is a species with five toes, forming the genus *Chalcides* of Fitzinger.

A species from Brazil, with four toes before, and five behind, *Heterodactylus imbricatus* of Spix.

A species with four toes on each foot, forming the genus *Brachypus* of Fitzinger.

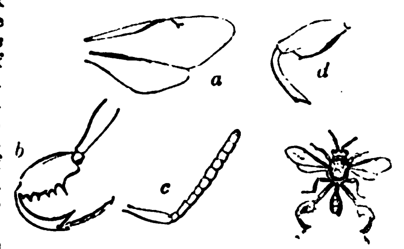
A species from Guyana, with five toes before, and three behind, but reduced to small tubercles so little visible that the species has been regarded at one time as having three toes, and at another as having but one. Cuvier adds, that on the first supposition, it is the *Chalcide* of Lacépède, pl. xxxii.; the *Chamæsaura Cophias* of Schneider; the genus *Chalcis* of Merrem; and the genus *Cophias* of Fitzinger; and that upon the second hypothesis, it is the *Chalcide monodactyle* of Daudin; the genus *Colobus* of Merrem; but, adds Cuvier, all these genera resolve themselves into a single species.

Chalcis tetradactyla has been given as an example of the family. It is the *Saurophis Seps* of Fitzinger, and under the name of *S. tetradactylis* is referred by Gray to his family *Cordyles*. [SAURIA.]



Chalcis tetradactyla.

CHALCI'DIDÆ, a family of Hymenopterous Insects, of the section *Pupivora* (Latreille). Nearly all the species are exceedingly minute. Many are very brilliant, their colours consisting of various shades of green, blue, or copperlike hues; in some of the sections however black is the prevailing colour. The thorax is usually large in proportion to the body, and the latter is often of a compressed form, and joined to the thorax by a distinct long petiole or stalk, as in *Chalcis clavipes*, which is one of the largest of the British species, measuring from tip to tip of the wings when expanded upwards of half an inch; it is of a dull black colour, and remarkable for the excessive development of the coxæ and femora of the hinder legs; the latter are of a reddish hue, and armed with eight little teeth beneath; the hinder tibiæ are curved. It is found on the leaves of shrubs in marshy situations.



Chalcis clavipes.

a, The wings; *b*, the hind-leg; *c*, antenna, magnified; *d*, hind femur and tibia of a species of *Donacia*.

In the species just described the oviduct is short, and hidden beneath the abdomen, a circumstance very common in this tribe; in some however the oviduct is very long, equalling or exceeding the body in length. This is the case in the genus *Callimome*, a group the species of which have very brilliant colours, principally green, and deposit their eggs in the larvæ of the Gall Insects (*Cynipidæ*), an operation which their long bristle-like ovipositors enable them readily to perform. Here, as in the genus *Chalcis*, the body is compressed. Many of the species however have that part depressed. One of the most striking characters in the *Chalcididæ* is in the wings, which are almost destitute of nervures. Most commonly there is in the superior wing a single nervure springing from the base and running parallel with the exterior margin for about one-third of the whole length of the wing. It then slopes upwards and joins the margin itself; and a little beyond the part where the slope takes place there is a small short ramification thrown out obliquely, which is generally thickened towards the extremity, and forms a little dark spot. The antennæ are always elbowed, that is, the terminal joints are bent forward at an angle with the basal joint. We have observed that when these little insects are about to leap, which a great portion of them have the power of doing, they invariably bend their antennæ under the body, and it appeared that this organ was used in making the spring. If this should be the case, it would be a most extraordinary use to make of those parts, which are usually considered either as organs of hearing or touch. We may observe that the species which we found to possess this power in a high degree had immensely thick antennæ, and the hind legs, the usual leaping organs, do not appear at all adapted for that purpose, nor can we discover any other part that is. Although in *C. clavipes* (the species figured) the hinder femora are thick, yet it does not possess the power of leaping; and when we examine the structure of this part, we find that it differs much from the thickened thigh of leaping insects. It is formed upon the same type as the same part in some of the *Donacia* tribe (among beetles), which appears to be used for clinging; and this species, inhabiting marshy situations, would probably require such a clinging apparatus for the same reason as the *Donaciæ* do, namely, to keep them from falling into the water. A figure of the leg of a species of *Donaciæ* is given, to show the resemblance both in the femur and curved tibia.

The *Chalcididæ* are all parasitical in their larva state. Some are so minute as to undergo their metamorphosis in the eggs of other insects. The chrysalides of some of the lepidopterous insects not unfrequently form the nidus of an immense number of these little insects. One species of *Chalcis* generally confines its attacks to the chrysalis of one species of lepidopterous insects; but occasionally we have reared more than one species of the *Chalcididæ* from the same chrysalis.

Mr. Walker, a gentleman who has written much on this group of insects, looks upon it as a great section of *Hymenoptera* rather than a family, and his views appear to us correct. The *Chalcididæ* are divided by him into two sections, which he calls *Chalcides Pentameri* and *Chalcides Tetrameri*, names applied from their having five or four-jointed tarsi; each of these sections is again subdivided into several families, the species of which are exceedingly numerous. Mr. Westwood, who, as well as Mr. Walker, has paid great attention to this interesting group, states that there are probably 1500 species in England.

CHALCOLITE, a mineral of a green colour containing Uranium. [URANIUM.]

CHALI'COMYS, a genus of Rodent *Mammalia*, allied to the beaver. From Eppelsheim; in Tertiary beds.

CHALICOTHE'RIUM, a genus of Fossil Pachydermatous Animals allied to the Tapirs, comprising two species found at Epplesheim, about 12 leagues south of Mayence, in sand, supposed to be of the Second Tertiary or Miocene period of Lyell. (Kaup, *Description d'Ossemens Fossiles*, Darmst., 1832.)

CHALILITE, a mineral belonging to the group of Zeolites. It occurs massive. Its fracture is splintery and flat conchoidal. Hardness 4·5. Colour deep reddish-brown. Lustre between vitreous and resinous. Translucent on the edges. Specific gravity 2·252.

By the blowpipe it becomes white, and spreads out; with carbonate of soda it effervesces, and fuses with some difficulty into a white bead with a pearly lustre; with borax it fuses into a colourless glass. It is found in the county of Antrim, Ireland.

Analysis by Dr. Thompson :—

Silica	36·56
Alumina	26·20
Lime	10·28
Peroxide of Iron	9·28
Soda	2·72
Water	16·66
	101·70

CHALIMUS, a genus of Entomostracous *Crustacea* allied to *Caligus*. [CALIGUS.]

CHALK FORMATION and CRETACEOUS GROUP, in Geology, consist of the upper strata of the Secondary series immediately below the Tertiary series and superincumbent on the Wealden, or where that is wanting, on the Oolitic system. This group is common to Europe, and also to at least a part of Asia. It consists of chalk resting upon either an arenaceous or argillaceous deposit. The Chalk bears a remarkably uniform mineralogical character over a surface extending from the British Islands through Northern France, Northern Germany, Denmark, and Sweden, into both European and Asiatic Russia. (De La Beche, 'Res. in Theor. Geol.') The Cretaceous system is subdivided into the following strata :—

Chalk	Upper.	1. Mæstricht beds	In which numerous species of marine fossils are found.
	Lower.	2. Chalk with flints	
	Marly.	3. Chalk without flints, and Chalk with marl	
Greensand	Upper Greensand		
	Gault		
	Lower Greensand (*Neocomien*)		

The area over which this system prevails in England, and the various strata which it contains, have been well defined by geologists.

The Cretaceous Group occupies nearly the whole of the south-eastern part of England. A line drawn from Crewkerne on the south-west to Hunstanton on the north-east forms its western boundary; and it extends from this line to the east coast, with the exception of a small part on the south-east. It is also found on the north of the Wash forming the Wolds of Lincolnshire. It is intersected by the Humber and constitutes also the Wolds of Yorkshire. It terminates near Flamborough Head at Speeton, about six miles north of that promontory. The same formation appears to prevail in the north of France, extending to the Cretaceous district of Aix-la-Chapelle. The Chalk, or upper portion of the system, is in some parts covered with the strata of the Tertiary series; in other parts it is denuded. The Greensand crops out round its edge, which is broken and interrupted in many places where the lower strata appear.

On the north-east the Chalk appears in a narrower belt along the cliff from near Cromer to Hunstanton. From Cromer along the coast to the mouth of the Thames, and along the north bank of that river, it is concealed by the upper strata, which extend a considerable distance inland.

Beginning with Norfolk and proceeding southwards, the boundary line between the Chalk and the superior strata is about 4 miles east of Snettisham, 2 miles west of Diss, 8 miles east of Mildenhall, between 4 and 5 miles west of Bury St. Edmunds, continuing to the north-east of Hertfordshire by Hertford and near St. Alban's, to 3 miles south-east of Wendover.

In the northern part of this district the Chalk has in a few places been partially denuded. On the north-east there is a small piece of Chalk along the banks of the Bure. The town of Norwich also stands upon Chalk, which, in its vicinity, extends along the banks of the Yare and Wensum. There is a piece of Chalk likewise at each side of small parts of the Stour and of the Orwell. The strata superincumbent on the Chalk series extend a little beyond Uxbridge on the west, and then run in a narrow tongue to the north-west, 3 miles south of Wendover, which intervening space at that point is the whole width of the denuded Chalk, Wendover being there its western limit. The Chalk becomes wider towards the south-east, taking in Maidenhead; it is again partially covered a little to the west of that place, and continues in a very uneven line to Reading, Newbury, and a little to the east of Marlborough. The Tertiary strata then run from west to east by Kingsclere, Basingstoke, Guildford, to 3 miles north of Dorking, round by the Darent, and appear near Woolwich and Greenwich. Another detached portion appears in the north-west of Kent, taking in the Isle of Sheppey, and continues from the æstuary of the Medway along the coast to the Isle of Thanet. The Chalk is covered on the west and north of Canterbury and at Sandwich; the beds which cover it terminate on the coast at Deal. On the south coast, from Worthing westward, the Chalk is again concealed by the superincumbent series, extending nearly in a straight line through Chichester as far as a little to the east of Salisbury; it then continues in a south-west direction nearly as far as Dorchester. The Chalk passes entirely across the Isle of Wight nearly from east to west, in a narrow ridge consisting of vertical strata, from Culver Cliff to Compton Bay; there is also a small piece on the south of the island. The limits of the Chalk on the other side, where it is bounded by the outcropping of the lower strata of the system, remain to be noticed. The cliffs of the whole of the Isle of Thanet are composed of Chalk. The chalk-cliffs again commence near Deal, and are continued past Dover to East Weare Bay, a distance of about 13 miles. As the Chalk rises from Dover towards Folkstone the upper beds disappear, and the cliffs consist entirely of the lower members of that stratum. The rise of the Marly Chalk occurs about 1¼ mile to the east of the escarpment of Folkstone Hill, which is 566 feet high. Just at the rise of this bed there is a very copious and perennial spring called Lydden Spout. About 2000 paces west of this spring the cliff recedes from the sea, and the intermediate shore thence to Copt Point is occupied by a mass of ruins which has fallen from above. The sudden transition from the chalk-cliffs is very remarkable. Turning inland the chalk-range is bounded on the south by the outcrop of the Greensand strata, which extend 4 miles north of Ashford, 3 miles north of Maidstone, and is cut by the Medway, whence it forms a line curving outward to the south as far as the Darent, where it is 5 miles north of Sevenoaks. Merstham is on the boundary, which then continues in nearly a west direction, immediately north of Reigate to Box Hill, near Dorking, and thence to Guildford, leaving a very narrow ridge of Chalk. From Guildford to a point about 2 miles from Farnham there is a remarkable ridge, called the Hog's Back, produced by an upthrow of the Chalk and the breaking off of the southern portion of the curve. The coast between Copt Point and Beachy Head, near these respective points, is occupied on each side by the Greensand, and the intermediate space by the Wealden Clay and Hastings Sand: the two latter do not belong to this series, being lower denuded strata. The Sussex chalk-range, or South Downs, commences at Eastbourne, near Beachy Head, and continues thence along the coast beyond Shoreham and onwards in a west-by-north direction. The Greensand bounds it on the north, and leaves a range of Chalk varying from 8 to 3 miles in breadth. About 3 miles south-west of Petersfield the Greensand again sinks below the Chalk, which is connected with the north range by the Alton chalk-hills, running from near Farnham to near Butser Hill (917 feet).

It now remains to define the boundary of the Chalk from Dorsetshire on the south-west to Norfolk on the north-east. It has been thus described by Dr. Fitton :—"The great range of the chalk-escarpment in the interior of England, which stretches like the shore of a sea or lake from Crewkerne in Dorsetshire to the north-east of Dunstable in

Bedfordshire, is perfectly analogous in structure and appearance to the Downs of Surrey and Sussex. It is interrupted by three or four indentations or gulfs; one of great width, opening towards the west between Crewkerne and the heights about Stourhead, in South Wiltshire; another expanding to the north-west, and terminating in the defile where the Thames cuts through the chalk in its way to the south-east from Buckinghamshire and Oxfordshire. The vales of Pewsey and of Warminster are intermediate bays of the same general structure, but of smaller dimensions; and all these valleys are apparently the result of denudation, aided by previous disturbance of the strata, which has carried away the chalk, and laid bare to various depths the strata beneath it." ('Geol. Tran.,' 2nd series, vol. iv. part 2nd., p. 243.) From the heights near Dunstable the Upper Chalk range passes through the north-west of Hertfordshire, by Hitchin and Baldock, to Barkway and Royston Downs, and thence by Balsham and Newmarket into Suffolk by Mildenhall, 2 miles west of Brandon, 4 miles west of Downham, by Narborough, and on to Snettisham. The chalk-hills decline rapidly in height in the north-east of Bedfordshire. Kensworth Hill is 904 feet above the level of the sea; the hills east of that town are 850 feet high. Lilleyhoe is 664 feet; Barkway Windmill, 513 feet; the station near Royston, 484 feet; Balsham, on the east of Cambridge, 380 feet; Newmarket station, 267 feet; Brandon, in Suffolk, 190 feet. The chalk-hills stretching from Cambridgeshire to the north-west coast of Norfolk rise nowhere probably above 600 feet in height, bounding "the fen country like the low shore of a sea."

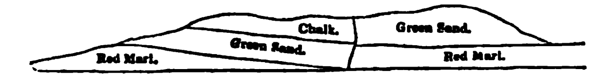
The Chalk Inland Range is highest towards the central part between Wiltshire and Hertfordshire. In departing from that central tract the rise is comparatively small both towards Devonshire on the south, as well as in the counties northwards. The Chalk nearly disappears in Devonshire, a few insulated portions only appearing there, principally upon the coast between Sidmouth and Lyme, and along a line from Beaminster through Chard and White Stanton. The transition from the Chalk to the Greensand is here distinctly seen, especially on the south-west of Axmouth, where sections of the subjacent beds are exposed in the cliffs. In many parts of the chalk-range the upper and lower strata are well defined even by the outward features; a marked difference appearing in the vegetation and general aspect. The Upper Chalk has usually layers of flint nodules occurring at regular intervals, and is softer than the Lower Chalk. At Sandown Bay, in the Isle of Wight, the latter stratum is defined by a layer of distant and insulated flints which separates it from the Flinty Chalk above; it is sometimes of a grayish colour, as is also the bed of Marly Chalk immediately beneath it. This Marly Chalk is of a tenacious nature, and sustains the water which descends through the Chalk; in consequence, a line of ponds has been produced along the bottom of the escarpment of the South Downs. The Malm-Land, remarkable for its fertility, is the soil over the lowest beds of Marly Chalk. The Malm-Rock, immediately below the Marly Chalk, consists of stony beds belonging to the Upper Greensand formation. Salisbury Plain, which is more than 25 miles in extent from west to east, and 12 miles from north to south, is occupied by the Upper Chalk. Though it has many inequalities of surface, it would be almost destitute of water but for the Avon and its branches, which traverse it. But in the tracts occupied by the Lower Chalk, and still more in the Chalk Marl, there are few valleys without streams; hence, as well as owing to the difference of soil, the vegetation differs also, and the luxuriance of the lower regions affords a strong contrast to the barrenness of the higher downs. The village of Dunstable stands on the Lower Chalk, which may be distinctly traced from Totternhoe through Houghton Regis, Upper Sundon, and Streatley.

Accurate measures of the entire thickness of the Chalk have rarely been made in England. The following are however approximate numbers taken from the best authorities. Sir Henry De La Beche's estimate of the average thickness of this stratum is 700 feet. Dr. Conybeare considers it to range from 600 to 1000 feet. The height of the cliff at Beachy Head, which at the summit includes part of the Flinty Chalk, and goes down very nearly to the Upper Greensand, is only 535 feet; 350 feet is the thickness of the Flinty Chalk at Dover. If then 250 feet are added for the remainder of that division at Beachy Head the aggregate thickness of the chalk on the Sussex coast may be estimated at about 800 feet. At Wendover Hill the total thickness of chalk is considered something more than 500 feet. At Diss, in Norfolk, it was found by boring to be 510 feet. The great variation in thickness is ascribed in part to the unequal removal and abrasion of the upper strata, and in part to the original inequality in the thickness of the Chalk itself.

Greensand.—The general position of this stratum has been sufficiently indicated in describing the boundary of the Chalk, the former outcropping round the latter in an uneven line, in some places much wider than in others.

The Upper Greensand commences immediately on the north of Copt Point, beyond Folkstone, where the succession of the various beds of the system is best seen. Here the Upper Greensand is of comparatively small thickness, and occupies a very narrow belt round the Chalk, running in a west-north-west and then in a westerly direction, as already defined in describing the chalk boundary. It assumes a new character near Godstone, and is there more distinctly marked. The firestone obtained in that part of the country is in the Upper Greensand, occupying four beds separated by seams of stratification; the thickness of the first two beds is respectively 1 foot 9 inches and 1 foot 4 inches; the two others are only 10 inches each. This stone is extensively quarried between Godstone and Reigate. Continuing still in a narrow belt to Guildford, the Upper Greensand forms a slight projection along the foot of the Hog's Back; from Farnham by Selborne and Petersfield to the south of Petworth, this stratum runs out beyond the foot of the chalk-escarpment like a step or terrace. Near Petersfield it is remarkable for its width, which is there 2 miles, a much greater extent than at any other part. A little east of Petersfield, for a short space, this stratum entirely disappears; it then continues in a narrow belt along the north escarpment of the South Downs. This formation is but partially disclosed along the base of the central ridge of Chalk in the Isle of Wight, but it is distinctly seen along the escarpments of the Under-Cliff; its step-like projection beyond the Chalk, as seen in Western Sussex, is likewise observable here in several places.

In the Isle of Purbeck the Greensand runs in a narrow band on the south escarpment of the Chalk, but there the separation of the Upper and Lower Greensands has in a great measure disappeared, and the latter is greatly reduced in thickness or wholly united with the Upper Greensand. The Black Down Hills, in Devonshire, are composed of Greensand; the two beds thus united wanting the intermediate Gault. These hills are distinguished by the uniform level of their summits; and, when cursorily viewed, appear to be composed of horizontal or nearly horizontal beds of Greensand, with here and there an occasional patch of Chalk. It is found however that the rocks composing these hills have been fractured subsequently to their deposition, and that the valleys mostly are lines of faults having a general northerly direction. At some parts there are faults which



do not form valleys. In a section across a southern part of the hills the Chalk and Greensand seem to form a continuance; Greensand being on one side of a vertical section, and Chalk on the other. In the yellowish sand, near the surface, at the Barnscombe side of the Beacon Hill, brown iron ore is found in polished fragments of very high lustre. Whetstones are obtained from the Black-Down Hills, the manufacture of which occupies a great number of the neighbouring inhabitants. The quarries are driven in direct lines into the hill, almost horizontally, about 80 feet below the top of the hill. The stones from which the whetstones are cut are irregular concrete masses, imbedded in a looser sand, and more properly belong to the Lower Greensand stratum; but the different strata of the Greensand of these hills are not distinguished by Dr. Fitton, as the Gault between the Upper and Lower Greensand is entirely wanting. The Upper Greensand is not distinctly marked in the great south-western escarpment of the Chalk till beyond the Stour, from the north bank of which it extends northward for about 10 miles to Shaftesbury, and continues thence round the Vale of Wardour. On the south side of the Vale of Wardour the upper beds of this stratum are concealed at the foot of the chalk-hills, but the lower beds shoot out into plateaus, which form the tops of the hills all the way from Shaftesbury along the south side of the Vale of Wardour. On the north side of the vale, the whole series of the Upper Greensand rises abruptly and forms a narrow ridge of unequal height. At the north of the valley this stratum appears to consist of two portions: that which immediately succeeds the Chalk is the same as the firestone of Surrey; the other is equivalent to the Malm-Rock of Sussex, and abounds in chert. In a well sunk at Ridge the Upper Greensand is distinguished into four different strata, their aggregate thickness being 100 feet. The Upper Greensand is not nearly so conspicuous inland as near the coast; from the Vale of Wardour it does not occur again till the Vale of Pewsey. The town of Devizes stands upon a platform of the Upper Greensand, which is there about 430 feet above the sea. It occurs again at Swindon, and then at Tetsworth, whence it continues in a narrow belt and in a north-east direction beyond Cambridge.

The Upper Greensand consists in some places of a soft marly sand, traversed in every direction by stem-like cylinders, having within them cores of darker green matter; it also contains some irregular masses of a bright brown or orange hue, but the greater part is composed of gray calcareous marl, resembling the lowest chalk, but so thickly interspersed with green particles as to entirely assume their colour. The green particles, according to analysis, are found to consist of—

Silica	48·5
Black Oxide of Iron	22
Alumina	17
Magnesia	3·8
Water	7
Potash	traces
	98·3

The thickness of this series near Folkstone is from 25 to 30 feet: at Godstone it increases considerably, and the depth of the wells sunk through it in the Malm-Rock strata of Hampshire varies from 60 to 100 feet. In Western Sussex the thickness is between 70 and 80 feet. It is about 70 feet in the Isle of Wight. The thickness of the Greensand at Black Down is about 100 feet, probably from 60 to 80 feet in the Vale of Wardour, and from 30 to 50 feet near Swindon. At Cambridge it is not more than 18 inches; thence through West Norfolk the stratum is nowhere distinctly seen. At Hunstanton the beds which are supposed to represent it are not more than 2 feet thick.

Gault.—The stratum which is usually found between the Upper and Lower Greensand is obscured at East Weare Bay by the ruins of the superior beds, but is visible in detached points. Farther on, towards Folkstone, it becomes more marked, and forms the greater part of the cliff at Copt Point, as well as the grassy cliff between the base of the Martello tower, situated in the vicinity, and the sea. Thence it forms a narrow band between the Upper and Lower Greensand. Near Godstone it occupies a tract distinguished as 'the Black Land,' and forms a slight depression below the stratum which affords the firestone. Between Farnham and Alton this narrow belt of Gault swells out to three or four times its former width, and then again narrowing, continues to form a narrow band between the two strata of Greensand as far as Beachy Head. In the Isle of Wight this stratum likewise forms a narrow band between the Upper and Lower Greensand. The Gault again appears in the Vale of Wardour: on the south it forms a rapid slope; on the north a depression immediately below the sand. It is here identified with that in the eastern counties by the characteristic fossils. At Ridge, near Fonthill Park, the clay of this stratum has been long used for tile-making, and it is there 75 feet in thickness. From the Vale of Wardour, and thence north-eastward to the sea at Hunstanton, the Gault everywhere appears, though it is much reduced in quantity in Norfolk. This stratum occupies a large part even of the higher grounds between Whitchurch and Wing. Immediately to the west of Hitchin and Baldock it is still wider; the towns of Shefford and Biggleswade stand on it. From Cambridge, for a few miles towards the north, it likewise occupies as great a width. In consequence of the numerous borings for water made in Cambridgeshire about this part, its relations and thickness have been well ascertained, especially from Basingbourne through Meldrith, and thence towards Cambridge. This stratum is very distinct at Mildenhall: the Blue Gault has been traced as far as West Newton, about three miles south of Ingoldsthorpe. The valley between the Chalk and Lower Greensand is there interrupted by an advance of the Chalk; and beyond that point the Blue Gault is no longer observable: its place is thence occupied by the red marly stratum of Hunstanton Cliff, which is a calcareous argillaceous matter, 4 feet thick, and it is questioned by geologists whether the term Gault should be applied to it. The Gault, as far as regards its composition, may be divided into two portions: the upper part, immediately succeeding the Upper Greensand, contains green particles, and thence for some feet downwards it is harsh and sandy. The lower portion consists of a smooth uniform very plastic clay, of a light-blueish colour, which is used for tiles and common pottery. Throughout the Gault, but chiefly in the lower part, concretions of iron pyrites are found, and other nodules and irregular masses. The thickness of this stratum at Copt Point is about 130 feet. At Merstham it is 150 feet thick, which is likewise the average thickness in Cambridgeshire. In the Isle of Wight it is about 70 feet; at Ridge about 75 feet; near Thame 90 feet; at Mildenhall the blue clay is only 9 feet. Mr. Rose considers it not more than 15 feet in West Norfolk.

The Lower Greensand.—This stratum appears of a uniform surface, shooting out beyond the Chalk in the south-east counties, and occupies a much larger area than either of the upper strata of the Greensand series. The resemblance in the aspect of the surface of the country, here occupied by the Lower Greensand, to that of the Black-Down Hills, in Devonshire, is extremely striking; and perhaps indicates that the description of the latter more properly belongs to this section than to that which treats of the Upper Greensand stratum. The Lower Greensand has three distinct subdivisions, clearly defined in most parts where it occurs. This series of strata rises gradually from Copt Point, and occupies the whole cliff west of the village; thence it is continued without interruption through Sandgate, and in the heights above Hythe. Its outcrop turns from the coast to the interior at Adlington Corner; here the subdivisions are all distinctly marked, and their respective limits defined. The lower beds, which contain much calcareous matter, are extensively worked in quarries, both for building and lime-burning, at Pluckley, on the north-west, and at Great Chart, on the south-west of Ashford; and generally along the outcrop west of Adlington Corner, where it forms a prominent ridge adjoining the valley of the Weald: here are the principal beds of stone known under the name of 'Kentish Rag.'

Extensive quarries are worked at Boughton, to the south of Maidstone. The stone for the construction of Westminster Abbey is said to have been procured here. The stone is a variety of the Kentish rag. From Adlington Corner the Lower Greensand continues towards the west in a broad band varying in width; on the coast the distance from the Chalk at Folkstone Hill to the outcrop of this series is about 10 miles, but from Lenham to the outcrop it is not more than 2 miles. Maidstone, Sevenoaks, Godstone, Reigate, Dorking, and Godalming stand on the Lower Greensand series. Near Godstone the surface is comparatively lower, and ponds are frequent where the middle stratum occurs; the stony beds of the lowest group then rise to form the escarpment of Tilburstow Hill, which is nearly on a level with the Chalk Downs. At the top of the hill, the beds, which to the north of Tilburstow Hill rise uniformly at an angle of not more than 10 degrees, are suddenly thrown up to about 45 degrees, giving decisive evidence of an elevation from the Chalk, or of a sinking towards it. Fullers' Earth has been dug in this part of Surrey for a very long period; at present the neighbourhood of Nutfield is the only place in which it is got. The beds occur near the top of the lowest stratum of Greensand; in one pit near Nutfield the principal bed of Fullers' Earth is 16 feet thick. On the south of the Hog's Back the Lower Greensand rises, like the Chalk, at a very high angle, and then, being bent suddenly in an opposite direction, is continued several miles to the south. Hindhead is the most prominent point in this part of the country, where the whole of the tract occupied by the Lower Greensand is wild and barren, producing only fern, heath, and furze.

As this formation turns towards the east and continues along Sussex to the coast, it is not nearly so wide as on the north of the Weald. At Beachy Head it is three miles wide, but it is only one mile wide a little to the west of the spot where the Adur runs through it. The Lower Greensand occupies a great part of the surface on the south of the Isle of Wight, and is everywhere conformable to the Chalk, a ridge of highly-inclined strata of Greensand crossing the island from the shore on the south of Bembridge-Down to the foot of Afton Down. The sands likewise form the lower ground of the interior from Mottestone through Newchurch to the coast.

A narrow belt of Greensand runs along the west and north-west of Dorsetshire. In the Vale of Wardour the Lower Greensand is nowhere prominent; but it occupies the whole of the entrance of the Vale of Pewsey, and continues with its subdivisions well defined through the northern counties in a north-east direction as far as the coast of Norfolk. The greatest width of the formation in this part occurs between Leighton and Ampthill in Bedfordshire, where it rises in Bow-Brickhill to the height of 683 feet above the sea. Near Woburn there is a fullers' earth pit, the beds of which occur, like those in Surrey, near the top of the lowest division; that of the best quality is in a bed from seven to nine feet thick. The pits in this part of the country have continued to supply fullers' earth for more than a hundred years.

The three groups into which this stratum is divided are, in most places in the south-east counties where sections have been made, well defined; and in general, in different situations where this formation occurs, the respective characteristics are found to be alike. The Cretacean System is not confined to England, but is found extending over very large portions of the continent of Europe. It is seen in France on the coasts opposite to England, and it is found on the north as far as Denmark. It may in fact be traced from the north-east of Ireland to the borders of Asia Minor, and from Denmark to the south of France. It also has its representative in some parts of North America. In South America deposits of this period have also been developed along the whole country from Columbia to Tierra del Fuego. The south-east of India has also yielded fossils, which apparently belong to this period.

The organic remains in the Chalk and Greensands are usually abundant, and are mostly marine. They consist of marine plants: *Infusoria*, Sponges, Zoophytes, *Echinodermata*, *Mollusca*, *Crustacea*, Fishes, and Reptiles. Sir Henry De La Beche observes, that "Organic remains are in general beautifully preserved in the chalk; substances of no greater solidity than common sponges retain their forms, delicate shells remain unbroken, fish even are frequently not flattened, and altogether we have appearances which justify us in concluding that since these organic exuviæ were entombed they have been protected from the effects of pressure by the consolidation of the rock around them, and that they have been very tranquilly enveloped in exceedingly fine matter, such as we should consider would result from a chemical precipitate."

The most remarkable form in which the fossils of this formation appear is that of flint. The production of this substance has by some been referred to organic agencies. [FLINT.]

Although the remains of plants are rare in this formation in England, they have been found in abundance in the contemporaneous sandstones of the continent of Europe. Amongst them have been found the remains of dicotyledonous plants.

An examination of the flints by the microscope reveals the existence of many forms of *Diatomaceæ* in the Chalk. From the siliceous structure of their frustules these organisms are entirely preserved wherever they occur. A large number of species have been discovered in the Chalk. [DIATOMACEÆ.]

Amongst the lowest animals we must now reckon the *Foraminifera*, which were formerly regarded as minute *Cephalopoda* by D'Orbigny. Many forms of these creatures, which seem to hold a place between the Sponges and some of the *Infusoria* are found in the Chalk. [FORAMINIFERA.]

Of the Zoophytes, the *Polyzoa* have been found in the greatest abundance in the Cretaceous beds (*Neocomien*) of the continent of Europe. They have been most elaborately described by D'Orbigny. [POLYZOA.]

The *Echinodermata* abounded during the period of the deposit of the Chalk, and afford a larger number of interesting forms than occur in any other formation. The genus *Marsupites* affords an instance of the passage amongst these creatures from *Encrinites* to the *Spatangi*. Numerous species of *Spatangus*, *Cidaris*, *Goniaster*, and other genera of this family are found. The spines of the *Echinidæ* are often found separated from the shell. [ECHINODERMATA.]

Several forms of *Crustacea* belonging to the more highly-developed sections of the family are found.

The *Mollusca* are abundant. Of these the forms of *Brachiopoda*, especially *Terebratula*, are numerous. The genus *Rudistes*, which D'Orbigny refers to the *Brachiopoda*, is in some respects the most interesting of the *Mollusca* of the Cretaceous Formations. The species are most abundant in the Cretaceous series of the South of Europe. The Cephalopodous *Mollusca* were very numerous and varied in their forms during the Cretaceous period. The following genera are found:—*Nautilus*, *Ammonites*, *Crioceratites*, *Turrilites*, *Scaphites*, *Baculites*, *Hamites*, and others.

The Fishes of the Cretaceous system are numerous, and belong to the Placoid, Ganoid, Ctenoid, and Cycloid types. Of the last two the genera are fewer in number than of the first two. The Ctenoids and Cycloids however appear in the Cretaceous system for the first time, and are interesting on this account.

The Reptiles, though not so numerous in the Cretaceous period as in that which immediately preceded it, are nevertheless numerous. It is here that the *Mosasaurus* has been found, also several species of *Pterodactyli*, and the remains of the *Iguanodon* and *Ichthyosaurus*, with species of *Chelonia*.

CHALYBÆUS, a genus of Birds, separated by Cuvier from the Cassicans of Buffon; *Barita* of Cuvier. The bill has the same form as that of the Cassicans, but it is a little larger at the base than that organ is in the last-named genus, and the nostrils are pierced in a large, membranous space.

The species come from New Guinea, and are remarkable for the metallic tints of their plumage.

Example, *Chalybœus paradisœus*. This richly-plumed bird is the *Paradisea viridis* of Gmelin; Le Calybé de la Nouvelle Guinée of Buffon; Le Grand Chalybé of Le Vaillant; Oiseau de Paradis Vert of Sonnerat; *Paradisea chalybea*, Blue-Green Paradise Bird, of Latham; *Cracticus chalybeus* of Vieillot; *Barita viridis* of the first edition of

Blue-Green Bird of Paradise (*Chalybœus paradisœus*).

the 'Règne Animal' (where it was placed under the Cassicans, *Barita*), and *Chalybœus paradisœus* of the last edition. It is the Mansinème of the Papuan tongue, according to Lesson, who thus writes on the subject from personal observation:—"Among the numerous skins of birds of paradise which the inhabitants of New Guinea brought daily on board, I found some *Chalybœi* deprived of their feet, and run through with a stick like the skins of the true birds of paradise. Afterwards we often procured in our shooting parties a bird which does not vary from that of which we speak, except in having a more sombre and tarnished plumage, there being no difference in the proportions of the body, bill, wings, or tail. We regard it as a slight variety of the Calybé of authors; for those that we saw which were adult and in complete plumage, did not permit us to think that they could be *Chalybœi* before or after their moult. The total length of our *Chalybœus* was 14 inches 6 lines (French). The bill differed not at all from the ordinary *Chalybœus*. The head is large, and the tail, 6 inches in length, is rounded by the disposition of the feathers, as in the preceding. The plumage is entirely bluish metallic green, having none of the iridescent, varying, and violet tints. The feathers of the neck and abdomen are not figured (gaufrées), nor powdered (sablées) with gold and silver on a green and blue ground of burnished steel, as it were (d'acier bruni), like the *Chalybœus*; but the plumage that covers these parts has a uniform tint, having the brilliancy of specular iron (fer spéculaire) following the reflections of the light. The feathers which cover the head and neck are short, close set, and velvety. The nostrils are partially closed by a membrane covered by the frontal feathers, which advance on each side of the edge (arête) of the bill, which is black. The iris is coral-red, and the legs are of the same colour as the bill. Their shanks (tarses) are covered with large scales (écussons), and their toes are strong, furnished with compressed claws, flattened above, and crooked.

"The *Chalybœus* lives solitary in the forests of New Guinea. We often saw it perched in the great trees, where it seeks for fruits. Its manners appeared to have great analogy to those of the crows."

CHALYBEATE WATERS. The water of springs charged with any of the salts of iron are called Chalybeate. [SPRINGS, MINERAL.]

CHAMA. [CHAMACEA.]

CHAMA'CEA, or CHA'MIDÆ, a family of Conchiferous *Mollusca*, the third of the Acephalous or Headless *Testacea*, according to Cuvier, who places them between his *Mytilacea* (Mussel-like Testaceans), and his *Cardiacea* (Cockle-like Testaceans).

Under the Linnæan genus *Chama* many heterogeneous forms were assembled; and as G. Sowerby observes, "in his arrangement regular and equivalve shells are placed with such as are irregular and equivalve; free shells with others that are attached to marine bodies; and shells which have two distinct muscular impressions with others which have only one."

Bruguière first divided this genus, and Lamarck carried out the reformation. The latter makes the *Chamidæ* to consist of the genera *Diceras*, *Chama*, and *Etheria*, placing *Tridacna* and *Hippopus* under his Tridacnées, the first section of his second order Conchifères Monomyaires.

Cuvier made the Camacées consist of the genera *Chama*, *Tridacna*, *Hippopus*, *Chama* (Brug.), *Diceras*, and *Isocardia*.

The genus *Chama* has the following characters:—The valves are irregular, inclining for the most part to the orbicular shape, unequal, generally foliated or spined externally, and adherent. The umbones are distant, unequal, and curled or involute. The hinge consists of one thick oblique somewhat notched tooth, inserted into the groove of the opposite valve. There are two muscular impressions, and they are distant and lateral. The ligament is external, and divided into two portions at its posterior extremity. The animal (*Psilopus* of Poli) is less irregular than the shell, and cordiform, or heart-shaped; the two lobes of the mantle unite posteriorly, and in the commissure are two very short ciliated siphons, like those of *Isocardia*. Upon the abdominal mass a small cylindrical truncated bent foot rises. The mouth is small, and is furnished on each side with a pair of somewhat square and obliquely-truncated palpi. Deshayes states that all the individuals of the same species adhere by the valve of the same side, and that the umbones curve in the same direction.

Broderip, in the first volume of the 'Transactions of the Zoological Society of London' (1834), where he describes several new species brought home by Mr. Cuming, says, "The shells are attached by their external surface to submarine bodies, such as corals, rocks, and shells, and have been observed at depths ranging from points near the surface to 17 fathoms. These shells appear to be subject to every change of shape, and often of colour, that the accidents of their position may bring upon them. Their shape is usually determined by the body to which they are fixed; the development of the foliated laminæ which form their general characteristic is affected by their situation; and their colour most probably by their food and by their greater or less exposure to light. The *Chama* that has lived in deep and placid water will generally be found with its foliations in the highest state of luxuriancy; while those of the individual that has borne the buffeting of a comparatively shallow and turbulent sea will be poor and stunted. Lamarck has divided the species into two sections, namely, first, those the umbones of whose shells turn from left to right; and, secondly, those whose umbones turn from right to left. M. Sander Rang, in his 'Manual,' has adopted this division, to which I cannot subscribe, because it will not bear the test of examination. Two remarkable instances are now well known of regular bivalves of the same species, in which one specimen may be regarded as being the reverse of the other, namely, *Lucina Childreni*, and an inequivalve

Mytilus in the British Museum: and to come at once to the case before us, the same species of *Chama* is sometimes attached by the right, sometimes by the left valve; or, in other words, in one individual of the species the umbones will turn from left to right, while in another individual they will turn from right to left." The same author observes, that the distinction of the species appears to him to be difficult, the variety being infinite. The number of recent species given in Deshayes's edition of Lamarck (1835) is seventeen, including *Chama albida* (Camostrée of De Roissy; *Cleidotharus* of Stutchbury). Broderip, in the paper above alluded to, describes eleven additional species with varieties not noticed by Deshayes, who has however some observations on the following species, *C. Lazarus*, *C. gryphoïdes*, *C. unicornis*, *C. asperella* (the living analogue of *C. echinulata* in Lamarck's fossil list), and *C. albida*, well worthy the attention of the student. We elect as an example *C. gryphoïdes* (*C. gigas*, Linn.), which is famous for its enormous size. Individuals have been known to weigh above three hundred pounds. The byssus by which it adheres to rocks is so tough that in order to procure the shell it must be cut with an axe. The animal may be eaten, but its flesh is very tough. Some very large specimens are to be seen in the Gardens of the Zoological Society, Regent's Park. One of the valves is sometimes used as a font for baptism in country churches.

Chama gryphoïdes.

The species are apparently confined to the warmer seas, the Mediterranean being the locality of the lowest temperature where any of them have been hitherto found.

Fossil Chamidæ.

The fossil species of *Chama* are numerous, and occur in the supracretaceous groups, particularly in the subappenine beds, and those of Bordeaux and Dax; in the Cretaceous group; and also in that of the Oolite. According to G. B. Sowerby, they are found in the London Clay, and Calcaire Grossier, also in the Chalk and Greensand. Deshayes, in his tables, gives fifteen living species, and twenty fossil (tertiary), occurring in the Pliocene, Miocene, and Eocene periods. Of these he makes four, namely, *C. gryphoïdes*, *C. crenulata*, *C. sinistrorsa*, and a new species, both living and fossil; the localities for the living (with the exception of *crenulata*, from Senegal) being the Mediterranean Sea. The species found in more than one Tertiary formation he makes *C. echinulata*, *C. rustica*, and *C. lamellosa*; and gives the following number of species in the localities here mentioned:—Four in Sicily, four in Italy (subappenine beds), one at Bordeaux, three at Dax, three in Touraine, two at Vienna, two at Angers, nine at Paris, one at London, and two at Valognes. In the fossil list of his edition of Lamarck (1835), Deshayes enumerates only thirteen fossil species, and of these he makes *C. gryphina* include *C. sinistrorsa* as a synonym, observing in a note that he knows the living analogue as existing in the Sicilian seas, and that the species No. 3 (*C. lacernata*) is a variety of this, while the valves cited as belonging to the environs of Angers belong to another species. *C. echinulata* he identifies with *C. asperella* now living in the Mediterranean. *C. unicornaria*, he observes, was formed for a variety of *C. gryphina*, with very large umbones; and he suggests the necessity of uniting *C. gryphina*, *C. lacernata*, and *C. unicornaria* in one species. Nilsson names *C. cornu Arietis* (*Diceras arietina?*), Kjuge; Morby, Sweden; and *C. laciniata*, Kjuge; Balsberg; Morby, Sweden; and Mantell, an undetermined species from the Chalk, Sussex. Phillips names *Chama mima*, or *Gryphæa mima* (the genera are sufficiently different, by the way), from the Coral Oolite and Calcareous Grits of Yorkshire. Smith, *Chama* (?) *crassa* from the Bradford Clay. Thurman, *C. Bernojurensis*, from the Calcareous Grit, Bernese Jura; and Lonsdale, an undetermined species from the Cornbrash Forest Marble, and Bradford Clay, Wilts.

Cuvier says that the *Dicerata* do not appear to differ from the *Chama* in anything essential; only their cardinal tooth is very thick, and the spirals (umbones) of their valves are sufficiently projecting to remind the observer of two horns. G. B. Sowerby thus writes: "On account of the similarity between this genus (*Chama*) and *Diceras* we shall be expected to explain the characters by which this latter is distinguished from *Chama*, with which indeed it is arranged by Bruguière; these, according to Lamarck, are the large, conical, diverging, spiral umbones, and the large, concave, subauriculate, prominent tooth in the large valve of *Diceras*. Not having ourselves seen the hinge of *Diceras*, we will not venture to offer an opinion; but, judging from the specimens we possess, we see in *Diceras* a sort of connecting link between *Isocardia* and *Chama*, having both the umbones free and involute, and being moreover a nearly equivalve shell, like *Isocardia*; but being attached by one valve, and not quite equivalve, in these respects resembling *Chama*." Rang observes: "This genus is very imperfectly known, without doubt, but nevertheless one may well believe that it is very near to *Chama*." Defrance enumerates five species. Deshayes does not give it as a genus in his tables and in his last edition of Lamarck only two species are recorded, *Diceras arietina* (Lam.), the type from Mont Salève and the neighbourhood of St. Mihiel, and *Diceras sinistra* (Desh.), from the superior Oolite in the vicinity of the last-named place.

Diceras arietina.

Rang would place next to *Diceras* the genus *Caprina* of D'Orbigny senior; and he is of opinion that if that zoologist would publish his discoveries on these interesting shells, the genus would be generally adopted. The genus *Ichthyosarcolite*, which has been always classed with the Cephalopods, might, he thinks, belong to a bivalve approximating to *Caprina*. Deshayes, he says, communicated to him the same idea. But the last-named author does not notice the genus when treating of *Diceras* in the last edition of Lamarck.

CHAMÆDO'REA, a genus of Palms, also called *Nunnezharia* and *Nunnesia*. They are small reed-like plants, with ringed shoots. Their leaves are either cleft or pinnated. The inflorescence is sessile within the sheaths of the leaves, and branched in an irregular manner; the spathes are membranous. The flowers are yellow and diœcious, without bracts, which is a remarkable circumstance. In the males the calyx is cup-shaped and 3-parted, the petals 3, and the stamens 6. In the females the calyx and petals are the same; the ovary 3-celled; the berry 1-seeded; the albumen even; and the embryo lateral. These are palms of humble growth, receding in that respect from the general character of the order, and approximating to Herbaceous Endogens, or to Bamboos. *C. fragrans*, the Chutasalium of the Peruvians, is a plant with a stem about a man's height, and so fragrant as to fill the groves with its perfume in the months of August, September, and October.

1, *Chamædorea pauciflora*; 2, *C. fragrans*.

CHAMÆLAUCIACEÆ, Fringe Myrtles, a small natural order of Polypetalous Exogenous Plants. They are characterised by having a 1-celled ovary, ascending ovules, dotted leaves, and the embryo fused into a solid mass. They are small bushes with evergreen leaves, and in external appearance have a close resemblance to heaths. All their parts abound in glandular oily cavities. They are mostly regarded as belonging to *Myrtaceæ*, and there is no doubt of their affinity to that order. Their peculiar aspect, abortive stamens, simple ovary, and pappose calyx sufficiently distinguish them. They have the fragrance of *Myrtaceæ*. Fifteen genera and fifty species are included in this order, all natives of Australia. Their position, according to Lindley, is between *Asteraceæ* and *Combretaceæ*, near to *Myrtaceæ*. (Lindley, *Vegetable Kingdom*.)

CHAMÆLE'DON, a genus of plants belonging to the natural order *Ericaceæ*. *C. procumbens* is a beautiful little alpine bush, formerly referred to *Azalea*, from which it differs essentially both in habit and botanical characters. It is a small evergreen creeping shrub, found on the mountains of Europe and North America. The leaves are leathery, shining, turned back at their edge, and about half an inch long. The flowers are minute, and grow in terminal umbels of a light flesh-colour. The calyx is 5-parted; the corolla campanulate and regularly 5-cleft, the anthers rounded and opening longitudinally. It is occasionally seen in gardens, but it is rather impatient of cultivation.

CHAMÆLEONIDÆ. [CHAMELEONS.]

CHAMÆPELIA. [COLUMBIDÆ.]

CHAMÆ'ROPS, a genus of Palm-Trees, in which is comprehended the most northern species of those remarkable vegetable productions whose home is so frequently in the tropics. It is characterised by its flabelliform leaves, polygamous flowers, which are sometimes even diœcious, and triple monospermous drupes, with ruminated albumen. *Chamærops humilis*, the European species, grows in hot-houses to the height of 15 feet; but in Spain and Barbary it is not more than 4 or 5 feet high, and in Italy it is much dwarfer. It is common upon the hills near Algiers. It occurs in many places in the southern parts of Italy, and reaches its northern limits in the vicinity of Nice. The trunk of this plant is 5 or 6 inches in diameter, and closely covered with triangular hard scales, which are the bases of the old leaves. The new leaves grow in a tuft at the top of the stem, and have smooth flat stalks, with rigid spines proceeding from the edge; the blade is deeply palmate, with from 12 to 15 narrow sword-shaped divisions, which are slightly glaucous and downy. The flowers grow within compressed spathes, which are downy at the edge, and from 6 to 8 inches long, and upon a short compressed spadix, which is closely covered over. The drupes are blackish-brown, and round, with a fibrous dry spongy flesh. The young underground parts of the stem and the young roots are said by Desfontaines to be eatable.

European Palm (*Chamærops humilis*).

CHAMÆZA, a genus of Birds belonging to the family *Merulidæ* of Vigors. [MERULIDÆ.]

CHAMECK. [ATELES.]

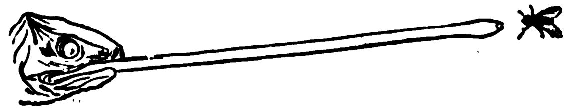
CHAMELEONS, CHAMELEON-TRIBE, CHAMÆLEONIDÆ, the name for a well-defined family of Saurians (Lizard-like Reptiles), whose differential and essential characters may be summed up as existing in the form of their feet, the toes of which are joined or bound up together in two packets or bundles opposed to each other—in their shagreen-like skin—in their prehensile tail—and in their extensile and retractile vermiform tongue.

Organisation.—Skeleton.—The more striking peculiarities consist in the elevated and pyramidal form of the occiput; the absence of a true sternum; and in certain apophyses of the vertebral column, especially about the tail, where they are placed en chevron, so as to leave at their base a space where the caudal artery, a prolongation of the pelvic, is protected somewhat in the same way as the spinal cord is by the bony case above it, when the prehensile tail would otherwise subject it to pressure in grasping boughs of trees or other solid bodies with its lower surface. The transverse apophyses of the tail are but little developed. The glenoid cavity is supported upon a short pedicle. The majority of Saurians have eight cervical vertebræ, but the Chameleons have only five. The first ribs are joined to the mesial line, which performs the office of a sternum, and the following ribs are united to each other by their cartilaginous prolongations towards the mesial line of the belly, so as to protect the abdomen by an entire bony circle. There are, as Schneider has observed, but two shoulder-bones, of which the coracoid is very small, the clavicle being entirely absent. Cuvier remarked the singular disposition of the wrist. The two carpal bones which come next to those of the fore-arm are articulated upon one large central piece, which receives the five bones which correspond to the metacarpal, three of these being for the external toes and two for the internal, thus forming two opposeable prehensile instruments, the two bundles being bound up in the integuments and skin to the very claws. In the pelvis, the ilia are long and slender and directed towards the sacrum, with which they partially unite, but are prolonged by a cartilage. The hind as well as the fore toes are five, and disposed in the same manner as those of the anterior extremities. The trunk, which has a compressed appearance, is mounted high on the legs, forming an exception to the majority of reptiles, whose belly touches the ground.

Skull of *Chamæleo bifidus*.

Organs of Respiration.—Cuvier observes that their lung is so large that when it is filled with air it imparts a transparency to the body, which made the ancients say that it lived upon air; and he inclined to think that to its size the Chameleon owed the property of changing its colour. But with regard to this last speculation he was in error, as we shall presently see.

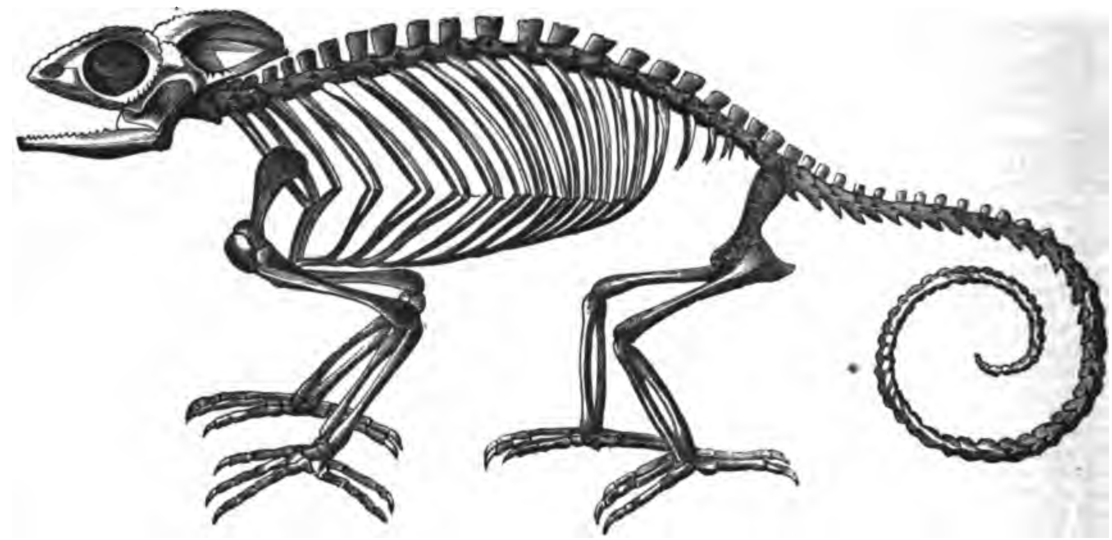
Organs of Nutrition and Digestion.—The teeth, as in the great majority of Saurians, have no true roots: their crowns, which are trilobated, seem to be soldered as it were upon the edge of the upper border of a groove hollowed in the maxillary bone; they are connected to the osseous portion and also to each other, so as to present the appearance of an enamelled and denticulated portion of the edge of the bone. But it is the vermiform extensile and retractile tongue which is the chief organ for taking the insects on which the chameleon lives. By a curious mechanism, of which the os hyoides (tongue-bone) is a principal agent, the Chameleon can protrude this cylindrical tongue, which is terminated by a dilated and somewhat tubular tip covered with a glutinous secretion, from the sheath at the lower part of the mouth (where the whole of the tongue, with the exception of the dilated tip, remains when at rest) to the length of six inches. When the Chameleon is about to seize an insect it rolls round its extraordinary eyeballs so as to bring them to bear on the devoted object: as soon as it arrives within range of the tongue, that organ is projected with unerring precision, and returns into the mouth with the prey adhering to the viscous tip.



Chameleon taking his prey.

There is not much difference between the œsophagus and stomach, which latter is small and bent back upon itself. There is no true pylorus, although there exists, at the point where it should be, a sort of contraction in the membranes, which are there thickened.

Organs of Sense.—Touch.—On the under surface of the tail and toes are granulated papillæ, probably for the purpose of conveying to the sensorium the nature of the body grasped. The tongue must have a considerable share of the sense of touch; whether it has any high perception of that of taste may be doubted. Smell.—Most probably not acute; the external orifices of the nostrils are more lateral, and consequently wider apart than in most of the other Saurians. Hearing.—There is no visible external ear, but an internal cavity not much developed in the bones of the sides of the skull, communicating with the throat, and covered externally by the common integuments.



Skeleton of Chameleon (*Chamæleo vulgaris.*)

Sight.—The eyes of the Chameleon are remarkable objects; large, projecting, and almost entirely covered with the shagreen-like skin, with the exception of a small aperture opposite to the pupil: their motions are completely independent of each other. It adds to the strange and grotesque appearance of this creature, to see it roll one of its eye-globes backwards, while the other is directed forwards, as if making two distinct surveys at one time. Its sight must be acute, from the unerring certainty with which it marks and strikes its prey.

Reproduction.—By means of eggs, which are numerous at each deposit, oval, and enveloped in a white, tough, parchment-like skin.

Habits, &c.—The Chameleons spend their lives in trees, clinging to the branches by means of their feet and tail. There they lie in wait for the insects which may come within their reach; and it is highly probable that, in such situations, their faculty of changing their colour becomes highly important in aiding them to conceal themselves. They move about with great regularity and a kind of affected gravity. The powers of abstinence possessed by this singular race are very great, and hence most probably arose the old fable of their living on air, which was for a long time considered to be "the chameleon's dish." We kept one for upwards of six weeks, and during all that time it never, as far as we could observe, took any sustenance, though meal-worms and other insects were procured for it. Notwithstanding this fast, it did not appear to fall away much. It would fix itself by the feet and tail to the bars of the fender, and there remain motionless, apparently enjoying the warmth of the fire for hours together. Its motions were excessively slow. It was a female, and died after laying a great number of eggs. Hasselquist describes one that he kept for near a month, as climbing up and down the bars of its cage in a very lively manner. Numbers have been exhibited from time to time in the Zoological Gardens, Regent's Park, but they do not live long. The males are distinguished by the thickness of their tails.

That the Chameleon was known to the ancients there is no doubt. It was the Χαμαιλέων of the Greeks and the *Chamæleo* of the Latins. Aristotle's history of the animal proves the acute observation of that great zoologist, for he notices the peculiarities of the animal, the absence of a sternum, the disposition of the ribs, the mechanism of the tail, the motion of the eyes, the toes bound up in opposeable bundles, &c., though he is not entirely correct in some points. ('Hist. Anim.,' book 2, ch. xi.) Pliny ('Hist. Nat.,' lib. viii., c. 33) mentions it, but his account is for the most part a compilation from Aristotle.

The power possessed by these creatures of changing colour has been a subject of wonder and exaggeration from an early period. Wood, in his 'Zoography,' gives the following translation of the account given by the French academicians of this phenomenon: "The colour of all the eminences of our chameleon, when it was at rest, in the shade, and had continued a long time undisturbed, was a bluish-gray, except under the feet, where it was white inclining to yellow; and the intervals of the granules of the skin were of a pale and yellowish-red. This gray, which coloured all the parts exposed to the light, changed when in the sun; and all the places of its body which were illuminated, instead of their bluish colour, became of a brownish-gray, inclining to minime. The rest of the skin which was not illuminated by the sun changed its gray into several brisk and shining colours, forming spots about half a finger's breadth, reaching from the crest of the spine to the middle of the back; others appeared on the ribs, fore legs, and tail. All these spots were of an Isabella colour, through the mixture of a pale yellow with which the granules were tinged, and of a bright red, which is the colour of the bottom of the skin which is visible between the granules; the rest of the skin not enlightened by the sun, and which was of a paler gray than ordinary, resembled a cloth made of mixed wool; some of the granules being greenish, others of a minime gray, and others of the usual bluish-gray, the ground remaining as before. When the sun did not shine, the first gray appeared again by little and little, and spread itself all over the body, except under the feet, which continued of the same colour, but a little browner; and when, being in this state, some of the company handled it, there immediately appeared on its shoulders and fore legs several very blackish spots, about the size of a finger nail, and which did not take place when it was handled by those who usually took care of it. Sometimes it was marked with brown spots, which inclined towards green. We afterwards wrapped it up in a linen cloth, where having been two or three minutes we took it out whitish; but not so white as that of which Aldrovandus speaks, which was not to be distinguished from the linen on which it was laid. Ours, which had only changed its ordinary gray into a pale one, after having kept this colour some time, lost it insensibly. This experiment made us question the truth of the chameleon's taking all colours but white, as Theophrastus and Plutarch report, for ours seemed to have such a disposition to retain this colour, that it grew pale every night, and when dead it had more white than any other colour; nor did we find that it changed colour all over the body, as Aristotle reports; for when it takes other colours than gray, and disguises itself to appear in masquerade, as Ælian pleasantly says, it covers only certain parts of the body with them. Lastly, to conclude the experiments relative to the colours which the chameleon can take, it was laid on substances of various colours, and wrapped up therein; but it took not them as it had done the white, and it took that only the first time the experiment was made, though it was repeated several times on different days. In making these experiments we observed that there were a great many places of its skin which grew brown, but very little at a time: to be certain of which we marked with small specks of ink those granules which to us appeared whitest in its pale state, and we always found that when it grew brownest and its skin spotted, those grains which we had marked were always less brown than the rest."

Numerous theories, some of them sufficiently absurd, have been proposed to account for this phenomenon. It was reserved for Milne-Edwards to give a complete and satisfactory explanation. In a paper published in the 'Annales des Sciences Naturelles' for January, 1834, and translated in the 17th vol. of the 'Edinburgh New Philosophical Journal,' he has given the result of his investigations. The following are his conclusions:—

1. That the change in the colour of Chameleons does not depend essentially either on the more or less considerable swelling of their bodies, or the changes which might hence result to the condition of their blood or circulation; nor does it depend on the greater or less distance which may exist between the several cutaneous tubercles; although it is not to be denied that these circumstances probably exercise some influence upon the phenomenon.

2. That there exists in the skin of these animals two layers of membranous pigment placed the one above the other, but disposed in

such a way as to appear simultaneously under the cuticle, and sometimes in such a manner that the one may hide the other.

3. That everything remarkable in the changes of colour that manifest themselves in the Chameleon may be explained by the appearance of the pigment of the deeper layer, to an extent more or less considerable, in the midst of the pigment of the superficial layer; or from its disappearance beneath this layer.

4. That these displacements of the deeper pigment do in reality occur; and it is a probable consequence that the chameleon's colour changes during life, and may continue to change even after death.

5. That there exits a close analogy between the mechanism by the help of which the changes of colour appear to take place in these reptiles, and that which determines the successive appearance and disappearance of coloured spots in the mantles of several of the Cephalopods.

This family embrace but the one genus, *Chamæleo*. Dr. J. E. Gray places the *Chamæleonidæ* in the tribe *Dendrosaura*, of the sub-order *Pachyglossæ*, of the order *Saura*, or Lizards. The tribe *Dendrosaura* embrace only this family, and have the following characters:— Scales of the belly, sides, and back, granular. Tongue elongate, sub-cylindrical, worm-like, very extensile. Eyes globular, very mobile, with a small central round opening. Toes equal, united in two opposing groups.

The species are inhabitants of the Old World, in Africa and Asia, and are naturalised in Southern Europe.

The following species are described in the 'Catalogue of the Specimens of Lizards in the British Museum:'—

* Back with an erect fin. Belly crested.

C. cristatus, the Fringed Chameleon. A native of Fernando Po.

** Back high, compressed. Belly and sides with a toothed crest.

C. lateralis, the Side-Crested Chameleon. It is a native of Madagascar.

*** Back and belly with a toothed crest. Sides simple.

† Scales equal, small. Muzzle simple.

C. vulgaris, the Chameleon. It is the *C. mutabilis*, Meyer; *C. cinereus*, Aldrovandus; *C. Parisiensis*, *C. Zeylandicus*, and *C. Mexicanus*, Laurent; *C. carinatus*, *C. subcroceus*, *C. calcaratus*, Merrem; *C. Zebra*, Bory; *Lacerta Chamæleon*, Linnæus. It is a native of the East Indies, and the species which is most frequently brought to England.

Chameleon (*Chamæleo vulgaris*).

C. Senegalensis, the Senegal Chameleon. It is the *Lacerta Chameleon* of Linnæus; *C. Boneæ Spei* of Laurent; *L. pumila* of Gmelin. It is a native of the West of Africa.

C. dilepis, the Flap-Necked Chameleon. Found in Africa. Specimens in the British Museum have come from Fantee, Ashantee, Gambroon, and Senegal.

†† Scales unequal, larger tubercles. Muzzle simple.

C. Pardalis, the Bourbon Chameleon. A native of Bourbon.

C. verrucosus, the Warty Chameleon. It inhabits Madagascar.

††† Scales unequal. Muzzle (of male) with a central prominence.

C. Rhinoceratus, the Rhinoceros-Chameleon. A native of Madagascar. Specimens of this and the last species were presented to the British Museum by Sir Edward Belcher.

**** Back with a toothed crest. Belly and sides simple.

† Chin and muzzle simple.

C. tuberculiferus, the Tuberculated Chameleon. A native of South Africa.

C. cucullatus, the Hooded Chameleon. An inhabitant of Madagascar.

†† Chin simple; muzzle compressed, produced.

C. nasutus, the Sharp-Nosed Chameleon. A native of Madagascar.

††† Chin simple; muzzle of male forked.

C. bifurcus, the Large-Naped Chameleon. A native of Madagascar.

†††† Chin bearded; muzzle simple.

C. Tigris, the Fringed Chameleon. Found in the Seychelle Islands.

C. ventralis, the Belly-Shaped Chameleon. Found in South Africa.

C. pumilus, the Pearled Chameleon. A native of the Cape of Good Hope.

***** Back and belly not crested.

C. Parsonii, Parson's Chameleon. A native of Madagascar.

C. Owenii, the Three-Horned Chameleon. It is a native of Fernando Po.

C. Brookesianus, Brookes's Chameleon. Locality unknown. Named from a specimen in the Museum of Joshua Brookes.

CHAMOIS. [ANTILOPEÆ.]

CHAMOISITE, a mineral, composed of Silicate of Iron.

CHAMOMILE. [ANTHEMIS.]

CHAMP, a valuable kind of timber, produced in the East Indies by *Magnolia excelsa*.

CHANDELIER-TREE, a species of *Pandanus* which grows in Guinea and St. Thomas's, and which, on account of the arrangement of its dichotomous branches, has obtained this name. [PANDANUS.]

CHAODINEÆ, Chaotic Plants, a family invented by Bory, for the purpose of placing a number of the lower forms of plants or organic beings of uncertain character, which could not be placed amongst other well-defined groups of *Cryptogamia*. To this family were at one time assigned forms of *Diatomaceæ*, *Desmideæ*, *Nostoc*, and others.

CHARA'CEÆ, *Charas*, the Chara Tribe, a curious group of plants inhabiting pools and slow streams, to which they communicate a nauseous offensive odour, which is said to become a pestilential miasma, when, as in the Campagna of Rome, the plants are in great numbers. They are jointed leafless plants, with verticillate branches, composed either of one or of several tubes adhering in bundles, and either encrusted with calcareous matter (*Chara*), or transparent (*Nitella*). The reproductive organs are of two kinds. One named a nucule, is an oval sessile spirally striated body, with a five-cleft apex, and a number of grains in its interior; this has been looked upon as the pistil, and has been seen to grow into a young plant. The other, called the globule, is a reddish body consisting of triangular scales, inclosing a mass of elastic wavy threads, and has been named an anther.

Chara.

a, A portion of tubular stem, showing the bases of a whorl of leaves; *b*, leaf, bearing the organs of fructification; *c*, a single organ of fructification, greatly enlarged; *d*, upright section of the fruit; *e*, plant germinating.

The following is Schleiden's description of these organs:—"On the lateral branches, generally in the axis of the above-mentioned pair of cells, five cells may be seen spirally wound round a thick mass, and having their parallel extremities surrounded by a kind of pentagonal crown. From this thick granular mass a large cell (spore) is formed, filled with large granules of starch, mucus, and oil-globules, and with a substance that closely invests the spore-cells; and from being at first transparent subsequently becomes green or red, and finally black. The five investing cells then either become cartilaginous, and remain until the whole decays after germination, or they are converted into a gelatinous state, and then speedily dissolved after the sporocarp has fallen. Close below this sporocarp there may generally be seen, at the same time, seated upon a short cylindrical cell, another cell, which is at first simple and spherical, but from which eight [query always eight?] cells are gradually developed, which become flattened, and inclose a cavity that appears from its origin to be filled with a dense grumous mass. The eight cells expand into closely compressed radii, arranged side by side, increasing the circumference and depth of the whole body, whilst red granules are gradually deposited upon their inner wall. The dark contents are meanwhile developed into other cells, so that in the perfect organ a conical cell projects from the cell forming the pedicle into the cavity, and a cylindrical cell is formed from the middle of each of the eight cells of the wall. These new cells, which likewise contain pale-red granules, bear on their free extremity several spherical or truncated cylindrical cells, from which project many long filaments composed of minute cells. The spherical cells and the filaments form a dense coil in the centre of the cavity. In each separate cell of the filament we at first see a grumous mass, which however subsequently disappears, giving place to a spiral fibre coiled up in two or three turns, and which manifests a peculiar motion on escaping from its cell. These mysterious organs have, as yet, without any reason, been termed anthers."

There is however an analogy between these organs and the so-called spermatozoids of other *Cryptogamia*, that would lead to the inference that they perform the same functions. [REPRODUCTION, VEGETABLE.] In addition to these organs, Montague has recently described bulbilli as present in the *Characeæ*, by which, he says, the species are frequently propagated.

The *Characeæ* are also highly interesting on account of the facility with which they exhibit the circulation of their fluids, and because of the light they thus appear to throw upon some of the more obscure of the phenomena of vegetable life. If one of the tubes of a *Chara* be observed under a pretty good microscope, by the aid of transmitted light, the fluid it contains will be distinctly seen to have a motion up one side of each tube, down the other, and then up again, after the manner of a jack-chain; and this goes on continually as long as the plant remains alive. No spectacle that we are acquainted with is more beautiful than this, if it is well seen with the aid of a good microscope. This movement was first described by Amici. It has led to the examination of other water plants; in most of which the same kind of circulation can be detected. The best account of these movements, with drawings, is that published by Varley in the 'Transactions of the Microscopical Society,' vol. ii. [CYCLOSIS.]

Remains of *Characeæ* are frequently found in the fresh-water Tertiary deposits, but not lower down. The species are met with almost everywhere in stagnant water in Europe, Asia, Africa, North and South America, and Australia. They are most prevalent in temperate climes. The species of *Chara* are of no known use. The stems of the species which are calcareous often present beautiful examples of crystals of carbonate of lime. They are easily cultivated in glass vessels, which is often done for the sake of examining their circulation under the microscope. In the *Chara* this can only be done after removing the calcareous incrustation, but in *Nitella* it is seen without any preparation. The family has three genera and thirty-five species. Their relations are evidently with the *Algæ* on the one hand, and the *Equisetaceæ* on the other.

CHARA'DRIADÆ, a family of Birds, placed by Mr. Vigors in the order *Grallatores*, or Waders. The genus *Charadrius*, including the True Plovers, the Dottrell, the Sea-Lark, the Sanderling, the Stone Curlew (*Œdicnemus*), the Long-Legged Plover (*Himantopus*), and the Spur-Winged Plover (*Charadrius spinosus*), was placed by Linnæus, in his 'Systema Naturæ,' between the genera *Tringa* and *Recurvirostra* [AVOSET], in his order *Grallæ*.

Cuvier makes the family of Plovers (Les Pluviers, *Charadrius*, Linn.), comprising those genera which want the hind toe, and have a moderate bill compressed and convex at the end, consist of two genera, *Œdicnemus*, and the Plovers so called (*Charadrius*, Linn.), embracing the Golden Plover, *Charadrius Morinellus*, *C. Hiaticula*, &c. The Plovers are succeeded by the Vanneaux (*Vanellus*, Bechst., *Tringa*, Linn.), consisting of *Squatarola*, Cuv., and *Vanellus*, Cuv.; which are followed by *Hæmatopus* and *Cursorius;* after which last, judging from external form, he places the Çariama (*Microdactylus*, Geoff., *Dicholopus*, Ill.). [ÇARIAMA.]

The following is Mr. G. R. Gray's arrangement. He makes the *Charadriadæ* the first family of the *Grallatores*.

Sub-Family 1. *Œdicneminæ.*

Genera. *Œdicnemus*, Temm. (*Charadrius*, Linn.; *Otis*, Lath.; *Pluvialis*, Briss.).

Burhinus, Ill. (*Œdicnemus*, Shaw; *Charadrius*, Lath.).

Sub-Family 2. *Cursorinæ.*

Genera. *Cursorius*, Lath. (*Charadrius*, Gm.; *Tachydromus*, Ill.; *Oreophilus*, Gould).

Ortygodes, Vieill. (*Hemipodius*, Sw.; *Ortygis*, Steph.).

Pluvianus, Vieill. (*Charadrius*, Gm.; *Cursor*, Wagl.; *Hyas*, Gloger; *Ammoptila*, Sw.; *Cheilodromus*, Rüpp.).

Sub-Family 3. *Charadrianæ.*

Genera. *Glareola*, Briss. (*Hirundo*, Linn.; *Trachelia*, Scop.

Squatarola, Cuv. (*Tringa*, Gm.; *Pluvialis*, Briss.; *Vanellus*, Bechst.; *Charadrius*, Pall.).

Vanellus, Briss. (*Tringa*, Linnæus; *Charadrius*, Wagler; *Gavia*, Klein).

Erythrogonys, Gould.

Philomachus, Mœhr. (*Parra*, Gmelin; *Vanellus*, Gmelin; *Hoplopterus*, Bonap.).

Charadrius, Linn. (*Pluvialis*, Ray).

Eudromias, Boie (*Charadrius*, Linn.; *Pluvialis*, Briss.; *Morinellus*, Gesn.).

Hiaticula, Mœhr. (*Charadrius*, Linn.; *Pluvialis*, Briss.; *Ægialitis*, Boie).

Pipis, Licht. (*Charadrius*, Licht.).

Anarhynchus, Quoy and Gaim. (*Scolopax?* Raffles).

Sub-Family 4. *Hæmatopinæ.*

Genus. *Hæmatopus*, Linn. (*Ostralega*, Briss.; *Scolopax*, Scop.).

Sub-Family 5. *Dromadinæ.*

Genera. *Dromas*, Payk. (*Erodia*, Stanley; *Corrira*, Briss.?)

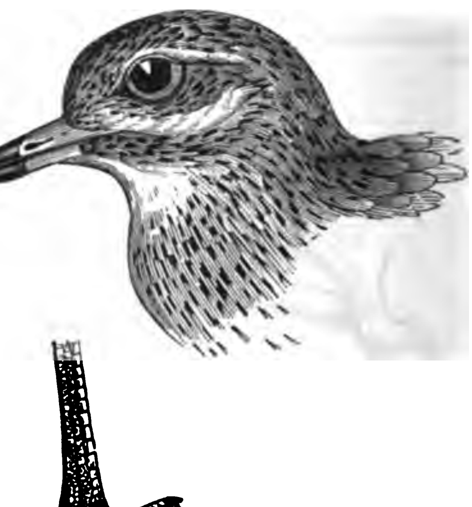
Esacus, Less. (*Carvanaca*, Hodgs.).

We now proceed to the consideration of some of the forms included in this family.

The first family of the order *Grallatores*, according to Mr. G. R. Gray's arrangement, is the *Charadriadæ*, which are divided by him into the following sub-families and genera:—

In illustration of this family we select principally the species inhabiting the British Islands.

Œdicnemus crepitans, the Great Plover. It is the *Otis Œdicnemus*, Pennant; *Charadrius Œdicnemus*, Montagu; *Oidicnemus Bellonii*, Fleming. It is also known by the common name of the Norfolk Plover. It is the Ostardeau of Belon; Le Grand Pluvier, ou Courlis de Terre, of the French; Gran Pivieri, Curlotte, Ciurlul, and Ciurlotti of the Italians; Lerchengraue Regenpfeifer, Grosser Brachvogel, and Grosse Bragvogel oder Gluth, of the Germans, among whom it is also called Triel, or Griel, according to Gesner, who thinks that it is the *Charadrius* of Aristotle; the Glin-braff of the ancient British. This genus connects the Bustards and Plovers.



Head and foot of *Œdicnemus.*

Mr. Gould, who concurs in this view, observes that he has often had occasion to remark, that while the normal or typical groups are abundant in species, the aberrant forms, which appear to be created for the purpose of filling up the intervening chasms, are restricted for the most part to a limited number of species: thus while the Bustards and Plovers comprise a vast multitude of species, the genus *Œdicnemus* contains at most but five or six species, and these confined entirely to the regions of the Old World. ('Birds of Europe.')

The following is the character of the genus:—Bill strong, nearly straight, rather depressed towards the tip; culmen elevated, lower mandible angulated; nostrils longitudinal, pierced through and through the horny part of the middle of the bill, and most open anteriorly. Tarsi long; three toes, all before, united as far as the second joint by a membrane which skirts their edges. Wings moderate; first quill shorter than the second, which is longest.

The only British example of the genus is the Great Plover. It has all the upper parts of a reddish ashy-brown, with a longitudinal dash on the middle of each feather; space between the eye and the bill, throat, belly, and thighs, pure white; neck and breast slightly coloured with reddish and speckled with longitudinal brown streaks; a longitudinal white band on the wing; towards the middle of the first quill a great white dash, and a very small one on the interior barb of the second; lower tail-coverts ruddy; quill-feathers, except those of the middle, terminated with black; base of the bill bright-yellowish, the rest black; naked skin round the eyes, iris, and feet, pure yellow. Length from the bill to the feet 16 inches 2 lines. Male and Female.

Great Plover (*Œdicnémus crepitans*).

Such is Temminck's description of the adult bird; but the plumage varies in some individuals. For instance, in the specimen figured and described by Gould, in his 'Birds of Europe,' there is an obscure bar of white above and below the eye, and the ground-colour of the flanks and under surface is stated to be yellowish-white; whilst the yellow toes and feet are noticed as having a tinge of green.

The young birds have the colours less distinct, and are detected at the first glance by the highly dilated form of the upper part of the tarsus and by the size of the knee-joint. Temminck, who gives this description, adds that this form of the tarsus exists in the young of the year of all species of birds with long slender legs, but is particularly remarkable in the young *Œdicnemi*.

Rapid on foot, powerful in flight, which it executes in wide circles, and haunting downs and open places, this species is in general approached with difficulty by the sportsman, though it will often squat in places favourable to its colour, till it is almost trod on. Their shrill evening cry pierces the ear, and may be heard nearly a mile in a still night. Slugs, worms, reptiles, and, some say, mice are eaten by them; but the two former seem to be their favourite food. White, in a letter to Pennant, dated 30th March, 1768, says, "I wonder that the Stone Curlew (*Charadrius Œdicnemus*) should be mentioned by writers as a rare kind: it abounds in all the campaign parts of Hampshire and Sussex, and breeds, I think, all the summer, having young ones, I know, very late in the autumn. Already they begin clamouring in the evening. They cannot, I think, with any propriety be called, as they are by Mr. Ray, 'circa aquas versantes;' for with us, by day at least, they haunt only the most dry, open, upland fields, and sheep-walks, far removed from water: what they may do in the night I cannot say. Worms are their usual food, but they also eat toads and frogs." No nest receives the eggs, which are two or three in number, of a light brown or dirty white, with dusky blood-coloured blotches and streaks. "It lays," says the author of the 'History of Selborne,' "its eggs, usually two, never more than three, on the bare ground, without any nest, in the field; so that the countryman, in stirring his fallows, often destroys them. The young run immediately from the egg, like partridges, &c., and are withdrawn to some flinty field by the dam, where they sculk among the stones, which are their best security; for their feathers are so exactly of the colour of our gray-spotted flints, that the most exact observer, unless he catches the eye of the young bird, may be eluded. . . . *Œdicnemus* is a most apt and expressive name for them, since their legs seem swollen like those of a gouty man. After harvest I have shot them before the pointers in turnip-fields." In his Manuscript the same author remarks that they seem to descend in the night to streams and meadows, perhaps for water, which their upland haunts do not afford them.

Geographical Distribution.—Europe generally, where it seems to be migratory in many parts, in Britain and Germany for instance. Temminck notes it as abundant in the south of France (in which country Belon found young ones that could not fly at the end of October), Italy, Sardinia, the Greek Archipelago, and Turkey. It is also found in Asia and Africa. It occurred among the Trebizond collection of birds presented to the Zoological Society of London by Mr. Keith Abbott; and the localities attributed to it by Mr. Gould are Europe and Africa, but not India. ('Zool. Proc.,' 1834.) Col. Sykes however had previously recorded it among the birds of the Deccan: at least he says "there is no visible difference between the Dukhun and British species." ('Zool. Proc.,' 1832.) If it be the *Charadrius Kervari* of Hasselquist, which Linnæus and most authors suppose it to be, that traveller describes it as inhabiting Lower Egypt, near the sepulchres, and in the deserts. In Britain it arrives early in the spring. The following is the earliest period recorded by White:—"On the 27th of February, 1788, Stone Curlews were heard to pipe; and on March 1st, after it was dark, some were passing over the village, as might be perceived by their quick short note, which they use in their nocturnal excursions by way of watch-word, that they may not stray and lose their companions. Thus we see that retire whithersoever they may in the winter, they return again early in the spring, and are, as it now appears, the first summer birds that come back. Perhaps the mildness of the season may have quickened the emigration of the curlews this year." They are seldom seen after the beginning of October; but Markwick states that he received on the 31st January, 1792, a bird of this species which had been recently killed by a neighbouring farmer, who said that he had frequently seen it in his fields (Sussex) during the former part of the winter. This, perhaps, adds Markwick, was an occasional straggler, which, by some accident, was prevented from accompanying its companions in their migration. As the autumn advances, these birds collect into flocks, soon after which they leave this country. Norfolk, Suffolk, Kent, and Hampshire seem to be the favourite counties of the Stone Curlew; but it occurs, though rarely, in the Yorkshire Wolds, higher than which it does not seem to go in these islands. Mr. Selby says that he never met with it or heard of it in the more northern English counties, nor in Scotland. It does not occur in Mr. Thompson's Irish list in the 'Zoological Proceedings.'

The Great Plover is a delicate bird for the table.

In the 'Portraits d'Oyseaux,' the following quatrain well describes the bird and the reason for the name given to it by Belon:—

> "L'on peut nommer cestuy-cy Ostardeau,
> Parcequ'il est approchant de l'Ostarde.
> Qui sous le ply des genoux l'os regarde,
> Le trouve gros plus qu' à nul autre oyseau."

Cursorius. Bill as long as head; mandibles arched, and compressed towards their extremities; base depressed; tip sharp and entire; nostrils basal, oval, with an oblong lateral opening. First quill longest. Legs long; three front toes separated throughout; middle toe much the longest, with a serrated claw.

C. Temminckii, Black-Bellied Courier, Swainson. The following is Mr. Swainson's specific character and description:—"Cream-coloured brown; top of the head and breast ferruginous, nuchal collar double; the lower, with the quills and middle of the body, black; the upper and the sides of the body white. Total length from the bill to the tail eight inches; bill one inch from the gape, and half from the end of the nostrils. Legs three inches from the naked thigh to the tip of the middle toe, the claw of which is serrated internally. Tail round; the middle feathers not spotted; the two next with a black dot near the tip, which, in the next pair, is further broken into two white dots; the outer pair white." ('Zool. Illust.,' pl. 106, first series). It inhabits Africa (Abyssinia.)

Black-Bellied Courier (*Cursorius Temminckii*).

C. Isabellinus, Meyer, Temminck; *C. Europœus*, 'Ind. Orn;' *C. Gallicus*, Gmelin; Le Courvite, Buff.; Cream-Coloured Plover, Latham; Cream-Coloured Courser, Pennant; Cream-Coloured Swift-Foot, Selby. It has been seen in France and England, but only as an occasional visitor. Thus we find (Mont. 'Orn. Dict.') that one was killed in France, where it was seen to run with great swiftness; another was shot near St. Alban's in East Kent, the seat of William Hammond, Esq., on the 10th of November, 1785, and he presented the prize to Dr. Latham. Mr. Hammond first met with it on some light land; and so little fearful was it, that having no gun with him at that time he sent for one, which did not readily go off, having been charged for some time, and, in consequence, he missed his aim; the report frightened the bird away, but after making a turn or two, it again settled within a hundred yards of him, when he was prepared with a second shot, which killed it. He observed it to run with incredible swiftness, considering its size, and at intervals to pick something from the ground: it was so bold as to render it difficult to make it rise in order to take a more secure aim on the wing. The note was unlike that of any known bird. Colonel Montagu says that one was shot in North Wales in the year 1793, and preserved in the collection of the late Professor Sibthorp at Oxford. Mr. Atkinson, author of 'The Compendium of Ornithology,' was also in possession of a specimen shot at Netherby, in April, 1816.

Another of these birds was taken in Austria; and the young bird in the Darmstadt Museum, alluded to by Temminck, was probably killed in Europe. Mr. Fox ('Zool. Journal,' vol. iii., p. 492) records the death of one shot on the 15th October, 1827, under Timberwood Hill, in Charnwood Forest, Leicestershire, by a tenant of Mr. T. Gisborne. He described it as coming flying over his head, uttering a cry with which he was unacquainted, and it settled near him. Some idea of the enormous prices which were at one time given by collectors for rare birds killed in Britain may be formed from the sum which Dr. Latham's specimen produced: Mr. Fox says it was purchased for 83 guineas.

Glareola, Brisson. Bill short, hard, convex, curved for upwards of half its length, and compressed towards the point. Nostrils at the sides of the base, oblong, and obliquely cleft. Legs feathered nearly to the knee; toes, three before and one behind, the outer united to the middle one by a short membrane; claws long, and drawn to a fine point. Wings very large, the first quill-feather the longest. Tail more ar less forked. (Gould.)

Example, *G. Pratincola* (*Hirundo Pratincola*, Linnæus), the Collared Pranticole. Both male and female when old have the summit of the head, nape, back, scapulars, and coverts of the wings gray-brown; throat and front of the neck white slightly tinged with red, which colour is encircled or framed, as it were, by a very narrow black band, which ascends towards the corners of the bill; space between the eye and the bill black; breast whitish-brown; under coverts of the wings chestnut-red; lower parts white, clouded with reddish; coverts of the tail and origin of the caudal feathers pure white, the rest blackish towards their end; bill black, red at its base, iris reddish-brown; naked circle round the eyes bright-red; feet reddish-ash. Tail very much forked. Length rather more than 9 inches. (Temm.)

In this state it is the Perdrix de Mer of Brisson, &c.; the Perdrix de Mer Ordinaire et à Collier of Gerard; Austrian Pratincole of Latham; Das Rothfüssige Sandhuhn of Bechstein; Das Oestrichische Halsband, and Südliche Sandhuhn, of Brehm; and Pernice di Mare of Savi.

Varieties.—The gray-brown brighter or deeper: the white of the throat more or less clouded with reddish or bright russet; the gular black band more or less intense in colour, and often accompanied by a very small white line. The band too is often only indicated by small black spots. (Temm.)

When young the upper parts are brown-ash, clouded with deeper undulations and whitish borders; throat tarnished white, surrounded with brown spots disposed so as to replace the band which surrounds this part in the old birds; breast and belly deep gray with brown spots, but sometimes without spots; the tail less forked, and the lateral feather much shorter than in the old.

In this state it appears to be La Perdrix de Mer à Collier, la grise, la brune, et la Giarole of Sonnini, of Buffon; La Perdrix de Mer des Maldives, de Coromandel, et de Madras, of Sonnerat; Das Braunringige Sandhuhn, and Gefleckte Sandhuhn, of Bechstein; and Collared and further varieties of Pratincole of Latham.

"The genus *Glareola*," says Mr. Gould in his great work on the 'Birds of Europe,' "appears to be strictly confined to the Old World, no transatlantic example having ever been discovered, nor indeed are we aware of any form in the ornithology of America which at all approaches the present. Three species are all that are as yet discovered. Of these, two (the *G. grallaria* and the *G. lactea*) are peculiar to the eastern provinces of Asia and Africa; the other, the bird now before us (*G. torquata*), is spread throughout the warm and temperate regions not only of these continents, but Europe also: hence it would seem as if nature endeavoured to make up by extent of habitat for the limitation of species. Still however, although thus diffused, the Prantincole may be said to be truly a native of the eastern provinces of Europe on the Asiatic borders, and especially Hungary, where wide tracts of morass and flat lands, abounding in lakes both fresh and saline, and traversed by mighty rivers, afford it food and security. 'In Hungary,' says M. Temminck, 'among the immense morasses of the lakes Neusidel and Balaton, I have been in the midst of many hundreds of these birds;' and we might add that it is no less abundant in Western Tartary. In England it is only an occasional visitor; but in Germany, France, and Italy, it is a bird of periodical occurrence."

M. Temminck, in the last part of his 'Manuel,' states that it breeds in Sardinia, and that it is very abundant in Dalmatia, on the borders of the lake Boccagnaro, on its spring passage. The eggs he describes as being yellowish-white. "With the long wings and forked tail of the swallow"—we again quote Mr. Gould—"the Pranticole possesses that rapidity and power of flight for which the bird is so remarkable. It takes its food, which consists of insects, and especially such as frequent marshes and the borders of rivers, while on the wing, darting along in the chase with the rapidity of an arrow; nor is it less distinguishable for celerity on the ground, and often catches its prey as it nimbly runs along. This elegant and graceful bird incubates in the concealment afforded by reeds, osiers, and tall herbage, laying three or four white eggs." A pair of Pratincoles were shot at Yarmouth in 1827; another in Wilbraham Fen in Cambridgeshire in 1835; and a specimen at Blakeney in Norfolk, in May, 1845.

Collared Pratincole (*Glareola Pratincola*).

Squatarola, Cuvier. Bill rather strong, cylindrical, straight, nearly as long as the head; the tip or horny part about half the length of the whole bill, tumid and arched, with the tomia bending inwards; nasal grooves wide, half the length of the bill; mesorhinum depressed below the level of the tip; nostrils longitudinally pierced in the membrane of the groove, linear, oblong. Wings rather long, acuminate, with the first quill-feather the longest. Legs slender, of mean length, naked above the tarsal joint; feet four-toed, three before and one behind; front toes joined at their base by a membrane, that portion of it between the outer and middle toe being the longest; hind toe very small or rudimental; tarsi reticulated. Plumage thick, close, and adpressed. (Gould.)

Head and Foot of *Squatarola*.

S. cinerea (*Tringa Squatarola*, Linn.), the Bastard or Gray Plover.

Adult Male and Female, Winter Plumage.—Front, throat, middle of the belly, thigh, abdomen, and upper coverts of the tail, pure white; space above the eye, front of the neck, sides of the breast and sides, white, varied with brown and ashy spots; upper parts blackish-brown, variegated with greenish-yellow spots, but the whole of the feathers terminated with ash-colour and whitish; long internal feathers of the wings deep black; lower coverts of the tail marked on their external barbs with small diagonal brown bands; tail white, but reddish towards the end, striped with brown bands, which are pale and few, and placed on the lateral feathers; bill black; iris blackish; feet ashy-black. Length rather more than 10 inches.

Adult Male and Female, in their Spring or Nuptial Plumage.—Space between the eye and the bill, throat, sides and front of the neck, middle of the breast, belly, and sides, deep black; front, a large band above the eyes, lateral parts of the neck, side of the breast, thighs, and abdomen, pure white; nape variegated with brown, black, and white; occiput, back, scapulars, and coverts of the wings, deep black; all the feathers of these parts terminated by a large space of pure white; large white spots on the greatest of the wing-coverts and on the scapulars; oblique black bands on the lower tail-coverts; feathers of the middle of the tail striped with white and black.

The young before the moult resemble more or less the adult birds and the young in winter; the front, space above the eye, sides of the neck, and sides are variegated with larger but paler spots; upper parts of a bright-gray tint varied with whitish, also a little whitish at the extremity of the quills; transverse bands of the tail gray. (Temm.)

In the first of these states of plumage the bird is the *Tringa Squatarola*, Gmel.; Le Vanneau Varié, Buff.; and Gray Sandpiper, Lath. ('Syn.')

In the second it is the *Vanellus melanogaster*, Bech.; *Tringa Helvetica*, Gmel.: *Charadrius apricarius*, Wils.; Le Vanneau Suisse, Buff.; Swiss Sandpiper, Lath.; and Schwarzbauchiger Kiebiz, Meyer.

The young before the moult are *Tringa Squatarola, var.*, Gmel.; Le Vanneau Pluvier, and Vanneau Gris, Buff.; Gray Sandpiper, Lath.; and Schwarzbauchiger Kiebiz im Herbstkleide, Meyer.

M. Temminck, who gives these synonyms, remarks in his 'Manuel,' that at the two epochs of the moult, individuals are found which have the deep black of the lower parts sprinkled with some white feathers, or when the white predominates it is variegated with some black feathers. The birds in winter plumage and the young may, he observes, be easily distinguished from those of the Golden Plover, first by the presence of the posterior toe, and secondly by the long black feathers which are found inside of the wings, near the body; the rest of the plumage differs so little at these epochs, that one might be easily mistaken.

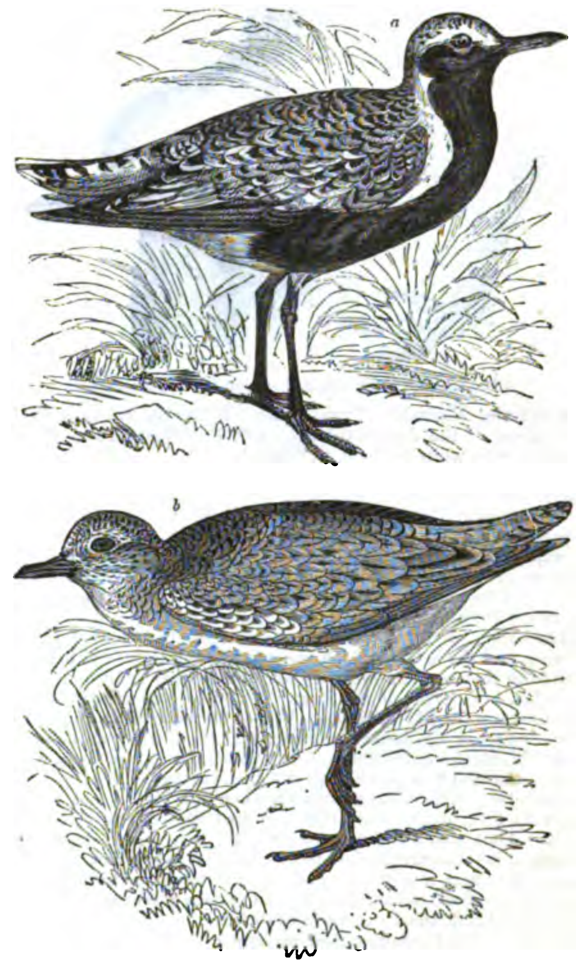
This species is the *Charadrius hypomelas* of Wagler, and the Gray Squatarole of Shaw. It appears to be the Pluvier Gris of Belon, and in the 'Portraits d'Oyseaux,' &c., is the following loyal quatrain under the figure of the bird:—

> "De nuict seulet, de jour en compagnie,
> Va le Pluvier suyvant son appelleur.
> Par la voit-on, que c'est bien le meilleur,
> Qu'une gent soit par un roy gouvernée."

M. Temminck, who, in the fourth part of his 'Manuel' (1840), protests against the generic separation of this form, not without a passing but sweeping censure on "toutes les autres coupes nouvelles," adds to the synonyms *Squatarola varia et Helvetica*, Brehm.; Kiebiz Regenpfeifer, Naum; Pivieressa, Savi; and Sprackling Vipa, Nils.

In Britain, where this bird is not numerous, and principally known as a migratory species, it is found on the coast "in oozy bays, or at the mouths of rivers," where it feeds upon worms, marine crustaceans, &c. The bird runs well, and its whistle is like that of the Golden Plover, but not so shrill. If killed in good season it is delicious for the table. The nest is of the most rude construction. A shallow depression in the earth is lined with a few pieces of dried bents or straw, and there four eggs generally, which are oil-green blotched with black, are deposited. According to Wilson and Nuttall, this Plover has often in the temperate parts of the United States two broods in a season, though it has only one in Massachusetts, where their nests are of rare occurrence. During the summer both young and old feed much upon various kinds of berries, particularly those of the early bramble, called dew-berries, and their flesh is then highly esteemed. About the last week in August they repair with their young to the borders of the sea-coast, where they assemble in great numbers, feeding on small shell-fish, shrimps, and other small marine animals. Grasshoppers and other insects that abound in the fields are also eaten by them. "They are," says Nuttall, "extremely shy and watchful, uttering a loud rather plaintive whistling note as they fly high and circling in the air, and are so often noisy, particularly in the breeding season, as to have acquired among many of the gunners along the coast the name of the Black-Bellied Killdeer. They usually linger round the sea-coast in the Middle States till the commencement of November, when the frosts beginning sensibly to diminish their prospect of subsistence, they instinctively move off towards the south, proceeding probably at this time under the shade of twilight, as moving flocks are nowhere, as far as I can learn, seen by day. About the middle of September, in the marshes of Chelsea (Mass.) contiguous to the beach, they sometimes assemble at daybreak in flocks of more than a thousand individuals together, and soon after disperse themselves in companies on the shores, to feed upon the small shell-fish and marine insects (*Crustacea*). This crowding instinct takes place a short time previous to their general migration southward." ('Manual of the Ornithology of the United States and Canada.')

The Gray Plover is found in all the temperate countries of Europe. More abundant in France than in Germany; rare in Switzerland; common enough in the islands and on the coasts of Holland. Abundant in summer in the regions of the Arctic Circle and of Oriental climates, where it breeds. M. Cantraine killed a young one in the Strait of Boniface. (Temm.) Dr. Von Siebold and M. Bürger saw it in Japan, and M. Temminck states that he has seen individuals from that locality in both summer and winter plumage. Sir John Richardson, who notices it as the Toolee-areeoo, or Tooglee-aiah, of the Esquimaux, says that it is observed in the Fur Countries in similar places to those frequented by the Golden Plover, though it is not equally common, and that it breeds in open grounds from Pennsylvania to the northern extremity of the continent. He describes a specimen killed at Hudson's Bay (lat. 57°) in August 1822. Captain James Ross, in the Appendix to Sir John Ross's 'Last Voyage,' observes that it was more rarely met with than the Golden Plover, but was found breeding near the margins of the marshes immediately to the south-west of Fury Point in considerable numbers. Some specimens were also obtained near Felix Harbour. It is met with in Egypt, and upon the confines of Asia, in Siberia, &c. (Selby.) The last-quoted author states that in Britain there are a few stations on the coast of Northumberland where it is found during the whole winter, but only in families or small flocks. It generally arrives about the middle of September, sometimes even earlier, he adds, at which time several of the old birds still retain a part of their summer plumage. In the month of May they go northward. Mr. Gould says that they appear in the greatest abundance in this country while performing their periodical migrations in the months of April and May along the coasts of Lincolnshire, Norfolk, Suffolk, Essex, and Kent. ('Birds of Europe.')



Gray Plover or Gray Lapwing (*Squatarola cinerea*).
a, Spring plumage; *b*, Winter plumage.

Vanellus (Briss.). Bill shorter than the head, straight, slightly compressed, the points of both mandibles horny and hard. Nasal groove wide, and reaching as far as the horny tip. Nostrils basal, linear, pierced in the membrane of the nasal groove. Legs slender, with the lower part of the tibiæ naked. Feet 4-toed, three before and one behind, united at the base by a membrane; hind toe very short, articulated upon the tarsus. Tarsi reticulated. Wings ample, tuberculated, or spurred. The first three quill-feathers notched or suddenly narrowed towards their tips, and shorter than the fourth and fifth, which are the longest. (Gould.)

V. cristatus (*Tringa Vanellus*, Linn.), the Peewit, or Lapwing. The male in winter plumage has the occipital feathers very long, loose barbed, and curved upwards. Top of the head, crest, front of the neck and breast, glossy black; upper parts deep green with brilliant reflections; sides of the neck, belly, abdomen, and base of the tail, pure white; tail-feathers terminated by a large black space, with the exception of the external feather; lower coverts ruddy, bill blackish; feet red-brown. Length rather more than 12 inches. The female has the black of the throat and breast less deep. The young before the moult have the occipital crest shorter; some blackish colour below the eyes; the throat varied with black and ashy brown; all the feathers of the upper and lower parts terminated with ochreous yellow; feet ashy-olive. The spring or nuptial plumage is scarcely distinguishable by the greater brilliancy of the reflections on the back and wings, and by the deeper intensity of the black of the throat and breast. The crest however is longer, and the colour of the feet bright reddish.

Head and foot of Peewit, or Lapwing (*Vanellus cristatus*).

Accidental Varieties.—Pure white. Yellowish white with faint indications of the deeper colours. One or other part of the body speckled with white feathers. (Temm.)

This species is Le Vanneau of the French; Paoncella Commune of the Italians; Gehaübte Kiebiz of the Germans; De Kievit of the Netherlanders; Peaseweep, Peewit, Bastard Plover, Lapwing, and Wype, of the British; Cornchwigel of the Welsh. It is also the Wipa, Kowipa, and Blæcka, of the Swedes; Vibe and Kivit of the Danes; and, according to Belon, Αἴξ of the Greeks (Aristot., 'Hist. Anim.,' viii. 3); Pavonzino and Parruchello of the Italians; and in some provinces Dixhuit and Papechieu of the French.

The habits of this species very much resemble those of the other Plovers, and the arts by which the parents try to lead either dog or man from their eggs or young by counterfeiting the gait of a wounded bird, &c., are as well if not better known as the stratagems of its congeners on the like occasions. This is the bird which furnishes the plover's eggs of the London market; and those who rob the nest are, it is said, careful not to take all, but they leave one or two, so as to induce the bird to go on laying, which she generally does to make up her number. The full complement, when the bird is not robbed, is generally four, and they are olive-coloured, spotted and blotched with black. That part of the egg which is usually called the white (the albumen) is transparent when boiled, and has somewhat of a bluish tinge. The nest, if nest it may be called, is the bare earth. It haunts the borders of rivers, lakes, plains, and marshy places, and is generally to be found near the sea-shore in the winter. This part of its habits well agrees with those described as proper to Aristotle's *Aix*, according to the reading given by Belon. This elegant bird seems to have been as much esteemed by the French for the table as by our own countrymen. In the 'Portraits des Oyseaux' the following quatrain appears under the figure of the bird:—

"Voy cy dessus le portraict du Vaneau,
Et le voyant, pourras ta veue paistre;
Mais si tu veulx d'un bon morceau repaistre
Il y a peu de meilleurs oyseaux d'eau."

In the 'Northumberland Household-Book,' 'Wypes' are charged at one penny each, and they are among the birds admitted to his lordship's own 'mess.'

The Peewit is spread over the whole of Europe, and is particularly plentiful in Holland. Mr. Gould states that he has seen specimens in collections from India and Africa. It is noted by Messrs. Dixon and Ross as occurring in great numbers near Erzeroom, arriving at the end of March, and departing at the end of November. During the summer it frequents the river (Kara-Su, or northern branch of the Euphrates), but on its arrival, and previous to its departure, it is found in moist fields. The native name is Kiz-Cooshóo (Maiden's Bird), or Kahmaum Cooshóo (Bath-Bird). *Vanellus Keptuschka*, and *Charadrius Morinellus* and *C. minor* were found by those gentlemen at the same locality. ('Zool. Proc.,' 1839.) It appears in the 'List of Birds' seen in Japan, by Dr. Von Siebold and M. Bürger; and Temminck states that individuals from that locality differ in nothing from those of Europe.

Peewit, or Lapwing (*Vanellus cristatus*).

This species is confined to the Old World; but Captain P. P. King, R.N., has described a second species from the Straits of Magalhaens. It is figured in the 'Illustrations of Ornithology,' under the name of *Squatarola cincta*.

Philomachus, the Spur-Winged Plover. It is the *Philomachus spinosus* (*Charadrius spinosus*, Linn.; *Pluvialis Senegalensis armata*, Briss.; *Pluvianus spinosus*, Gould.)

Spur-Winged Plover (*Philomachus spinosus*).

When the male and female are in perfect plumage all the summit of the head and occiput, throat, front of the neck, breast, sides, quills, and three-fourths of the tail are black; region below the eyes, lateral base of the bill, sides of the neck, nape, long feathers on the sides, inside of the wings, the whole border of the wing, thighs, abdomen, rump, and first fourth of the origin of the tail, pure white; the whole of the mantle, quills nearest the body, as well as all the coverts, gray-brown, more or less deep or umber-colour; two lateral feathers of the tail terminated with white. Length 10 to 11 inches.

This is Le Pluvier à Aigrette, Le Pluvier Huppé de Perse, and the Pluvier Armé du Senegal, of Buffon; Spur-Winged and Black-Breasted Indian Plover of Latham.

Little or nothing is known of the habits of this species, with the exception of what we learn from Dr. Latham, who says that it inhabits Russia, and is frequent near Aleppo, about the river Coie. "The Spur-Winged Plovers," says he, "are very numerous and exceedingly noisy, have a hasty and continual movement of the head and neck, drawing them up briskly, and then stretching them quickly forward, almost as if they were making hasty and eager bows."

M. Temminck gives Egypt and Senegal as the habitat of this bird, and says that it shows itself accidentally in Italy, but is said to be more common in the islands of the Grecian Archipelago. In Greece, he adds, great numbers are found; and Professor Nordmann killed one in Russia.

Charadrius (Linn.). Bill slender, straight, compressed, shorter than the head; nasal furrow prolonged more than two-thirds; mandibles enlarged towards the tip. Nostrils basal, jagged, cleft longitudinally in the middle of a large membrane which covers the nasal fossa. Toes three, directed forwards, the external united to the middle one by a short membrane; the inner toe free. Tail square or slightly rounded. Wings moderate, first quill-feather longest. (Gould.)

Head and foot of Golden Plover (*Charadrius pluvialis*).

C. pluvialis (Linn.), the Golden Plover. The old male in winter plumage has the top of the head, as well as all the upper parts of the body, wings, and tail, sooty black, marked with large spots of golden yellow, disposed on the borders of the barbs of the feathers; sides of the head, neck, and breast varied with ashy brown and yellowish spots; throat and lower parts white; quills black, shafts white towards the end; bill blackish; feet deep ash-colour; iris brown. Length rather more than 10 inches.

The young of the year have the upper parts ashy black with spots of yellowish ash. (Temm.)

In this garb the birds are, according to Temminck, *C. pluvialis*, Gmel.; *C. auratus*, Suckow; Le Pluvier Doré, Buff.; Golden or Green Plover, Lath; Goldregenpfeifer, Bechst.; Piviere Dorato, of the 'Stor. degl. Ucc.'; Goud Plevier, Sepp.

The old male and female in summer or nuptial plumage have the upper parts deep black; over all the borders of the feathers are disposed small spots of a very bright golden yellow; front and space above the eyes pure white; lateral parts of the neck white also, but varied with great black and yellow spots; throat, front of the neck, and all the other lower parts, deep black.

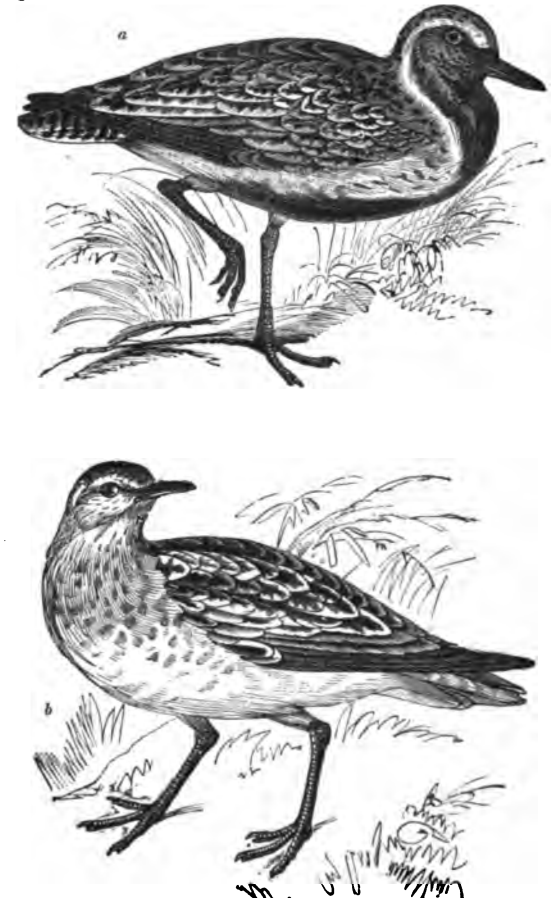
White and black mingled are often seen on the lower parts of the feathers during the moult. This livery is always to be seen on the young birds, even after their first spring moult. (Temm.)

In this state the bird is, according to M. Temminck, *C. apricarius*, Gmel.; Le Pluvier Doré à Gorge Noire, Buff.; Alwargrim Plover, Lath.

In the fourth part of his 'Manuel,' M. Temminck adds the following synonyms:—*C. auratus*, Naum.; Der Platköpfige, Hochsternige, Mittlere, und Hochköpfige Goldregenpfeifer, Brehm.; Brockfogel, Nils.; and Ploiere, Savi.

This species is also Le Pluvier Guillemot of Belon (who says that it is named Pluvier, "pour ce qu'on le prend mieux en temps pluvieux qu'en nulle autre saison," and he gives an amusing account of the mode of taking these birds by the peasants); Der Rechte Brachvogel of the Germans; Hawk's Eyes of the Hudson's Bay residents (?); Cwttyn yr aur of the ancient British.

Mr. Selby gives a most correct and interesting account of the habits of the bird in this country:—"About the end of May or beginning of June the females begin to lay, making but a little artificial nest, a small depression in the ground amidst the heath being generally taken advantage of, and lined with a few dry fibres and stems of grass. The eggs are four in number, rather larger than those of the lapwing, of a cream-yellow inclining to oil-green, with large irregular confluent blotches or spots of deep umber-brown. The young, when excluded, are covered with a beautiful particoloured down of bright king's yellow and brown. They quit the nest as soon as hatched, and follow their parents till able to fly and support themselves, which is in the course of a month or five weeks. The old birds display great anxiety in protecting their young brood, using various stratagems to divert the attention of an enemy; among others, that of tumbling over, as if unable to fly, or feigning lameness, is most frequent, and appears indeed to be the instinctive resort of those birds that construct the nest and rear their young on the ground. When aware of an intruder near, the female invariably runs to some distance from her nest before she takes wing, a manœuvre tending to conceal its true situation; and the discovery of it is rendered still more difficult by the colour and markings of the eggs assimilating so closely to that of the ground and surrounding herbage. The usual call-note of the Plover is a plaintive monotonous whistle, by imitating which it may frequently be enticed within a very short distance. In the breeding season a more varied call is used, during which it flies at a great elevation, and continues soaring round for a considerable time. Towards the end of August these birds begin to leave the moors (having there congregated in large flocks), and descend to the fallows and the newly-sown wheat-fields, where an abundance of their favourite food can be readily obtained. At this season they soon become very fat, and are excellent at the table, their flesh not being inferior in flavour to that of the Woodcock or any of our most esteemed sorts of game. In these haunts they continue till severe weather approaches, when they either move nearer to the coast or migrate to the southern parts of the kingdom. They fly with strength and swiftness, and if disturbed, when in large flocks, generally perform many aërial evolutions and rapid wheelings before they again settle on the ground. The Golden Plover is a nocturnal feeder, and during the day is commonly seen squatted upon the ground or standing asleep, with the head drawn down between the shoulders. Its food consists of earth-worms, slugs, insects, and their larvæ, particularly those of the Lepidopterous tribe, many rare species of which I have, upon dissection, found in their stomachs and gullet during the summer season. It runs very fast, and, when wounded, is difficult to be caught without the aid of a dog."



Golden Plover (*Charadrius pluvialis*.)
a, Summer dress; *b*, Winter dress.

This species has been always considered, and most justly, a delicious dish. It figures in the old bills of fare accordingly. Thus in the account of Sir John Nevile, of Chete Knight, of the viands, &c., used at the marriage of his son-in-law Roger Rockley and his daughter Elizabeth Nevile, the 14th of January, in the seventeenth year "of the reigne of our soveraigne lord king Henry VIII.," we find in the second course, "Item, plover, 8 of a dish," and among the charges, "Item, in plover, 3 doz., 5*s*." In the charge of the said Sir John Nevile, at Lammas Assizes, twentieth of Henry VIII., we also find "Item, 6 doz. plovers, 12*s*." Four hundred plovers appear among "the goodly provision" at the intronization of George Nevell, archbishop of York, in the reign of Edward IV. Drayton, in his 'Polyalbion,' makes Lyndsey boast that her "fowle more ayrie are" than those of Holland (Lincolnshire);

> "And make fine spirits and blood;
> For neere this batning isle, in me is to be seene,
> More than on any earth, the plover grey and greene."

There is evidence of the presence of the Golden Plover in each of the four quarters of the globe. Mr. Gould indeed, in his observations on the geographical distribution of the species collected by Mr. Keith Abbot in the neighbourhood of Trebizond, notices the bird as inhabiting Europe, and the adjoining portions of Africa and Asia, but not America. ('Zool. Proc.,' 1834.) Now Temminck expressly says that the species is the same in America and Asia. Sabine also (Parry's 'First Voyage') makes Wilson's *C. apricarius* and the Golden Plover identical, and states that it breeds in the swampy parts of the North Georgian Islands in considerable abundance. Richardson states that the breeding-quarters of this well-known bird are the Barren Grounds and the coasts and islands of the Arctic Sea. "It hatches," he says, "early in June, and retires southward in August. Numbers linger on the muddy shores of Hudson's Bay and on the sandy beaches of rivers and lakes in the interior until the hard frosts of September and October drive them away. At this period they are very fat, and are highly prized by the epicures of the Fur Countries. They make but a short stay in Pennsylvania, and are said to winter beyond the United States." ('Fauna Boreali-Americana.')

Captain Sir James Ross, R.N., notices it as abundant during the breeding season in most parts of the arctic regions, and he found them plentifully in the neighbourhood of Felix Harbour, feeding in the marshes in company with *C. semipalmatus* (American Ring-Plover). (Sir John Ross's 'Second Voyage.') Nuttall remarks that the bird is, according to the season of the year, met with in almost every part of the world, particularly in Asia and Europe, from Kamtchatka to China, as well as in the South Sea Islands, and from Arctic America, where it breeds, to the Falkland Islands. The Prince of Canino ('Birds of Europe and North America') appears, on the other hand, to agree with Mr. Gould, for the Prince makes the American analogue of *C. pluvialis*, Linn., *C. Virginiacus*, Borkh. (*C. pluvialis*, Wils.); and Colonel Sykes notes it among the birds of the Deccan, and as identical with Javanese specimens, smaller indeed than one North American specimen and two English specimens in the British Museum, but absolutely identical with other British specimens. He says that it is rare in the Deccan, and appears only in the cold weather. In the stomach he found beetles, land-insects, and coarse sand. ('Zool. Proc.,' 1832.) It appears among the list of birds seen in Japan by Dr. Von Siebold and M. Bürger; and Temminck states that those killed there did not differ essentially from those of Europe. Mr. Selby allows a wide geographical range to it, though not to the extent supposed by many naturalists, the birds which have been considered by them as belonging to this species being of a different one, namely, *C. marmoratus* of Wagler. Instead therefore of extending the range of the Golden Plover to America, Australia, and other parts of the southern hemisphere, he feels inclined to limit it to Europe, Northern Asia, and some few districts in the north of Africa. ('British Ornithology.')

C. Morinellus, Linn., the Dotterel. It is *Eudromias Morinella*, Boie; *E. Morinella montana et stolida*, Brehm, according to Temminck.

This bird in its winter plumage has the top of the head and occiput blackish-ash; large eyebrows of reddish-white uniting on the occiput; face white, dotted with black; upper parts blackish-ash tinged with greenish, all the feathers of those parts framed as it were with ruddy colour; breast and sides reddish-ash; the large patch on the breast and the middle of the belly pure white; shaft of the first quill white, except towards the end, tail terminated with white; bill black; iris brown; feet greenish-ash. Length more than 8 inches.

The young have the tints more ashy; top of the head reddish or rusty, varied with longitudinal spots; the ruddy colour which frames as it were the feathers of the upper parts less vivid; tail terminated with bright ruddy.

In their summer or nuptial plumage the very old male has the face and eyebrows very pure white; summit of the head and occiput blackish; nape and sides of the neck ashy; feathers of the mantle and wings bordered with very deep ruddy; on the breast a narrow brown band, succeeded by a large white cincture; part below the breast and sides very bright ruddy; middle of the belly deep black; abdomen reddish-white. The female is of a ruddy colour on the sides often clouded with ash-colour; black spot of the middle of the belly less apparent than in the male, or varied with white feathers.

This is the Pluvier Guignard and Pluvier Solitaire of the French; Piviere de Corrione and Piviere Tortolino of the Italians; Der Dumme Regenpfeifer of the Germans; Dotterel, Dotterell, and Dottrell of the British, and Hullan of the Welsh.

Drayton sings, of this bird—

> "The Dotterell, which we think a very dainty dish,
> Whose taking makes such sport as man no more can wish;
> For as you creepe, or cowre, or lye, or stoupe, or goe,
> So marking you (with care) the apish bird doth doe,
> And acting everything, doth never mark the net,
> Till he be in the snare which men for him have set."

Poets have a right to a little licence, and in many of the older prose writers a similar account of the silly mimicry of the bird is given. "The Dotterel," says Mr. Selby, "has always been considered a stupid bird, but for what reason I cannot conceive. I allow that, on its first arrival, it shows but little fear of man, but this, I apprehend, arises more from inexperience of persecution in its native wilds than from any other cause, and which appears evident from the birds, when harassed and repeatedly fired at, soon becoming too cautious to admit of near approach any longer. Their habits also contribute to render them unwary, for being nocturnal-feeders (like many others of the *Charadriadæ*), they are at rest and asleep during the greater part of the day, in which state also the Golden Plover (a wary bird when roused) will frequently admit of a close approach. As to the story of the Dotterel mimicking the actions of the fowler, by stretching out its leg, wing, or head, when he sets the example, it, without doubt, arose from the motions that they as well as other birds usually and most naturally make when roused from a state of repose; and which every one who attends to the habits of the feathered race must (in flocks of gulls, plovers, tringas, &c.) have frequently observed." The food consists principally of insects, slugs, and worms. For a long time it was doubted whether the Dotterel bred in this country, but these doubts are now removed, as the reader will find in the next paragraph. The rude nest is formed of lichens or moss, and the three or four lustreless olive-coloured eggs are sprinkled with large dots and numerous spots of deep brown-olive.

Mr. Selby notices the Dotterel as particularly abundant in Northern Asia and the eastern parts of Europe, and as inhabiting Siberia and the vast steppes of Tartary, frequently living in the vicinity of the salt lakes and marshes of that open region. He adds, that it is also found, during its winter migration, in Italy and Spain, and that the great body of these birds retires to the high latitudes of Northern Asia, Russia, and Lapland Alps to breed; but the flocks which pass along the eastern coast of our island are supposed to limit their flight to the upland districts and mountains of Sweden and Norway. Temminck states that it breeds in the north of Russia; also in Norway on the great bare plateaux of the mountains, and in no great number on the high mountains of Bohemia and Silesia at an elevation of from 4500 to 4800 feet. In this country, Sussex, Hampshire, Wiltshire, Berkshire, Cambridgeshire, Lincolnshire, Derbyshire, Yorkshire, and Northumberland possess it. Dr. Latham states that in the elevated district of Braemar, Aberdeenshire, these birds hatch their young on dry mossy ground near to and on the very summits of the highest parts, sometimes in the tufts of little short heather or moss. The female sits three weeks, and the young appear about the middle of July. Mr. Yarrell exhibited eggs of this bird, belonging to Mr. Heysham, of Carlisle, obtained on Skiddaw in the summer of 1835. Several pairs were breeding in the same locality. ('Zool. Proc.,' 1836.) Mr. Gould ('Birds of Europe') says, "The eggs of these birds are so difficult to obtain, that we only know one collector who possesses them. They are one inch eight lines long, by one inch two lines and a half in breadth, light olive-brown blotched and spotted with black: these specimens were procured from the Grampian Hills."

Dotterel (*Charadrius Morinellus*), in nuptial plumage.

They are excellent for the table when in season. Numbers are shot near Cambridge and Royston during their spring migration. We find 'Dotrels' charged at one penny each, a considerable sum in those days, in the 'Northumberland Household-Book,' and enumerated among the birds admitted to the high (his lordship's) table. They now find a ready sale in the London market at about six shillings a couple.

C. hiaticula, the Ringed Plover, Ring-Dotterel, Grand Pluvier à Collier of Temminck. It is found throughout the year on most of the shores of the British Islands, and is even more numerous on our own shores in winter than it is in summer.

C. Cantianus, the Kentish Plover, Pluvier à Collier Interrompu, Temminck. This bird was first obtained at Sandwich in Kent, and named by Dr. Latham in his 'General Synopsis of Birds.' Dr. Plomley of Maidstone states that it is very numerous in Romney Marsh at the present time. It arrives in April, breeds on the shingle, and departs in August. (Yarrell, 'British Birds,' vol. ii.)

C. minor, the Little Ringed Plover, or the Little Ring-Dotterel, Petit Pluvier à Collier, Temminck. Although on the continent of Europe by no means a rare bird, it has been obtained very rarely in England.

Hæmatopus. Bill long, strong, compressed; point very much compressed, chisel-like. Nostrils lateral, longitudinally slit in the groove of the bill. Feet strong, muscular; three toes directed forwards, middle toe united to the external one, up to the first joint, by a membrane, and to the internal toe by a small rudiment; toes bordered with the rudiment of a membrane. Wings moderate, the first quill longest.

Habits of the Genus.—The species live along the sea-shore, on the beach or sands; following the retreat of the waves, to gather such crustaceous or marine animals as they wash up. They assemble in great flocks for their migrations, but live solitarily during the time of pairing and incubation. Their nests are made in the herbage and in the marshy meadows near the sea, and they both run and fly with rapidity. Their cry is shrill and resounding. They moult twice, in autumn and spring, but the colours of the plumage scarcely change at all at those periods; the only marked difference observed at this change of plumage exists in the absence or presence of the white gorget. There is no difference in the sexes. (Temm.)

H. ostralegus (Linn.), the Oyster-Catcher. The male and female in winter plumage have the head, nape, upper part of the breast, back, wings, and extremity of the tail, deep black; a very marked gorget under the throat; rump, origin of caudal feathers and quills, transverse band on the wings, as well as all the lower parts, pure white; bill and naked circle round the eyes very bright orange; iris crimson; feet obscure red.

The young of the year have the black of the plumage clouded and bordered with brown; the white dirty; bill and naked circle of the eyes blackish-brown; iris brown; feet livid gray.

The summer or nuptial plumage has all the upper parts of the front of the neck of the same black as the wings, which black is more lustrous and with reflections. (Temm.)

This is L'Hultrier, Pie de Mer, and Becasse de Mer, of the French; Beccaccia di Mare of the Italians; Marspitt and Strandskjura of the Swedes; Tialldur (fem. Tilldra) of the Icelanders; Kielder of the Feroe Islanders; Tield, Kield, Glib, and Strand-Skiure, of the Norwegians; Strand-Skade of the Danes; Geschackte Austernfischer of the Germans; Scholackster of the Netherlanders; Oyster-Catcher and Sea-Pie of the British; and Piogen y Môr of the Welsh.

It is common in Denmark, Sweden, and Norway, Russia, Siberia, and extending to Kamtchatka; the British Islands (where it is indigenous, and breeds), from the Scilly Isles to Shetland; common and resident in Ireland. Temminck states that this species also lives in North America, but that the Oyster-Catcher of Brazil and the whole of South America forms a distinct race. He adds that it also inhabits Japan. The Prince of Canino, in his 'Birds of Europe and North America,' however does not include it among the North American birds, but places opposite to it (in the American column) *Hæmatopus palliatus*, Temm. (*H. ostralegus*, Wils.; *H. Brasiliensis*. Licht.).

Oyster-Catcher, or Sea-Pie (*Hæmatopus ostralegus*).

It feeds upon small crustaceans, &c. and bivalve mollusks, which last its powerful bill and frame well enable it to open, so as to get at the contents. It will frequently wade far out, and trust to swimming back for its return. Their four eggs, of a bright hue, inclining to olive or yellowish stone-colour, spotted with ash-gray or dark brown, or blackish, are deposited in a shallow hole, scratched in the gravel or sand, and sometimes among the shingles of the beach, but most frequently among the herbage of marshy places near the sea. It can hardly be said to make a nest. Time of incubation three weeks. Young when first hatched covered with down of a brownish-gray colour. It is sometimes seen far up rivers and inland, where it feeds on earth-worms, &c., and fresh-water insects and mollusks. Easily domesticated in poultry-yards. Several used to be kept upon the grass in front of the Pavilion at Brighton, and there are some in the Gardens of the Zoological Society in the Regent's Park.

Strepsilas (Ill.). Bill moderate, hard at the point, strong, straight, of an elongated conical shape, slightly curved upwards; arête flattened; point straight, truncated. Nostrils basal, lateral, long, half-closed by a membrane, pierced through and through. Feet moderate; not much nakedness above the knee; three toes before and one behind; the three anterior toes united at the base by a very short membrane; the posterior toe articulated upon the tarsus. Wings acuminate; the first quill the longest. (Temm.)

S. interpres (*Cinclus interpres*, G. R. Gray), the Turnstone. The very old male has the front space between the bill and the eye, a large collar on the nape, a part of the back, a longitudinal band and another transversal one upon the wing, upper coverts of the tail, middle of the breast, as well as the other lower parts, all of pure white; deep-black takes the shape of a narrow frontal band, which, passing before the eyes, is dilated below, where on one side it is directed on the lower jaw, and on the other dilating itself anew on the sides of the neck, it surrounds the throat, and forms a wide plastron in front of the neck and on the sides of the breast; top of the head reddish-white, striped longitudinally with black; upper part of the back, scapulars, and coverts of the wing bright chestnut red, sprinkled irregularly with large black spots; a large brown band on the rump; lateral quill of the tail pure white; bill and iris black; feet orange-yellow. Length 8 inches and 2 or 3 lines. The female differs only in having the shades less pure and the black less deep.

In this state of plumage the bird is *Tringa interpres* of Gmelin; *Morinella collaris*, Meyer; Turnstone or Sea-Dotterel of Edwards.

The young of the year have no trace of black nor of red chestnut. Head and nape of ashy-brown striped with deep-brown; white spots on the sides of the head and neck; throat and front of the neck whitish; feathers of the sides of the breast deep brown, terminated with whitish; the other lower parts and the back pure white; upper part of the back, scapulars, and coverts of the wings deep brown; all the feathers surrounded by a wide yellowish border; transverse band of the rump deep brown bordered with ruddy; feet yellowish-red. The black and white more regularly defined, in proportion as the bird advances in age.

In this plumage the bird is *Tringa Morinella*, Linn.; *Tringa interpres Morinella*, Gmel.; *Arenaria cinerea*, Briss.; the Turnstone, Pennant.

The young at the age of a year have the large plastron, or collar on the front of the neck and on the sides of the breast, marked out with black feathers, terminated by a narrow whitish border; summit of the head and nape brown, spotted with blackish-brown; back, scapulars, and coverts of the wings black, all the feathers surrounded

Turnstone (*Strepsilas interpres*).

by a ruddy border; a great black spot on the lateral tail-feather; the rest as in the adults. (Temm.)

This is the Voltapietre of Savi; Steinwälzer of Brehm; and Huttan y Môr of the Welsh.

Geographical Distribution.—Very wide. Nova Zembla. Greenland, Winter Island, Felix Harbour, the coast between Victoria

Harbour and Fury Point—about the middle and end of June. Shores of Hudson's Bay and of the Arctic Sea up to the 75th parallel, where it breeds in June, quitting in September, halting in October on the shores of the Delaware, and proceeding farther south on the setting in of cold weather. The United States. The straits of Magellan. Cape of Good Hope. Japan, Sunda, the Molucca Islands, and New Guinea. Australia. In Europe, from Russia southward to Italy. Norway. Madeira. In this country it is found on the coasts from August to May, when it returns northward to breed. Stationary in Zetland, according to Dr. Fleming, who concludes that it breeds there.

The Turnstone, as its name implies, procures its food—small crustaceans, molluscous animals, &c.—by turning over with its strong bill the stones on the shore which shelter its prey. Mr. Hewitson found its nest on the coast of Norway placed against a ledge of rock, and consisting of nothing more than the dropping leaves of the juniper bush. Under a creeping branch of this shrub the eggs, four in number, of an olive-green colour, spotted, and streaked with ash-blue and two shades of reddish-brown, were concealed and sheltered.

CHARÆ'AS (Stephens), a genus of Moths of the family *Noctuidæ*. It has the following characters: Wings more or less denticulated; the posterior wings usually whitish in the males and brown in the females; palpi short, 2-jointed; maxillæ long; antennæ rather long, simple in the females, and more or less pectinated in the males; head small; thorax large, not crested; apex of the body furnished with a tuft of hairs in the males.

Several species of this genus have been found in England; their larvæ are naked, feed upon roots, and assume the pupa state underground.

C. Graminis (*Cerapteryx Graminis*, 'Cat. Brit. Lep. in Brit. Mus.'), the Antler Moth. It varies from an inch to an inch and a half in width, measured from tip to tip of the wings when expanded; it is of a brownish colour; the upper wings have a longitudinal white streak, which extends beyond the middle, and gives out three branches at the apex: touching this white line above there are two pale brown spots, and another of the same colour beneath, near the base of the wing; the apex of the wing has a row of pointed black spots, more or less distinct.

The caterpillar is of a brownish colour, with yellow streaks on the sides and back: it feeds upon grasses, and is exceedingly destructive to the pastures in Sweden. In England the insect is not so abundant; there is however an instance on record of its having committed considerable devastation in the north of England during the larva state. We allude to an account given by Mr. Wailes, in the second volume of the 'Entomological Magazine,' who observed a portion of the mountain of Skiddaw thus affected—their devastation causing the herbage to have a dry and parched appearance: the part affected comprised at least fifty acres, and extended some distance down the western side of the mountain; and so marked was the line that the progress made by the larvæ could be distinctly seen from the town of Keswick. Large flocks of rooks were observed to frequent the spot, and no doubt devoured immense numbers; the moths however appeared in great abundance in the month of August. From this same gentleman's observations we find that the history of the moth is also interesting. It appears to be their habit to fly from about half-past seven to half-past eight in the morning, during which time they are seen in some parts of the country in the utmost profusion; their appearance and disappearance are extremely sudden. The field in which Mr. Wailes observed them became in one moment a moving mass, and after about an hour not a single moth was to be seen, all having disappeared in a manner equally sudden: they fly about three or four inches from the ground, and thread their way with considerable rapidity through the stalks of grass. This moth is by no means abundant in the south of England: it departs a little from the characters of the genus in not having the wings notched.

The other species of this genus are *C. cæspitis*, the Hedge-Rustic, *C. lutulenta*, the Barred-Feathered Rustic, *C. Æthiops*, the Black Rustic.

CHARD-BEET. [BETA.]

CHARLOCK. [SINAPIS, *See* SUPPLEMENT; RAPHANUS.]

CHARR, or CHAR. [SALMONIDÆ.]

CHASMO'DIA, a genus of Coleopterous Insects of the section *Lamellicornes* (*Scarabæus*, Linn.), and sub-section *Xylophili* (Latreille). The species have the following characters:—Body rather convex and broad; scutellum large, somewhat triangular, equalling in length at least one-third of that of the elytra; the mesosternum is prolonged into a blunt point, and extends as far as the base of the femora of the anterior pair of legs; the mandibles are entire, and obtuse at the apex; maxillæ with only two teeth, and furnished with a tuft of fine hairs at the extremity; mentum elongated; elytra shorter than the abdomen, broad behind, and obtusely rounded. The male *Chasmodia* has the upper claw of the fore tarsi very broad and bifid, or divided at the apex; the inner claw is small and entire; the claws of the four posterior legs are entire, and of large size. The female has all the claws of small size; those of the anterior pair of legs simple; the four posterior legs have the outer claw bifid. The tarsi of the male are thicker than in the female, particularly those of the anterior pair of legs.

All the species of this genus are of large size, and may be readily distinguished from the *Cetoniæ* by their large scutellum and convex form, combined with their smooth and glossy appearance. The thorax is convex, and has the posterior margin considerably waved; the part joining the scutellum has a segment of a circle as it were cut out to admit the fore part of the latter, which is rounded; this character is also observed in the genus *Cetonia* and *Macraspis*, and affords a good point of distinction between these and the groups nearest allied. The genus *Macraspis* has also a very large scutellum, but differs in the tarsi and other parts. [MACRASPIS.]

Chasmodia viridis is about an inch in length and of a deep blue-green colour throughout, with the exception of the antennæ, the basal joints of which are pitchy-red, and the club is black.

There are four other species known, some of which are of a glossy brown or chestnut colour. They all inhabit South America. The species above named is common in collections from the Brazils.

CHATOESSUS, a genus of Fishes belonging to the family *Clupeidæ*. It resembles the common herring, but the first dorsal ray is prolonged in the filament. The species are inhabitants of the warmer seas.

CHATTERER. [BOMBYCILLA.]

CHAULIODUS, a genus of Natatorial Birds belonging to the family *Anatidæ*, instituted by Swainson. [DUCKS.]

CHAULIODUS, a genus of Fishes belonging to the Pike Family (*Esocidæ*). There is but one species, *C. Sloani*. It has two teeth in each jaw, across the other jaw when the mouth is shut. The dorsal fins are between the pectorals and ventrals. The first dorsal ray terminates in a filament. It has been taken at Gibraltar, is about 18 inches long, and of a deep green colour.

CHAULMOOGRA, a native Indian name for the bruised seeds of *Gynocardia odorata*. [PANGIACEÆ.]

CHAUNA. [PALAMEDEA.]

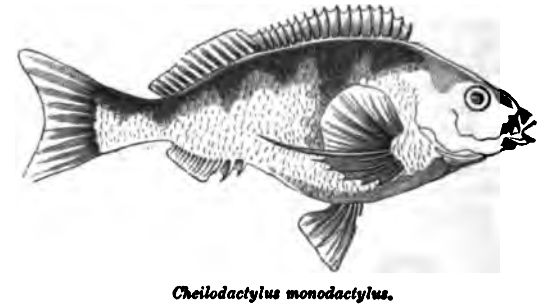
CHAVICA, a genus of plants belonging to the natural order *Piperaceæ*. It includes many of the species which are ordinarily referred to the genus *Piper*. [PIPER.]

CHEESE-RENNET, the *Galium verum* of botanists, which derives its popular name from having been formerly employed to curdle milk. [GALIUM.]

CHEILINUS. [LABRIDÆ.]

CHEILODA'CTYLUS, a genus of Fishes belonging to the section *Acanthopterygii* and family *Sciænidæ*. The mouth is small; dorsal fin with numerous spiny rays; lower rays of the pectoral fins simple and continued beyond the membrane.

Cheilodactylus monodactylus (*Chætodon monodactylus*, Carmichael. 'Linnæan Transactions,' vol. xii.) will serve to illustrate this genus. This fish is about 18 inches in length; the body is somewhat oval and compressed; the teeth are small and crowded; the pectoral fin is large, and has 15 rays, the six lower of which are simple and protrude beyond the membrane; the sixth ray from the bottom is very much elongated. The colour is olive, or bronze, with six dark stripes on the back; the fins are blackish, with the exception of the pectorals, which are amber-coloured.



Cheilodactylus monodactylus.

This species is very common on the coast of the small island of Tristan da Cunha, and feeds upon the *Fucus pyriferus*.

CHEILODI'PTERUS (Lacépède), a genus of Fishes belonging to the section *Acanthopterygii* and family *Percidæ*. The body is rather short; pre-operculum double-edged, the edges finely serrated; scales large, easily dislodged, continued on to the pre-operculum; the two dorsal fins widely separated.

The characters here detailed are those of the genus *Apogon*, from which the present genus differs chiefly in having the jaws furnished with long and pointed teeth. Three species of *Cheilodipterus* are known; they are all of small size, and furnished with slender longitudinal stripes. *C. octo-vittatus*, as its name implies, has eight stripes. *C. quinquelineatus* has five longitudinal black stripes, the ground colour of the body being silvery white; it is about four inches in length, and comes from the Society Islands. The third species, *C. Arabicus*, is of an olive-green colour above, and has the under parts silvery with a pinkish hue; this species has from 14 to 17 longitudinal stripes.

As an example of the genus *Apogon*, of which there are several species, we may notice the *Apogon Rex Mullorum*, or Roi des Rougets (Cuvier): this species rarely exceeds six inches in length, and is of a beautiful red colour with three large black spots on the back; one under each of the dorsal fins, and one towards the tail; the whole surface is also sprinkled with small black dots. The remaining species are also small, and most of them are of a red colour; a few have been found off the coast of Australia, but most of them frequent the Indian seas.

CHEIRACA'NTHUS, a genus of Fossil Fishes from the Old Red-Sandstone of Gamrie in Forfarshire and the Orkneys. (Agassiz.)

CHEIRANTHUS, a genus of plants belonging to the natural order *Cruciferæ*. This genus is known by possessing square or compressed siliques; a 2-lobed or capitate stigma; a calyx bi-saccate at the base; ovate compressed seeds in one series. The species are biennial or perennial herbs, or under-shrubs. The leaves are oblong, lanceolate, entire, or toothed. The flowers are arranged in racemes, and are of various colours—yellow, white, purple, or parti-coloured. Many of the species exhale a delicious odour, and are great favourites in gardens.

C. Cheiri, the common Wall-Flower, has lanceolate entire leaves, which are either smooth or covered with 2-parted appressed hairs; linear pods, and recurved lobes of the stigma. It is found wild throughout Europe, on old walls and in stony places, and almost constantly amongst the ruins of old castles. On this account it is a great favourite with poets, and is popularly regarded as an emblem of faithfulness in adversity. The general colour is a brown yellow, or, as a poet has called it, the "yellow wall-flower stained with iron-brown." It is however subject to considerable varieties of colour even in its wild state, and these are much increased by cultivation. On account of its scent it has been transferred from ruined walls to the flower-borders of gardens, and there, by the doubling of its flowers and the variations of its colours, a number of distinct varieties have been recorded. The following is a list of the most remarkable varieties found in gardens:—

α. *flore simplici.*	Single Yellow.
β. *flore pleno.*	Double Yellow.
γ. *maximus.*	Large-Flowered Yellow.
δ. *serratus.*	Large Yellow, saw-leaved.
ε. *patulans.*	Double Yellow, spreading.
ζ. *ferrugineus.*	Double Rosy.
θ. *varius.*	Double, variegated with purple and yellow.
ι. *flavescens.*	Large Double, pale yellow.
κ. *thyrsoideus.*	Bunch-Flowered, yellow.
λ. *gynantherus.*	Flowers with anthers changed into carpels.
μ. *hæmanthus.*	Single and Double, bloody-flowered.

The Wall-Flower is a common wild plant in Great Britain. It possesses the slight acridity of the order to which it belongs, and it has been recommended to sow it in pastures for the purpose of preventing rot in sheep. The wild flower has by some botanists been distinguished from the cultivated plant by the name of *C. fruticulosus*, but they are both the same.

Several other species of this genus have been described, and are occasionally found in collections in gardens in this country. In their cultivation the hardy shrubby species, such as the common Wall-Flower, may be propagated by cuttings, which soon strike root when planted under a hand-glass. Other perennial species will permit of growth by dividing the roots. The annual species may be sown in the open border or on rock-work, where they will flourish, and most of them will survive the winter in such a situation.

CHEIROGALEUS. [LEMURIDÆ.]

CHEIRO'LEPIS, a genus of Fossil Fishes from the Old Red-Sandstone of the Orkney Islands and Morayshire. The scales are very minute. (Agassiz.)

CHEIROMELES. [CHEIROPTERA.]

CHEI'ROMYS, one of the generic names given the Aye-Aye (which must not be confounded with the Ai, or Sloth [BRADYPUS], from which it very strongly differs in organisation), an animal discovered by Sonnerat at Madagascar, and described by him in the second volume of his 'Voyage aux Indes.' The name Aye-Aye it appears is an exclamation of the natives; and it is conjectured that it was given to this animal in consequence of a supposed resemblance to its cry. Sonnini, who formed the genus, censures Gmelin for denominating it *Sciurus Madagascariensis* (Madagascar Squirrel), because a quadruped of the latter genus really exists in Madagascar. Cuvier places the form next to the Flying Squirrels, Polatouches (*Pteromys*), and immediately before the Rats (*Mus*, Linn.), remarking that the lower incisors are much more compressed, and especially more extended from before backwards, than those of the squirrels, and resemble ploughshares (socs de charrue). The feet, he adds, have all five toes, of which four of those on each anterior extremity are elongated, the middle toe being much more slender than the others; in the hind feet, the great toe is opposeable to the others, so that in this respect the animal is among the Rodents what the Opossums (Sarigues) are among the Carnassiers. The structure of the head, he continues, is very different from that of the other Rodents, and has more relation to the *Quadrumana*.

$$\text{Dental formula: incisors, } \frac{2}{2}\text{; molars, } \frac{4-4}{3-3}=18.$$

Sonnerat says that the Aye-Aye, which is found chiefly if not exclusively on the western part of the island, does not approach any genus, but that it leans towards the Maki, the Squirrel, and the Ape. Its large and flat ears, he observes, resemble much those of a bat; and states that its principal character, and a very singular one it is, is the middle toe or finger of the fore foot, the two last joints of which are very long, slender, and denuded of hair. This member, he adds,

Skull of Aye-Aye (*Cheiromys Madagascariensis*).

is useful to it in drawing worms out of holes in the trees, and that it seems also to be of service in holding on to the branches of trees. He says that it appears to be a subterranean animal, and does not see during the day, and that its eye resembles in colour that of the owl. He describes it as being very slothful, but good tempered, remaining always at rest, and requiring a good deal of shaking to make it move. The subject of his observations lived two months upon no other nourishment than cooked rice, and it fed itself with its two fingers like the Chinese with their chopsticks. All the time M. Sonnerat had this animal alive, he never saw it carry its tail elevated like the squirrel. It always dragged.

Buffon describes the colour as a musk-brown mixed with black and gray-ash. On the head, round the eyes, on the body, thighs and legs, the colour was deep musk, in which nevertheless black predominated upon the back and many parts of the body and legs. The tail was entirely black: the sides of the head, the neck, the jaw, and the belly were grayish. There were woolly hairs of this gray colour below the great black or white hairs, of two or three inches long, which were on the body and legs; but the legs and thighs were of a reddish-brown. Black prodominated at the approach of the feet, which were covered with small hairs of that colour. The head was like that of a squirrel, and the ears large, naked, erect, and round at their extremities, with a wide opening. It is about the size of a common hare.

Aye-Aye (*Cheiromys Madagascariensis*).

This animal is the Aye-Aye Squirrel of Pennant, Shaw considered it to be a species of *Lemur*, and Schreber named it *Lemur psilodactylus*, a name adopted by Shaw.

CHEIRONECTES, or CHIRONECTES (Illiger), a genus of Marsupial animals. [MARSUPIATA.]

CHEIRO'PODA, *Cheiropeds*, a name proposed by Mr. Ogilby for all the mammiferous animals that are possessed of hands. The following is Mr. Ogilby's arrangement of his Cheiropeds:—

- CHEIROPEDS .. (Mammals with opposeable thumbs)
  - I. BIMANA .... *Homo.* (on the fore hands only)
  - II. QUADRUMANA.. (on both fore and hind hands)
    - SIMIÆ .... (and anthropoid teeth): *Troglodytes. Satyrus. Hylobates. Semnopithecus. Colobus. Cercopithecus. Papio. Cynocephalus.*
    - LEMURIÆ .... (and abnormal teeth): *Lichanotus. Propithecus. Lemur. Otolicnus. Cheirogaleus. Stenops. Tarsius. Cheiromys. Galeopithecus.*
  - III. PEDIMANA .. (on the hind hands only)
    - SIMIADÆ .... (and anthropoid teeth): *Cebus. Ateles. Mycetes. Lagothrix. Callithrix. Aotus. Pithecia. Hapale.*
    - DIDELPHIDÆ .... (and abnormal teeth): *Phascolarctos. Phalangista. Petaurus. Didelphis. Cheironectes. Dasyurus. Phascogale.*

Mr Ogilby states that observations, commenced in 1829 and continued for more than six years, have assured him that the non-opposeable character of the inner finger of the anterior extremities, which he first remarked in *Mycetes Seniculus*, is not confined to that genus, but extends throughout the whole of the genera of the South American monkeys, individuals of all of which have, he states, been seen by him in a living state. In none of them consequently, he observes, does a true thumb exist on the anterior limbs; and he considers that it follows as a further consequence that the whole of them have been hitherto incorrectly referred to the *Quadrumana* by zoologists generally. The following extract from the 'Proceedings of the Zoological Society,' for 1836, will explain the views of this naturalist:—

"Of the eight natural genera which include all the known monkeys of the western hemisphere, one, *Ateles*, is entirely destitute of a thumb, or has that member existing only in a rudimentary form beneath the skin. In five others, *Mycetes, Lagothrix, Aotus, Pithecia,* and *Hapale*, the anterior thumbs (using the ordinary expression for them) are placed absolutely on the same line with the other fingers, are of the same form with them, act invariably in the same direction, and are totally incapable of being opposed to them. In the two remaining genera, *Cebus* and *Callithrix*, the extremities of the anterior limbs have a greater external resemblance to the hands of man and of the monkeys of the Old World: the internal finger is placed farther back than the general line of the other fingers, and has on that account, when superficially noticed, the semblance of being opposed to them; but, as has been correctly observed by D'Azara with reference to *C. capucinus*, it is less separated than in man: it is besides of precisely the same slender form with the rest, is weaker than them, absolutely without power of opposition to them, and habitually acts in the same direction with them. The impression derived from contemplating the hands of the Old World monkeys might induce the belief that the extremities of the *Cebi* are similarly constituted; but if the knowledge that in *Mycetes, Pithecia*, &c., there are no opposeable thumbs leads to a close observation of the anterior extremities of the *Cebi*, it will be found that they do not act as hands and cannot be considered as possessing the powers of those organs. From innumerable observations of many species of that genus, Mr. Ogilby states that it was very evident, notwithstanding the fallacious appearance occasioned by the backward position of the organ, that they had not the power of opposing the thumbs to the other fingers in the act of prehension; and in fact their principal power of prehension seems to be altogether independent of the thumb, for generally speaking that member was not brought into action at all, at least not simultaneously with the other fingers, but hung loosely on one side, as Mr. Ogilby has seen it do in like circumstances in the Opossums, Phalangers, and other arboreal mammals: when actually brought into play however the thumb of the *Cebi* invariably acted in the same direction as the other fingers. *Cebus* consequently agrees in the character of non-opposeableness of thumb with the nearly allied genera. And in this hitherto unsuspected peculiarity zoologists obtain a far more important character by which to distinguish the monkeys of the Old and New World than that hitherto relied on, the comparative thickness of the septum narium, or than the accessory aids afforded by the absence of cheek-pouches and callosities. Hence, according to Mr. Ogilby, as the monkeys of America have now been ascertained to be destitute of anterior hands, they can no longer be included among the *Quadrumana*, and he proposes in consequence to regard them as *Pedimana*. He considers that the latter series, the monkeys of America, form a group parallel to that of the monkeys of the Old World among the *Quadrumana:* and viewing the *Quadrumana* as consisting of two primary groups, that of which *Simia* forms the type, and the *Lemuridæ*, he proceeds to analyze the *Pedimana*, in order to determine whether any group analogous to the Lemurs exists in it. He finds such a group in the association of the genera *Didelphis, Cheironectes, Phalangista, Petaurus*, and *Phascolarctos* (together with a new genus, *Pseudochirus*, which he has found it necessary to separate from *Phalangista* as at present constituted); and for this association he uses the name of *Didelphidæ*. Aware that the modifications observable in the dentary systems of these several genera have been regarded by many zoologists as betokening a difference of regimen, which has led to their being viewed as constituting distinct families, he in the first place states, as the result of his observation of the habits of the numerous species of all these genera which have been from time to time exhibited in the Society's Gardens, that there is little or no difference in this respect between the Opossums and Phalangers, but that all are equally omnivorous; and then proceeds to discuss the modifications that exist among them in the number and forms of the several kinds of teeth, which are not in his estimation so very different in reality between the Opossums and Phalangers as they appear to be at first sight. In further support of his opinion that this association of genera forms a natural family, Mr Ogilby refers to the gradual and uninterrupted transition from the naked-prehensile-tailed Opossums of South America, through the equally naked-tailed Couscous, *Balantia*, of the Indian Isles, to the true Phalangers; and from these to the Petaurists directly on the one hand, and by means of the Pseudocheirs to the Koalas on the other.

"On the prehensile power of the tail Mr. Ogilby particularly insists as on a faculty possessed by the greater number of the *Pedimana*, and as one which is in truth almost confined to them; only three known genera belonging to other groups, *Synetherus, Myrmecophaga*, and *Cercoleptes*, being endowed with it. He remarks on this faculty as on one of considerable importance, affording as it does in some degree a compensation for the absence of opposeable thumbs on the anterior limbs. Combined with the prehensile tail, in every known instance, whether among the *Pedimana* or in other groups, is a slowness and apparent cautiousness of motion, not observable in any of the *Quadrumana*, except in the *Nycticebi*. In none of the true *Quadrumana* is the tail prehensile.

"Another evidence of the distinctness, as two groups, of the *Quadrumana* and the *Pedimana* is furnished by their geographical distribution. The *Quadrumana* are strictly confined to the limits of the Old World; the *Pedimana* almost as exclusively to the New World, for Mr. Ogilby considers the continent of Australia to belong more properly to America than to Asia. The very few apparent exceptions that occur to this latter position are in the presence of some species of Phalangers in the long chain of islands that connect the south-eastern shores of Asia with the north-eastern coast of Australia; islands which may in truth be fairly regarded as belonging partly to the one and partly to the other, and the productions of which might consequently be expected to partake of the character of both.

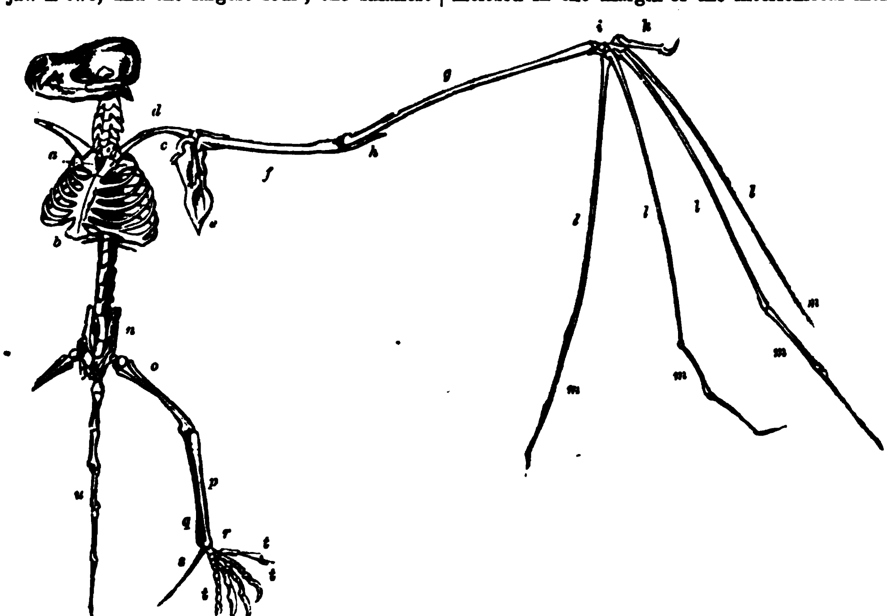
"Mr. Ogilby subsequently adverts to another Pedimanous animal, the Aye-Aye of Madagascar, constituting the genus *Cheiromys*; respecting the affinities of which he speaks with hesitation, because, having never had an opportunity of examining the animal itself, he is acquainted with its characters only at second hand. He is however disposed to regard it as representing a third group among the *Pedimana*, to be placed in a station intermediate between the Monkeys of the New World and the *Didelphidæ*. With the latter he would, in fact, be disposed to associate it, were it not destitute of the marsupial character which belongs to all the other animals comprised in that group. In some of the *Didelphidæ*, the Phalangers and Petaurists especially, there is a marked approximation to that rodent form of incisor teeth which obtains in *Cheiromys*, and which has hitherto been regarded as especially attaching to it an abnormal character.

"Man is the only other animal furnished with hands, and however distinct he may be as regards his moral and intellectual powers, he must, zoologically, be considered on physical grounds. By the structural characters he becomes associated with all those of which mention has previously been made in Mr. Ogilby's communication; although he unquestionably constitutes among them a peculiar group, sensibly exalted above the rest, as well as above all other Mammals."

CHEIROPTERA (χείρ, a hand, πτερόν, a wing), the name of a natural family or division of Mammiferous Animals; the Bats or Flitter-Mice of the English; Fledermäuser of the Germans; *Vespertiliones* of the Latins; Pipistrelli and Nottoli of the Italians; Chauve-souris of the French.

The animals belonging to this wing-handed family embrace those which come under the genus *Vespertilio* of Linnæus. They all have the faculty of sustained flight, and their organisation and habits point them out as a separate and well-defined group, distinguished by a folding extension of the membranous skin, which, rising from the sides of the neck, is spread between their fore feet and their fingers.

Organisation.—Skeleton.—The skull is thin, and there is a marked difference between that of the so-called Frugivorous group (*Pteropus* and *Cephalotes*) and the true or Insectivorous Bats, the former being much more elongated than the latter. The bony tentorium, so strongly developed in the majority of the *Carnivora*, is entirely absent; but there is a considerable development of the auditory portion of the temporal bone. The occipital bone is remarkably narrow. The superior maxillary is very much elongated, particularly in the so-called Frugivorous order, a term which we would change for Omnivorous, for their well-developed sharp canines, and the structure of some of their other teeth, would seem to be more trenchant than fruit-eating habits alone would require; and indeed Cuvier, in the last edition of the 'Règne Animal,' says of the genus *Pteropus*, "they live principally on fruit, of which they destroy a great deal; but they know, nevertheless, how to pursue birds and small quadrupeds;" and we think it highly probable that they occasionally prey on the large insects which are found in the climates they inhabit. All the family have four great canine teeth, but there is considerable difference between the molars of the fruit-eating section and of that whose diet is confined entirely to insects, the crowns of the former being comparatively blunt, and hollowed out or grooved lengthwise, while those of the latter are shorter and sharper, and beset with points. The molars vary in number in the different genera, the smallest development being three in each jaw, and the largest five above and six below, or vice versâ. The incisors set in the small and short intermaxillary bones vary also in the different genera. The smallest number in the upper jaw is two, and the largest four; the smallest number is also two in the lower jaw, and the largest six. The atlas is of considerable size, but the dentata is not large. The greatest number of the dorsal vertebræ is twelve, the smallest eleven. The canal for the spinal cord is large in these vertebræ. The lumbar vertebræ vary in number; the smallest number is four, the largest seven. The ossa coccygis are slender and elongated: their use seems only to be to assist (somewhat like a spreat) in spreading the interfemoral portion of the membranes, by the aid of which the animal sails in the air; their smallest number is six, and their largest twelve; for in the majority the tail extends to the margin of the membrane, while in some it protrudes beyond it, and in others it does not reach more than half way. In *Pteropus* there is no trace of these bones.



Skeleton of Bat (*Vespertilio murinus*).

a, manubrial bone; *b*, xiphoid cartilage; *c*, coracoid bone; *d*, clavicle; *e*, shoulder-blade; *f*, humerus; *g*, radius; *h*, rudiment of ulna; *i*, carpus (wrist); *k*, metacarpus of thumb, terminated by a hook-shaped phalanx; *l*, metacarpal bones of the fingers; *m*, digital phalanges; *n*, pelvis; *o*, femur; *p*, tibia; *q*, fibula; *r*, tarsal bones of foot; *s*, styliform appendage to os calcis; *t*, metatarsus and toes; *u*, tail.

The ribs are remarkably long, except the first pair, which is very short, and remarkably broad, especially in the cartilage, which is ossified; and the sternum is highly developed, as might be expected from the exigencies of the animal. The anterior portion is expanded laterally into what is termed the manubrium, which seems to be largest in the Horse-Shoe Bat (*Rhinolophus*), forming a suitable point of attachment for the strong long arched clavicles, which are articulated both to the sternum and scapula; the latter is very large and elongated, and the lower surface is very concave. The fossæ for the strong muscles, both above and below the spine of this bone, are deeply marked. The habits of the animal required an ample development of these parts to give the shoulder the required solidity for working the mechanism of the wing, and we accordingly find the strength thrown into the sternum, clavicles, and scapula. But these same habits would have rendered the rotatory motion of the fore-arm worse than useless, for such a disposition would have weakened the power of the limb in beating the air with the extended membrane. We accordingly find that this power is absent: the ulna, indeed, is remarkably small, and in some the bone is merely rudimentary, forming a mere flat process, only partially separated from the radius; there is no olecranon (elbow). The humerus is long, slender, and cylindrical, and the head of the bone large and round. The structure of the wrist is peculiar: first come two bones next to the radius, and on these that bone rests; one of these is very large, and the other very small—the second series consists of the usual four bones; but it is in the bones of the metacarpus and of the fingers that the adaptation of the osseous parts of the animal to its necessities is, perhaps, most strongly shown. These, with the exception of the phalanges of the thumb, are greatly elongated, and run outwards and downwards to the edge of the wing-membrane, something after the fashion of the whalebones that assist in spreading an umbrella. The first finger is the shortest, and extends to the upper angle of the outer edge of the membrane; the second is generally the longest, and the third and fourth nearly of a length; the last three descend to the lower edge of the membrane. The pelvis is straight and lengthened, and rather wider below than it is above, the ilia being very narrow and elongated. The ossa ischii approach even to the contact of their tuberosities, and in some examples touch the ossa coccygis. The ossa pubis, in some species, recede from each other, the intermediate space being filled by a ligament; and in others these bones touch each other in the male, and are separated in the female. The sacrum and ilia are anchylosed early in life. The lower extremities do not offer any very striking differences from those of other mammifers, excepting that the thighs being directed outwards, the bones of the leg are partially turned round as it were (the fibula appearing at the inner side of the tibia, and a little posterior to that bone), and that there is a singularity about the heel. An elongated delicate bony process is given off from the back part of the foot, is inclosed in the margin of the interfemoral membrane, and proceeds about halfway to the tail. Cuvier thought this a portion of the os calcis; Daubenton, that it was a distinct bone; and Meckel, that it is only a development of the tuberosity of the bone, disunited from its body.

Besides the difference of the molar teeth in the Fruit-Eating (or Omnivorous) and the Insectivorous Bats, the stomach and intestines present a remarkable corresponding variance. The stomach of the former is very complicated, and the intestines very long: in *Pteropus*, for example, they are seven times as long as the body. In the latter the stomach is very simple, and merely divided into the cardiac and pyloric portions, and the intestines are not more than twice the length of the body. These differences, together with that of the greater or less development of the tail, which is powerful, generally speaking, in the true Insectivorous Bats, and either absent, rudimentary, or comparatively inefficient in the Fruit-Eaters, which last do not require to turn so rapidly as the desultory flight of the prey of the former makes it necessary for them to do, form, it is true, a marked distinction between the two groups; but we are, notwithstanding, of opinion that very few bats confine themselves entirely to a vegetable diet.

The nervous system of *Cheiroptera* is fully developed. The senses of taste, smell, sight, and hearing are acute. The external ear is very large in many of the species. The sense of touch, or a sense analogous to it, must be highly developed. Spallanzani—we cannot compliment him on his humanity—extracted the eyes of bats and covered the empty sockets with leather; yet, in this condition, they flew round his room, avoiding the sides, never striking against anything, and flying out of the door without touching the door-case. In flying through a sewer which made a right angle, they turned at the proper point, though at a distance of two feet from the walls. They found their resting-place on a cornice, and flew through threads, suspended perpendicularly from the ceiling, without touching them, though scarcely farther apart than would admit their extended wings; and they avoided all obstacles with equal facility when the whole head was covered with varnish. But, according to the experiments of Carlisle, the British Long-Eared Bat was entirely at a loss, if, when blinded, its ears were stopped, for in that condition the blinded bats struck against the sides of the room, and seemed to be quite unaware of their situation. The following additional note to the English translation of Blumenbach however corroborates Spallanzani:—"Bats have been supposed to possess a peculiar power of perceiving external objects, without coming actually into contact with them. In their rapid and irregular flight, amidst various surrounding bodies, they never fly against them; yet it does not seem that the senses of hearing, seeing, or smelling, serve them on these occasions, for they avoid any obstacles with equal certainty when the ear, eye, and nose, are closed. Hence naturalists have ascribed a sixth sense to these animals; it is probably analogous to that of touch. The nerves of the wing are large and numerous, and distributed in a minute plexus between the integuments. The impulse of the air against this part may probably be so modified by the objects near which the animal passes, as to indicate their situation and nature." Cuvier, in his 'Leçons d'Anatomie Comparée,' had, in a great measure, solved the mystery by observing, as is remarked in the note just quoted, that the whole surface of the flying membrane, on both sides, is endowed with extraordinary sensibility, and may be considered as one continuously expanded organ of touch. Nor is this the only peculiarity connected with the integument of the bats, for in the genus *Nycteris* there exists a power of inflation to such a degree, that when the faculty is exerted the animal looks, according to Geoffroy, like a little balloon fitted with wings, a head, and feet. The subcutaneous tissue is the part inflated, and as the skin adheres to the body at particular points only, the connection being by means of loose cellular membrane, spaces are left which can be filled with air at the will of the *Nycteris*, through the cheek pouches, which are perforated at the bottom so as to communicate with those spaces. When the *Nycteris* wishes to inflate its skin, it draws in its breath, closes its nostrils, and transmits the air through the perforations of the cheek pouches to the subcutaneous spaces, and the air is prevented from returning by the action of a sphincter, which closes those openings, and by valves of considerable size on the neck and back.

The organs of reproduction nearly approach those of the *Quadrumana* and man in many respects. In the female two teats are placed on the breast as in man and in the *Quadrumana*.

The *Cheiroptera* are widely spread over the globe. They are to be found in the Old and New World and in Australia. A tolerably temperate climate seems necessary for them, and the greatest development of the form takes place in warm countries. Sir John Richardson ('Fauna Boreali-Americana') notices two species, *Vespertilio pruinosus* (Say) caught at Cumberland House, on the Saskatchewan in 54° N. lat., and *Vespertilio subulatus* (Say), which he observes is the most common species near the eastern base of the Rocky Mountains on the upper branches of the Saskatchewan and Peace River.

Habits.—Generally speaking they remain in concealment during the day in caverns, ruinous buildings, hollow trees, and such hiding places, and flit forth at twilight or sunset to take their prey. White, in his 'Selborne,' thus describes the mode of feeding a tame bat: "It would take flies out of a person's hand; if you gave it anything to eat it brought its wings round before the mouth, hovering and hiding its head, in the manner of birds of prey when they feed. The adroitness it showed in shearing off the wings of flies, which were always rejected, was worthy of observation, and pleased me much. Insects seemed to be most acceptable, though it did not refuse raw flesh when offered; so that the notion that bats go down chimneys and gnaw men's bacon, seems no improbable story. While I amused myself with this wonderful quadruped I saw it several times confute the vulgar opinion, that bats, when down on a flat surface, cannot get on the wing again, by rising with great ease from the floor. It ran, I observed, with more dispatch than I was aware of, but in a most ridiculous and grotesque manner." The Large-Eared Bats, collected by Carlisle, refused, according to Shaw, every species of food for four days, as did a large number which were afterwards caught and preserved in a dark box, for above a week. During the day-time they were extremely desirous of retirement and darkness; and, while confined to the box, never moved or endeavoured to get out the whole day; and when spread on the carpet they commonly rested some minutes, and then, beginning to look about, crawled slowly to a dark corner or crevice. At sunset the scene was quite changed: every one then endeavoured to scratch its way out of the box; a continual chirping was kept up, and no sooner was the lid of their prison opened than each was active to escape; either flying away immediately, or running nimbly to a convenient place for taking wing. When these bats were first collected, several of the females had young ones clinging to their breasts in the act of sucking. One of them flew with perfect ease, though two little ones were thus attached to her, which weighed nearly as much as the parent. All the young were devoid of down, and of a black colour. One of the most interesting and detailed accounts of the habits of these animals is that made by Mr. Daniell to the Zoological Society of London. The bats consisted of two species, the Pipistrelle (*Vespertilio Pipistrellus* of Geoffroy) and the Noctule (*Vespertilio noctula* of Schreber). Mr. Daniell stated that in July, 1833, he received five specimens, all pregnant females, from Elvetham in Hampshire. Many more were congregated together with them in the ruins of the barn in which they were taken, but all the rest escaped. They had been kept in a tin powder canister for several days, and on being turned loose into a common packing-case, with a few strips of deal nailed over it to form a cage they exhibited much activity, progressing rapidly along the bottom of the box, ascending by the bars to the top, and then throwing themselves off as if endeavouring to fly. They ate flies when offered to them, seizing them with the greatest eagerness, and devouring them greedily, all of them congregating together at the end of the box at which they were fed, and crawling over, snapping at, and biting each other, at the same time uttering a grating kind of squeak. Cooked meat was next presented to them, and rejected; but raw beef was eaten by them with avidity, and with an evident preference for such pieces as had been moistened with water. This answered a double purpose; the weather being warm numbers of the Blue-Bottle Flies (*Musca vomitoria* of Linnæus) were attracted to the meat; and on approaching within range of the bats' wings were struck down by their action, the animal itself falling at the same moment with all its membranes expanded, and cowering over the prostrate fly, with its head thrust under in order to secure its prey. When the head was again drawn forth the membranes were immediately closed, and the fly was observed to be almost invariably taken by the head. Mastication appeared to be a laboured operation, consisting of a succession of eager bites and snaps, and the sucking process (if it may be so termed), by which the insect was drawn into the mouth, being much assisted by the looseness of the lips. Several minutes were employed in devouring a large fly. In the first instance the flies were eaten entire, but Mr. Daniell afterwards observed detached wings in the bottom of the box. These however he never saw rejected, and he is inclined to think that they are generally swallowed. A slice of beef attached to the side of the box was found not only to save trouble in feeding, but also by attracting the flies to afford good sport in observing the animals obtain their food. Their olfactory nerves appear to be very acutely sensible. When hanging by their posterior extremities, and attached to one of the bars in front of the cage, a small piece of beef placed at a little distance from their noses would remain unnoticed; but when a fly was placed in the same situation they would instantly begin snapping after it. The beef they would eat when hungry, but they never refused a fly. In the day-time they sometimes clustered together in a corner; but towards evening they became very lively, and gave rapid utterance to their harsh grating notes. One of them died on the fifth day after they came into Mr. Daniell's possession; two on the fourteenth; the fourth survived until the eighteenth; and the fifth until the nineteenth day. Each was found to contain a single fœtus.

On the 16th of May, 1834, Mr. Daniell procured from Hertfordshire five specimens of *Vespertilio noctula*—four females and one male. The latter was exceedingly restless and savage, biting the females, and breaking his teeth against the wires of the cage, in his attempts to escape from his place of confinement. He rejected food, and died on the 18th. Up to this time the remaining four continued sulky; but towards evening they ate a few small pieces of raw beef in preference to flies, beetles, or gentles, all of which were offered to them; only one of them, however, fed kindly. On the 20th one died, and on the 22nd two others. The survivor was tried with a variety of food, and, evincing a decided preference for the hearts, livers, &c. of fowls, was fed constantly upon them for a month. In the course of this time large flies were frequently offered to her, but they were always rejected, although one or two May Chafers (*Melolontha vulgaris*) were partially eaten. In taking the food the wings were not thrown forward as in the Pipistrelle, and the food was seized with an action similar to that of a dog. The water that drained from the food was lapped, but the head was not raised in drinking, as Mr. Daniell had observed it to be in the Pipistrelle. The animal took considerable pains in cleaning herself, using the posterior extremities as a comb, parting the hair on either side from head to tail, and forming a straight line along the middle of the back. The membrane of the wings was cleaned by forcing the nose through the folds and thereby expanding them. On the 20th of June this specimen produced a young one. At the time of its birth the young was larger than a new-born mouse, and its hind legs and claws were remarkably strong and serviceable, enabling it not only to cling to its dam, but also to the deal sides of the cage. On the 24th the animal took her food in the morning, and appeared very careful of her young, shifting it occasionally from side to side to suckle it, and folding it in the membranes of the tail and wings. On these occasions her usual position was reversed. In the evening she was found dead, but the young was still alive, and attached to the nipple, from which it was with some difficulty removed. It took milk from a sponge, was kept carefully wrapped up in flannel, and survived eight days, at the end of which period its eyes were not opened, and it had acquired very little hair. All the species of *Cheiroptera* hybernate.

Systematic Arrangement.—Among the ancients Aristotle says but little about the Bat, and Pliny is considered to have placed it among the Birds, none of which, he observes, with the exception of the Bat, have teeth. ('Hist. Nat.' lib. xi. c. 37.) Again (lib. x. c. 61), he notices it as the only winged animal that suckles its young, and observes on its embracing its two little ones and flying about with them. In this arrangement he was followed by the older of the more modern naturalists; Belon, Gesner, and Aldrovandus, for instance. The former, after expressing some doubt, places it at the end of the Night-Birds, in his 'Histoire de la Nature des Oyseaux' (folio, 1555), and it occupies the same position in the small 4to (1557), with the following quatrain:—

"La Souris Chauve est un oiseau du nuict,
Qui point ne pond, ains ses petits enfante,
Lesquels de laict de ses tetins sustante,
En petit corps grande vertu reluit."

The Bat (*Attaleph*, 'bird of darkness') was one of the unclean animals of the Hebrews (Deut. xiv. 18), where it is placed among the forbidden birds.

Under the title 'Vespertilio,' the fourth and last genus of his first order, *Primates*, Linnæus arranged all the *Cheiroptera* known to him, and the number of species recorded in the twelfth edition of the 'Systema Naturæ' amounts only to six. In the thirteenth edition (Gmelin's) the number of species given amounts to twenty-three. This edition was printed in 1789, and few families afford stronger evidence of the great influx of the new species within the last five-and-forty years than is to be found in the numbers of *Cheiroptera* which have been described within that period. Of English bats alone Jenyns enumerates sixteen species, and the general numbers have been increased more than six-fold. Cuvier made the *Cheiroptera* the first family of his third order of Mammifers, placing them next to the *Lemuridæ*, which close his second order, *Quadrumana*. Jenyns, in his 'Manual of British Vertebrate Animals,' places them under the order *Primates*, which he makes the second in his arrangement of British *Mammalia*, the *Feræ* being the first; and they come immediately after the shrews and the hedge-hog.

The classification of the family we propose to follow, is taken in great measure from the French authors, and adopted by Desmarest and Lesson. *Galeopithecus*, which is the type of the first tribe of *Cheiroptera*, according to Lesson, we have removed, in accordance with the opinions of other zoologists, from this family; and though the *Vespertilionidæ* may be divided into two natural sections, the Insectivorous Bats and the Fruit-Eaters, we have, in consideration of the gradual shades of form when the numerous species are brought under observation, followed M. Lesson's arrangement, with the exception above alluded to.

Vespertilionidæ.

§ 1. *Istiophori*, Spix.

Bats having a membrane in form of a leaf upon the nose. Molar teeth with sharp tubercles.

1. Sub-Family, *Phyllostomatina*.

Nose-leaf simple, solitary, or unequal, the forefinger composed of two joints.

Phyllostoma, Geoff. Four incisors above and the same number below. Canine teeth very strong. Nose supporting two nasal crests, one leaf-like, the other like a horseshoe. Ears large. Internal oreillon dentelated. Tongue bristled with papillæ. Tail variable in length, sometimes none. The dental formula is—

$$\text{Incisors, } \frac{4}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{5-5} = 32.$$

a. Tail shorter than the interfemoral membrane.

P. crenulatum. The borders of the nasal leaf are dentelated, the end of the tail free. Locality unknown.

b. No Tail.

P. perspicillatum, Geoff. *Vespertilio perspicillatus*, Linn.

Vampirus, Geoff. and F. Cuvier. The same character as in the *Phyllostomata*, with the exception of the dental formula, which is as follows:—

$$\text{Incisors, } \frac{4}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{6-6} = 34.$$

V. Spectrum. This is the celebrated Vampire Bat of which so many bloodthirsty stories have been told; the *Phyllostoma Spectrum* of some authors, *Vampirus sanguisuga* of others, the Andira-guaca of Piso, and the *Vespertilio Spectrum* of Linnæus. The nose-leaf is entire, higher than it is wide, although it becomes widened at the base. The following is Piso's account of its habits:—"They seek out every kind of animal, and suck their blood. But in Maranhan (Maranham) there is a certain kind of bats which approach by night the naked feet of men, and wound them with their rostrum, for the sake of sucking human blood. The bite is so slight and subtle that the wounded do not feel it before the bed covered with blood gives token of the wound. So great a quantity of blood flows from the envenomed bite that it can

Phyllostoma crenulatum.

Phyllostoma perspicillatum.

Teeth of Vampire Bat (*Vampirus Spectrum*).

Vampire Bat (*Vampirus Spectrum*).

only be stopped with difficulty, and the peril is imminent unless a cure by the prescribed remedies be effected. The inhabitants first wash these wounds with hot sea-water, and afterwards apply hot ashes, or even cautery, if the blood be not stopped." Captain Stedman, who states that he was bitten, thus describes the operation:—"Knowing by instinct that the person they intend to attack is in a sound slumber, they generally alight near the feet, where, while the creature continues fanning with its enormous wings, which keeps one cool, he bites a piece out of the tip of the great toe, so very small indeed that the head of a pin could be scarcely received into the wound, which is consequently not painful; yet through this orifice he continues to suck the blood until he is obliged to disgorge. He then begins again, and thus continues sucking and disgorging till he is scarcely able to fly; and the sufferer has often been known to sleep from time into eternity. Cattle they generally bite in the ear, but always in places where the blood flows spontaneously. Having applied tobacco-ashes as the best remedy, and washed the gore from myself and my hammock, I observed several small heaps of congealed blood all round the place where I had lain, upon the ground, on examining which the surgeon judged that I had lost at least twelve or fourteen ounces during the night." This is sufficiently circumstantial, and the narrative is assisted by Mr. Wood, who quotes the passage in his 'Zoography,' and who informs us that "it is said to perform the operation by inserting its aculeated tongue into the vein of a sleeping person with so much dexterity as not to be felt; at the same time fanning the air with its large wings, and thus producing a sensation so delightfully cool that the sleep is rendered still more profound, and the unfortunate person reduced almost to death before he awakes." And the same author further informs us that "there is reason to believe that this thirst after blood is not confined to the bats of one continent, nor to one species, since at Java they seldom fail to attack those persons who lie with their feet uncovered." The same sort of stories are to be found in most books of Natural History up to a late period. Wood's work was published in 1807, and the tales are continued in Bewick in the edition of 1820. Cuvier, in the last edition of the 'Règne Animal' (1829), says, "They have accused this species of having caused men and beasts to perish by sucking them, but it contents itself with making very small wounds, which may sometimes become envenomed by the climate." Lesson (1827), in his notice of the genus, says, "The single American species is celebrated by the fables with which they have accompanied its history." Dr. Horsfield, who paid particular attention to the Javanese Bats, does not say a word of their blood-thirsty propensities. That some of the *Phyllostomata* suck the blood of animals as well as the juices of succulent fruits, zoologists are agreed; and we have above endeavoured to describe the peculiar apparatus with which they are furnished. Where the "aculeated tongue" fitted for insertion "into the vein of a sleeping person" is to be found among the known bats, we are ignorant. The rough tongue of the genus *Pteropus* has been supposed to have been employed for abrading the skin, to enable the animal to suck the part abraded, but zoologists are now agreed that the supposition is groundless. It is more than probable that the celebrated Vampire superstition and the blood-sucking qualities attributed to the Bat have some connection with each other.

Piso describes the bodies of his Bats (Andira-guaca) as being as large as European pigeons.

Madateus, Leach. Characterised by four incisors in each jaw; the two intermediate upper ones are longer than the lateral; they are bifid; the lower incisors are equal, simple, and pointed. Four molar teeth in the upper and five in the lower jaw on each side. Two nasal leaves. No tail. Lips furnished with soft fringed and compressed papillæ. Tongue bifid at the point.

M. Lewisii. Nasal leaf suddenly pointed; ears moderate and rounded. Fur blackish. Interfemoral membrane notched. Expansion 16 inches. Locality, Jamaica.

Glossophaga. Four incisors in each jaw; canines moderately strong. Tongue very long, extensile, and terminated by a sort of sucker. Nose surmounted by a crest in form of a pike-head. Tail none, or variable in length. Interfemoral membrane very small, hardly any.

$$\text{Incisors } \frac{4}{4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{3-3}{3-3}=24.$$

Locality, entirely American. The extensile tongue, says Lesson, enables the species to suck the blood of animals.

G. soricina of Geoffroy, *Vespertilio soricinus* of Pallas and Gmelin. Interfemoral membrane comparatively large. No tail. Locality, Surinam and Cayenne.

Rhinopoma, Geoff. Two incisors in the upper jaw, four in the lower. Nose long, conical, cut square as it were at the end, and surmounted with a small leaf. Nostrils straight, transversal, and operculated. Ears large, earlet (oreillon) external. Tail long, enveloped at its base in the interfemoral membrane, which is cut as it were square, and free at the extremity.

$$\text{Incisors, } \frac{2}{4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{4-4}{5-5}=28.$$

There are two species only; one African, the other American.

R. microphylla. This is Belon's Chauve-Souris d'Egypte. The fur is ash-coloured, and the tail very long and slender. It is the species that abounds in the long and dreary galleries of the Egyptian Pyramids.

Artibeus, Leach. Four incisors in each jaw, of which the upper ones are bifid and the lower ones truncated. Two canines above and the same number below; the upper ones have an internal border at their base. Four molars above and five below on each side. Two nasal leaflets; one horizontal, the other vertical. No tail.

A. Jamaicensis, the only species known. Brown above, grayish below. Flying membranes, and ears brownish. The lips are surrounded with a regular series of warts, and the mouth is provided internally with a narrow, fimbriated, cribriform membrane. Expansion about 1 foot, 3 inches. Length from the muzzle to the extremity of the interfemoral membrane, 4 inches, 10 lines. Dr. Horsfield calls it *Phyllostoma Jamaicense*, and says that in many particulars it agrees with *Phyllostoma planirostrum* of Spix, though it is clearly distinguishable from it.

Monophyllus, Leach. Four unequal incisors in the upper jaw, of which the two middle ones are longer than the lateral, and bifid; none in the lower jaw; two canines in each jaw. Five molars above and six below on each side. A single straight leaf upon the nose. Tail short.

M. Redmani. Brown above, grayish below. Ears rounded. Nose-leaf, which is sharp, covered with small white hairs. Membranes brown. Locality, Jamaica.

2. Sub-Family, *Rhinolophina.*

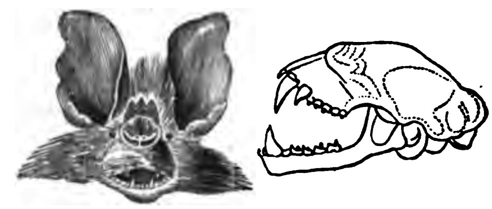
Nasal leaf complicated, membranous. Index with a single phalanx. Wings largely developed. Females with pectoral teats often accompanied by pubic warts simulating mamillæ.

Rhinolophus, Geoff. Nose at the bottom of a cavity bordered by a wide crest of a horseshoe shape, and surmounted by a leaf. Ears moderate, lateral, without an earlet (oreillon). Tail long, entirely enveloped by the interfemoral membrane, which is very much developed.

$$\text{Incisors, } \frac{2}{4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{5-5}{6-6}=32.$$

There are several species.

R. tridens (*Asellia tridens*, Gray) is a native of Egypt.



Head and skull of *Rinolophus tridens.*

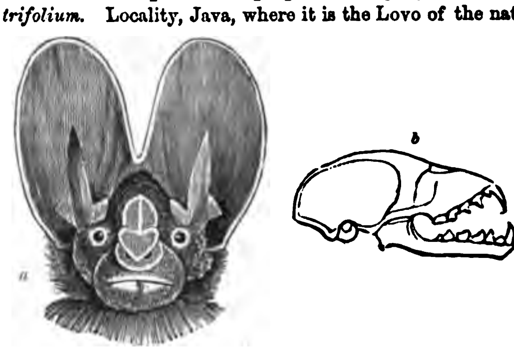
R. nobilis is a rare and fine Javanese species: it is the Kêbblêk of the natives. It was described by Dr. Horsfield, who observes that it belongs to the second section of the genus. The nasal apparatus consists of a broad membrane stretching transversely across the nose in form of a shelf; the sides are bounded by several parallel folds, and inferiorly it constitutes a semicircular envelope, which has a short obtusely-rounded point in the middle. Colour above, pure brown; beneath, brown variegated with gray. Fur remarkably long and silky, and supplied with a most delicate down at the base, so as to be throughout very soft to the touch. Body 4 inches in length. Expansion 19½ inches.

Rhinolophus nobilis.

Megaderma, Geoff. Ears very much developed, and brought forward on the head. Earlet internal, wide. Three nasal crests, one vertical, one horizontal, and one inferior of a horseshoe shape. No tail. Interfemoral membrane cut square.

$$\text{Incisors, } \frac{0}{4}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{4-4}{5-5}=26.$$

M. trifolium. Locality, Java, where it is the Lovo of the natives.

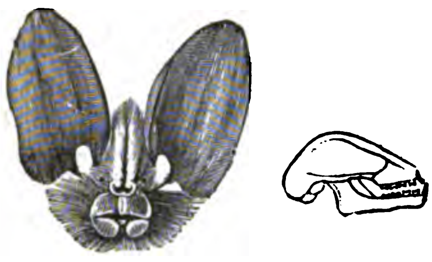


Head of *Megaderma trifolium*; *b*, Skull of *Megaderma Frons.*

Nycteris, Geoff. A very deep longitudinal sillon upon the chanfrein. Nostrils covered by a cartilaginous moveable operculum. Ears large, united at their base. Earlet external. Interfemoral membrane very large, comprehending the tail, the last vertebra of which is terminated by a bifurcated cartilage.

$$\text{Incisors, } \frac{4}{6}\text{; canines, } \frac{1-1}{1-1}\text{; molars, } \frac{4-4}{5-5}=32.$$

N. Geoffroyi. Fur, gray-brown above; brighter below. Ears very large. A well-developed wart placed upon the lower lip, between two bourrelets, having the form of a V. Locality, the Thebaïd and Senegal.



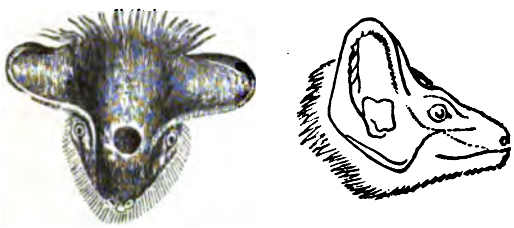
Nycteris Geoffroyi, and skull.

Taphozous, Geoff. Chanfrein with a sillon. Upper lip thick. Ears moderate and wide apart. Tail fine towards its point, beyond the interfemoral membrane, which is large, prolonged, and angular at its external border.

Incisors, $\frac{0}{4}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{5-5}=28$.

There are several species.

T. Mauritianus. Fur, chestnut above, ruddy below. Earlet terminated by a sinuous border. Locality, Mauritius.



Taphozous Mauritianus, and profile of the same.

Mormops, Leach. Four upper unequal incisors, of which the intermediate ones are widely notched, and four below which are equal and trifid; two canines in each jaw, the upper ones twice the length of those below, almost compressed and canaliculated before; five molars above and six below on each side. A single nasal leaf united to the ears, which are very complicated.

M. Blainvillii, the only species; and it is remarkable for the extreme elevation of its front; the excavation of its chanfrein; the lobated crenellated form of its upper lip, and the division of the lower one into three membranous lobes; the existence on the tongue of papillæ, of which the anterior are bifid and the posterior multifid; the folding of the nasal leaf, and the division of the upper border of its ears into two lobes. Locality, Jamaica.

Nyctophilus, Leach. Two upper, elongated, conical, pointed incisors; six lower ones, equal and trifid, with rounded lobes; two canines above and two below, the lower ones having a small point at the back part of their base. Four molars on each side of the jaws, with crowns furnished with pointed tubercles. Two nasal leaves, of which the posterior is the largest. Tail projecting a little beyond the interfemoral membrane.

N. Geoffroyi, the only species known. Fur, yellowish above. Belly, breast, and throat dirty white. Ears large. Membranes brownish-black.

§ 2. *Anistiophori*, Spix.

Bats without any nasal appendage.

3. Sub-Family, *Vespertilionina*.

Molar teeth with pointed tubercles. Wings wide and extended. A single phalanx to the forefinger (index). Head elongated. The lips simple. Tongue short. Tail long.

Vespertilio, Linn., Geoff. Upper incisors four, sometimes two. Lower incisors six. Muzzle very simple. Ears separated, but sometimes united at their base. Earlet internal. Tail long, entirely enveloped in the interfemoral membrane. Cheek pouches.

Incisors, $\frac{4}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{4-4}{5-5}=32$.

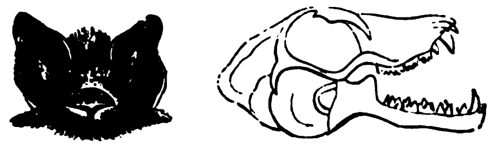
Lesson observes, that many *Vespertiliones* have but two incisors. The species of the genus are many in number, and their geographical distribution is very wide.

α. European Species.

V. murinus, Linnæus. This is the Flitter-Mouse, Flutter-Mouse, and Rear-Mouse, of the English; La Chauve-Souris of Buffon, and, according to Pennant, the Ystlum of the Welsh; the Nattola, Notula, Sporteglione, Vispistrello, and Vilpistrello, of the Italians; Murciegalo and Morciegalo of the Spaniards; Morcego of the Portuguese; Speckmaus and Fledermaus of the Germans; Vledermuys of the Dutch; Laderlap and Fladermus of the Swedes; and Flagermaus and Aftenbakke of the Danes.

The ears are oval, of the length of the head; the earlets falciform. The fur of the adults is ruddy-brown above, whitish-gray below; that of young individuals is gray-ash.

This species is common in Europe. It has been supposed to exist in Asia, and even in Australia. Its haunts are caves, ruined buildings, church-towers, the roofs of houses or churches, and hollow trees, where it hybernates during the whole winter, snugly wrapped up in the wing membranes, and suspended by the hind feet. We have given the skeleton of this species, and below will be found a head and skull of *V. Pipistrellus*, another European species.



Head and skull of *Vespertilio Pipistrellus*.

β. African Species.

V. nigrita. Adanson discovered this species at Senegal. The ears are oval, triangular, very short, one-third of the length of the head. Earlet long, and terminating in a point. Fur yellowish-brown above, and yellowish-ash below.

γ. Asiatic Species.

V. pictus. The ears are shorter than the head, oval, wider than they are high. Earlet oval-shaped. The fur is reddish, passing into bright yellow upon the back, and of a tarnished yellow on the belly. Citron-coloured rays mark the course of the fingers in the wings, which are chestnut-brown. Locality, Ceylon.

δ. American Species.

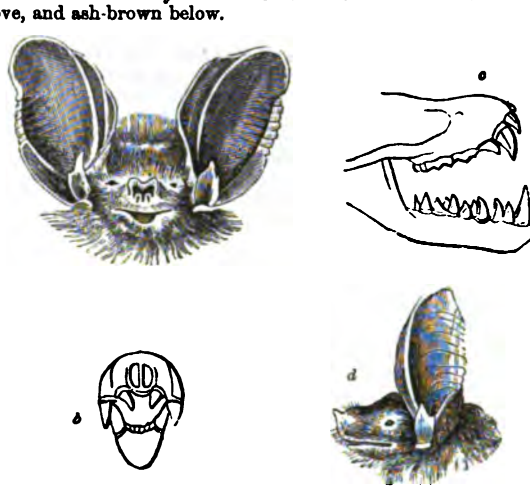
V. Naso. This species, remarkable for the length of its nose, was first described by the Prince de Neuwied. The nasal organ is elongated in a straight line above the upper jaw, almost like a proboscis. The ears are small, and very much pointed. The fur is grayish-brown above and yellowish-gray below. Locality, Brazil, in trees.

Plecotus, Geoff. This genus in many of its characters agrees with *Vespertilio*, but the ears are very much developed, being larger than the head.

Incisors, $\frac{4}{6}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{5-5}{6-6}=36$.

There are several species, and the form occurs in all the four quarters of the globe.

P. Timoriensis. This species was discovered by Péron and Lesueur in the island of Timor, one of the Moluccas. The ears are ample, united at their base by a small membrane. The fur is blackish-brown above, and ash-brown below.



Plecotus Timoriensis.

b, front view of the teeth, &c.; *c*, profile of the skull; *d*, profile of the head.

The genera *Atalapha*, *Hypexodon*, and *Nycticeus* of Rafinesque, are considered doubtful by Lesson and others.

Myopteris, Geoff. The chanfrein is united and simple. The ears are large, insulated, and lateral, with an internal earlet. Tail long, half enveloped in the interfemoral membrane. Muzzle short and large.

Incisors, $\frac{2}{2}$; canines, $\frac{1-1}{1-1}$; molars, $\frac{4-4}{5-5}=26$.

M. Daubentonii, Geoff.; Le Rat Volant (Flying Rat) of Daubenton. The locality of this species is unknown. The upper part of the head and body is brown; beneath, the colour is dirty white, with a slight tinge of yellow.

4. Sub-Family, *Noctilionina*.

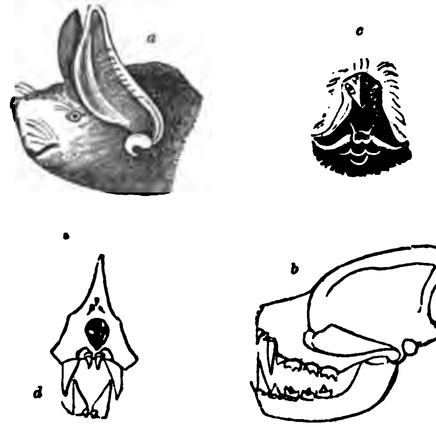
Molars tubercular. Wings long and straight. Two phalanges to the forefinger (index). Head short and obtuse. Lips very large.

Tail recurved. The females often furnished with lateral pouches for the reception of the young in nursing.

Noctilio, Geoff. Canines very strong. Muzzle short and swollen, and divided and studded with fleshy tubercles or warts. Nose simple, and losing itself in the lips. Ears small and lateral. Interfemoral membrane very much developed. Tail enveloped at its base.

$$\text{Incisors, } \frac{4}{2}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{4-4}{5-5} = 28.$$

N. Leporinus. Size of a rat. Fur of a uniform reddish-yellow. This is the *Vespertilio Leporinus* of Gmelin; *Noctilio unicolor* of Geoffroy. Localities, Brazil, Peru, and Paraguay.



Noctilio Leporinus.

a, Profile of head; *b*, profile of skull; *c*, front view of muzzle; *d*, front view of teeth, &c.

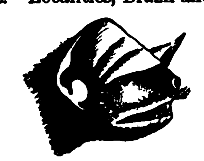
Dysopes, Illiger. M. Temminck is of opinion that *Molossus, Nyctinomus*, and *Cheiromeles* are identical with *Dysopes*. The following is the character of the teeth, according to F. Cuvier: two incisors above and four below; two canines in each jaw; four molars on each side of the upper jaw; that is to say, two false and two normal; ten molars in the lower jaw, namely, four false and six true. Type, *D. Moops*. We proceed to give the definition of *Molossus, Cheiromeles*, and *Nyctinomus*, for the assistance of the student.

Molossus. Head short; muzzle swollen. Ears large; earlet external. Interfemoral membrane straight, with a square termination. Tail long, enveloped at its base, and most frequently free at its extremity.

$$\text{Incisors, } \frac{2}{2}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{5-5} = 28.$$

The geographical distribution of this form is wide: Africa, Asia, and South America possess it: but the species, which are numerous, occur principally in the two last-mentioned localities.

M. obscurus, M. fumarius of Spix, *Dysopes obscurus* of Temminck. Size of the Barbastelle of Europe. Fur composed of hair of two colours, blackish-brown above, and ash-brown below. Whiskers at the border of the lips. Length about 3 inches, 3 lines. Expansion 9 inches. Localities, Brazil and Guyana.



Head of *Molossus obscurus.*

Skull and front teeth.

Cheiromeles, Horsfield. Two incisors above and two below; the upper ones large, approximate, semiconical, and acute, the lower very small and simple. Muzzle conical, sulcated, and with setiferous glandules. Ears distant, patent, with a short, semicordate, obtuse operculum. Axillary pouch ample; but the hind foot, according to Dr. Horsfield, constitutes the chief distinguishing character. The hind foot, or rather hand, "consists of four fingers, which have the same disposition and structure as in other animals of this family, and of a distinct thumb, essentially agreeing with this member in many *Quadrumana*, and in several animals of the *Rodentia* and *Marsupialia*. It is a complete antagonist to the fingers, enables the animal to take hold of objects, and thus constitutes a perfect hand."

C. torquatus, Horsfield, 'Researches in Java;' *Molossus Cheiropus*, Auct.; *Dysopes Cheiropus*, Temminck. Length, 5½ inches. Expansion nearly 2 feet. Localities, Siam and Western Asia.

Nyctinomus, Geoff. Nose flat, losing itself in the lips, which are deeply slit and wrinkled. Ears large, and hanging with an external earlet. Interfemoral membrane moderate and angular. Tail long, and nearly half of it enveloped.

$$\text{Incisors, } \frac{2}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{5-5} = 30.$$

Localities. This form occurs in Africa, Asia, and South America.

N. Ægyptiacus, Geoff.; *Dysopes Geoffroyi*, Temminck. Reddish above and brown below. Tail slender. Interfemoral membrane enveloping only half of the tail. Locality, ruins and subterraneous places in Egypt.

Dinops, Savi. Ears united and extended on the front. Lips pendent and plaited. Tail enveloped for half its length in the interfemoral membrane.

$$\text{Incisors, } \frac{2}{6}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{5-5} = 32.$$

D. Cestonii, Savi. Fur thick and soft, gray-brown, tending slightly to yellowish, but a little browner on the back. Wings black-brown. Muzzle, lips, and ears black, the latter large, rounded, and a little notched on their external border. Tail long, of a brown-black. Locality, the environs of Pisa, where Savi discovered it.

Stenoderma, Geoff. Nose simple. Ears small, lateral, and isolated; earlet internal. Interfemoral membrane rudimentary, and bordering the legs. No tail.

$$\text{Incisors, } \frac{4}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{4-4}{4-4} = 28.$$

But it should be remembered that Cuvier only allows of two incisors in the upper jaw, instead of four, the number given by Geoffroy.

S. rufa. Fur uniform, chestnut-red. Ears moderate, oval, and a little notched on their external border.

Celæno, Leach. Two upper incisors pointed and simple; four lower ones contiguous and cylindrical. Two canines above and below, the upper ones largest. Four molars on each side of the jaws, the first pointed and simple, and the last three with their crowns beset with points. Third and fourth finger with three phalanges, the fifth or external with two only. Interfemoral membrane prolonged a little below the toes of the hind feet. Ears separated; earlets simple. No tail.

C. Brooksiana. Back ferruginous; belly and shoulders yellowish-ferruginous. Ears pointed, with the anterior border rounded and the posterior one straight. Membranes black.

Ællo, Leach. Two upper incisors large, compressed, bifid, and with rounded lobes. Two lower equal, trifid, with rounded lobes. Two upper canines, long, very sharp, with a small projecting point before and behind their base; the two lower smaller and less pointed. Four upper molars on each, the two first pointed and triangular, the second largest, the third bifid, and the fourth trifid externally. Third finger of the wings with four phalanges, fourth and fifth with three. Interfemoral membrane straight. Ears contiguous, short, very large; no earlet. Tail not exceeding the membrane.

A. Cuvieri. Colour ferruginous-Isabella. Wings obscure brown. Ears truncated, as it were, at the end.

Scotophilus, Leach. Four upper incisors unequal, pointed, the intermediate ones being largest and simple, and the lateral ones bifid with equal lobes: six lower incisors indistinctly trifid. Two canines above and below, the upper ones with a small point behind their base, and the corner ones with a similar one in front. Four molars with crowns armed with points. Fourth and fifth fingers of the wings with three phalanges.

S. Kuhlii. Fur ferruginous. Ears, nose, and wings brown.

5. Sub-Family, *Pteropina.*

We now come to a numerous and widely distributed family containing some of the largest forms of the *Vespertilionidæ*, and subsisting principally on vegetables and fruits. It is not improbable that the fabulous Harpy may have had its origin in some of these enormous bats with their well-developed pectoral mammæ.

Pteropus Dussumieri.

Molar teeth tuberculated and grooved longitudinally. Wings rounded. Interfemoral membrane and tail often wanting. Index with three phalanges. Head long and hairy. Females for the most part with nursing pouches.

Pteropus, Brisson (Roussettes of the French). A small nail on the index wing-finger. Head conical. Ears short. Tail absent, or rudimentary. Interfemoral membrane very little developed.

α. Tailless.

P. Javanicus. Upper part of the neck smoky red, rest of the fur blackish, some white hairs mingled with the black ones of the back. Expansion 5 feet. This is the Kalong of the Javanese, which, according to Dr. Horsfield, is extremely abundant in the lower parts of Java, and uniformly lives in society. The more elevated districts are not visited by it. "Numerous individuals," continues the Doctor, "select a large tree for their resort, and suspending themselves with the claws of their posterior extremities to the naked branches, often in companies of several hundreds, afford to a stranger a very singular spectacle. A species of *Ficus*, in habit resembling the *F. religiosa* of India, which is often found near the villages of the natives, affords them a very favourite retreat, and the extended branches of one of these are sometimes covered by them. They pass the greater portion of the day in sleep, hanging motionless: ranged in succession, with the head downwards, the membrane contracted about the body, and often in close contact, they have little resemblance to living beings, and by a person not accustomed to their economy are readily mistaken for a part of the tree, or for a fruit of uncommon size suspended from its branches. In general these societies preserve a perfect silence during the day: but if they are disturbed, or if a contention arises among them, they emit sharp piercing shrieks, and their awkward attempts to extricate themselves when oppressed by the light of the sun, exhibit a ludicrous spectacle. In consequence of the sharpness of their claws, their attachment is so strong, that they cannot readily leave their hold without the assistance of the expanded membrane: and if suddenly killed in the natural attitude during the day, they continue suspended after death. It is necessary therefore to oblige them to take wing by alarming them, if it be desired to obtain them during the day. Soon after sunset they gradually quit their hold, and pursue their nocturnal flight in quest of food. They direct their course by an unerring instinct to the forests, villages, and plantations, occasioning incalculable mischief, attacking and devouring indiscriminately every kind of fruit, from the abundant and useful cocoa-nut which surrounds the dwelling of the meanest peasantry, to the rare and most delicate productions which are cultivated with care by princes and chiefs of distinction. By the latter, as well as by the European colonists, various methods are employed to protect the orchards and gardens. Delicate fruits, such as mangoes, jambus, lansas, &c., as they approach to maturity, are ingeniously secured by means of a loose net or basket, skilfully constructed of split bamboo. Without this precaution, little valuable fruit would escape the ravages of the Kalong. There are few situations in the lower parts of Java in which this night wanderer is not constantly observed: as soon as the light of the sun has retired one animal is seen to follow the other at a small but irregular distance, and this succession continues uninterrupted till darkness obstructs the view. The flight of the Kalong is slow and steady, pursued in a straight line, and capable of long continuance. The chase of the Kalong forms occasionally an amusement of the colonists and inhabitants during the moonlight nights, which in the latitude of Java are uncommonly serene. He is watched in his descent to the fruit-trees, and a discharge of small shot readily brings him to the ground. By this means I frequently obtained four or five individuals in the course of an hour."

Pteropus Javanicus.

β. With Tails.

P. stramineus. Fur reddish-yellow; tail very short. Expansion two feet. Brought from Timor by Péron and Lesueur.

γ. With Wings on the Back.

Cephalotes, Geoff. A small nail on the index in one species. Head conical; ears short; tail but little apparent. Interfemoral membrane notched. Flank-membrane springing from the mesial line of the back.

$$\text{Incisors, } \frac{4}{6}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{4-4}=32.$$

C. Peronii. Fur brown or red, and very short. No nail on the index. Wings springing from the middle of the back. Expansion two feet. Locality, Timor. N.B. Temminck thinks that the *P. palliatus* of Geoffroy is the young of this species.

Harpya, Illiger. Differing from *Cephalotes* in the want of lower incisors and of the last small molars in both jaws. Geoffroy thinks that the difference between the system of dentition in *Harpya* and *Cephalotes Peronii* is attributable to age only.

$$\text{Incisors, } \frac{2}{0}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{4-4}{5-5}=24.$$

H. Pallasii (*Cephalotes Pallasii*, Geoff.). Fur consisting of scanty and soft hairs, grayish-ash above, pale white below. A nail on the index. Expansion 1 foot 11 inches. Locality, the Moluccas.

Head of *Harpya Pallasii.*

Cynopterus, F. Cuvier. Four incisors and two rudimentary false molars in each jaw, like the *Pteropi*, but they entirely want the last molars. The jaws are abbreviated, and the heads much resemble those of *Cephalotes.*

Macroglossa, F. Cuvier. A genus approaching very closely to *Pteropus* and formed by F. Cuvier for the Lowo-assu of the Javanese, *P. minimus* of Geoffroy, *P. rostratus* of Horsfield. Its character depends upon the extreme length of the head, the absence of false molars, the great development of the posterior molar and the extensile tongue.

$$\text{Incisors, } \frac{4}{4}; \text{ canines, } \frac{1-1}{1-1}; \text{ molars, } \frac{5-5}{6-6}=34.$$

M. Horsfieldii (*Pteropus rostratus*, Horsfield). Temminck is of opinion that *M. Kiodotes*, *P. minimus*, Geoff., and *M. Horsfieldii* are identical.

δ. Wings placed extremely backwards.

Epomophorus (Gray). *E. Whitii* (*Pteropus Epomophorus*, Bennett). Pale brown, the colour being paler posteriorly; belly white; humeral brush (or epaulette) white and large. Total length, six inches three quarters; length of the head, two inches and a quarter. Expansion 12 inches.

The following is the arrangement of the species of this order of which there are specimens in the British Museum, as given in the list of the *Mammalia* by Dr. J. E. Gray:—

VESPERTILIONIDÆ.

A. Istiophori.

a. Phyllostomina.

1. *Rhinopoma Hardwickii*, the Indian Rhinopome.
2. *R. microphylla*, the Egyptian Rhinopome. Egypt.
3. *Sturnira Spectrum*, the Sturnira. Brazils.
4. *Arctibeus Jamaicensis*, the Jamaica Arctibeus. Jamaica and Brazils.
5. *A. fimbriatus*, the Fringe-Lipped Arctibeus. Brazils.
6. *A. verrucatus*, the Warty-Chinned Arctibeus. South America.
7. *A. falcatus*, Sickle-Arctibeus. Cuba.
8. *Vampyrus Spectrum*, the Pale Vampire. Jamaica.
9. *Phyllostoma hastatum*, the Javeline Phyllostome. Brazils.
10. *P. fuliginosum*, the Sooty Phyllostome. South America.
11. *P. Childreni*, Children's Phyllostome. South America.
12. *P. soricinum*, the Soricine Phyllostome. Jamaica, West Indies.
13. *P. Bennettii*, Bennett's Phyllostome. South America.
14. *P. lanceolatum*, Long-Leaved Phyllostome. South America.
15. *P. elongatum*, Elongated Phyllostome. Brazils.
16. *Brachyphylla Cavernarum*, the Cavern-Bat. St. Vincent's, West Indies; Cuba.
17. *Phyllophora megalotis*, Large-Eared Phyllophore. Brazils.
18. *P. nigra*, Black Phyllophore. Brazils.
19. *P. amplexicaudata*, West-Indian Phyllophore. West Indies, Jamaica.
20. *Glossophaga Soricina*, the Soricine Bloodsucker. Jamaica, West Indies.
21. *Monophyllus Redmani*, Redman's Leaf-Nosed Bat. Jamaica.
22. *Anoura Geoffroyi*, Geoffroy's Tailless Bat. Brazils.
23. *Megaderma Lyra*, Lyre-Nosed Broad-Winged Bat. Java; India, Madras and Bengal.
24. *M. Spasma*, the Cordate Bat. Java and Singapore.
25. *Lavia frons*, the African Leaf-Bat. West Africa, Gambia.

b. Rhinolophina.

26. *Ariteus flavescens*, the Yellowish Ariteus.

27. *Rhinolophus Hipposideros*, the Smaller Horseshoe-Bat. Devonshire.
28. *R. ferrum-equinum*, the Larger Horseshoe-Bat. England and Turin.
29. *R. megaphyllus*, the Large-Leaved Horseshoe-Bat. Australia.
30. *R. morio*, the Black Horseshoe-Bat. Singapore.
31. *R. tragatus*, Nepaul Horseshoe-Bat. Nepaul.
32. *R. Capensis*, Cape Horseshoe-Bat. Cape of Good Hope.
33. *R. clivosus*, Short-Faced Horseshoe-Bat. North Africa.
34. *Hipposideros fulvus*, Foxy Horseshoe-Bat. India, Madras.
35. *H. murinus*, Mouse-Coloured Horseshoe-Bat. India, Madras.
36. *H. bicolor*, *Rhinolophus bicolor*, Two-Coloured Horseshoe-Bat. Java.
37. *H. apiculatus*, Apicillated Horseshoe-Bat. India, Madras.
38. *H. larvatus*, Masked Horseshoe-Bat. Java.
39. *H. penicillatus*, Pencilled Horseshoe-Bat. Madras.
40. *H. vulgaris*, Javanese Horseshoe-Bat. Java.
41. *H. nobilis*, Noble Horseshoe-Bat. Java.
42. *H. armiger*, Hodgson's Horseshoe-Bat. Nepaul.
43. *Asellia tridens*, the Three-Toothed Asellia. Egypt.

B. Anistiophori.

c. Vespertilionidæ.

44. *Nycteris Thebaica*, Egyptian Nycteris. Egypt.
45. *N. Damarensis*, Damara Nycteris. South Africa, Damara country.
46. *N. Poensis*, Fernando Po Nycteris. Africa, Fernando Po.
47. *Petalia Javanica*, Kuhl's Petalia. Java.
48. *Nyctophilus Geoffroyi*, the Australian Nyctophile. Australia.
49. *Barbastellus communis*, the Barbastelle. England.
50. *Plecotus communis*, Common Long-Eared Bat. England, London.
51. *P. Christii*, Egyptian Long-Eared Bat. North Africa, Egypt.
52. *Romicia calcarata*, the Long-Spurred Romicia.
53. *Vespertilio mystacinus*, the Whiskered Bat. Devonshire and Cambridgeshire.
54. *V. Daubentonii*, Daubenton's Bat. Scotland, Aberdeen.
55. *V. Caroli*, Prince Charles's Bat. North America.
56. *V. muricola*, the Wall-Bat. Nepaul.
57. *Trilotitus Blepotis*, the Blepote. Timor.
58. *T. Horsfieldii*, the Lowo-Manir. Java; India.
59. *Myotis murinus*, the Large-Eared Bat. Hamburg and England.
60. *M. Bechsteinii*, Bechstein's Bat. New Forest, Hampshire.
61. *M. Nattereri*, Natterer's Bat. England.
62. *Kerivoula picta*, the Kerivoula. Java.
63. *K. formosa*, the Nepaul Kerivoula. Nepaul.
64. *K. Sykesii*, Sykes's Kerivoula. India, Calcutta.
65. *K. trilatitoides*, the Javanese Kerivoula. Java.
66. *K. Hardwickii*, Hardwicke's Kerivoula. Java.
67. *K. Poensis*, the Fernando Po Kerivoula. Fernando Po.
68. *K. grisea*, the Gray Kerivoula.
69. *K. Brasilensis*, the Brazilian Kerivoula. Brazils.
70. *Natalus stramineus*, the Natale. America.
71. *Scotophilus Serotinus*, the Serotine. England.
72. *S. discolor*, Parti-Coloured Bat. England.
73. *S. Leisleri*, the Hairy-Armed Bat. England.
74. *S. murinus*, the Bat. England; North of Scotland; Hamburg; and Madeira.
75. *S. fuliginosus*, the Sooty Scotophile. Nepaul.
76. *S. Hodgsonii*, the Indian Bat. India, Calcutta.
77. *S. lobatus*, the Lobed Scotophile. India.
78. *S. Maderaspatanus*, the Madras Bat. Madras.
79. *S. morio*, the Australian Bat. Van Diemen's Land, Australia.
80. *S. Gouldii*, Gould's Scotophile. Van Diemen's Land.
81. *S. pumilus*, the Dwarf Bat. Australia.
82. *S. Greyii*, Captain Grey's Bat. Australia.
83. *S. Cubensis*, the Cuba Bat. Cuba.
84. *S. MacLeayii*, MacLeay's Bat. Cuba.
85. *S. Bellii*, Bell's Bat. West Indies.
86. *S. Greenii*, Green's Bat. North America.
87. *S. Temminckii*, Temminck's Noctule. Calcutta and Java.
88. *S. falcatus*, the Falcated Noctule. India.
89. *S. Leachii*, Leach's Noctule. India.
90. *S. fulvus*, the Foxy Noctule. Java and Madras.
91. *Noctulinia altivolans*, the Noctule. England.
92. *N. Malaccensis*, the Singapore Noctule. Singapore.
93. *N. labiata*, Large-Lipped Noctule. Nepaul.
94. *Lasiurus rufus*, the Red Hairy-Tailed Bat. America.
95. *L. pruinosus*, the Powdered Hairy-Tailed Bat. North America.
96. *Scotophilus Capensis*, the Cape Bat. Cape of Good Hope.
97. *Murina suillus*, the Pig-Nosed Bat. India.

d. Noctilionina.

98. *Taphozous perforatus*, the African Taphozous. Africa and Mauritius.
99. *T. longimanus*, the Long-Armed Taphozous. India, Calcutta.
100. *T. nudiventer*, the Naked-Bellied Taphozous. Africa, Nubia.
101. *T. melanopogon*, the Black-Bearded Taphozous. Caves of Kenneri, Hindustan.
102. *T. saccolaimus*, the Javanese Taphozous. Java.
103. *Noctilio Americanus*, the Bull-Dog Bat. Para.
104. *N. mastivus*, the Striped Bull-Dog Bat. Brazils and Central America.
105. *Mosia nigrescens*, the Mosia. South America.
106. *Mystacina tuberculata*, the Mystacine. New Zealand.
107. *Centurio senex*, the Wrinkled-Faced Epaulet-Bat. Amboyna.
108. *Chenolycteris MacLeayii*, MacLeay's Fringe-Nosed Bat. Cuba.
109. *Mormops Blainvillii*, the Mormops. Cuba and South America.
110. *Nyctinomus plicatus*, the Groove-Cheeked Bat. Java and Bengal.
111. *N. Rüppellii*, Rüppell's Groove-Cheeked Bat. Fernando Po and Singapore.
112. *N. pumilus*, the Smaller Groove-Cheeked Bat. Egypt.
113. *N. murinus*, the Murine Groove-Cheeked Bat. Jamaica.
114. *N. macrotis*, the Large-Eared Groove-Cheeked Bat. Cuba.
115. *Molossus velox*, the Swift-Flying Thick-Lipped Bat. Brazils, and St. Lucia, West Indies.
116. *M. fuliginosus*, the Sooty Thick-Lipped Bat. Bermuda, Jamaica, and Portobello.
117. *M. rufus*, the Reddish Thick-Lipped Bat. Brazils.
118. *M. tropidorhynchus*, the Ridge-Nosed Thick-Lipped Bat. Cuba.
119. *M. Brasiliensis*, the Brazilian Thick-Lipped Bat. Brazils.
120. *M. Norfolcensis*, the Norfolk Island Thick-Lipped Bat. Norfolk Island.
121. *Diclidurus Freyreisii*, the Diclidure. Pueblo Nuevo, Tropical America.

e. Pteropina.

122. *Pteropus poliocephalus*, Gray-Headed Kalong. Australia.
123. *P. Edwardsii*, the Wurba-Gool. India, Nepaul, and Molucca.
124. *P. edulis*, the Kalong. Sumatra.
125. *P. funereus*, Red-Naped Kalong. Australia, Port Essington.
126. *P. pselaphon*, Hairy-Footed Kalong. Island of Bonin (Loo-Choos).
127. *P. rubricollis*, the Roussette. Cape of Good Hope.
128. *Xantharpyia amplexicaudata*, the Xantharpye. Amboyna.
129. *X. Ægyptiaca*, Egyptian Xantharpye. North Africa, Egypt.
130. *X. straminea*, the Pale Xantharpye. Africa.
131. *Epomophorus Whitii*, the Shoulder-Knot Bat. West Africa, Gambia.
132. *Cynopterus marginatus*, the Margin-Eared Cynoptere. India, Java, and Nepaul.
133. *C. Horsfieldii*, Horsfield's Cynoptere. Java and India.
134. *C. brevicaudatus*, the Short-Tailed Cynoptere.
135. *C. affinis*, the Indian Cynoptere. Himalaya.
136. *Macroglossus minimus*, the Kiodote. Java.

Fossil Cheiroptera.

Cuvier described the skeleton of a species of bat allied to the Serotine, which was petrified and imbedded in a block of the Eocene Gypsum at Montmartre, Paris. Some fossil teeth resembling those of a Cheiropterous animal have been found in the Eocene Sand at Kyson near Woodbridge in Suffolk. More numerous remains of this family have been met with in England in the limestone caverns containing the fossil bones of extinct bears, hyænas, and other animals. Professor Owen says of these remains that he has "failed to detect in the more complete skulls and skeletons from cave-localities any character by which they could be distinctly referred to unknown species of bats, or to such as do not now exist in England; and after much pains bestowed on the less complete and more abundant fragmentary and detached parts of the enduring framework of the *Cheiroptera* I have been seldom able—partly indeed from the still imperfect state of the osteology of this order—to arrive at any sound specific determinations." One of the most complete examples of the skeleton of a bat from a crevice of a bone-cave in the Mendip Hills Professor Owen refers to *Vespertilio noctula*. Remains of a bat from the bone-cave called Kent's Hole, near Torquay, Devon, are preserved in the British Museum; and from an examination of these Professor Owen concludes that they belong to the *Rhinolophus ferrum-equinum*, the Great Horseshoe-Bat, which is not now a native of these islands. Other Cheiropterous remains have been found in the bone-caves of the continent of Europe. [*See* SUPPLEMENT.]

CHEIROSTE'MON, a genus of plants belonging to the natural order *Sterculiaceæ*. *C. platanoides*, a most singular plant, is commonly called the Hand-Tree, in consequence of its stamens being so arranged as to present an appearance somewhat similar to that of a human hand. It is a lofty tree, with the habit of a plane, and a trunk about as thick as a man's body. Its head divides into a number of close horizontal branches, which are of a brownish colour towards their extremities in consequence of the number of short fawn-coloured hairs that beset them. The leaves are heart-shaped, slightly 7-lobed, six or eight inches long, and a little toothed; they are of a rich deep green on the upper side, and are covered with fawn-coloured hairs on the under side. The flowers are of a bright red, and appear at the end of the branches; they consist of three external lanceolate brownish bracts, and a bell-shaped fleshy angular calyx, about an inch and a half deep, bright red inside, covered externally with a russet down; it is deeply divided into five lobes, and is marked on the outside at the base with five prominences, which correspond with an equal number of little pits filled with a slightly viscid whitish fluid. There is no corolla. There are five stamens combined into a central columnlike tube, from the apex of which proceed five long slender sharp-pointed processes, which are all curved one way, coloured red, and look very much like what one might imagine to be the claws of a demon's hand; on the convex side these processes bear the anthers. The fruit is a large woody 5-celled 5-valved capsule, with from fifteen to twenty seeds in each cell.

Hand-Tree (*Cheirostemon platanoides.*)

a, fruit opened; *b*, section of young fruit, showing the disposition of the seeds; *c*, pistil and bracts; *d*, flower opened to show the tube of the stamens and the five anthers (all these figures are about one-sixth less than the natural size; those which follow are, some of the natural size, and others slightly magnified); *e*, *f*, *g*, seeds; *h*, *i*, sections showing the situation of the embryo; *k*, the embryo, placed to show the cotyledons.

The singular form of the stamens and their large size have rendered this tree an object of curiosity and veneration in Mexico from time immemorial. The native Mexicans call it by the unpronounceable name of Macpal Cochiquauhitl, which the Spaniards translate Arbol de Manitas, and the English Hand-Tree. What made it a greater object of admiration was, that in all Mexico only one tree was known, which was near the town of Toluca, about sixteen leagues west of the city of Mexico. The flowers of this plant were so constantly gathered by the Indians as objects of veneration that the fruit never ripened, and it was not till the year 1801 that cuttings transferred to the Botanic Garden at Mexico struck root, and began to multiply this vegetable wonder. The original tree must be much more ancient than the conquest of Mexico, for it has been distinctly described by the Spanish historians. The people of Toluca imagine that the tree is one and indivisible, that no other was ever created, nor any other ever propagated. Seeds however have been produced from the young plants in the Botanic Garden, Mexico, whence they may now be procured without difficulty. Plants of it were thus obtained some years since by Mr. Lambert, of Boyton House, in Wiltshire, and they are not uncommon in large collections. Notwithstanding the belief of the Mexicans to the contrary, it is really found wild in Guatemala, where whole forests of it were observed near the city of that name by one of the pupils of Professor Cervantes. The Hand-Tree is said to form a very large tree, which preserves its leaves all the year round, and forms a fine shady canopy, flowering in November, December, and January.

(Hernandez, *Hist. Plant. Nov. Hisp.*, vol. ii., ed. 2, p. 531; Vetancourt, *Theatr. Mexic.*; Larreategui, *Dissert.*, June, 1795; Tilesius in *Act. Petrop.*, 5, 321, t. ix.; Humb. and Bonpl., *Pl. Æquinoct.*, i. 85.)

CHEIROTHE'RIUM. The footprints on the Red-Sandstone of Hildburghausen were referred by Kaup to a mammiferous animal under the above title. To the same origin many similar remains in England have been referred. Professor Owen is of opinion that the animal was reptilian, and that it may be regarded as identical with the *Labyrinthodon* of the same formations, of which the teeth are very characteristic. The animal was probably a Batrachian Reptile. The footprints occur with ripple marks, and what are called rain marks, on the flaggy red-sandstones of the Mersey and also in Dumfriesshire.

CHELIDO'NIUM, a genus of plants belonging to the natural order *Papaveraceæ*. *C. majus* is the only species. It is a glaucous rather hairy annual, with small yellow flowers, a siliquose capsule, and orange-coloured juice. It is not at all uncommon in waste places in this country; it is commonly called Celandine, and possesses no useful properties worth naming.

CHE'LIFER, a genus of *Arachnida* remarkable for the resemblance which the species composing it bear to scorpions. Hence Lamarck styled the order in which he placed them 'les Faux Scorpions,' associating them with *Galeodes*. They belong however to the *Trachearian* division of the class *Arachnida*. The mandibles of *Chelifer* are short, with didactylous extremities. The palpi are two, very long, and fine pointed, resembling arms, and having claws at their extremities. The maxillæ are connivent and two in number. The eyes are two in the *Chelifers* proper, as distinguished by Hermann from the species of the genus *Obisium* of Leach, which have four; they are placed at the sides of the thorax. The body is ovate, anteriorly acute, and depressed. The feet are eight.

These curious animals are very small, and resemble miniature scorpions deprived of their tails. They run fast, moving backwards, forwards, and often sideways like crabs. They live under stones, in crevices of rocks by the sea-side, under bark of trees, and in houses among old papers and old furniture. They feed upon insects. They are found in all parts of Europe.

CHE'LMON. [CHÆTODON.]

CHE'LODUS, a genus of Fossil *Mammalia* proposed by Kaup. It is of the rodent type, allied to the beaver and porcupine, and occurs in Tertiary Beds at Eppelsheim, near Mainz.

CHE'LONARIUM. [ELATERIDÆ.]

CHELONE. [CHELONIA.]

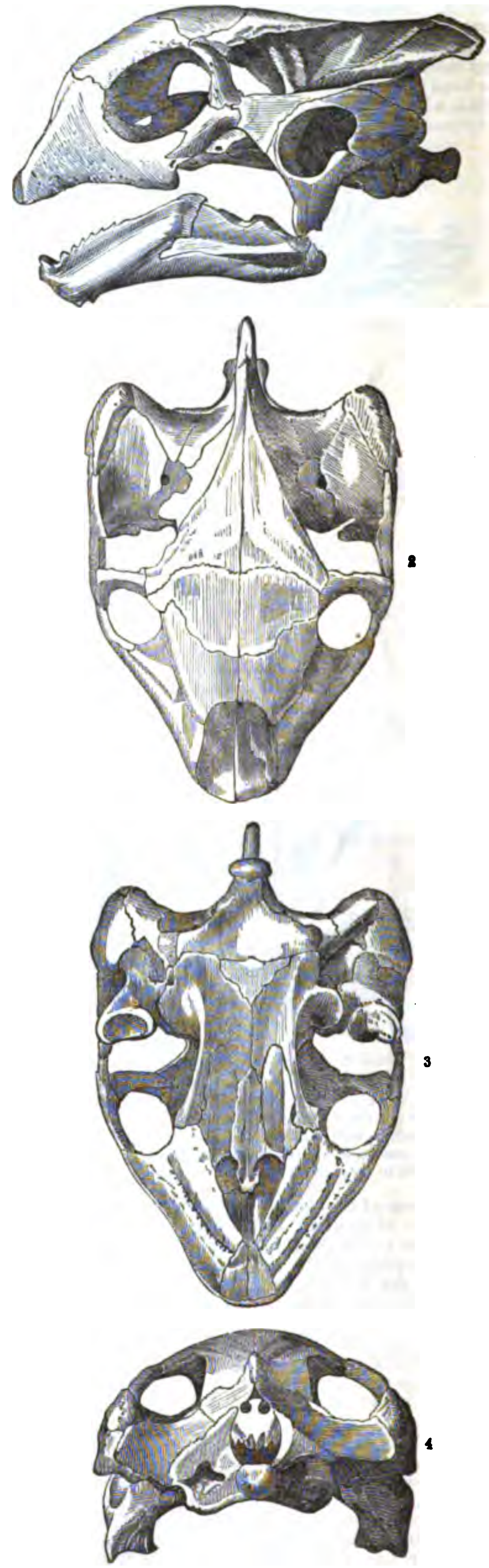
CHELONIA (Χελώνη, a Tortoise), Tortoises and Turtles, a numerous and highly interesting order of Reptiles, generally considered the first by herpetologists. They are also termed *Testudinata* (from *Testudo*, the Latin name for a Tortoise), and are distinguished at the first glance by the double shield in which their body is normally inclosed, whether they are terrestrial, fresh-water, or marine. They were all comprised by Linnæus under his genus *Testudo*.

The following account of the organisation of these animals is principally derived from Cuvier.

Skeleton.—The surface of the skull in these reptiles is continuous, being without any moveable articulations, as is the case with the Serpents and the Tailed Batrachians. But whilst this character prevails in all the genera of which the order is composed, many of those genera differ much in their cranial structure, and it becomes necessary to point out these differences, which are much greater than those which exist in the crania of the Crocodiles.

In the Land-Tortoises the head is oval and obtuse anteriorly; the interval between the eyes is large and convex; the aperture of the nostrils is large, higher than it is wide, and a little depressed backwards. The orbits, which are large, are nearly round, complete throughout, directed sideways and a little forwards. The parietal region terminates backwards in a large projecting occipital spine, and has on each side two large temporal fossæ, under which are enormous tympanic cavities; behind these cavities, and a little above, project two large mastoidean protuberances, and beneath them are the apophyses, which serve for the articulation of the under jaw. These apophyses descend vertically, and are not directed backwards as in the Crocodiles. Underneath, the basilary region is flat, the palatine concave; and upon the anterior part of this last the osseous posterior nostrils open, there being no palatine roof, and the palatine part of the maxillaries being open up to the anterior fourth of the muzzle; a disposition rendered necessary by the mode of respiration in these animals, and which as much resembles that of the Frogs as it differs from that of the Crocodiles. The occipital region is in its totality vertical, although the occipital spine, the mastoidean protuberances, and the articular condyle of the skull, which is a very projecting tubercle, render it very unequal.

The first remarkable feature in the composition of the head of the Tortoises is the absence of nasal bones. In the recent animal the external bony nostrils are narrowed by cartilaginous laminæ, which represent these bones; but in the skeleton is found immediately at their upper border the anterior frontal bone, which takes its ordinary place in the frame of the orbit, is articulated also, as ordinarily, to the ante-orbital apophysis of the maxillary bone, descends within the orbit, forms the anterior septum, which separates the orbit from the nose, and is articulated below with the palatine and the vomer, leaving between it, the maxillary, and the palatine, an oblong hole, which leads into the posterior nostrils. The osseous cavity of the nose is oblong, and formed by the maxillaries, the intermaxillaries, the vomer, the two anterior and the two principal frontals. The extent of the anterior frontals and the absence of the nasal bones are the causes that the first articulate with each other, and that they extend above the orbit and outside the principal frontals up to the posterior frontals in *Testudo Indica*, or very near it in some other species. The intermaxillaries have no ascending apophysis. They form, as ordinarily, the termination of the muzzle, and are directed backwards in the palate between the maxillaries, and even between the posterior nostrils, to the vomer. The posterior nostrils are two large apertures pierced on each side in the middle of the nasal cavity between the maxillaries, the intermaxillaries, the vomer, and the anterior frontal bones. The bottom of the cavity of the nose is covered above and closed behind by the principal frontals, which leave a large aperture between them, closed by a cartilage which permits the passage of the filaments of the olfactory nerve. Lower and laterally there is, between the frontal, the anterior frontal, and the vomer, a rather large space closed by a continuation of the same cartilage, which represents the os planum. In the Terrestrial Tortoise there is no inter-orbital simple cartilaginous septum, or nearly none; but this is not so in other sub-genera. The frontals cover but very little of the cerebral chamber, because they are short, and together form a lozenge wider than it is long. The parietals form together a pentagon, the most acute angle of which proceeds to unite itself with the occipital spine. They cover more than half of the cerebral chamber, and are directed backwards by means of a scaly suture on the occipital bone and on the petrous bone. On each side the parietal bone descends very low into the temporal fossa; there it occupies nearly all the space which the temporal wing of the sphenoid bone occupies in the crocodile, and in the tortoise there only remains a very small portion of this bone, which unites on one side to the descending portion of the parietal; on the other to the palatine, the internal pterygoid, the body of the sphenoid, the tympanic cavity, and the os petrosum. The jugal bone is articulated, as ordinarily, with the external and posterior angle of the maxillary bone. It is narrow and continued under the orbit, behind which it encounters the posterior frontal bone, which completes the frame in this part, and the squamous portion of the temporal bone, which forms by itself the whole zygomatic arch, as may be seen in many of the *Cetacea*. The temporal bone widens to unite itself to the tympanic cavity, which is extremely large. It forms a frame which is nearly completely bony for a large tympanum; and below this frame it descends in form of an apophysis for the articulation of the lower jaw. This frame leads into a vast cavity, completed only at its upper posterior angle by the mastoidean. At the bottom of this cavity is a hole through which passes the ossiculum auditûs to arrive at a second cavity, formed externally by the bone of the tympanic cavity, on the internal side by the petrous bone and the occipital bones, below a little by the sphenoid bone, and closed backwards by cartilage. It is a second part of the tympanic cavity which is thus divided by a constriction, of which we have examples among the mammals, especially in the genus *Felis*, but the communication between the two parts is less narrowed than in the Tortoise. The tympanic bone forms besides a considerable part of the posterior walls of the temporal fossa. Between it and the parietal the petrous bone shows itself in this same temporal fossa, and the cranium is closed behind by the occipital bone, which is here divided into six bones, not into four; for the lateral occipitals are each divided into two parts, the most external of which Cuvier terms the exterior occipital. The fenestra ovalis is, he observes, common to the petrous bone and this exterior occipital; as, in the crocodile, it is common to the petrous bone and the ordinary lateral occipital: the fenestra rotunda, on the contrary, is pierced in the exterior occipital, as it is pierced in the lateral occipital of the crocodile. The two bones contribute to the formation of the cell of the labyrinth with the upper occipital, as the petrous bone and the lateral occipital contribute to it in the crocodile. In both genera the great aperture for the exit of the fifth pair of nerves is in front of the petrous bone, between it and the temporal ala. In the Turtle this hole is between the petrous bone and the descending part of the parietal bone. The ossiculum auditûs is simple, as in the crocodile, and formed of a slender stem, which widens at the point of its approximation to the fenestra ovalis, and which is there applied by a round and concave surface, so that it has nearly the figure of a trumpet. The Eustachian tube is entirely cartilaginous or membranous. It commences in the external chamber of the cavity, above, by a large notch of the posterior border of the tympanic bone, near the edge of the tympanum itself, and is directed obliquely within, passing between the bone of the cavity and the depressor muscle of the lower jaw, to a notch of the lateral and posterior border of the pterygoid bone, whereby it penetrates into the back of the fauces, on the side, close to the articulation of the lower jaw, but far enough from its congener, and especially very far behind the internal nostrils. On the palate, or rather, behind the roof of the back of the mouth, may be seen the orifices of two tubes, under the form of two small holes separated from each other.



Skull of *Testudo Indica*.

1, Profile; 2, seen from above; 3, seen from below; 4, seen from behind.

Reverting to the lower surface of the cranium, behind the maxillaries and the frontals, posterior to the two sides of the vomer, are the palatines, surrounded behind and externally by the pterygoid bones, which last extend along the external border of the palatine to the maxillary bones. The rest of the pterygoids covers the lower surface of the cranium between the two tympanic cavities and the two temporal alæ, leaving exposed to view behind only a triangular part of the body of the sphenoid. The olfactory and optic nerves have their exit by the cartilaginous septa of the cranium, and not by any particular opening in the skull. Cuvier thinks that it is the same with the third and fourth pairs: the sixth goes forth by a small canal of the body of the sphenoid bone. The fifth pair has a great hole between the petrous bone and the temporal ala divided into two externally. There is at the external border of the palatine bone a hole analogous to the pterygo-palatine.

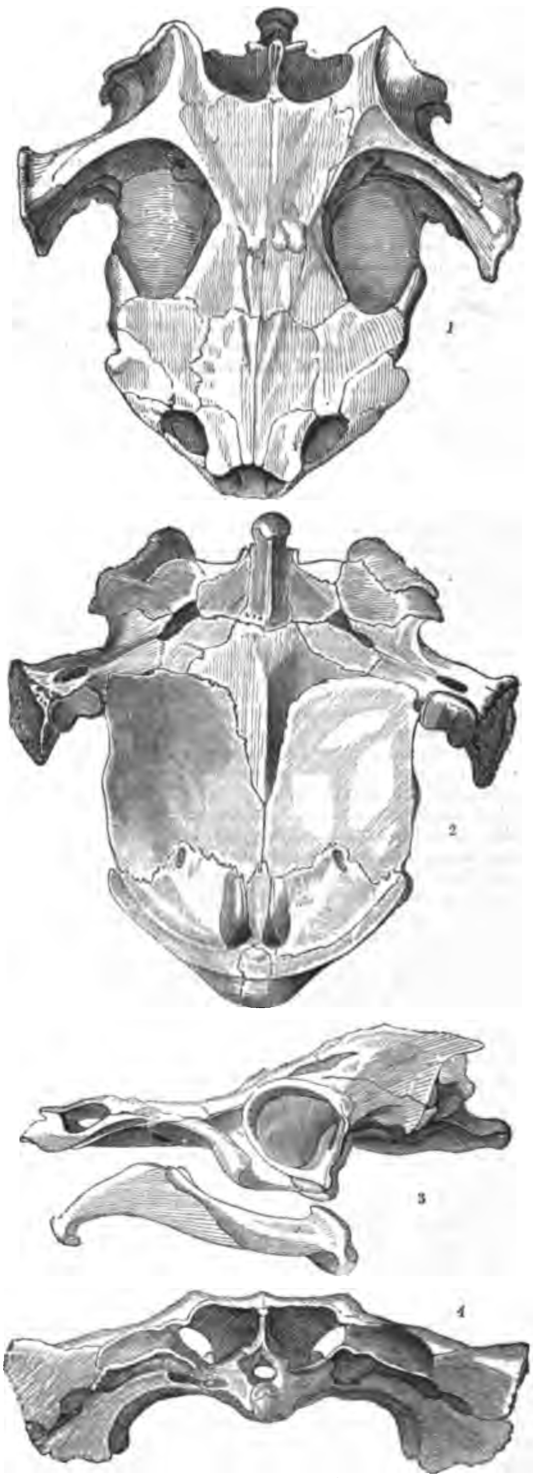
Internally, the cerebral cavity is higher than it is wide; the bottom of it is very entire: but, in front, in the sphenoid, there is a deep fosset for the pituitary gland, a kind of saddle. From the sides of this part spring the cartilaginous septa, which in going to form a junction with the ante-cerebral partition of the frontal bone, close the cavity of the cranium, support the whole anterior part of the encephalon, and occupy the place of the cribriform plate, of the orbital alæ; or otherwise, the anterior sphenoid, and the greater part of the temporal alæ, of which another considerable part is replaced by the descending portions of the parietal, so that what remains does not participate in the formation of the chamber of the cranium except a little in front of the hole for the fifth pair of nerves. There is no more bony trace of the anterior sphenoid than in the crocodile.

In the *Emydes*, or ordinary Fresh-Water Tortoises, the head is more flattened. The principal frontals, although they are wider than they are long, do not always reach to the border of the orbit, as is, for example, the case in the *Testudo* (*Cistudo*) *Europæa;* the posterior frontal is wider. The frame of the tympanum is not complete, and in lieu of a hole there is a fissure for the passage of the ossiculum auditûs from one hollow of the cavity to the other. The basilary and palatine regions form but one plane; the palatines not being even concave. Cuvier observes that *Testudines scripta, picta, scabra, dorsata, centrata, clausa,* and *virgulata,* belong to this category. Certain *Emydes,* he remarks, *Emys expansa* for instance, tend to the Sea-Tortoises, or Turtles, and the Fresh-Water Tortoises, and yet exhibit characters peculiar to themselves.

In the *Trionyces*, or Soft Tortoises, the skull is depressed, and elongated backwards; the muzzle, pointed in certain species (that of the Nile for instance), is short and rounded in some others. The intermaxillary bones are very small, and have neither nasal nor palatine apophysis; there is behind them a large incisive hole. The maxillaries unite upon the palate for a rather long space, so that the posterior nostrils are more backwards than in the Land-Tortoises. The palatines do not unite below to prolong the palate; they are hollowed into a demi-canal anteriorly, and less extended than in the Land-Tortoises.

The principal character of the Marine Tortoises, or Turtles, is that a lamina of their parietal, their posterior frontal, their mastoidean, their temporal, and their jugal, unite together, and with the tympanic cavity, by sutures, to cover the whole region of the temple with a bony roof, which has no solution of continuity. Their muzzle being shorter than in other tortoises, and their orbits much longer, their nasal cavity is smaller, and as wide as it is high and long. Its posterior wall belongs entirely to the anterior frontals, and it is between them that the olfactory nerves are introduced. The bony tubes of the back nostrils commence in the lower part of this posterior partition, and, like the palatines, have a palatine part or lower lamina; these tubes are rather longer, more directed backwards, and bear less resemblance to simple holes. It results also from the size of the orbit that the inter-orbital membranous or cartilaginous space is more extended.

The most heteroclite skull among the tortoises is that of the Matamata (*Testudo fimbriata, Chelys fimbriata*). Extraordinarily large and flat, it seems to have been crushed. The very small orbits are close to the end of the muzzle. The posterior region of the cranium is elevated; and the two tympanic bones, in form of trumpets, widen out on each side of the cranium. The temple is a wide horizontal fossa, not deep, and not at all covered, except behind by the union of the posterior angle of the parietal with the mastoidean bone; and, what is peculiar, Cuvier observes, to this sub-genus, this fossa is not framed in externally, because there is no temporal bone, or at least it is reduced to a simple vestige. The two maxillaries form together a transversal arch, in the middle of which, below, is a single intermaxillary, and, above, the external aperture of the nostrils, which is continued into a small fleshy proboscis. The two palatine bones, and, between them, the vomer, fill below the concavity of this arch, and have in front the two back nostrils well separated, but which the palatines do not encircle below. At the posterior border of the palatine is a rather large pterygo-palatine hole. The anterior and posterior frontals form the upper part of the orbits. The principal frontals advance between the anterior frontals to the edge of the external nostrils. There is no more nasal bone than in the other tortoises. The jugal proceeds from the posterior angle of the orbit between the maxillary and posterior frontal, beyond which it does not go, touching a little behind and below the pterygoidean; but not forming any projection behind to border the temple. This last is in this manner separated from the orbit by a postorbital branch of excessive width, and which takes in the totality of the posterior frontal and the jugal bones. The posterior frontal articulates itself to the pterygoidean by its external posterior angle. The rest of its posterior border is free, and is continued with that of the parietal



Skull of Matamata (*Chelys fimbriata*).
1, seen from above; 2, seen from below; 3, profile; 4, seen from behind.

to cover a wide and flat canal of communication, proceeding from the temple to the orbit, and formed below by the pterygoidean and palatine bones. The two pterygoideans are enormous. They form the greatest part of the base of the cranium and of the bottom of the temple. Their external border is curved in its anterior part for its continuation with the free border of the posterior frontal; there are neither orbital nor temporal alæ. The parietal bones, which form above a great rectangle, unite by their descending portions to the palatines, the pterygoideans, the petrous, and the upper occipital bones. They form by themselves nearly the whole roof of the cranium. Following the pterygoidean, the temple is bounded behind by the tympanic bone or the tympanic cavity, which resembles in part a trumpet. The frame of the tympanum is complete. A hole in the posterior wall suffers the ossiculum to pass into the second chamber, which, in the skull, is only a long groove of the posterior surface of the cavity, which terminates in a hollow, in the formation of which the petrous bone, the external occipital, and the lateral occipital concur. It is not closed behind, except by cartilage and membranes; and in the wall of the side of the cranium are pierced the two fenestræ, as ordinarily. Above this hole of the first chamber, by which the ossiculum passes, is another which conducts into the mastoidean cellule, which, on account of the outward projection of the tympanum, is found within and not behind. The occipital spine is a short vertebral crest, and the mastoidean tubercles are transversal crests, which belong entirely to the mastoidean. Even in large individuals the six occipitals ordinary to the tortoises may be distinguished. Below, the smooth and nearly plane cranium presents a sort of regular compartment, formed of the intermaxillaries, the maxillaries, the vomer, the palatines, the pterygoideans, the sphenoid, the petrous bones, the tympanic cavities, the basilary, and the lateral and external occipitals. Behind the ceiling of the temple the petrous bone forms a square compartment between the pterygoidean, the tympanic cavity, the external occipital, the superior occipital, and the parietal bones.

The lower jaw of the tortoises is divided in a manner which it is not very easy to refer to that manifested in the crocodile, to which, Cuvier observes, that of the birds has a much more striking relation; but the bird's jaw, he adds, also approaching to that of the tortoises, aids us in referring it to a common type. The space occupied in the crocodile by the two dental and the two opercular bones is filled in the Marine Tortoises, the Fresh-Water, and Land-Tortoises, as well as in the *Trionyces*, with a single bone only, the analogue of the two dental bones. Cuvier never saw in all these sub-genera, even in their youth, any trace of symphysis: the bone is continuous in the tortoises, as in birds. The Matamata, or *Chelys*, on the contrary, preserves in every age a division at the anterior part. The opercular bone always exists, as in the crocodile, at the internal surface; but it is carried farther backwards, and attains to the posterior extremity. Beneath it is the angular bone forming the lower edge of the jaw. That which Cuvier names the surangular bone occupies the external surface of this part of the jaw, and proceeds also to its posterior extremity, but only touches the angular bone quite behind, and in becoming separated on the two anterior thirds by a long point of the dental bone. Above, and towards the back part, between the opercular and surangular bones, the articular bone is situated, as in the birds; but in the tortoises it is reduced to smaller dimensions, only serving for the articulation and for the insertion of the depressor muscle, or the analogue of the digastric muscle. The coronoid apophysis does not belong at all to the surangular bone in this order, but to a bone placed between the dental, the opercular, and the surangular bones; and in front of the aperture by which the nerves enter the jaw, an opening, which is here found at the upper border, instead of being, as in the crocodile and the birds, at the internal surface. This bone, which is not found in the birds, can only respond to the complementary bone in the crocodile. Cuvier saw in the *Emys expansa* the surangular, the opercular, and the articular bones anchylosed, and their sutures effaced, at a period when all the others were still visible. The general form of the bony jaw corresponds nearly to what is seen externally. More pointed in the *Trionyces* and *Chelone Caretta;* more obtuse, more parabolic, in *C. Mydas* and the Land-Tortoises; semicircular in front of the coronoid apophyses in the Matamata; it differs also in the furrow with which it is hollowed. This furrow is narrow, deep, and equally wide in the Land-Tortoises; widens and deepens towards the symphysis in *C. Mydas;* and is entirely wanting in *Trionyx*, *C. Caretta*, &c.

The os hyoides of the tortoises is more complicated than that of the crocodiles, and varies singularly in form from one genus and even one species to another. It is in general composed of a body itself, sometimes subdivided into many pieces, and of two, sometimes three pairs of horns: and under the anterior part of its body is, besides, suspended a bone or a cartilage, sometimes double, which is the true bone of the tongue analogous to that seen in the birds, but articulated in them in front of the body of the os hyoides, whilst in the tortoises it is suspended below it. The greatest horns (the anterior pair when there are only two, the middle when there are three, representing the styloidean bones) embrace the œsophagus, and mount behind the muscles which are the analogues of the digastrics, or depressors of the lower jaw, but without being fixed otherwise than by their proper muscles. The Land-Tortoises have the body of the os hyoides wider, its anterior portion longer, and want the small anterior horns, whilst the anterior angle is very much developed. In the middle of the disc are two round spaces, which in certain tortoises, the *Testudo Indica* for example, are only more delicate; but which in the others, *Testudo radiata* for instance, are absolutely membranous.

In some Fresh-Water Tortoises, *Testudo Europœa* and *T. clausa* for example, the body of the bone is longer than it is wide; and has in the front a small membranous space, and at its anterior angles the small lateral horns. Sometimes two or even four osseous nuclei are there formed.

The os hyoides of *Trionyx* differs still more. Its body is composed in front of a cartilaginous point, under which is suspended a great lingual oval cartilage. At the base of this a rhomboidal osseous piece adheres on each side, which piece represents the anterior horns, and afterwards four others forming a thick disc, concave above, wider in front, and notched on the sides and behind. At the anterior angles of this disc adhere the middle horns, and to the posterior angles are attached the posterior horns: all four are very bony. The middle are formed by a long piece, which is compressed, arched, and terminated by a small cartilage. The others are wider, flatter, and prolonged by a cartilage, in the substance of which are encrusted in a row from five to six bony nuclei, which are round or oval, very hard and very distinct; so that the entire bone comprehends twenty different osseous pieces, which appear to remain distinct to old age.

The most singular of all these is that of the *Chelys*, and is very early entirely ossified. Its body is composed of a long narrow prismatic piece, hollowed above by a canal where the trachea runs. In front this piece is dilated, and carries on each side two angular portions, four in all, without counting the piece itself. The two intermediate ones unite in front, leaving between them and the principal body a membranous space on which the larynx reposes. The lateral portions, Cuvier observes, represent perhaps the small anterior horns. It is on the angle which they form with the dilatation of the principal body that the middle horns are articulated; these last are very strong, prismatic on their internal moiety, and then slender, and terminated by a bony and pointed piece, distinct from the rest of the horn. The posterior horns are articulated at the posterior extremity of the prism formed by the principal body. They are long, strong, slightly compressed, and curved into an arch.

Under the anterior and dilated part is suspended the true bone of the tongue, formed in front of a semicircular cartilage, and behind of two bony pieces in form of a crescent, the internal angle of which is prolonged into a sort of tail or pedicle, which lies under the prismatic body of the os hyoides.

In the Turtles, *Chelone Caretta* for instance, the body of the bone is in the form of an oblong buckler, concave above for the support of the larynx and the commencement of the trachea, and drawn out in front into a point which penetrates into the flesh of the tongue in passing upon the lingual bone. It presents on each side an angle for carrying the anterior horn, which is very small; the great horn curved into an obtuse angle for going round the œsophagus and jaw, more bony than all the rest of the apparatus, is articulated to the middle of the lateral border of the body of the bone, and its free or upper extremity is terminated by a small cartilaginous articulation. The posterior horns are articulated to the posterior angles. They are cartilaginous, flat, rather wide, and scarcely arched.

Bones of the Trunk: Dorsal Buckler, or Carapace.—The wide differences prevalent in the modification and arrangement in the bones of the head in this order lead one to expect, as the great French zoologist observes, proportional differences in the rest of the skeleton. The cranial differences are, as he remarks, greater perhaps than obtain among the whole of the mammals, and most certainly are more extensive than can be found in the whole class of birds.

The general distinguishing character of the Tortoises, that which separates them from all the *Vertebrata*, is the external position of the bones of the thorax, enveloping with a cuirass or double buckler the muscular portion of the frame, and serving also as a protection for the shoulder-bones and the pelvis.

The dorsal buckler is principally formed of eight pairs of ribs, united towards the middle by a longitudinal succession of angular plates, which adhere to the annular parts of so many vertebræ, or even form a part of them; but it is remarkable that these annular portions alternate with the body of the vertebræ, and do not correspond directly with them.

The ribs are inlaid by means of sutures into these plates; they are also united with each other, on the whole or a part of their length, according to the species, and even in each species according to the ages of the individuals. There are eight anterior vertebræ which do not enter into this conjunction. The first seven (the ordinary cervical) are free in their movements. The eighth, which may be regarded as the first dorsal, is placed obliquely between the last cervical and the first of the fixed vertebræ of the dorsal buckler, which shortens it anteriorly; behind, its spinous apophysis is elongated, and enlarges a little to attach itself by synchondrosis to a tubercle of the first of the plates of the intermediate series of the plastron.

The first of these fixed vertebræ, which is the second dorsal, is still rather short, and carries also its proper annular part, the spinous apophysis of which, shorter than the preceding, attaches itself to the second plate by a cartilage. This second plate, narrower than the first, forms but one bone with an annular part which is below, and of which the anterior portion is articulated by two small apophyses with the articular apophyses of the second dorsal. This, properly speaking, is the annular portion of the third dorsal vertebra; but the body of this third vertebra is only articulated by its anterior moiety with the posterior moiety of this third annular part, and by its posterior moiety it is articulated to the anterior moiety of the fourth annular portion; and this alternation continues, so that the body of the fourth vertebra responds to the annular portions of the third and the fourth, the body of the fifth to the annular portions of the fourth and fifth, and so on to the tenth.

But it is necessary to distinguish in the ribs the plate included in the buckler, and a small branch which proceeds from its lower surface, and which represents what is termed the head of the bone in the ordinary ribs. This head is always articulated between two bodies of vertebræ. The first of all these ribs has only this small branch, without having any plate belonging to it in the buckler, excepting only in some of the *Emydes*, where may be seen, between the first and second longitudinal plate, and the first or second widened rib, a small piece which can only represent the enlarged portion of this first rib, but which does not belong to its head. It is articulated between the eighth vertebra or first dorsal, and the first fixed vertebra, and by its other extremity applies itself to the internal surface of the second rib. This last has a plate which incorporates itself by its anterior border with the first of the longitudinal series, by its spinal border with the second piece of that series or the annular portion of the third vertebra, and by its head between the body of the second vertebra and that of the third. The succeeding ribs observe the same law, are articulated by means of their head between the body of one vertebra and that of the succeeding vertebra, and incorporate themselves by means of their dilated part with the plate which represents the annular portion of the second of these two vertebræ: and this, Cuvier observes, is a return to the general law; for in man and in the quadrupeds the ribs are articulated by their head between two vertebræ, and by means of their tuberosity, with the transverse apophysis of the second of the two. The dilated portions of the ribs of the tortoise, in the part where they are incorporated with the plates of the longitudinal series, represent, then, the tuberosities of the ribs of mammals. The ninth plate of the longitudinal series, which belongs to the tenth dorsal, is the last with which a pair of the dilated ribs is incorporated; and this last is the ninth in all, or the eighth of those which enter into the composition of the dorsal buckler. It is directed from its posterior border backwards, and embraces again the succeeding plates, with the external edges of which it becomes incorporated: but these three plates do not, any more than the first, serve to complete the vertebral canal.

The tenth rib, attached between the bodies of the tenth and eleventh vertebræ, produces no plate and enters not into the composition of the dorsal buckler. Like the first, it has only a portion of the head, and is joined by its other extremity to the internal surface of the ninth.

The eleventh vertebra after the cervical is the only one that can be termed lumbar; it carries no rib. In the Turtles, its annular portion again gives a plate to the longitudinal series of the dorsal buckler, and is the tenth and the smallest of the pieces of this series. The twelfth and thirteenth vertebræ are the sacral. At their sides are attached two lateral pieces sufficiently similar to the heads of the ribs, but stronger, especially the first, and convex at the end, in order to their union with the posterior and upper angle of the ossa ilii. Their annular portion is close and complete, and is not incorporated with the plates of the buckler which follow that of the eleventh vertebra. The vertebræ of the tail are free, like those of the neck: hence the plates of the longitudinal series, which follow the tenth, do not adhere to the vertebræ, and, if they belong thereto, only so belong by a metaphysical relation, and accordingly they may be considered as having been dismembered. So of the first of all the plates of the series. It only furnishes an attachment to the annular portion by synchondrosis, otherwise close and complete, of the first dorsal vertebra; and if one would regard it as belonging thereto, it would be necessary to consider it as dismembered.

The Turtles have three longitudinal plates after the tenth, making thirteen in all; but the second is sometimes divided into two, and the ninth also, which increases their number to fifteen.

Cuvier found fourteen in some of the *Emydes*, the *Emys serrata* for instance; but the eleventh and twelfth, he adds, are very small in them. There is but a single one after the tenth in the Land-Tortoises and the *Chelydes*, so that they have only eleven in all. It sometimes happens that one or two of these plates are not seen externally. Thus in the Box-Tortoises, the two ribs of the last pair are joined to each other, and thus cover the ninth plate; and in this respect many modifications occur in the same species; of which Bojanus has, in his third plate, given many examples taken from the European Tortoise.

In *Chelys* the last and penultimate rib are attached to the eighth plate, and the ninth remains hidden. In both cases the tenth and the eleventh subsist as ordinarily.

In the Turtles, the eight pairs of ribs and the thirteen plates of the longitudinal series form a slightly convex oval buckler, a little narrowed backwards. The ribs are not incorporated throughout their length, a narrow fraction remains towards their exterior, and the intervals between this portion and that of the anterior and posterior ribs are filled up by a cartilaginous membrane only. It is only in extreme old age that some are widened to the end. Cuvier had sometimes seen the first three and a part of the fourth in this state.

In the Fresh-Water Tortoises and in *Chelys* the buckler is entirely filled up in time, and the ribs incorporate themselves throughout their length, between each other and with the marginal pieces. The ossification proceeds still faster in the Land-Tortoises, and it is only in their youth that vacant spaces are observed between the external parts of their ribs.

Carapace of *Trionyx*, seen from below.

The Sternum Plastron, or Breast-Plate is always composed of nine pieces, of which eight are pairs, and the ninth is odd and always placed between the four anterior ones, with the first two of which it generally coheres, when it is not articulated with the four.

These nine pieces vary much in figure according to the genera and species.

In the Land and Fresh-Water Tortoises and in *Chelys* they only leave vacancies between each other in early youth, when they are formed by bony rays shooting in various directions in the still cartilaginous disc of the plastron, like the bones of the cranium in the fœtus of mammals; but, with age, these rays join each other from every side, and form a disc compact in all its parts, which unites itself by a more or less considerable extent on each side to the dorsal buckler.

In the Turtles, and in the *Trionyces*, or Soft Tortoises, these radiating expansions do not unite throughout; and even when the four pieces on each side unite together and the odd piece is joined to those of the first pair, there remains in the middle, between them all and on each side between them and the dorsal buckler, great spaces which are filled up by cartilage only.

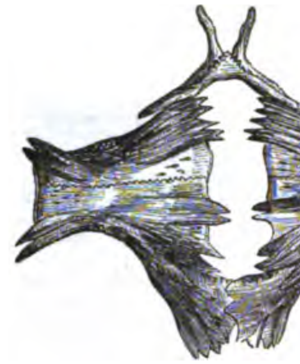
Vertebræ.—The atlas is composed of four pieces. The first two, united above in a slight spinous prominence, after having surrounded the vertebral canal, and each having given backwards its articular apophysis, concur with a third very small one in the formation of a ring for the reception of the condyle of the head: Cuvier calls it a ring, because in the skeleton this fosset is open, and its bottom filled by a fourth piece, which is a true body of a vertebra without the annular portion, and which, presenting an anterior convex surface in the space here noticed, is articulated behind by a concave surface on the body of the axis. This piece, analogous to what we have already seen in the crocodile, represents, he observes, the odontoid apophysis of the axis of mammals. At their junction, there is besides, attached below, a small bone formed nearly like a patella (rotule).

The axis and the succeeding vertebræ are composed of a nearly rectangular body, carinated below, concave in front, convex behind, and of an annular portion, which remains distinct from the body throughout life, by means of two sutures, is elevated above by a crest in lieu of a spinous apophysis, and whose anterior articular apophyses, placed at first under the posterior portions of the preceding vertebra, raise themselves obliquely to embrace them slightly up to the sixth, and nearly resume their horizontal position in the two succeeding ones. At the anterior angle of each side of the body is a small facet, common to the body and the annular portion.

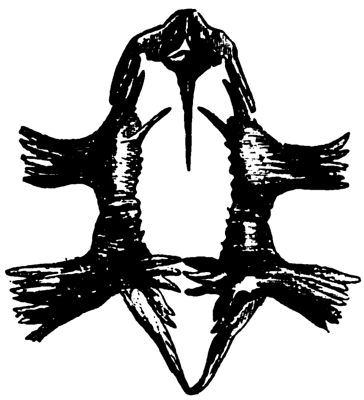
The vertebræ adhering to the dorsal buckler have their body wide and feebly carinated in the Marine and Fresh-Water Tortoises: in these last it is even flattened in the anterior ones. It is also wide and with but little convexity in *Trionyx*, and *Chelys* has it wide and elevated longitudinally into a small crest. But there are Land-Tortoises (*Testudo geometrica* and *T. radiata*) in which it is excessively compressed, and does not even join itself throughout, except by a membranous partition, to the pieces of the middle row of the buckler, these pieces only affording each two narrow laminæ, and descending on each articulation of the two bodies. It is in a fold of the lower portion of this membrane, between these vertical laminæ, and in a semicanal hollowed at the upper part of the bodies, that the spinal marrow goes.

In the other sub-genera the pieces of the longitudinal series of the dorsal buckler afford more complete vertical partitions, which form with the bodies a continuous bony canal, the nerves of which go out through holes which remain between the laminæ.

The sacral and caudal vertebræ are each composed of a body, concave before and convex behind, of an annular portion, squarely flattened, and without a spine above, the anterior articular apophyses of which obliquely embrace below the posterior apophyses of the preceding vertebra, and of two transverse short apophyses, articulated on each side on the suture, which joins the body to the annular ring Cuvier counted 23 caudal vertebræ in *Testudo Græca*, *T. Indica*, and other Land-Tortoises, and as many as 27 in *Testudo radiata*. He states that there were only 18 in the Fresh-Water and Marine Tortoises which he examined.



Sternum of *Trionyx*.



Sternum of *Chelone*.

Sternum of *Cistudo*.

Bones of the Extremities.—The bone which goes from the dorsal buckler to the sternum is suspended by a ligament under the dilatation of the second rib, but in front of the first, which, as we have seen, consists only of a head articulated under the second; so that in some respects this bone is outside the thorax. There is sometimes in the ligament by which it is attached one, and even two, peculiar bones. This bone is at first nearly cylindrical: it proceeds forwards, and after having afforded on its external surface a portion of the articular facet which receives the head of the humerus, it goes with a more or less strong inward bend to attach its other extremity to the internal surface of the sternum, towards the lateral angle of the odd piece. The rest of the facet for the articulation of the humerus is furnished by another bone, which is directed more or less obliquely backwards and towards the mesial line, widening into a fan-shape, and which thus lies nearly parallel to the sternum. The osseous branch which comes from the bony buckler, is, according to Cuvier's self-corrected opinion, the shoulder-blade, and the part which it offers beyond the articular fosset is its acromion. The flattened bone which is directed backwards is, he adds, incontestably the coracoid bone: and he further remarks that all the muscles which proceed from these bones to go to the arm are respectively the same as in birds, whatever changes they have undergone in their position relatively to the horizon in their size and in their figure. Cuvier considers that it remains to be known whether there is a clavicle or not.

The three-branched shoulder, the nearly cylindrical shoulder-blade, the acromial portion nearly equal in volume to the rest of the shoulder blade, are characteristic of the Tortoises. There is nothing parallel to this conformation in the other animals, because there is no other shoulder situated within the thorax. The varied forms of these parts afford, Cuvier observes, very good characters for the sub-genera; and he details the modifications characteristic of the Marine Tortoises, the Land-Tortoises, the Fresh-Water Tortoises, *Chelys*, and *Trionyx*.

The humerus of the Tortoises is required to turn singularly upon its axis, in order to place the fore foot in the position required by the bony cuirass, which only leaves a narrow passage for it. The result is that its internal tuberosity is become posterior and superior, and that the external tuberosity is become internal and also posterior. The head of the bone goes out of the axis more than in any other animal, and that towards the posterior face which in the ordinary position is the superior one. It presents the segment of a sphere, and is very convex. The two tuberosities are very large, very projecting, and leave between a concavity, as there is one backwards, between the condyles of the humerus in the greater part of the mammals. The internal tuberosity—become, as has been pointed out, posterior—is the largest. It has the form of a long obtuse crest, analogous to the deltoidean, and which receives the same muscles. The other tuberosity forms a crest also, but much shorter. Both are near the head. The body of the bone is bent; and its concavity, which in man would be anterior, is ordinarily found inferior. The opposed surface is convex. Above it is a small hollow opposite the end of the fossa, which is between the two tuberosities. The lower part of the bone is widened and a little flattened from before backwards. On the external border is a furrow, not much developed in the Land-Tortoises; deeper in the *Emydes*, the *Chelydes*, and the *Trionyces*; and which in the Marine Tortoises nearly separates the lower head of the bone into two unequal parts. This furrow, Cuvier observes, is perhaps the best character for distinguishing the lower part of the humerus from that of the femur, which is without it, but which in every other point offers only very slight differences. Its lower head, transversely oblong and of uniform convexity, receives the bones of the fore-arm, but without offering two distinct facets.

The *Trionyces* do not differ from the Land-Tortoises, excepting in having the tuberosities more apart. Other differences are manifested in *Emys* and *Chelys*, for which we refer to Cuvier's work, but the humerus of the Marine Tortoises cannot be passed by without particular notice, for it differs from that of all the other *Testudinata* in being not bent longitudinally, but nearly straight; in having its great tuberosity (the analogue of the small or internal tuberosity in man) longer, overreaching the head, and resembling an olecranon; and, lastly, in having the other tuberosity shorter, and representing a chevron-shaped crest.

There are always two bones in the fore-arm, but they have little motion one on the other. They are placed, when the animal progresses, so that the ulna forms the external and the radius the internal border of the arm.

The radius has a semicircular, slightly concave, upper head, a somewhat slender body, and the lower head compressed and cut, as it were, obliquely, so that it is shorter on the ulnar side.

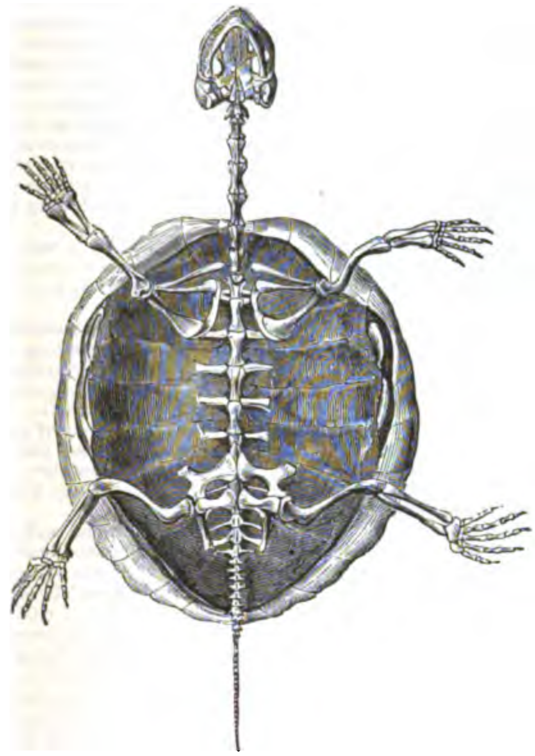
The ulna is compressed. Its upper head is triangular and cut obliquely, so that its external border is longer upwards than the radial border without having a true olecranon. This border is trenchant. The lower one is cut square. Differences occur, as in *Trionyx* and the *Chelones*, or Marine Tortoises.

The pelvis is always composed of three distinct bones, contributing, as in the *Mammalia*, to the composition of the cotyloid fossa, namely, an elongated os ilium, which attaches itself by ligaments to the transversal processes of the sacral vertebræ and the neighbouring part of the eighth pair of the dilated ribs; a pubis and an ischium, which are directed, widening as they proceed towards the plastron, and are each united to its similar piece. At the point of union for the formation of the cotyloid cavity, each bone has three faces; one for each of the two others and one for the cavity. On the rest of the length the os ilii is oblong, the ischium proceeds, widening as it goes, directly towards the symphysis, and the pubis, after first directing itself forward, makes a curve towards the symphysis, and widens also to reach it. Various differences occur in this part of the skeleton in the Land and Marine Tortoises, in *Chelys*, and in *Trionyx*.

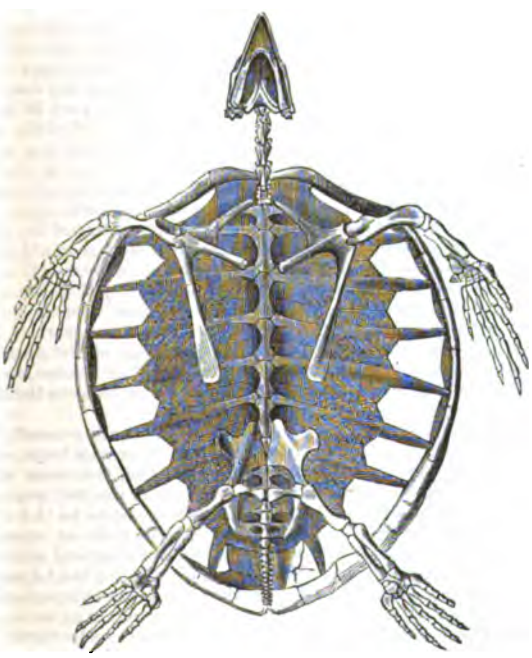
The femur might be easily mistaken for the humerus of a mammiferous quadruped. Its oval head leaves the body of the bone, without being precisely separated from it, by a narrow neck. In lieu of the trochanter there is a transverse crest, but little elevated, separated from the head by a semicircular depression. The middle of the bone is delicate and round, and the lower part compressed from before backwards, widening by degrees to form the lower head, which is a transverse portion of the cylinder a little inflected backwards. Differences of modification occur in the Fresh-Water and Marine Tortoises.

The two bones of the leg are nearly straight. The tibia is larger and nearly semicircular above, becoming again slightly larger below; the fibula is more compressed and wider below. The first presents a slightly concave uniform surface, the other one which is slightly convex and rhomboidal at the astragalus. Modifications occur in the Land-Tortoises, in *Chelys*, in *Trionyx*, and in the *Chelones*.

Bones of the Fore Foot.—The differences in the mode of progression required corresponding variations in the bones of the fore and hind feet especially. Accordingly we find that in the *Chelones* all the bones of the wrist are flat and cut nearly square. In the first row are two bones adhering to the ulna, and in the last row five smaller ones, supporting the five bones of the metacarpus. There is besides an intermediate bone under the first ulnar bone, and upon the second and third of the last row. Cuvier observes that this would seem to correspond with that dismembered trapezoidal bone which is found in the monkeys. Lastly, there is a great semilunar bone out of the rank, adhering to the external border of that which is above



Skeleton and Carapace of *Cistudo vulgaris*, seen from below.



Skeleton and Carapace of *Chelone Caouana*, seen from below.

the metacarpal of the little finger. It is a true pisiform bone, although a little descended. Between that which is on the metacarpal of the thumb and the radius there is for a long time nothing but ligaments, and one does not see the great semilunal scaphoidal which may be observed in the other sub-genera: but with age a small radial bone shows itself in this place. Very large individuals have also the two penultimate bones of the second row anchylosed together. The metacarpal of the thumb is short and large: the others are long and slender. The little finger has two phalanges, and is not larger than the thumb; the three others are elongated, especially the middle finger; and the whole result is a pointed hand, which has the unguial phalanx of the thumb and forefinger only armed with a claw.

In the Land-Tortoises there are but two phalanges on each finger. There are found in the carpus a great radial or semilunar scaphoidal, two ulnar bones nearly square, five bones of the second row supporting the five metacarpals, and an intermediate bone placed between the great radial, the first cubital or ulnar, and those which carry the third and fourth metacarpal. This intermediate bone, according to Cuvier, is often anchylosed with the semilunar scaphoidal bone. The bones of the metacarpus are even shorter than the phalanges.

In the Fresh-Water Tortoises the three mesial fingers have their three phalanges well developed; but there are only two belonging to the thumb and the little finger. The metacarpals are rather long, and the two external ones are carried on a single bone of the carpus: nevertheless the last row consists also of five bones, because there is one, very small, externally on the side of the thumb. In the first row the ulna, in the European Tortoise at least, carries four bones—two large ones, a small intermediate one, and another small one out of the rank; but there are other species, *Testudo clausa* for instance, where the two small ones do not appear. The great radial or semilunar scaphoidal passes partially under the two uluar bones.

The *Chelydes* have the hand formed nearly like the Fresh-Water Tortoises, except that their radial bone is small, and re-enters towards the inside of the carpus at the side of the bone named by Cuvier intermediate; and that the little finger has, like the three intermediate ones, three phalanges.

The *Trionyces* have also the radial bone re-entering at the side of the intermediate bone. Their first three fingers have their three phalanges large, wide, and pointed to carry the claws; the fourth has four phalanges, all rather slender; and the last three.

Hind Feet.—Cuvier remarks that in the *Chelonia*, generally, the calcaneum is without any backward prominence, so that their tarsus is flat like a carpus.

In the *Chelones* it is composed of six or seven bones, if the first of the little toe be counted: two in the first row, of which the largest, nearly rhomboidal and answering equally to the tibia and fibula, is the astragalus; the smaller, which is square and articulated only to the fibula, is the sole vestige of a calcaneum. In the second row there are four: three wedge-shaped for the metacarpals of the great toe and the two next toes, and one larger for the two last metatarsals. The bones of the metatarsus of the great and little toes are shorter than the others, and singularly wide and flat. That of the little toe however may be taken for one out of the rank of the tarsus. In this last case the little toe would have but two phalanges, otherwise three like the others. The great toe has but two. It carries a claw, and so does the next toe. The two succeeding toes have still their last phalanges rather large, although without claws, but the last has that phalanx very small.

In the Land-Tortoises the bone analogous to the astragalus is larger and thicker; and the fibular bone on the analogue of the heel is smaller. The four other bones exist, and that here called the metatarsal of the little toe seems to make up the suite by its position and figure. It sometimes carries a vestige of a toe formed of one piece, which seemed to Cuvier to be wanting in many species. The metatarsal of the great toe is very short and not flattened; the others are rather longer. None of the four existing toes has more than two phalanges.

The tarsus of the Fresh-Water Tortoises is nearly the same, except that the fibular ossicle, or calcaneum, when it is not united to the astragalus, is larger; that the ossicle which serves as a vestige of the little toe is longer; and that the three toes which succeed the great toe have their phalanges very distinct.

In the tarsus of the *Trionyces* the fibular bone descends outside the three cuneiform or wedge-shaped bones, and carries half the head of the third metatarsal and the whole of that of the fourth. At its external border a large square bone adheres, that about which Cuvier expressed a doubt whether it was a metatarsal bone or one out of the rank. It carries the fifth metatarsal on the first phalanx of the little toe; but in this case the little toe would have three. It is true, Cuvier adds, that the fourth toe has four, without counting its metatarsal. The great toe has two, and the two succeeding toes three each. In all three the last is large, wide, and pointed to carry a claw. In the fourth and fifth toe this last phalanx is very small and without a claw.

In the Matamata (*Chelys*) the fourth toe is, like the two preceding, composed of three phalanges, and armed with a claw; the fifth also has three phalanges, and it would even have four if one regarded the bone as to which Cuvier has expressed his doubts as a tarsal bone; but the last is very small, cartilaginous, and without a nail. The tarsus is the same as in *Trionyx*, with this difference that the analogues of the astragalus and the calcaneum are divided transversely each into two bones; so that what is detached from the calcaneum forms a fourth cuneiform bone for the fourth metatarsal, and that which is detached from the astragalus is a true scaphoid, which carries the first three cuneiform bones.

Muscular System.—We have seen that the shoulder-blade is internal in the tortoises, that is, it is placed on the inside of the ribs; the muscles, consequently, of the head and neck, instead of being attached upon the ribs and spine, as in the other *Vertebrata*, are attached beneath them; the same observation holds as to the bones of the pelvis and the muscles of the thigh; so that, to use Cuvier's expression, a tortoise may be termed, in this respect, "un animal retourné"—an animal turned inside out, or rather, so to speak, outside in.

The progressive motions to be accomplished by the bony and muscular apparatus of the tortoises are those of walking and swimming or paddling.

The walk of a tortoise is proverbially slow, such as might be expected from a reptile whose limbs are so imperfectly developed. Short, and placed at a great distance from the centre, they form a sort of short crutches, calculated to drag the unwieldy body gradually along, and if the animal be turned on its back it becomes almost helpless. The feet are little better than stumps, the toes being only indicated externally by what may be termed a collection of hoofs, placed, as in the elephants, on the circumference of the apology for a foot, and which serve, so to speak, as a sort of grapplings to hold on the surface of the ground and drag the armed trunk onwards. We hardly need add that progression in a vertical direction is impossible; but many tortoises can burrow with some difficulty.

Nor is this slowness out of place: the preservation of the animal is provided for by the very strong bony carapace and plastron protecting the whole body, and only suffering the head, tail, and four feet to be protruded from its anterior and posterior part and its four angles; these protruded parts can be withdrawn into the shell upon the approach of danger, and the animal then rests secure in its portable arched castle, leaving the enemy to the hopeless task of besieging a garrison that can remain for months without food. A large Land-Tortoise can defy the whole animal world except man, from whom nothing is safe.

The most complete defence is made by the Box-Tortoises; for in them the pieces which form the sternum are moveable, and may be compared to doors or hinged lids, which shut upon the carapace and thus form a sort of closed coffer in which the head, neck, tail, and feet, in short, the only exposed parts, can at will be inclosed far more securely than a snail in its shell.

But this slowness is confined to the Terrestrial Tortoises; for the aquatic species swim with great facility on or below the surface; and some, *Chelone* and *Sphargis* for instance, with rapidity. But the well-developed flipper that enables the Marine Tortoise to oar its way with swiftness, is even a worse organ for land progression than the clumsy foot of a Land-Tortoise. Not but that they will shuffle back to the sea, which they have only occasion to leave in order to deposit their eggs, at a good pace, and they will deal heavy blows with their flippers to those who attempt to stop them (for they, as well as the Land-Tortoises, are very strong), as those who have been foiled in turning turtles, have known to their cost.

But however powerfully the muscles which act upon the head, tail, and extremities are developed in this order of reptiles, those of the abdomen, as might indeed be expected, have little extent, and those of the ribs, as might also be divined, are non-existent; for nature does nothing in vain: but the square muscle of the loins, whose principal office in mammals is to move the lumbar vertebræ, acts in the tortoises, which have those vertebræ fixed, in another direction, and is employed in drawing up the moveable os ilii; and the straight muscle (rectus abdominis) which extends from the pubis to the sternum, moves the whole haunch in the greater part of the *Testudinata*.

Digestive System.—The *Chelonia* have no teeth, although there are often a median groove and denticulated projections and hollows; but the mandibles are covered with a horny case, as in the birds. The *Chelydes* and the *Trionyces*, though they have the horny covering, have the mouth furnished with soft skin so as to form a kind of lips. The muscles that work the lower jaw, which is the only moveable one, are very powerful in many of the species; and the force with which the great Turtles and many other Chelonians grasp a solid body in their vice of a mouth is prodigious. The *Chelydes* are the only *Testudinata* which have the jaws flat and the gape of the mouth very wide.

The food with which the *Chelonia* have to deal is various, and there are modifications in the digestive organs accordingly. The *Chelones* and *Testudines* generally prefer a vegetable diet. The *Trionyces* and *Chelydes* prey upon fishes and small aquatic birds; and the *Emydes* attack the weaker animals, such as Crustaceans, Insects, Worms, and Mollusks.

These aliments are submitted in the Terrestrial Tortoises and in the Chelonians to the trenchant horny bill, well fitted to mince up vegetable fibre, assisted by the tongue, which draws the food into the mouth and the horny grooves and hollows of the jaws; the *Trionyces* and *Emydes* seize their living prey in their sharp-edged beaks and tear it to pieces with the cutting and pointed claws of their fore feet: some of these dart out their head and long neck upon their prey from an ambush; or, stealing along like the cats till they come within reach, suddenly extend their destructive apparatus with unerring aim. The *Chelydes*, whose fleshy jaws are flat, swallow their prey whole, and in this respect, as well as in the general conformation of the head and the os hyoides, they resemble the Toads, and especially the Pipas, like which they are obliged to be content with a victim of small dimensions suited to the calibre of their mouth, which is, in truth, sufficiently large. They are said never to seize their prey till they are satisfied by its motions that it is alive, for they never feed on carcasses.

The tongue of the tortoises is fleshy, like that of the parrots, and its nervous papillæ are very distinct. The œsophagus is short, and in the Chelonians is furnished internally with a number of close-set cartilaginous points, directed so as to prevent the regurgitation of the food towards the stomach, which has a transverse position. The intestines are long; the cloaca is situated beneath the tail, and rounded, and internally is found the orifice of canals which terminate in the cavity of the peritoneum. The liver is voluminous, forming two masses or lobes placed transversely below the heart and in front of the junction of the œsophagus with the stomach. The pancreas is a very large gland, and the spleen is rounded, median, and situated at a considerable distance from the liver. The chyle is translucid and aqueous in the vegetable feeders, but of a white and milky tint in those species which feed on animals.

The power of abstinence in this order of Reptiles is very great. Messrs. Duméril and Bibron state that they have seen a Long-Necked Emys remain more than a year without food; and Redi kept Land-Tortoises fasting for eighteen months.

Circulating System.—The heart in the *Chelonia* is composed of two auricles, and one ventricle with two unequal chambers which communicate together. The blood of the body enters into the right auricle and that of the lung into the left; but both these modifications of blood mingle more or less in passing by the ventricle.

Respiratory System.—Cuvier remarks that the quantity of respiration in Reptiles is not fixed, like that of Mammals and Birds, but varies with the proportion of the diameter of the pulmonary artery compared with that of the aorta. Thus, he observes, the Tortoises and the Lizards respire much more than the Frogs.

The lungs are of great extent, and placed in the same cavity with the abdominal viscera. We have seen that the thorax is immoveable, in the greater number at least, and the inlaid fixed ribs can give no assistance in respiration in the full-grown normal forms. It is therefore by the play of the parts about the mouth that the *Chelonia* respire, and here the complicated os hyoides is called into prominent action. The jaws are closed, and the animal alternately elevates and depresses the os hyoides; the first movement lets the air enter by the nostrils, and the tongue then closing their interior aperture, the second movement compels the air to penetrate into the lungs. In short, the Tortoises swallow or gulp down the air necessary for their respiration like Frogs.

John Hunter, in his 'MS. Catalogue,' observes that the vessels of the lungs of those animals whose whole blood passes through them are confined to the lungs, and lungs only, as distinctly as if the lungs were a separate animal; but this, he adds, is not the case with the *Amphibia*, "for," says he, "we find the vessels of the lungs of the Turtle communicate with those of other parts, such as the vessels of the œsophagus, which shows that the blood of that part is not so perfect in them as in others. From this it must appear that the lungs are not of that consequence in this class of animals that they are in the more perfect, for the lungs themselves appear to share in common with the other parts. Some of the blood which just came from the lungs returns back again to them, which would appear to answer no purpose; and on the other hand a considerable quantity of the blood which had undergone the general circulation (and therefore would appear to require refinement) just returns through the same course. It would appear from this admixture that it was not necessary that the whole of the blood should have undergone a thorough change for its greatest motion; yet we do not see why the lungs should have a part of their blood of the perfect kind. The cells of the lungs of the *Amphibia* seem to increase in size, the farther from the trunk or trachea, so that the trachea and its ramifications bear no proportion between them and the cells."

Brain, Nervous System, and Senses.—In the *Chelonia* generally, the vertical height of the capacity of the cranium is greater than in the other Reptiles; but in the Sea-Tortoises, or Turtles, the mass of the encephalon does not entirely fill it, and the highly vaulted bones are rather destined to serve as solid points of resistance to the upper beak, and to the powerful action of the muscles which act upon the lower jaw. The mass of the encephalon is less elongated and more compact than in the serpents. Bojanus, in his work on the 'Anatomy of the European Emys,' has shown that the great sympathetic or ganglionic series of nerves exists in that reptile nearly as it does in the other *Vertebrata*; that on the one hand it has sympathetic relations with the encephalic and vertebral nerves, and that on the other it makes a communication between the two lateral and symmetrical parts of the body, at the same time that its filaments are distributed and intermingle in numerous plexuses round the principal arteries destined to the nutrition of the internal viscera. Elaborate illustrations of the Nervous System, and especially of the great Sympathetic of the Hawk's-Bill Turtle, have been published by Mr. Swan, in his 'Comparative Anatomy of the Nerves,' 4to., 1836.

Here we must notice the experiments of Redi, which were perhaps more cruel in appearance than in reality. Most are familiar with the length of time that a turtle will move after its head is off, and the snap of the jaws which the severed head will give; but there is reason for believing that there is more of irritability than sensation in such motions; and the state of Redi's tortoises must have been analogous.

Redi, in the beginning of November, made a large opening in the skull of a Land-Tortoise, extracted the brain, and cleaned out the cavity. He then set the animal at liberty, and it groped its way freely about wherever it pleased, as if it had not been injured. Redi makes use of the term 'groping' (brancolando), because he says that when the tortoise was deprived of its brain it closed its eyes, which it never again opened. The wound which was left open skinned over in three days, and the tortoise, continuing to go about and execute other movements, lived to the middle of May. On a post-mortem examination the cavity which the brain had occupied was found empty and clean, with the exception of a small dry and black clot of blood. He repeated this experiment upon many other Land-Tortoises in the months of November, January, February, and March, with this difference, that some were locomotive at their pleasure, whilst others, though they made other motions, did not move about: he found the same results when he treated Fresh-Water Tortoises in the same manner, but they did not live so long as the terrestrial species. He states his belief that the Marine Tortoises would live a long time without their brain, for he received a turtle which he treated in the same way, and though it was much spent and faint from having been long out of the sea, it lived six days. In November he deprived a large tortoise of its head, without which it continued to live twenty-three days: it did not move about as those did whose brain had been taken out, but when its fore or hind legs were pricked or poked, it drew them up with great strength, and executed many other movements. To assure himself beyond all doubt that life, such as it was, continued in such cases, he cut off the heads of four other tortoises, and on opening two, twelve days afterwards, he saw the heart beat and the blood enter and leave it.

We have already had occasion to call attention to the great length of time during which these reptiles will live without food, and the facts above recorded afford additional proof of their extreme tenacity of life.

Touch.—In the greater part of this order, skin, properly so called, does not exist at all on certain parts of the body, or is reduced to a delicate fibrous plate applied like a simple periosteum on the bones of the head and on the external parts of the vertebræ of the back, the ribs, and sternum. The Soft Tortoises (*Trionyx* and *Sphargis*, for instance) are the only ones that differ in this respect. Nevertheless the neck, the feet, and most frequently a considerable part of the tail, are covered with a true flexible skin. This skin in the Matamata is fringed, or furnished with moveable appendages on the lateral parts of the head and neck. There can be no doubt that the sort of touch or sensation which will indicate to a *Trionyx*, or even to a Marine or Land-Tortoise, the differences of temperature that affect the medium wherein it moves, is present in those animals, but the sensibility of a true touch must be very much blunted in them. Some have their toes united down to the nails, or rather hoofs, and absolutely immoveable; others have them flattened, and forming a sort of paddle, as in *Chelone* and *Sphargis*; or the whole foot terminates by a sort of shapeless stump, rounded like that of the elephant, the presence of the toes being only indicated by those nails or hoofs, as in the Land-Tortoises. Others, it is true, *Emys*, *Trionyx*, and *Chelys*, for example, have their toes very distinct, but they are nevertheless united by membranes, and in general their feet seem more adapted for the different modes of transport than for touch. The Matamata indeed has its nose prolonged into a sort of moveable proboscis; but this organisation seems to be directed more to favour the required mode of respiration, than to give the animal that sort of perception exercised by the snout of swine and the muzzles of moles and some shrews. (Duméril and Bibron.)

Taste.—The wide fleshy tongue, with its distinct papillæ, like those of Mammals, seems well calculated for tasting vegetable and animal juices after the food is minced up by the horny mandibles; the fleshy lips on the outside of these mandibles in the *Trionyces* probably assist in retaining these juices.

Smell.—Though there is probably sufficient of this sense to assist the animal in its discrimination of food, and aid the functions of the tongue in giving the animal a perception of flavour, it may be concluded from the very simple state of the organs, so different from the complication of those in animals where the sense is known to be highly developed, that it is not very acute in the tortoises.

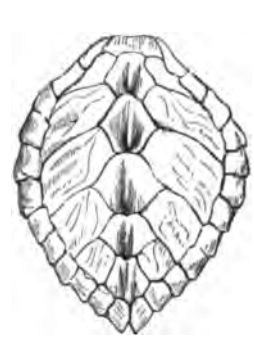
Hearing.—From the structure of the internal ear, to which we have before alluded, it might be inferred that this function is tolerably acute, but many of the species appear very insensible to sound.

Sight.—The eye is well developed and is large. It is modified so as to be adapted to the medium, whether air or water, through which the light is to be transmitted. In the substance of the cornea scales or osseous plates are found analogous to those in birds, and there are three eyelids and two lachrymal glands.

Reproduction.—According to the accounts of voyagers the Coriaceous Tortoises (*Sphargis*) and the *Trionyces* seem to pair, and two individuals of different sexes remain constantly together in the same places. The great Marine Tortoises, as is well known, come every year at their appointed times to deposit their eggs in the sand on the shores of the sea and banks of rivers near strands of gentle declivity. There the females hollow out a sort of rude but strong vaulted nest or oven, as it may be termed, wherein the eggs may have the benefit of the concentrated rays of the sun, so as to enjoy an equable heat, as in the case of eggs under a sitting hen, but under circumstances which do not permit the body of the mother to impart the necessary warmth. The shell of these eggs is generally solid, and their form globular, or of a short cylindrical shape equally rounded at the extremities. A female Turtle will lay as many as a hundred at one time. The plastron of the males of many species of *Chelonia* is concave, that of the females being convex. Messrs. Duméril and Bibron say that in the Chelonians and Anourous Batrachians from eighteen to thirty-one days and more have elapsed before the male has quitted the female.

With regard to the integument of the carapace and plastron, the number, colour, and shape of the investing plates of horn or shell, as it is termed, vary considerably. The subjoined cuts will convey a better notion than words of their arrangement in a land and marine species; but it must be considered that these are mere examples, and that the variety is very great.

Carapace of *Testudo marginata*, covered with shell.



Carapace of *Chelone Caouana*, covered with shell.

Systematic Arrangement and Natural History.

Aristotle has mentioned three principal groups of Tortoises, or at any rate genera, under the names of Χελώνη χερσαία for the Land-Tortoise; Χελώνη θαλαττία or θαλασσία for the Sea-Tortoise or Turtle ('Hist. Anim., ii. 17); and 'Εμύς for the Fresh-Water Tortoise (Ibid., v. 33). Gesner remarks that there are three "summa genera" of Tortoises: the 1st, terrestrial; the 2nd, living in fresh-waters; and the 3rd, in the waters of the sea. Messrs. Duméril and Bibron copy his 'Corallarium de Testudinibus in Genere,' to show how far it accords with their own arrangement, as follows:—

Testudo aut est	*terrestris*		
	aquatica, aut in	mari	*Testudo marina*, Χελώνη θαλαττία. *Mus marinus*, Μῦς θαλάττιος.
		aquâ dulci	puriore, ut lacubus, amnibus. cænosâ, ut paludibus.

Linnæus placed the form at the head of his *Amphibia Reptilia*, under the generic name *Testudo*.

Cuvier divides them into five sub-genera:—1, the Land-Tortoises (*Testudo*, Brongn.); 2, the Fresh-Water Tortoises (*Emys*, Brongn.), including the Box-Tortoises (*Terrapene*, Merrem; *Kinosternon*, Spix; *Cistudo*, Fleming); 3, the Marine Tortoises; 4, the Chelydes (*Testudo fimbriata*); 5, the Soft Tortoises (*Trionyx*, Geoff.).

Dr. J. E. Gray, in his 'Catalogue of the Tortoises, Crocodiles, and Amphisbænians, in the Collection of the British Museum,' 1844, makes the *Chelonia*, the third order of Reptiles in his arrangement, come under his second section, *Cataphracta*, the *Squamata* being the first.

Family 1. *Testudinidæ*.

Genera:—*Testudo*. *Chersina*. *Kinixys*. *Pyxis*.

Family 2. *Emydidæ*.

Genera: — *Geoemyda*. *Emys*. *Cyclemys*. *Malaclemys*. *Cistudo*. *Kinosternon*. *Chelydra*. *Platysternum*.

Family 3. *Chelydidæ*.

Genera:—*Sternotherus*. *Pelomedusa*. *Hydraspis*. *Chelymys*. *Phrynops*. *Chelodina*. *Hydromedusa*. *Chelys*. *Peltocephalus*. *Podocnemis*.

Family 4. *Trionycidæ*.

Genera:—*Trionyx*. *Emyda*.

Family 5. *Cheloniadæ*.

Genera:—*Sphargis*. *Chelonia*. *Caretta*. *Caouana*.

Messrs. Duméril and Bibron, in their elaborate and highly valuable 'Erpétologie,' divide the Tortoises, or Chelonians, into the following families:—1st, the Chersites (Chersians, or Land-Tortoises); 2nd, the Elodites (Elodians, or Marsh-Tortoises); 3rd, the Potamites (Potamians, or River-Tortoises); 4th, the Thalassites (Thalassians, Sea-Tortoises, or Turtles).

Of these groups the authors observe that Chersites is not perfectly limited, for some of the species arranged by them under the succeeding family (Elodites) seem to form a natural passage between the Land- and Marsh-Tortoises. Such are *Cistudo Carolina* and *Emys Muhlenburgii*, which are in reality Paludines, or Marsh-Tortoises, with distinct toes, though they possess only very short membranes and but slightly palmated feet.

The principal characters which distinguish the Chersites, or Chersians, from the three other divisions of the order *Chelonia* are thus defined:—Body short, oval, convex, covered with a carapace and a plastron; four feet; no teeth. But Messrs. Duméril and Bibron remark that the principal distinction may be enunciated by this simple term drawn from the conformation of the limbs, and which indicates perfectly the manner of life of the group—stumpy feet (des pattes en moignon):—this would recall the condition of those feet, namely, that they are short, unshapely, though nearly of equal length, with toes but little distinct, nearly equal, immoveable, united by a thick skin, and conglomerated into a sort of truncated mass, callous in its periphery, on the outside of which one only distinguishes horny cases, a sort of hoofs which for the most part correspond with the last phalanges they incase, and would consequently show that these animals live only on the land, never in the water. The other three groups differ from the last and from each other in the form of the feet.

The Thalassites, or Thalassians, have the carapace very much depressed, and their two pairs of feet, unequal in length, are flattened into the form of oars or solid fins, because their toes are always conjoined and hardly distinct from each other, incased as they are in these paddles.

The Elodites, or Elodians, have the toes separate, or rather separately moveable, furnished with crooked claws, most frequently palmated or united at their base by membranes, as in the Duck Tribe among birds; but the transition of these last three families is, so to speak, insensible on the one side between the species of the genus *Cistudo*, and on the other between *Chelys* and all the species generally known as Soft Tortoises.

These last, the Potamites, or Potamians, have also the toes palmated or connected by membranes; they have pointed claws, three in number only, on each foot; their pointed and trenchant beak is constantly furnished externally with folds of the skin, like lips, appendages which have hitherto been only observed in this family. In addition their bony carapace is covered with a coriaceous skin, the edges of which in the greater number remain flexible and floating on the sides of the body.

Family 1. Chersians—Land-Tortoises.

				Genera.
Carapace	Moveable behind, where it is, as it were, articulated			4, *Kinixys*.
	Immoveable; nails on the anterior feet	four only		2, *Homopus*.
		five, front of the plastron	moveable	3, *Pyxis*.
			immoveable	1, *Testudo*.

Testudo.—Feet with five toes, hind-feet with four nails only; carapace of a single piece; sternum not moveable anteriorly.

This genus is divided by Messrs. Duméril and Bibron into three sections or sub-genera:—

1. Those species which have the posterior portion of their plastron moveable. These correspond with the genera *Chersus* of Wagler; *Testudo* of authors; *Chersina* of Gray.

2. Those species whose plastron is solid in all its parts, or of a single piece covered with twelve plates.

3. Those species which have the sternum equally immoveable, but covered with eleven horny plates.

These sections embrace twenty-two species.

In the first section *Testudo marginata*, Schœpf., and *T. Mauritianica*, Dum. and Bibr., are placed.

In the second are *Testudo Græca*, Linn.; *T. geometrica*, Linn.; *T. actinodes*, Bell; *T. pardalis*, Bell; *T. sulcata*, Miller; *T. nigrita*, Dum. and Bibr.; *T. radiata*, Shaw; *T. tabulata*, Walbaum; *T. carbonaria*, Spix; *T. polyphemus*, Daud.; *T. Schweiggeri*, Gray; *T. elephantina*, Dum. and Bibr.; *T. nigra*, Quoy and Gaim.; *T. gigantea*, Schweigg.; *T. Daudinii*, Dum. and Bibr.; *T. Perraultii*, Dum. and Bibr.

In the third are *T. angulata*, Dum. and Bibr.; *T. Graii*, Dum. and Bibr.; *T. peltastes*, Dum. and Bibr.; and *T. Vosmaeri*, Fitzing.

For an account of the habits of Land-Tortoises we turn to the records of two acute and eloquent observers, whose narratives it would be unjust to give in other words than their own.

White of Selborne thus writes to the Honourable Daines Barrington, in April, 1772:—"While I was in Sussex last autumn, my residence was at the village near Lewes, whence I had formerly the pleasure of writing to you. On the 1st of November I remarked that the old tortoise formerly mentioned began first to dig the ground in order to the forming its hybernaculum, which it had fixed on just beside a great tuft of hepaticas. It scrapes out the ground with its fore feet, and throws it up over its back with its hind feet; but the motion of its legs is ridiculously slow, little exceeding the hour-hand of a clock. . . . Nothing can be more assiduous than this creature night and day in scooping the earth and forcing its great body into the cavity; but as the noons of that season proved unusually warm and sunny, it was continually interrupted, and called forth by the heat in the middle of the day; and though I continued there till the 13th of November, yet the work remained unfinished. Harsher weather and frosty mornings would have quickened its operations. No part of its behaviour ever struck me more than the extreme timidity it always expresses with regard to rain; and though it has a shell that would secure it against a loaded cart, yet does it discover as much solicitude about rain as a lady dressed in all her best attire, shuffling away on the first sprinklings, and running its head up in a corner. If attended to, it becomes an excellent weather-glass; for as sure as it walks elate, and as it were on tiptoe, feeding with great earnestness in the morning, so sure will it rain before night. It is totally a diurnal animal, and never pretends to stir after it becomes dark. The tortoise, like other reptiles, has an arbitrary stomach as well as lungs, and can refrain from eating as well as breathing for a great part of the year. When first awakened it eats nothing; nor again in the autumn before it retires: through the height of the summer it feeds voraciously, devouring all the food that comes in its way. I was much taken with its sagacity in discerning those that do it kind offices; for as soon as the good old lady comes in sight who has waited on it for more than thirty years, it hobbles towards its benefactress with awkward alacrity, but remains inattentive to strangers. Thus, not only 'the ox knoweth his owner, and the ass his master's crib,' but the most abject reptile and torpid of beings distinguishes the hand that feeds it, and is touched with the feelings of gratitude." In a postscript he adds, that in about three days after he left Sussex the tortoise retired into the ground under the hepaticas.

In April, 1780, White again writes to Mr. Barrington:—"The old tortoise that I have so often mentioned to you is become my property. I dug it out of its winter dormitory in March last, when it was enough awakened to express its resentment by hissing; and, packing it in a box with earth, carried it eighty miles in post-chaises. The rattle and hurry of the journey so perfectly roused it, that when I turned it out on a border, it walked twice down to the bottom of my garden; however, in the evening, the weather being cold, it buried itself in the loose mould, and continues still concealed. As it will be under my eye, I shall now have an opportunity of enlarging my observations on its mode of life and propensities, and perceive already that, towards the time of coming forth, it opens a breathing-place in the ground near its head, requiring, I conclude, a freer respiration as it becomes more alive. This creature not only goes under the earth from the middle of November to the middle of April, but sleeps great part of the summer; for it goes to bed in the longest days at four in the afternoon, and often does not stir in the morning till late. Besides, it retires to rest for every shower, and does not move at all in wet days. When one reflects on the state of this strange being, it is a matter of wonder to find that Providence should bestow such a profusion of days, such a seeming waste of longevity, on a reptile that appears to relish it so little as to squander more than two-thirds of its existence in a joyless stupor, and be lost to all sensation for months together in the profoundest of slumbers.

"While I was writing this letter a moist and warm afternoon, with the thermometer at 50°, brought forth troops of shell-snails; and, at the same juncture, the tortoise heaved up the mould and put out its head; and the next morning came forth, as it were raised from the dead, and walked about till four in the afternoon. This was a curious coincidence—a very amusing occurrence—to see such a similarity of feeling between the two φερέοικοι—for so the Greeks call the shell-snail and the tortoise."

Again White reverts to the "old family tortoise" in the same letter:—"Because we call this creature an abject reptile, we are too apt to undervalue his abilities and depreciate his powers of instinct. Yet he is, as Mr. Pope says of his lord,

'much too wise to walk into a well;'

and has so much discernment as not to fall down an haha, but to stop and withdraw from the brink with the readiest precaution. Though he loves warm weather, he avoids the hot sun, because his thick shell, when once heated, would, as the poet says of solid armour, 'scald with safety.' He therefore spends the more sultry hours under the umbrella of a large cabbage-leaf, or amidst the waving forests of an asparagus-bed. But as he avoids heat in the summer, so, in the decline of the year, he improves the faint autumnal beams by getting within the reflection of a fruit-wall; and though he never has read that planes inclining to the horizon receive a greater share of warmth, he inclines his shell by tilting it against the wall, to collect and admit every feeble ray. Pitiable seems the condition of this poor embarrassed reptile: to be cased in a suit of ponderous armour which he cannot lay aside; to be imprisoned, as it were, within his own shell, must preclude, we should suppose, all activity and disposition for enterprise. Yet there is a season of the year (usually the beginning of June) when his exertions are remarkable. He then walks on tiptoe, and is stirring by five in the morning; and, traversing the garden, explores every wicket and interstice in the fences, through which he will escape, if possible; and often has eluded the care of the gardener, and wandered to some distant field. The motives that impel him to undertake these rambles seem to be of the amorous kind; his fancy then becomes intent on sexual attachments, which transport him beyond his usual gravity, and induce him to forget for a time his ordinary solemn deportment."

Mr. Darwin in his 'Journal' describes the habits of *Testudo Indica*, or rather one of the species that have been confounded under that name, and, not improbably, the *Testudo nigra* of Quoy and Gaimard. He speaks of their numbers as being very great, as indeed they always seem to have been, for he quotes Dampier, who states that they are so numerous that five or six hundred men might subsist on them for several months without any other sort of provisions, and describes them as being so extraordinarily large and fat that no pullet eats more pleasantly. The day on which Mr. Darwin visited the little craters in the Galapagos Archipelago was glowing hot, and the scrambling over the rough surface and through the intricate thickets was very fatiguing. "But," says Mr. Darwin, "I was well repaid by the Cyclopian scene. In my walk I met two large tortoises, each of which must have weighed at least two hundred pounds. One was eating a piece of cactus, and when I approached it looked at me, and then quietly walked away; the other gave a deep hiss and drew in his head. These huge reptiles, surrounded by the black lava, the leafless shrubs, and large cacti, appeared to my fancy like some antediluvian animals."

Mr. Darwin states his belief that these tortoises are found in all the islands of the Archipelago; certainly in the greater number, and thus continues his description:—"They frequent, in preference, the high damp parts, but likewise inhabit the lower and arid districts. Some individuals grow to an immense size. Mr. Lawson, an Englishman, who had, at the time of our visit, charge of the colony, told us that he had seen several so large that it required six or eight men to lift them from the ground, and that some had afforded as much as two hundred pounds of meat. The old males are the largest, the females rarely growing to so great a size. The male can readily be distinguished from the female by the greater length of its tail. The tortoises which live on those islands where there is no water, or in the lower and arid parts of the others, chiefly feed on the succulent cactus. Those which frequent the higher and damp regions eat the leaves of various trees, a kind of berry (called guayavita) which is acid and austere, and likewise a pale green filamentous lichen, that hangs in tresses from the boughs of the trees.

"The tortoise is very fond of water, drinking large quantities, and wallowing in the mud. The larger islands alone possess springs, and these are always situated towards the central parts, and at a considerable elevation. The tortoises, therefore, which frequent the lower districts, when thirsty are obliged to travel from a long distance. Hence, broad and well-beaten paths radiate off in every direction from the wells even down to the sea-coast; and the Spaniards, by following them up, first discovered the watering-places. When I landed at Chatham Island, I could not imagine what animal travelled so methodically along the well-chosen tracks. Near the springs it was a curious spectacle to behold many of these great monsters; one set eagerly travelling onwards with outstretched necks, and another set returning, after having drunk their fill. When the tortoise arrives at the spring, quite regardless of any spectator, it buries its head in the water above its eyes, and greedily swallows great mouthfuls, at the rate of about ten in a minute. The inhabitants say that each animal stays three or four days in the neighbourhood of the water, and then returns to the lower country; but they differed in their accounts respecting the frequency of these visits. The animal probably regulates them according to the nature of the food which it has consumed. It is however certain that tortoises can subsist even on those islands where there is no other water than what falls during a few rainy days in the year.

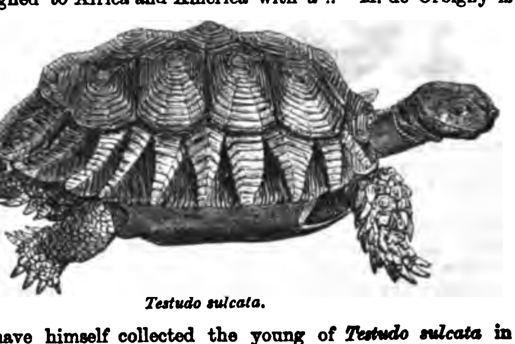
"I believe it is well ascertained that the bladder of the frog acts as a reservoir for the moisture necessary to its existence: such seems to be the case with the tortoise. For some time after a visit to the springs, the urinary bladder of these animals is distended with fluid, which is said gradually to decrease in volume and to become less pure. The inhabitants, when walking in the lower district, and overcome with thirst, often take advantage of this circumstance, by killing a tortoise, and if the bladder is full, drinking its contents. In one I saw killed, the fluid was quite limpid, and had only a very slightly bitter taste. The inhabitants however always drink first the water in the pericardium, which is described as being best. The tortoises, when moving towards any definite point, travel by night and by day, and arrive at their journey's end much sooner than would be expected. The inhabitants, from observations on marked individuals, consider that they can move a distance of about eight miles in two or three days. One large tortoise which I watched, I found walked at the rate of 60 yards in 10 minutes, that is, 360 yards in the hour, or four miles a day—allowing also a little time for it to eat on the road. During the breeding season, when the male and female are together, the male utters a hoarse roar or bellowing, which, it is said, can be heard at the distance of more than 100 yards. The female never uses her voice, and the male only at such times; so that when the people hear this noise, they know the two are together. They were at this time (October) laying their eggs. The female, where the soil is sandy, deposits them together, and covers them up with sand; but where the ground is rocky, she drops them indiscriminately in any hollow. Mr. Bynoe found seven placed in a line in a fissure. The egg is white and spherical; one which I measured was 7⅜ inches in circumference. The young animals, as soon as they are hatched, fall a prey in great numbers to the buzzard with the habits of the caracara. The old ones seem generally to die from accidents, as from falling down precipices. At least several of the inhabitants told me they had never found one dead without some such apparent cause. The inhabitants believe that these animals are absolutely deaf; certainly they do not overhear a person walking close behind them. I was always amused, when overtaking one of these great monsters as it was quietly pacing along, to see how suddenly, the instant I passed, it would draw in its head and legs, and uttering a deep hiss fall to the ground with a heavy sound, as if struck dead. I frequently got on their backs, and then, upon giving a few raps on the hinder part of the shell, they would rise up and walk away; but I found it very difficult to keep my balance. The flesh of this animal is largely employed, both fresh and salted; and a beautifully clear oil is prepared from the fat. When a tortoise is caught, the man makes a slit in the skin near its tail, so as to see inside its body, whether the fat under the dorsal plate is thick. If it is not, the animal is liberated; and it is said to recover soon from this strange operation. In order to secure the tortoises, it is not sufficient to turn them like turtle, for they are often able to regain their upright position.

"It was confidently asserted that the tortoises coming from different islands in the Archipelago were slightly different in form; and that in certain islands they attained a larger average size than in others. Mr. Lawson maintained that he could at once tell from which island any one was brought. Unfortunately, the specimens which came home in the 'Beagle' were too small to institute any certain comparison. This tortoise, which goes by the name of *Testudo Indica*, is at present found in many parts of the world. It is the opinion of Mr. Bell, and some others who have studied reptiles, that it is not improbable that they all originally came from this Archipelago. When it is known how long these islands have been frequented by the buccaniers, and that they constantly took away numbers of these animals alive, it seems very probable that they should have distributed them in different parts of the world. If this tortoise does not originally come from these islands, it is a remarkable anomaly; inasmuch as nearly all the other land inhabitants seem to have their birthplace here."

In his travels in Lycia, Professor E. Forbes gives the following account of the Tortoise:—"Among Lycian reptiles," he says, "the Tortoise (*Testudo Græca* and *marginata*) is the most conspicuous and abundant. The number of these animals straying about the plains and browsing on the fresh herbage in spring, astonishes the traveller. In April they commence love-making. Before we were aware of the cause, we were often surprised, when wandering among ruins and waste places, at hearing a noise as if some invisible geologist was busily occupied close by trimming his specimens. A search in the direction of the noise discovered the hammer in the shape of a gentleman tortoise, who, not being gifted with vocal powers, endeavoured to express the warmth of his affection to his lady-love by rattling his shell against her side. The ardour of the tortoise is celebrated by Ælian. In ditches and stagnant waters the Fresh-Water Tortoise (*Emys Caspica*) is equally plentiful. In fine weather long rows of them may be seen sunning themselves on the banks; whence, on being alarmed, they would waddle and plunge with great rapidity into the water, apparently always following a leader, who made the first plunge from one end of the row."

The Tortoise lives to a great age. White relates that one was kept in a village till it was supposed to be 100 years old, and it is conjectured that the patriarchs of the Galapagos Islands exceed that age.

T. sulcata will serve for an illustration of this genus: it is the species assigned to Africa and America with a ?. M. de Orbigny is



Testudo sulcata.

stated to have himself collected the young of *Testudo sulcata* in Patagonia, where, according to him, the species is very common. Messrs. Duméril and Bibron declare that other specimens come without doubt from Africa.

Homopus, Dum. and Bibr.—Four toes only on each foot, and all unguiculate; carapace and sternum of a single piece. There are two species:—

H. areolatus; H. signatus.

Pyxis, Bell.—Feet each with five toes, the posterior ones with four nails only; carapace of a single piece; sternum moveable anteriorly.

This genus is the only Land Box-Tortoise; but an analogue (*Sternotherus*) occurs among the Marsh-Tortoises, in the division of Pleurodere Elodians.

The anterior portion of the plastron of *Pyxis*, which is susceptible of motion, is of very small extent, for it only reaches, backwards, to the space of the first two pairs of sternal plates, and consequently it is under the strongly indicated suture of the second with the third pair that the elastic ligament which performs the office of a hinge is seen. By means of this sort of moveable door or lid, the *Pyxis* can, by lowering it at will, protrude its head and its fore feet, and by raising it, shut itself up in a sort of box, for the edges of this hinged operculum closely fit those of the carapace, which serve it as a door-case. The animal then has nothing to fear, because its sternum protects behind, by its enlargement, the space by which the feet and the tail can be put forth and deeply drawn up.

Pyxis arachnoides, seen from above.

P. arachnoides is the only species known.

Kinixys, Bell.—Feet with five toes, the posterior ones with four nails only; carapace moveable behind; sternum of a single piece.

Messrs. Duméril and Bibron observe that this is the most curious of the family Chersites. The Chelonians that compose it alone enjoy the faculty of moving the posterior part of their carapace in order to lower it and apply it against the plastron, so as completely to close the osseous box behind, as the *Pyxides* close theirs before when they elevate the moveable anterior portion of their plastron. But, as we have seen, the mobility of the anterior part of the sternum is in *Pyxis* due to the presence of an elastic ligament which performs the office of a hinge, whilst in *Kinixys* the carapace offers no really moveable articulation; the bones, the vertebræ, and ribs are the parts which bend. In consequence of this elasticity of the bones and their thinness, the carapace can be moved down to approximate the sternum. The sinuous line on which this flexion operates is indicated externally by a slight space, which is filled by a sort of fibro-cartilaginous tissue. This undulated line exists between the antepenultimate and the penultimate margino-lateral plate.

Pyxis arachnoides, seen from below.

The three known species have not, like all the other Chersians, the abdominal plates much more extensive than the other horny plates of the sternum, which, joined to the enlargement and the rounded contour of the plastron behind, approximates them in a certain degree to *Cistudo*, the first genus of the Elodians. There are three species:—

K. Homeana; K. erosa; K. Belliana.

Pausanias notices a Land-Tortoise in the woods of Arcadia, whose shell was used to make lyres.

Family II. Elodians—Marsh-Tortoises.

The habits of the Elodians differ very much from those of the other three great groups of Chelonians. The Marsh-Tortoises have not the slowness of the Land-Tortoises. They swim with facility, and on land make much quicker progress than the Chersians. They frequent small streams whose course is not too rapid, lakes, ponds, and marshes: they are not almost entirely vegetable-feeders, like the Chersians and Thalassians, but, like the Potamians, prey on living animals; river-mollusks, Anourous and Urodele Batrachians, and Annelides are their food.

The eggs are generally spherical, with a calcareous shell, and white, like those of the other Chelonians. The females deposit them in shallow cavities, which they hollow out in the earth, nearly in the same manner as the Land-Tortoises; but the Elodians prefer the banks of the waters where they dwell, in order that their young ones may the more easily there find refuge from their numerous enemies. The number of eggs varies according to the species, and probably according to the age of the individuals, for the females are capable of producing fertile eggs for some years before they have attained their full growth.

Sub-Family 1.—Cryptodere Elodians.

Cryptoderes are not only distinguished from the Pleuroderes by the power of completely concealing their cylindrical neck with its sheath of loose skin under the middle of the carapace; but also by their head, which is nearly equal in width to its height at the occiput. The eyes are always lateral, and their orbits so large that the diameter of the cavity nearly equals a fourth of the total extent of the cranium considered with regard to its length. The jaws of the Cryptoderes are stronger than those of the Pleuroderes; sometimes they are simply trenchant, sometimes more or less dentilated on their edges, which are straight, or sometimes sinuous. In the greater number of species the anterior extremity of the upper beak offers a large notch, on each side of which may be seen pretty constantly a rather strong tooth; in which case it is rare for the corresponding extremity of the mandible not to curve upwards towards the muzzle in a sharp point. In short, in such cases the upper beak closely resembles that of birds of prey.

Sub-Genus 1.—The Clausiles.

Cistudo, Fleming, reformed by Gray.—Feet with five toes, the posterior with four claws only; plastron wide, oval, attached to the buckler by a cartilage, moveable before and behind on the same transversal mesial hinge, furnished with twelve plates; twenty-five marginal horny plates or scales.

C. Carolina; C. Amboinensis; C. trifasciata.

Sub-Genus 2.—The Gapers.

C. Europœa and *C. Diardii.*

Emys, Dum. and Bibr.—Feet with five toes, the posterior with four nails only; plastron wide, immoveable, solidly articulated upon the carapace, furnished with twelve plates; two axillary and two inguinal shells; head of ordinary size; tail long.

1st Group.—European *Emydes.*

E. Caspica; E. Sigritz.

2nd Group.—American *Emydes.*

E. punctularia, E. marmorea, E. pulchella, E. geographica, E. concentrica, E. serrata, E. Dorbignii, E. irrigata, E. decussata, E. rubriventris, E. rugosa, E. Floridana, E. ornata, E. concinna, E. reticulata, E. guttata, E. picta, E. Bellii, and *E. Muhlenbergii.*

3rd Group.—African *Emys.*

E. Spengleri.

4th Group.—Oriental *Emydes.*

E. Trijuga, E. Reevesii, E. Hamiltonii, E. Thurjii, E. tecta, E. Bealei, E. crassicollis, E. spinosa, E. ocellata, E. trivittata, E. Duvaucellii, and *E. lineata.*

Tetraonyx, Lesson.—Five toes, one of them without a nail on all the feet; sternum solid, wide, furnished with six pairs of plates; twenty-five marginal scales.

T. Lessonii; T. Baska.

Platysternon, Gray.—Head armed or shielded, and too large to enter under the carapace; upper jaw hooked; sternum wide, immoveable, fixed solidly to the carapace, with short alæ; three sterno-costal scales; five nails on the anterior feet; four only on the posterior feet; tail very long, scaly, without a crest.

P. megacephalum.

Emysaura, Dum. and Bibr.—Head large, covered with small plates; muzzle short; two barbles under the chin; plastron immoveable, cruciform, covered with twelve plates; three sterno-costal scales; five nails on the fore feet, four on the hind feet; tail long, surmounted by a scaly crest.

E. serpentina. It lives in lakes and rivers, feeding on fish, and, as it would seem, on young birds. This is *Testudo serpentina*, Linn.; *Chelydra serpentina*, Schweigg., and *Chelonura serpentina*, Say, &c.

Emysaura serpentina.

Staurotypus, Wagler.—Head sub-quadrangular, pyramidal, covered in front with a single very delicate scale only; jaws more or less hooked; barbles under the chin; twenty-three limbar scales; sternum thick, cruciform, moveable in front, furnished with eight or eleven scales; axillary and inguinal scales contiguous, placed on the sterno-costal sutures; anterior feet with five nails; posterior feet with four only.

S. triporcatus; S. odoratus, so called from the musky odour which it is said to exhale.

Kinosternon, Wagler.—Head sub-quadrangular, pyramidal; a single rhomboidal plate upon the cranium; jaws slightly hooked; barbles under the chin; scales of the shell slightly imbricated; limbar plates to the number of twenty-three; sternum oval, moveable before and behind on a fixed piece, furnished with eleven scales; alæ short, narrow, sub-horizontal; a very large axillary plate and an inguinal still larger; tail long (in the males), unguiculate.

K. scorpioides. It lives in marshes and on river-banks. *K. Pennsylvanicum* lives in muddy waters, feeding on small aquatic animals, and exhaling a strong musky odour. *K. hirtipes.*

Sub-Family 2.—Pleurodere Elodians.

The Pleuroderes, as their name indicates, have all of them the neck retractile upon one of the sides of the anterior aperture of the carapace; but they are never able completely to draw it in between their fore feet and under the middle of the buckler and plastron, like the Cryptoderes.

Peltocephalus, Dum. and Bibr.—Head large, sub-quadrangular, pyramidal, covered with large, thick, slightly imbricated plates; jaws extremely strong, hooked, without dentilations; eyes lateral; plates of the carapace slightly imbricated; no nuchal plate; feet slightly palmated: two large rounded scales at the heels; nails straight, robust; tail unguiculate.

P. Tracaxa.

Podocnemis, Wagler.—Head slightly depressed, covered with plates; front hollowed with a large longitudinal furrow; jaws slightly arched, without dentilations; two barbles under the chin; no nuchal plate; sternum wide, immoveable; feet largely palmated, the posterior ones carrying at the heels two large but delicate rounded scales; tail short, not unguiculate.

P. expansa. It lives in streams and rivers. *P. Dumeriliana.*

Pentonyx, Dum. and Bib.—Head large, depressed, covered with plates; muzzle rounded; jaws slightly arched, trenchant; two barbles under the chin; no nuchal plate; sternum immoveable; five claws on all the feet; tail moderate, not unguiculate.

P. Capensis; P. Adansonii.

Sternotherus, Bell.—Head depressed, furnished with great plates; jaws without dentilations; no nuchal plate; sternum wide, with very narrow lateral prolongations; free anterior portion of the plastron rounded, moveable: five claws on each foot.

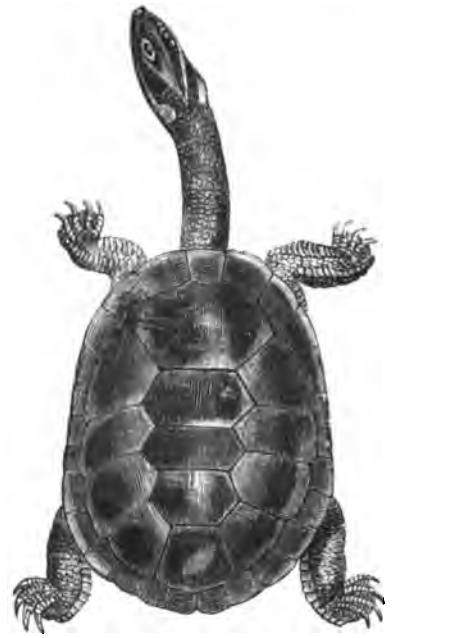
S. niger; S. nigricans; S. castaneus.

Platemys, Wagler, as reformed by Messrs. Duméril and Bibron, comprising part of *Hydraspis* of Gray, *Platemys*, *Rhinemys*, and *Phrynops* of Wagler.—Head flattened, covered with a single delicate scale or with a great number of small irregular plates; jaws simple; two barbles under the chin; carapace very much depressed; sternum immoveable; five claws on the fore feet, four on the hind.

It embraces the following species:—*P. Martinella* (Brazil and Cayenne); *P. Spixii* (Brazil); *P. radiolata* (Brazil, where it lives in the marshes); *P. gibba; P. Geoffreana* (young sent from Buenos Ayres by M. d'Orbigny); *P. Waglerii* (Brazil); *P. Nieuwiedii* (Brazil); *P. Gaudichaudii* (Brazil); *P. Hilarii* (Brazil); *P. Miliusii* (Cayenne); *P. rufipes* (Brazil, banks of the River Solimoens); *P. Schweiggerii* (South America); *P. Macquaria* (Macquarie River, Australia).

Chelodina, Fitzinger.—Head very long and very flat, covered with delicate skin; muzzle short, gape wide, jaws feeble, without dentilations; no barbles to the chin; neck very much elongated; a nuchal plate, plastron immoveable, very wide, rounded in front and solidly fixed on the carapace; sternal alæ very short; intergular scale larger than each of the gulars; four claws on each foot; tail excessively short.

C. Novæ Hollandiæ; C. flavilabris; C. Maximiliani.



Chelodina Novæ Hollandiæ.

Chelys, Dum. and Bibr.—Head much depressed, wide, and triangular; nostrils prolonged into a proboscis; gape wide, jaws rounded, of but little thickness; neck furnished with long cutaneous appendages, two barbles to the chin; a nuchal plate; five claws on the fore feet, four on the hind feet.

The gape extends beyond the ears. Messrs. Duméril and Bibron remark that the jaws are rounded, narrow, and not simply covered with soft skin, as Cuvier, Wagler, and Gray believed, but protected by horny cases, like those of all the other Chelonians; only in *Chelys* they are extremely delicate.

C. Matamata. It lives in stagnant waters. A female lived some months at Paris and laid three eggs, one of which was hatched and the young animal preserved in the Paris Museum.

Chelys Matamata.

Family III. Potamians, or River-Tortoises.

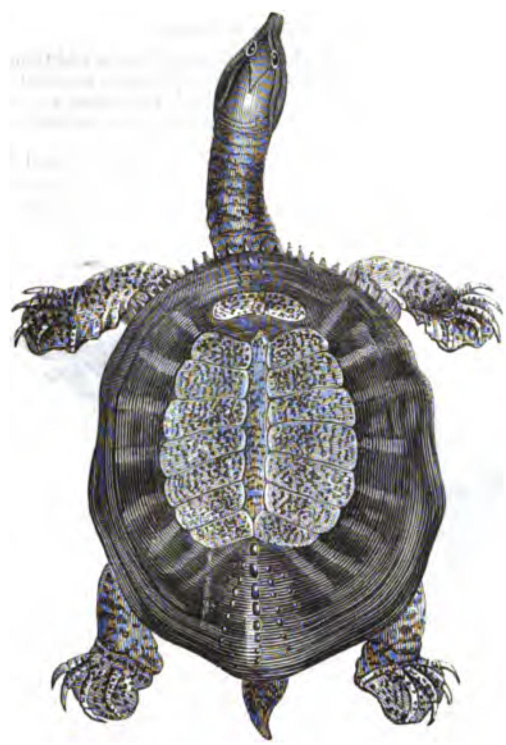
The species belonging to this family live constantly in the water, only coming out occasionally.

It would seem that individuals of this family attain a large size. Messrs. Duméril and Bibron quote Pennant as mentioning some which weighed 70lbs.; one which he kept three months weighed 20lbs., and its buckler was 20 inches in length, not reckoning the neck, which measured 13¼ inches. Their mode of life and habits seem to have great similarity. They swim with much ease both on the surface and at mid-water. The lower part of their body is generally pale white, rosy, or bluish; but their upper parts vary in their tints, which are most frequently brown or gray, with irregularly marbled, dotted, or ocellated spots. Straight or sinuous brown, black, or yellow lines are disposed symmetrically on the right and left, principally on the lateral parts of the neck and on the limbs. During the nights, and when they believe themselves to be secure from danger, the Potamians come to repose on the islets, the rocks, the fallen trunks of trees upon the banks, or floating timber, whence they precipitate themselves in the water at the sight of man or at the least alarming noise. They are very voracious and agile, and pursue, as they swim, reptiles, especially young crocodiles and fishes. Their flesh being esteemed they are angled for with a hook and line baited with small fish or living animals, or with a dead bait, to which the angler gives motion and apparent life; for they are said never to approach a dead or immoveable prey. When they would seize their food or defend themselves they dart out their head and long neck with the rapidity of an arrow. They bite sharp with their trenchant beak, and do not let go till they have taken the piece seized out; so that their bite is much dreaded, and the fishermen generally cut off their heads as soon as they have caught them.

The males appear to be fewer in number than the females, or at least they come less frequently to the banks of rivers, where the females resort to deposit their eggs in hollows, which contain from fifty to sixty. The number varies according to the age of the females, which are less fruitful in proportion to their youth. The eggs are spherical, their shell is solid, but membranous or slightly calcareous.

Gymnopus, Dum. and Bibr. (*Trionyx*, Geoff.; *Aspidonectes*, Wagler). Carapace with a cartilaginous circumference, very large, floating behind, and deprived of bone externally; sternum too narrow behind to hide the limbs completely when the animal draws them up under the carapace. *Trionyx* and *Testudo ferox* of authors.

G. spiniferus. M. Lesueur states that towards the end of April, or most frequently in May, the females of this species seek out on the river banks sandy spots for the deposit of their eggs; steeps of ten or fifteen feet elevation deter them not when they are choosing places exposed to the sun. Their eggs are spherical, and their shell is more fragile than that of the eggs of the species of Elodians living in the same waters; their eggs amount to from fifty to sixty. M. Lesueur counted in the ovary twenty ready for laying, and a great quantity of others of variable dimensions, from that of a pin's head to the much greater volume which they attain when they are covered with their calcareous coat. The retreats of these tortoises are on rocks and on the trunks of trees overthrown in the river. They may be taken with hook and line baited with a little fish; they are very voracious, and bite their captors, so that the prudent cut off their heads. M. Lesueur was often bitten by those he had: they dart out their heads like lightning. The young begin to show themselves in July. The flesh of this species is very delicate.



Gymnopus spiniferus.

G. muticus (*Trionyx muticus*, Lesueur, Lecoñte, and Gray).

G. Ægyptiacus (*Trionyx Ægyptiacus*, Geoff.; *T. Niloticus*, Gray). This is supposed to be the 'Εμύς of Aristotle ('De Part. Anim.,' v. 9).

G. Duvaucelii (*Trionyx Gangeticus*, Cuv.; *T. Hurum*, Gray); *G. ocellatus* (*Trionyx ocellatus*, Hardwick; *T. Hurum*, the young, Gray); *G. lineatus* (*Trionyx Ægyptiacus*, var., Hardw.; *T. Indicus*, Gray); *G. Javanicus* (*Trionyx Javanicus*, Schweigg.); *G. subplanus* (*Trionyx subplanus*, Geoff.); *G. Euphraticus* (*Trionyx Euphraticus*, Geoff.).

Cryptopus, Dum. and Bibr. (*Trionyx*, Wagl.; *Emyda*, Gray).—Carapace with narrow cartilaginous borders supporting above the neck and behind the thighs small bony pieces; sternum large, forming in front a moveable door or lid which can hermetically close the aperture of the osseous box. The posterior part of the sternum furnished right and left with a cartilaginous operculum, shutting the apertures which give passage to the hind feet; there is a third operculum besides to stop the opening whence the tail issues.

C. granosus (*Trionyx granosus*, Schweigg.). It lives in fresh-water lakes. The flesh is eaten. *C. Senegalensis.*

Family IV. Thalassians, Sea-Tortoises, or Turtles. (*Cheloniadæ*, Gray; *Carettoids*, Fitzing.; *Halychelones*, Ritgen; *Oiacopod Tortoises*, Wagl.).

This family is at once distinguished from all the others by the comparatively depressed carapace and the long and broad paddles, the anterior of which are very much prolonged when compared with the posterior ones. Indeed their limbs are entirely so modified as to become swimming organs.

The Turtles hardly ever leave the sea excepting for the purpose of laying their eggs; but some accounts state that they will crawl up the shores of desert islands in the night, and clamber up the edges of isolated rocks far at sea, for the purpose of browsing on certain favourite marine plants. They have been seen in smooth water as far as 700 or 800 leagues from the land, floating motionless on the surface of the sea as if they were dead, and it has been supposed that they are then asleep. They dive well, and can remain beneath the surface a long time, as might be expected from the extent and volume of their arbitrary lungs, capable of retaining and furnishing a sufficient quantity of air while they are submerged.

Messrs. Duméril and Bibron speak of the Potamians and Turtles as exceptions to the rest of the *Chelonia*, which, generally speaking, can produce no other sounds than hisses: we find however from Mr. Darwin's account above given, that the Great Land-Tortoises, the males at least, bellow loudly at the pairing season. The cries of the Potamians and of some Thalassians have been noticed by observers, and especially those of the Coriaceous Turtle, or *Sphargis*. Individuals of this last genus, when hampered in nets or grievously wounded, have been heard to utter loud roars, from which they derive their name (σφαραγίζω, to roar, or cry loudly).

The food of the Thalassians consists principally of marine plants; but it appears that some of them, especially those which exhale a musky odour, *Chelonia Caouana* (*Caouana*, Gray), for instance, feed also on crustaceans and many species of mollusks, the cuttles especially. Their jaws are robust, like the beaks of birds of prey; solidly articulated and worked with highly developed muscles; and their horny beak, hooked above and below, is trenchant on the edges, and most frequently serrated, so as to assist in securing a slippery prey.

Whilst little is known with regard to the conduct of the two sexes during the breeding season, those attending the deposit of the eggs are better known. To reach the destined spot, the females have often to traverse the sea for more than fifty leagues, and the males accompany them to the sandy beaches of those desert islands selected for the places of nidification. Arrived at the end of their voyage, they timidly come forth from the sea after sunset; and as it is necessary to leave the eggs above high-water mark, they have often to drag themselves to a considerable distance before they can hollow out their nests (about two feet in diameter) during the night, and there lay at one sitting to the number of a hundred eggs. This laying is repeated thrice, at intervals of two or three weeks. The eggs vary in size, but are spherical, like tennis-balls; and when they are laid, their investing membrane is slightly flexible, although covered with a delicate calcareous layer. After slightly covering the nest with light sand, the parent returns to the sea, leaving the eggs to the fostering influence of a tropical sun. The eggs are said to be hatched from the 15th to the 29th day; and when the young turtles come out, their shells are not yet formed, and they are white as if blanched. They instinctively make for the sea; but on their road, and as they pause before entering the water, the birds of prey that have been watching for the moment of their appearance hasten to devour them; whilst those that have escaped their terrestrial persecutors by getting into the sea, have to encounter a host of voracious fishes and legions of ambushed crocodiles.

Those that escape attain, under favourable circumstances, enormous dimensions. Individuals of the genus *Sphargis* have been known to weigh from 1500 lbs. to 1600 lbs.; and some whose carapace has measured in its circumference more than 15 feet, and near 7 feet in length, have weighed down more than from 1800 lbs. to 1900 lbs. Aged turtles often carry about with them on their carapace a little world of parasites, such as *Flustræ*, *Serpulæ*, *Balani*, and *Coronulæ*; whilst certain *Annelides* securely fix themselves at the origin or base of the limbs, where the motion of the turtle cannot displace them.

Though many of the other *Chelonia* are highly useful to man, especially as articles of food, none are of such great utility as the Thalassians. The advantages to be derived from them were not lost upon the ancients; and though Mercury is said to have taken the first hint for the structure of a lyre from the dried carapace and tendons of a tortoise (a *Gymnopus*, probably), found by the god after an inundation of the Nile, and which sounded when he struck 'the chorded shell,' the benefits arising from the Thalassians are, if not so refined, of a much more substantial and varied nature. The inhabitants of those countries where the turtles grow to a large size do not merely derive from them a supply of food, but they convert their carapaces into boats, into huts, into drinking-troughs for their domestic animals, and baths for their children. The *Chelonophagi* of old, who inhabited the shores of India and the Red Sea, converted the enormous shells of the turtles which they caught into roofs for their houses and boats for their little voyages, as Strabo and Pliny testify. The latter, in the tenth chapter of his ninth book, enters at large upon the subject.

As an article of food the Green Turtles (Tortues Franches of the French), are so highly prized, that they have become a considerable article of commerce. The fat of many species, when fresh, is used with success in lieu of butter and oil in cookery; and in those species which have a musky odour (*Chelonia Caouana* and *C. Caretta* for instance), is used for embrocations, leather-dressing, and as lamp-oil.

The Imbricated Turtles furnish that valuable article tortoise-shell, or rather the best sorts of it, so highly prized in ancient and modern times, and so ornamental and useful in the arts. The eggs of all the species, particularly those of the Green Turtles, are excellent.

In proportion to the benefits derived from the spoils of the turtles, the ingenuity of man has been sharpened by his eagerness to acquire them. One of the most obvious methods of capture was, and is, to watch the females as they emerge from the sea to deposit their eggs, and then turn them upon their backs on the high and dry sand, where they helplessly remain till the captors come to fetch them on the morrow. When the turtles lie floating on the sea, either for the purposes of sleep or respiration, the turtle-fishers approach them quietly with a sharp harpoon, carrying a ring at the butt-end, to which a cord is attached. The harpooner strikes, and the wounded animal dives, but is at last secured by the cord. In the South Seas skilful divers watch them when so floating, and, getting under the animals, suddenly rise, and so seize them. Mr. Darwin, with his usual felicity, describes another method of capture. In his account of Keeling Island, he says:—"I accompanied (April 6, 1836) Captain Fitzroy to an island at the head of the lagoon: the channel was exceedingly intricate, winding through fields of delicately branched corals. We saw several turtles, and two boats were then employed in catching them. The method is rather curious: the water is so clear and shallow, that although at first a turtle quickly dives out of sight, yet in a canoe or boat under sail, the pursuers, after no very long chase, come up to it. A man standing ready in the bows at this moment dashes through the water upon the turtle's back; then clinging with both hands by the shell of the neck he is carried away till the animal becomes exhausted, and is secured. It was quite an interesting chase to see the two boats thus doubling about, and the men dashing into the water, trying to seize their prey." ('Journal.')

But the most extraordinary mode of fishing is that said to be practised towards the coasts of China and the Mozambique, where turtles are taken by the aid of living fishes trained for the purpose, and thence named Fisher-Fishes. The fact appears to have been known to Columbus, and has been verified by Commerson and cited by Middleton and Salt. The fish is a species of *Echeneis* or *Remora*, and the islanders who use it are said to proceed in the following manner:—They have in their little boat tubs containing many of these fishes. The upper part of the head of the fish is covered with an oval plate, soft and fleshy at its circumference. In the middle of this plate is a very complicated apparatus of bony pieces, disposed across in two regular rows, like the laths of Persian blinds. The number of these plates varies from 15 to 36, according to the species; they can be moved on their axis by means of particular muscles; and their free edges are furnished with small hooks, which are all raised at once like the points of a wool-card. The tail of each of the trained fishes in the tubs is furnished with a ring for the attachment of a fine but long and strong cord. When the fishermen perceive the basking turtles on the surface of the sea, knowing that the slightest noise would disturb the intended victim, they slip overboard one of their Remoras tied to the long cord, and pay out line according to their distance from the turtles. As soon as the fish perceives the floating reptile he makes towards it, and fixes himself to it so firmly that the fishermen pull in both fish and turtle to their boat, where the fish is very easily detached by pushing its head in a direction from behind forwards, and the turtle is secured.

Chelonia, Brongn. (*Caretta*, Merrem).—Body covered with horny scales or shells. One or two nails on each foot.

Sub-Genus 1.—Chelonées Franches. Green Turtles.

Discoidal plates to the number of thirteen, not imbricated. Muzzle short, rounded. Upper jaw with a slight notch in front and small dentilations on the sides; horny case of the lower jaw formed of three pieces and having its sides deeply dentilated. A nail on the first toe of each foot.

C. Mydas. Messrs. Duméril and Bibron observe that this and the three following species are so similar, that it is possible for them to form one species only: but they add that this question can only be satisfactorily solved by those who have opportunities of comparing the living animals.

C. virgata; C. maculosa; C. marmorata.

Sub-Genus 2.—Imbricated Chelonees.

Plates of the disc imbricated and thirteen in number. Muzzle long and compressed. Jaws with straight edges without dentilations, curved slightly towards each other at their extremities. Two nails on each fin.

C. imbricata, the Hawk's-Bill Turtle of Catesby and Brown (*Caretta imbricata*, Gray; *Testudo imbricata* Linnæus). Flesh bad. Eggs very good.

Hawk's-Bill Turtle (*Chelone imbricata*).

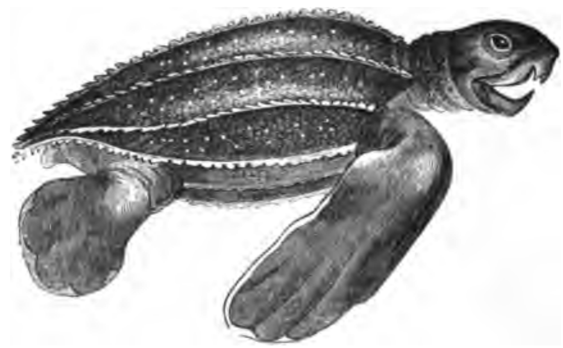
Sub-Genus 3.—Chelonées Caouanes. Logger-Head Turtles.

Plates of the carapace not imbricated. Fifteen plates on the disc. Jaws slightly curved towards each other at their extremity.

C. Caouana, the Logger-Head Turtle of Catesby (*Caouana Caretta*, Gray); *C. Dussumierii* (*Chelonia olivacea* of Eschscholtz; *Caouana olivacea*, Gray).

Sphargis, Merrem (*Coriudo*, Flem.; *Dermatochelys*, Blainv.).—Body enveloped in a coriaceous hide, tuberculous in young subjects, completely smooth in adults. Feet without nails.

S. coriacea (*Testudo Lyra*, Donnd. and Bechst.; Tortue Luth of the French; Coriaceous Tortoise of Pennant).



Sphargis coriacea.

Plastron of *Sphargis coriacea.*

This turtle has been taken on many of the European coasts; several of large size (700 lbs. and 800 lbs. in weight) have been captured on those of Britain. One case, where the capture was effected off the coast of Scarborough, should be a warning not to use it rashly as food. Pennant relates that one of the three taken in 1748 or 1749 was purchased by a family, who invited several persons to partake of it. A gentleman present told the guests that the flesh was unwholesome, but one of the company persisted in eating of it, and suffered most severely, being seized with dreadful vomiting and purging; and yet the Carthusians, Pennant tells us, are said to eat no other species. It would seem, then, that the severe effect above noticed must have been accidental, and the animal may have been in an unhealthy condition. It is said to grow very fat; but the flesh is reported be coarse and bad. The French name is given probably upon supposition that it was the species used by the ancients in the early construction of the lyre.

This and the last-named turtle are the only species of the *Chelonia* that have been taken alive on the British coasts. Professor Bell in his 'British Reptiles' expresses his conviction that several of the "fresh-water species, both of Europe and North America, might be naturalised in the southern parts of England. The *Terrapene Europæa*," he says, "the common Lacustrine Tortoise of the continent, is found in Portugal, Spain, Italy, and Greece, in France, and even in Prussia. These tortoises are eaten by the inhabitants of all the countries in which they are found; and as they live principally upon small fish, the air-bags of which they reject, it is said that the people are wont to judge of the quality of the tortoises to be found in a lake or pond by the number of air-bags which are seen swimming on the surface of the water. I once placed in a small pond, in which were some of these Fresh-Water Tortoises, six small living fish, and on the following morning I found the air-bags of five of them floating on the surface of the water and the sixth fish still alive. In some parts they are fed upon grains and other nourishing food, and fattened for the table. There are also several American species of *Emys*, or Fresh-Water Tortoise, which will bear a greater degree of cold than that of most of our winters without perishing; and it is certainly desirable that a wholesome and agreeable food, like that afforded by some of these, should not be lost to us, if the species can be easily perpetuated and multiplied in our climate."

Several species of Fresh-Water Tortoises are now in the collection of the Zoological Society, in the Aquavivarium of the Regent's Park Gardens.

The following list of *Chelonia*, arranged according to their geographical distribution, is from Dr. J. E. Gray's, 'Catalogue of the Tortoises and Crocodiles, &c., in the Collection of the British Museum.' When a species is found in two of the larger divisions of the list on account of its extensive range, it is preceded by an asterisk.

EUROPE.
Testudo marginata.
**T. Græca.*
Emys Caspica.
Cistudo Europæa.
**Sphargis coriacea.*

ASIA.
River Tigris.
Tyrse Rafeht.
Cabul.
Testudo Horsfieldii.
India.
Testudo Indica.
Emys tectum.
E. tentoria.
E. Duvaucellii.
E. trijuga.
E. lineata.
E. Dhongoka.
E. Thurjii.
E. trivittata.
E. ocellata.
E. Hamiltonii.
Tetraonyx Batagur.
Emyda punctata.
Tyrse Gangetica.
Dorgania subplana.
Chitra Indica.
Ceylon.
Testudo stellata.
Emys Seba.
China.
**Geoemyda Spengleri.*
G. Bealii.
G. Reevesii.
G. mutica.
G. nigricans.
Cistudo trifasciata.
Platystemon megacephalum.
Tyrse perocellata.
Japan.
Emys Japonica.
Sumatra.
Geoemyda spinosa.
Emys crassicollis.
E. platynota.
Amboyna.
Cistudo Amboinensis.
Java.
Cistudo dentata.
Tyrse Javanica.

AFRICA.
North.
**Testudo Græca.*
Tyrse Nilotica.
Eastern.
Pelomedusa Gehafiæ.
Western.
Testudo sulcata.
**Kinixys Homeana.*
K. erosa.
K. Belliana.
Sternotherus Derbianus.
Emyda Senegalensis.
Tyrse Argus.
Southern.
Testudo pardalis.
T. semiserrata.
T. geometrica.
T. Verroxii.
Homopus areolatus.
H. signatus.
Chersina angulata.
**Geoemyda Spengleri.*
Emys oculifera.
Sternotherus castaneus.
Pelomedusa subrufa.
Madagascar.
Testudo radiata.
Pyxis arachnoides.
Sternotherus niger.
S. subniger.
**Hydraspis gibba.*

AUSTRALIA.
Chelymys Macquaria.
Chelodina oblonga.
Chelodina longicollis.

OCEANIC.
Mediterranean and Atlantic.
Sphargis coriacea.
Atlantic and Indian Ocean.
Caouana Caretta.
Atlantic Ocean.
Caouana elingata.
Chelonia virgata.
C. viridis.
Indian Ocean.
Caouana olivacea.
Red Sea.
Caretta imbricata.

NORTH AMERICA.
East coast.
Testudo Gopher.
Emys Mulhenbergii.
E. pulchella.
E. geographica.
E. megacephala.
E. Bennettii.
E. serrata.
E. rivulata.
E. scripta.
E. Holbrookii.
E. Troostii.
E. mobilensis.
E. concinna.
E. reticulata.
E. macrocephala.
E. Floridana.
E. hieroglyphica.
E. guttata.
E. picta.
E. Bellii.
Malaclemys concentrica.
Cistudo Carolina.
Kinosternon oblongum.
K. Doubledayii.
K. Pensylvanicum.
K. odoratum.
Chelydra serpentina.
Trionyx ferox.
T. muticus.
West coast.
Emys ornata.
E. Oregonensis.

TROPICAL AMERICA.
Testudo tubulanta. W. Indies.
**Kinixys Homeana.*
Emys scabra.
E. rugosa. W. Indies.
E. decussata. W. Indies.
E. vermiculata.
Kinosternon scorpioides.
K. triporcatum.
Hydraspis planiceps.
H. radiolata.
H. Spixii.
H. depressa.
**H. gibba.*
H. nasua.
H. Waglerii.
H. Gaudichaudii.
H. Hilairii.
H. lata.
H. affinis.
Phrynops Geoffroyana.
P. rufipes.
P. Bellii.
P. Miliusii.
Hydromedusa Maximiliana.
H. flavilabris.
Chelys Matamata.
Peltocephalus Tracaxa.
Podocnemis expansa.
P. Dumeriliana.

SOUTH AMERICA.
East coast.
Emys Dorbignii.
Phrynops Geoffroyana.
Galapagos Islands.
Testudo Indica. Naturalised.
Locality unknown.
Emys kinosternoides.
E. annulifer.
E. Kuhlii.

Fossil Chelonia.

Cuvier, in his treatise upon Fossil Tortoises, observes that the number of living species is so considerable that it is very difficult to decide whether a fossil tortoise is or is not of an unknown species; inasmuch as it is not only necessary, before arriving at this conclusion, to compare the carapaces and plastrons covered with their horny plates or scales, as they are ordinarily seen in cabinets and represented in books, but also the skeletons, so that the observer may accurately study the joining of the ribs and other bones which concur to compose their cuirasses. He names twenty-nine species that he himself had stripped of their covering, and says that he had performed that operation on others beside.

Cuvier commences his description with the fossil *Trionyces*, and distinguishes—1, those from the gypsum-beds of the environs of Paris; 2, those from the gypsum-beds of Aix; 3, those from the 'molasse' of the department of the Gironde; 4, those from the gravel and clay-beds of Hautevigne in the department of the Lot and Garonne; 5, those from the gravel-beds in the neighbourhood of Castelnaudry; and 6, those from the sandy beds in the environs of Avaray.

He next considers the *Emydes*, or Fresh-Water Tortoises, noticing—1, those from the Paris gypsum-beds; 2, those discovered together with crocodiles in the Jurassic limestone of the neighbourhood of Soleure; 3, those of the ferruginous sand of Sussex; 4, those of the 'molasse' of La Grave and those of the 'molasses' of Switzerland; 5, those from our Isle of Sheppey; 6, those from the environs of Brussels; and 7, those from the marly sand (sable marneux) of the province of Asti.

The Marine Tortoises, or true Chelonians, he divides into—1, those of the environs of Maestricht; and 2, those of the slate of Glaris.

The Land-Tortoises noticed are—1, those of the environs of Aix; and 2, those found in the Isle of France under the volcanic beds.

The conclusions drawn by Cuvier are, that the Tortoises are as ancient inhabitants of the world as the Crocodiles; that they accompany the remains of the latter generally; and that as the greater number of their remains belong to fresh-water or terrestrial species they confirm the conjectures drawn from the bones of crocodiles as to the existence of isles or continents which were frequented by reptiles before the existence of viviparous quadrupeds, or at least before there was a sufficient number of these last to afford a quantity of remains at all comparable to those of reptiles.

Professor Owen, in his elaborate 'Report on British Fossil Reptiles,'—drawn up at the request of the British Association for the Advancement of Science, and published in their Transactions—gives the following account of the order *Chelonia* :—

I. Family *Testudinidæ*, Tortoises, or Land-Tortoises.

1. New Red-Sandstone Tortoises. The most ancient of the evidences of Chelonians in British formations appear to Professor

Owen to be referrible to the Land-Tortoises; and he quotes the foot-prints from the quarries at Corncockle Muir, and those subsequently discovered at the quarries of Craigs, two miles east of Dumfries, as examples. [AMPHIBIA.]

2. Oolite Tortoises. Examples. Impressions of horny scutes about the size of those covering the carapace of a tortoise, ten inches in length, in the Oolite Slate of Stonesfield.

II. Family *Emydidæ*, Fresh-Water Tortoises.

1. An undetermined species in the museum of Professor Bell, from the Eocene Clay near Harwich.

2. *Emys testudiniformis*, Owen (Emys de Sheppey, Cuv.?). Sheppey.

3. *Platemys Bowerbankii*, Owen. Sheppey.

4. *Platemys Bullockii*, Owen. Sheppey.

5. *Tetrosternon punctatum*, Owen. Purbeck Limestone. N.B. Closely allied to *Trionyx*.

6. With regard to *Platemys Mantelli* (Emys de Sussex, Cuv., *Emys Mantelli*, Gray), Professor Owen remarks that the fossils discovered by Dr. Mantell in the Wealden strata of Tilgate Forest, and the resemblance of which to the flat species of Emydian discovered by M. Hugi in the Jura Limestone at Soleure has been pointed out by Cuvier, are referrible to the pleuroderal section of the Emydian family as arranged by Messrs. Duméril and Bibron, and in that section to the genus *Platemys* (*Hydraspis*, Bell); but that not enough of the skeleton of any individual has yet been obtained to afford a foundation for specific character.

7. Large Emydian from the Kimmeridge Clay. A bone in the museum of Sir P. Grey Egerton, Bart., from Heddington Pits, probably belonging to a species of *Platemys*.

8. Footsteps of Emydians in New Red-Sandstone. Stourton Quarries, Cheshire.

With regard to the genus *Trionyx*, Professor Owen remarks that certain British fossils from the Secondary Formation referred to *Trionyx* have been proved to belong to another family of Chelonians: the supposed *Trionyx* from the New Red-Sandstones (Caithness) has been pronounced to be a ganoid fish (genus *Coccosteus*) by Agassiz. Nor had Professor Owen when he wrote (1841) seen any Chelonite from the Wealden Formation that could be confidently affirmed to belong to *Trionyx*.

A femur from the Lias at Linksfield in the possession of Mr. Robertson of Elgin, 4¼ inches in length, and found with remains of *Plesiosaurus* and *Hybodus*, though not identical in form with any *Trionyx* with which Professor Owen could compare it, he found to resemble the modifications of the bone in that genus more closely than in Tortoises, Emydians, or Turtles. He remarks that although some of the Turtles of the Eocene period, as the *Chelone longiceps*, present such modifications of the jaws as seem to have adapted them to habits and food analogous to those of the *Trionyx*, yet evidences of this genus, to which the destruction of the eggs and young of crocodiles is more particularly assigned in the Nile and Ganges, are not wanting in certain localities where the London Clay appears to have been deposited under circumstances analogous to those at the termination of equally gigantic rivers; and he adds that unequivocal portions of a true *Trionyx* have been obtained from the Eocene Clay at Sheppey and at Bracklesham, and that they are also associated, as in the Paris basin, with remains of *Anoplotherium* and *Palæotherium* in the Eocene Limestone deposits in the Isle of Wight.

III. Family *Chelonidæ*, Thalassian Family, or Turtles.

1. *Chelone planiceps*, Owen. Portland Sandstone.

2. *C. obovata*, Owen. Purbeck Limestone.

3. An undetermined species of *Chelone* from the Wealden. Portions of the carapace, plastron, and bones of the extremities of a large species of Marine Turtle, some of them indicating individuals nearly three feet in length, discovered by Dr. Mantell in the Wealden strata of Tilgate Forest, are figured in the Doctor's 'Illustrations of the Geology of Sussex.' This species, in Professor Owen's opinion, comes nearest to *C. planimentum* of the Harwich Eocene Clay.

4. *C. pulchriceps*, Owen. Superincumbent beds of the Lower Greensand; Greensand near Barnwell, Cambridge.

5. *C. Benstedi*, Owen (*Emys Benstedi*, Mantell). Chalk; Burham, Kent.

In a monograph on the 'Fossil Reptilia of the London Clay,' by Professors Owen and Bell, published by the Palæontographical Society, the following species are described, and figures of the remains found, given.

Order—*Chelonia*.

Family—*Marina*.

Genus—*Chelone*.

1. *C. breviceps* (*Emys Parkinsonii*, J. E. Gray; Emys de Sheppey, H. V. Meyer; *Chelone antiqua*, König). Eocene Clay of Sheppey.
2. *C. longiceps*. Eocene Clay of Sheppey.
3. *C. crassicostata*. Harwich Clay.
4. *C. declivis*. Eocene Deposits of Bognor, Sussex.
5. *C. trigoniceps*. Eocene Clay at Bracklesham.
6. *C. cuneiceps*. London Clay of Sheppey.
7. *C. subcarinata*. Sheppey.

Remarking on the descriptions of these species, Professor Owen says, "A retrospect of the facts above detailed relative to the Fossil Chelonians of the genus *Chelone*, or marine family of the order, leads to conclusions of much greater interest than the previous opinions respecting the Chelonites of the London Clay could have suggested. Whilst these fossils were supposed to have belonged to a fresh-water genus, the difference between the present fauna and that of the Eocene period, in reference to the Chelonian order, was not very great; since the Emys, or *Cistudo Europæa*, still abounds on the Continent, after which it was named, and lives long in our own island in suitable localities.

"But the case assumes a very different aspect when we come to the conviction that the majority of the Eocene Chelonites belong to the true marine genus *Chelone*; and that the number of species of these extinct Turtles already obtained from so limited a space as the Isle of Sheppey, exceeds that of the species of *Chelone* now known to exist throughout the globe. Notwithstanding the assiduous search of naturalists, and the attraction to the commercial voyager which the shell and the flesh of the Turtles offer, all the tropical seas of the world have hitherto yielded no more than five well-defined species of *Chelone*; and of these only two, as the *C. Mydas* and *C. Caouana*, are known to frequent the same locality. It is obvious, therefore, that the ancient ocean of the Eocene epoch was much less sparingly inhabited by Turtles; and that these presented a greater variety of specific modifications than are known in the seas of the warmer latitudes of the present day.

"The indications which the English Eocene Turtles, in conjunction with other organic remains from the same formation, afford of the warmer climate of the latitude in which they lived, as compared with that which prevails there in the present day, accord with those which all the organic remains of the oldest Tertiary deposits have hitherto yielded in reference to this interesting point.

"That abundance of food must have been produced under such influences cannot of course be doubted; and we may infer that to some of the extinct species, which like the *Chelone longiceps* and *C. planimentum* exhibit either a form of head well adapted for penetrating the soil, or with modifications that indicate an affinity to the *Trionyces*, was assigned the task of checking the undue increase of the now extinct crocodiles and gavials of the same epoch and locality, by devouring their eggs, or their young becoming probably in return themselves an occasional prey to the older individuals of the same carnivorous Saurians."

Family—*Fluvialia*.

Genus—*Trionyx*.

1. *T. Henrici*. Eocene at Hordwell.
2. *T. Barbaræ*. Eocene at Hordwell.
3. *T. incrassatus*. Eocene Formations of the Isle of Wight.
4. *T. marginatus*. Eocene Deposit at Hordwell Cliff.
5. *T. rivosus*. Eocene Beds at Hordwell Cliff.
6. *T. planus*. Eocene at Hordwell and Bracklesham.
7. *T. circumsulcatus*. Eocene at Hordwell.
8. *T. pustulatus*. Clay at Sheppey.

Family—*Paludinosa*.

Genus—*Platemys*.

1. *P. Bullockii*. London Clay.
2. *P. Bowerbankii*. Clay at Sheppey.

Genus—*Emys*.

1. *E. testudiniformis* (Emys de Sheppey, Cuvier?). Eocene Clay of Sheppey.
2. *E. lævis*. Clay of Sheppey.
3. *E. Comptoni*.
4. *E. bicarinata*.
5. *E. Delabechii*. London Clay, Isle of Sheppey.

Amongst the Fossil remains brought from the Tertiary Formations of India by Dr. Falconer and Major Cautley, are those of a gigantic species of Land-Tortoise. The species referred to has been named *Colossochelys Atlas*. Portions of its skeleton and a model of the entire animal are now in the collection of the British Museum. The carapace of this gigantic animal measures in some specimens above 12 feet in length. These remains were found associated with the bones of gigantic extinct *Mammalia* allied to *Palæotherium*, and the other *Pachydermata* of the Paris basin. In the same deposits were also found the remains of several smaller species of *Chelonia*, and of the one which now inhabits India. There have been also found in the same locality the remains of gigantic crocodiles, differing from those now inhabiting India, and several species of elephant.

In the 'Reports' of the United States Surveying Expedition in Wisconsin, Iowa, and Minesota, in 1850, an account is given of the discovery of the remains of a large number of species of *Chelonia*, both Tortoises and Turtles, with the remains of extinct forms of *Mammalia* in the district of the Mauvaises Terres on the Missouri.

CHELO'NIA (Godart), a genus of Lepidopterous Insects, of the section *Nocturna* (Latreille), and family *Arctiidæ* (Leach). Before we proceed with an account of this genus, which contains two of tl most conspicuous and beautiful of the British moths, it may be well briefly to state the characters of the family *Arctiidæ*, as far as the diversified habit of the species will admit. The palpi are two in number, mostly 3-jointed and hairy. The antennæ have a double series of pectinations; thorax large; the apex of the body generally furnished with a tuft; wings closing so as to form an angle by their junction, or folding horizontally. The males are usually larger than the females; larvæ generally very hairy, frequently furnished with numerous tufts, those on the tail and towards the head the longer.

The genus *Chelonia* is synonymous with *Arctia* of Schrank. The latter name is generally adopted by British entomologists from its priority. The term *Chelonia* is open to another objection, being commonly used to designate a section of Tortoises.

Arctia Caja, the Large Tiger-Moth, or the Garden-Tiger, is very common in the south of England, but apparently less so in the north. The expanded wings measure from 2½ to 3 inches in width; the upper wings are of a chocolate-brown colour, with numerous irregular cream-coloured markings; the under wings are scarlet, with five or six large blue-black spots; the body is also scarlet, or pinkish above, with several transverse black bands; on the under side the ground-colour is black, with pink bands; the head and thorax are brown, separated with a red ring; the legs are red at the base, and the antennæ are white.

The caterpillar of this moth is found in great abundance near London, and is frequently seen crawling on pathways: it is covered with long black hairs, and when touched will roll itself up in a ring: it feeds upon a great variety of plants, but seems most fond of lettuce, groundsel, and chickweed. The larva is found in the spring months, and turns into a pupa about June. The pupa is inclosed in a loose web of a white colour; the moth appears in the autumn.

This species is extremely variable in its imago state; we have seen specimens in which the upper wing is nearly all white, and others in which the white is almost obliterated: the spots on the under wing vary also considerably; they sometimes run one into the other so as to form a band.

Arctia Villica, the Cream-Spot Tiger-Moth, is the only other well authenticated British species; it is far less abundant than the other. The upper wings are black, with about eight large cream-coloured spots; the under wings are yellowish, spotted more or less with black, and has an irregular black fascia near the margin; the abdomen is reddish, spotted with black; the head and thorax are black; the latter has two cream-coloured spots.

The caterpillar very much resembles the one last described, but has a red head, and legs of the same colour; like the last it feeds upon various plants, particularly the chickweed. The moth appears about the end of June, and is rather less than the Large Tiger.

CHELONIANS. [CHELONIA.]

CHELYS. [CHELONIA.]

CHEMNITZIA, a genus of *Mollusca* belonging to the Prosobranchiate section of the *Gasteropoda*, and referred to the family *Pyramidellidæ*. [PYRAMIDELLIDÆ.]

CHENALOPEX, a genus of Birds belonging to the family *Anatidæ*, to which the Egyptian Goose (*C. Ægyptiacus*) is referred. [DUCKS.]

CHE'NNIUM, a genus of Coleopterous Insects. [PSELAPHUS.]

CHENOCOPROLITE, a Mineral of a yellow or pale-green colour, belonging to the silver series, and supposed to be an arsenate of silver and iron.

CHENOPODIA'CEÆ, *Chenopods*, the Chenopodium Tribe, a natural order of Exogens, consisting of numerous species, used either for culinary purposes or for the manufacture of soda. They are apetalous plants, with minute green herbaceous flowers, a small number of stamens, which are opposite the segments of the calyx, and a one-celled membranous fruit, containing one single erect seed, or a very small number. The leaves are soft and rather succulent, without any trace of stipules. Most of them are found in the cold and temperate parts of the world. They differ from *Polygonaceæ* and *Urticaceæ* in the want of stipules, and from *Amarantaceæ* in their flowers not being coloured and enveloped in membranous bracts. This order embraces plants of opposite characters, and when better investigated will probably be split up. Schleiden has observed that certain species have the wood very compact, and pierced with vertical cords of cellular tissue. The order contains 63 genera and 360 species. They are natives of all parts of the world, in waste and uncultivated places. Spinach [SPINACIA], Fat Hen, Good King Henry [CHENOPODIUM], Garden Orach [ATRIPLEX], Chard-Beet, Beet, Mangold Wurzel [BETA], belong to this order. Soda is obtained from species of *Salsola* and *Salicornia*. [SALSOLA; SALICORNIA.]

CHENOPO'DIUM, a genus of plants the type of the natural order *Chenopodiaceæ*. It consists of weedy plants, common on dunghills and in waste places, and known by the strange names of Fat Hen (*C. album*), Good King Henry (*C. Bonus-Henricus*), &c. They are generally insipid plants, whose leaves and young shoots may be eaten as spinach, but which have no particular merit. In this genus is however found the celebrated Quinoa of Peru (*C. Quinoa*). This plant, whose seeds are said to be of as much importance to the Peruvians as the maize, potato, and wheat, is an annual weedy species, with an appearance similar to that of Garden Orach, to the size of which it grows. Its flowers appear in close clusters about the ends of the branches, and

Chenopodiaceæ. Blitum virgatum.

a, angle of the petiole, showing the peduncle; *b*, flower; *c*, flower deprived of its calyx, showing the ovary, surmounted by three pistils; *d*, calyx; *e*, fruit imbedded in the succulent calyx; *f*, *g*, fruit separated from the calyx; *h*, horizontal section of fruit; *i*, vertical do.; *k*, embryo. All these figures, excepting *a*, magnified in various degrees.

are succeeded by a profusion of little black or white seeds (according to the variety) about the size of grains of millet. Its leaves are employed as spinach, and the seeds in soup or broth as rice, and in some parts of South America they are in as much use as rice in India. They are said to yield a pleasant beer when fermented. It is chiefly upon the highest land of Southern Peru, where neither barley nor rye will ripen, as, for instance, at the height of nearly 13,000 feet on the table-land of Chiquitòs, that Quinoa forms the great article of agriculture; it there forms fields, the limits of which the eye can hardly reach, of a monotonous and unpleasant aspect, scarcely mixed with a single other species, and very unlike the rich and waving greenness of our standing corn. It is also extremely common about the great lake of Titicaca. The seeds are ripened in England, and may now be purchased at any of the seed-shops; but the plant can hardly be considered worth the attempt at cultivating it where anything else will grow. *C. olidum* has an atrocious odour, and has a reputation as an antispasmodic and emmenagogue.

The following is an analysis of the British species of *Chenopodium*.

* Perianth enveloping the fruit.

† Leaves undivided.
Leaves ovate rhomboidal. *C. olidum*.
Leaves ovate-elliptical. *C. polyspermum*.

†† Leaves toothed, angled, or lobed.
Leaves triangular. *C. urbicum*.
Leaves sinuate-dentate. *C. album*.
Leaves unequally 3-lobed. *C. ficifolium*.
Leaves rhomboid-ovate. *C. murale*.
Leaves subcordate. *C. hybridum*.

** Perianth not covering the fruit.

† Stigmas short.
Leaves rhomboid. *C. rubrum*.
Leaves triangular. *C. botryoides*.
Leaves oblong. *C. glaucum*.

†† Stigmas elongated.
Leaves triangular. *C. Bonus-Henricus*.

CHERIMOYER, the fruit of a Peruvian downy-leaved species of *Anona*, the *A. Cherimolia*. It is described as the fruit most esteemed by the people of the western parts of South America, and is very like the Custard Apple of the West Indies. [ANONA.] It is a tree about 12 feet high; the leaves are oval, pointed at both ends; the flowers solitary, very fragrant, of a greenish-white colour, and the fruit somewhat heart-shaped, with a scaly appearance on the outside: when ripe it is grayish-brown, or black. The flesh is white and sweet, mixed with several seeds of the colour of coffee. The Creoles think this fruit the best of the country. Baron Humboldt speaks of it in terms of high praise, and his account is completely confirmed by the testimony of many officers who have been in the South American service; but Feuillée says, one European pear or plum is worth all the Cherimoyers of Peru.

CHERLE'RIA, a genus of plants belonging to the natural order *Caryophyllaceæ*. It has 5 sepals, 5 petals (sometimes absent), 10 stamens, the outer ones opposite to the sepals, springing from an oblong emarginate glandular base, 3 styles, a 3-valved capsule. There is only one species which is a native of Great Britain. It was called by Linnæus *C. sedoides*. The petals are very generally wanting, the flowers are solitary on short stalks. The stems are numerous, forming a dense mass close to the ground. The leaves are very numerous, linear-subulate, and finely ciliated. It is found on the summits of the mountains of Scotland.

CHERRY, the fruit of the various species of *Cerasus*. [CERASUS.] Like most of the fruits yielded by the natural order *Amygdalaceæ*, it is characterised by the hardness of its endocarp, hence this part is often called the stone. This hard part is often used for ornamental carving, specimens of which may be seen in the museum of the Royal Gardens at Kew. For the varieties of Cherry, and the culture of the tree, see CHERRY, in ARTS AND SC. DIV.

CHERRY-LAURELS. [CERASUS.]

CHERRY-TREES. [CERASUS.]

CHERSIANS. [CHELONIA.]

CHERT, a variety of quartz being a kind of granular Chalcedony. It is a transition from the smoother forms of Quartz to Hornstone. [AGATE.]

CHERVIL, a culinary vegetable, the *Anthriscus Cerefolium* [ANTHRISCUS] of botanists. It is an annual, and a native of the south of Europe. Its leaves have a slight aromatic taste, and are used in soups and salads. It is little cultivated.

CHESTNUT, BUCK'S-EYE. [PAVIA.]

CHESTNUT, HORSE. [ÆSCULUS.]

CHESTNUT, SWEET. [CASTANEA.]

CHIASTOLITE is a name given to a variety of *Andalusite*. [ANDALUSITE.] It is also called *Macle*. [MACLE.]

CHICA. [BIGNONIA.]

CHICHA. [STERCULIA.]

CHICK-PEA. [CICER.]

CHICKRASSIA, a genus of plants belonging to the natural order *Cedrelaceæ*. *C. tabularis* is said to be a powerful astringent.

CHICKWEED, a common annual, with soft light-green opposite ovate leaves, a brittle stem, and minute white petals, almost split into two parts. It and groundsel are two plants which are to be found in flower on any day in the year. Botanists name it *Stellaria media*. [STELLARIA.]

CHICORY. [CICHORIUM.]

CHIFF-CHAFF. [SYLVIA.]

CHIGOE. [PULEX.]

CHILDRENITE, a Mineral found in Derbyshire. It occurs in minute yellowish-brown crystals, coating spathic iron. It is supposed to consist of phosphoric acid, alumina, and iron.

CHILINA, a genus of Testaceous Mollusks, separated by Dr. J. E. Gray from *Auricula*, and including *Auricula Dombeiana* of Lamarck, and *Auricula fluviatilis* of Lesson. Locality, South America, in fresh-water streams, with most of the habits of the *Limneæ*.

CHILLIES. [CAPSICUM.]

CHILLINGHAM CATTLE. [BOVIDÆ.]

CHILO'GNATHA (Latreille), an order of Insects belonging to the class *Myriapoda*. It has the following characters:—Body generally cylindrical, and consisting of numerous crustaceous rings or segments; the head is furnished with two short 7-jointed antennæ, and two mandibles; the horny substance of the mandibles does not continue uninterruptedly from the base to the apex, but is divided in the middle so that the upper part is, as it were, hinged to the lower by a tough membrane; they are covered above by the fore part of the head, which forms a kind of upper lip, and beneath by an under lip; this last part is divided externally into four portions by three sutures; the two central portions are narrower than the outer ones, and spring from a plate of a semicircular shape; the apex of the under lip is furnished with several large tubercles. The first segment of the body, or that next the head, is considerably larger than the following segments. The legs are short, very numerous, and terminated by a simple hook; the anterior segments of the body are some of them unprovided with legs, and others have a single pair each; the remaining segments (with the exception of the last two or three) commencing from the fourth, fifth, or sixth from the head, are each furnished with two pairs of legs. The sexual organs of the male are situated behind the seventh pair of legs, and those of the female behind the second pair. The respiratory orifices are situated on the sternal part of each segment of the body; they communicate internally with a double series of pneumatic sacs which extend the whole length of the body, and from which the tracheal branches spring and spread over the other organs; these sacs are not connected with each other, as is usually the case, by a principal trachea. A series of pores on each side of the body have been mistaken for the stigmata, but their orifices give vent to an acid liquid secretion which has a very disagreeable odour, and probably serves as a means of defence.

The *Chilognathæ* crawl slowly, and appear to glide over the ground, and when touched they will roll themselves up spirally. They feed upon decaying animal and vegetable substances. The genus *Iulus* of Linnæus [IULUS] included all the species of this order known in his time. It now embraces several genera and upwards of seventy spècies. [MYRIAPODA.]

CHILO'PODA (Latreille), an order of Insects belonging to the class *Myriapoda*. This family is synonymous with the order *Syngnatha* (Leach), and the genus *Scolopendra* of Linnæus. The characters are:—Antennæ thick at the base, and gradually growing slender towards the apex, composed of fourteen or more joints; the mouth consists of two mandibles, which are furnished with a palpiform process, and provided at the apex with numerous little denticulations; covering these is an upper lip and an under lip; the latter is composed of four distinct portions, of which the two outer parts are the largest, and transversely jointed; above this part (viewing the head from beneath) are two palpi, which resemble legs in being terminated by a pointed claw: covering this under lip, there is a second lip, an organ furnished with two lateral processes, each of which is terminated by a large bent claw, which is said to be perforated beneath by a hole through which a poisonous liquid is ejected.

The body is depressed, composed of numerous segments, which are covered above and beneath with plates of a horny substance, and each segment is generally furnished with a pair of legs; the last pair are thrown back. The sexual organs are placed at the posterior extremity of the body. The organs of respiration consist wholly or partly of tubular tracheæ. The stigmata are placed on the sides of the body.

These insects are carnivorous, and crawl about by night. Most of them are very active in their movements, and some emit a phosphoric light. They conceal themselves under stones and fallen trees, and are all found in rotten wood. In hot climates some of the species grow to an immense size (especially those of the genus *Scolopendra*, as it is now restricted), and, owing to their venomous bite, are much dreaded by the inhabitants of those parts.

The animals commonly known by the name of Centipedes belong to this family. [SCOLOPENDRA.]

The species of this order have been recently greatly increased. It now embraces nearly a hundred species. [MYRIAPODA.]

CHIMÆ'RA, a genus of Cartilaginous Fishes allied to the Sturgeon and Shark sections. [STURIONIDÆ.] One species, *C. monstrosa*, inhabits the British seas, and is known by the names of the King of the Herrings, the Rabbit-Fish, and Sea-Monster.

CHIMÆRIDÆ, a family of Fishes between the Sharks and the Sturgeons, to which is referred the anomalous genus *Chimæra*. [STURIONIDÆ.]

CHIMA'PHILA, a genus of plants belonging to the natural order *Pyrolaceæ*. *C. corymbosa* (Pursh), the *Pyrola umbellata* of Linnæus, the Corymbose Wintergreen, is a small evergreen woody plant, common in the pine-forests of the north of Europe, also found in Asia and in North America, to the Indian inhabitants of which its virtues have been long known. The leaves possess diuretic properties joined to a tonic power, and they impart strength and comfort to the stomach while they increase the action of the kidneys. Applied externally, they cause redness and vesication of the skin. Chemical analysis shows them to consist of tannin, resin, and an acrid extractive. The taste is at first sweet, afterwards bitter. Their tonic and diuretic properties render them valuable remedial agents in dropsies, especially such as follow acute diseases. They have also been given advantageously in intermittent and even typhus fever. Dr. Chapman ascribes a diaphoretic power to them. Infusion, decoction, and extract are the forms in which they have been given: decoction is preferable, of which some ounces may be given repeatedly during the day.

CHIMONA'NTHUS, a genus of plants belonging to the natural order *Calycanthaceæ*. The species or rather varieties of this genus are called in the gardens Japan Allspice. They are deciduous plants, with opposite pale-green sharp-pointed rather rough leaves, of an ovate-lanceolate figure. About the end of November these fall from the bushes, and are succeeded by the flowers, which appear at Christmas-time upon the naked branches. They consist of an inferior calyx, formed of a considerable number of roundish scale-like sepals, the outermost of which are pale brown, the innermost semi-transparent, with some tinge of yellow. The petals are yellowish ovate leaves, stained with chocolate-red veins, and surrounding a small number of stamens. The fruit is a bright-brown leathery calyx-tube, inclosing three or four oblong bright-brown polished nuts. There is probably no plant more deliciously fragrant than this, orange flowers and violets not excepted. The plant is quite hardy if protected a little by a wall or by palings. The only species is *C. fragrans*. Of this three varieties are known in the gardens; the common kind, *C. fragrans*, with small pale-yellow flowers; the *C. f. grandiflorus*, with large bright-yellow flowers; and another, *C. f. parviflorus*, with flowers resembling those of the first, except in being much smaller. The last is not worth cultivating; both the former should be found in every garden, however small. Nothing can be more elegant as room-ornaments than handfuls of their round flowers placed on little porcelain trays.

CHIMPANZEE, the name by which one of those forms which approach nearest to man is most generally known. The term has been applied to the *Simia Satyrus* of Linnæus, the Oriental Orang; but zoologists are now agreed in its proper application to the Black or African Orang or Pygmy (*Troglodytes niger* of Geoffroy, *Simia Troglodytes* of Blumenbach). Linnæus placed the form under the genus *Homo*, with the specific name *Troglodytes*, next to *Homo sapiens*, arranging, as we have seen above, the Asiatic Orang under the *Simiæ*. But he seems to have confounded the two species of Orangs, which differ very considerably; for he refers to the figure given by Bontius, which was intended for the Asiatic, and yet he gives, quoting Pliny, the borders of Ethiopia as its habitat, as well as Java, Amboyna, Ternate, and Mount Ophir in Malacca. That the Chimpanzee, though much of its organisation bears a striking resemblance to that of Man, is separated from him by a wide interval, the accurate investigations of modern anatomists sufficiently prove. Tyson, Camper, Blumenbach, Cuvier, Lawrence, and especially Owen, have set that question at rest, though Bory de St. Vincent struggled hard to retain Man and the Orangs as members of the same zoological family. Before we refer to the arguments of the last-named zoologist and his followers, it will be necessary to apprize the reader that, to say nothing of the difference of organisation in other parts of the body and foot, the heel-bone (os calcis) of man does not project backwards so far in proportion as that of the Chimpanzee, and Lawrence notes this as an infallible human characteristic; '*ex calce* hominem.' Bory de St. Vincent, and those who support the theory of gradual development of animal form, endeavour to show that the position of the great toe, upon which its conversion into an opposeable organ, or thumb, and the consequent transmutation of the foot into a hand, principally depends, is a character subject to modification; and, after a somewhat sweeping assumption that it is the only difference of organisation between the Orangs and Man, points the whole strength of his argument against its value as a zoological character; and, by a rather retrograde process of reasoning, endeavours to support his views by giving an instance where man, under certain circumstances, obtains a prehensile power of foot. Calling in aid the Resiniers of the Landes of Aquitaine, he exhibits them as having acquired a power of opposing the great toe to the others, a faculty supposed to have been arrived at by their scansorial habits in obtaining their living by gathering the resin of *Pinus maritima*. "But," as Professor Owen well observes, "supposing the extent of motion of the great toe to be sufficiently increased by constant habits of climbing, or in connection with a congenital defect of the upper extremities, yet it does not appear that the os calcis, or the other bones of the foot, have lost any of those proportions which so unerringly distinguish man from the ape." M. Bory, however, in his zealous endeavours to lower the arrogance which makes man unwilling to fraternise with apes and monkeys, is carried so far as to give vent to this naïve question:—"En effet, quatre mains ne vaudraient elles pas mieux que deux comme élémens de perfectibilité?"—"In fact, are not four hands of more value than two as elements of perfectibility?" Now, let us look at this fallacy, for a fallacy it is. There might be a little, and a very little after all, in the query, if any one of the four hands of the *Quadrumana*, or all of them put together, approached the hand of man as an instrument of action,—an instrument whereby, though born the most helpless of animals and without clothing or any natural protection, he has made himself master of all, and compelled the apparently most impracticable natural productions to minister not only to his wants but to his most luxurious imaginations. Let any one who is at all conversant with animal mechanics look at the hand of a Chimpanzee, and compare it with his own; or let any one observe the Chimpanzee using his apology for a thumb, and then cast his eyes on the merest hodman at his work, and he will soon see where the advantage lies. And this is not all. "To give due force to this proposition," says Professor Owen in his paper 'On the Osteology of the Chimpanzee and Orang-Utan,' "the four hands of the ape ought to be independent of any share in stationary support or progression. Now, it is scarcely necessary to observe that the perfection of the hands of man results, in a great measure, from the free use he is enabled to make of them in consequence of the organisation of the lower members as exclusive instruments for sustaining and moving the body. It has, however, been suggested that the hallux (thumb) of the orang might acquire increased length and strength during the efforts of successive generations to maintain the erect position; but if we look a little further into the anatomy of the orangs, a difficulty presents itself unforeseen by Lamarck and Bory. The muscle called 'flexor longus pollicis pedis' terminates, in the human subject, in a single tendon, and its force is concentrated on the great toe, the principal point of resistance in raising the body upon the heel. In the orang, however, the analogous muscle terminates in three tendons, which are inserted separately and exclusively in the three middle toes, obviously to enable these to grasp with greater force the boughs of trees, &c. It is surely asking too much to require us to believe that in the course of time, under any circumstances, these three tendons should become consolidated into one, and that one become implanted into a toe, to which none of the three separate tendons were before attached. The myology of the orangs, to which I may hereafter endeavour to direct more attention than it has yet received, affords many arguments equally unanswerable against the possibility of their transmutation into a higher race of beings." From the same author we take the following summary comparison of the Chimpanzee and Orang-Outan with each other, and with man:—

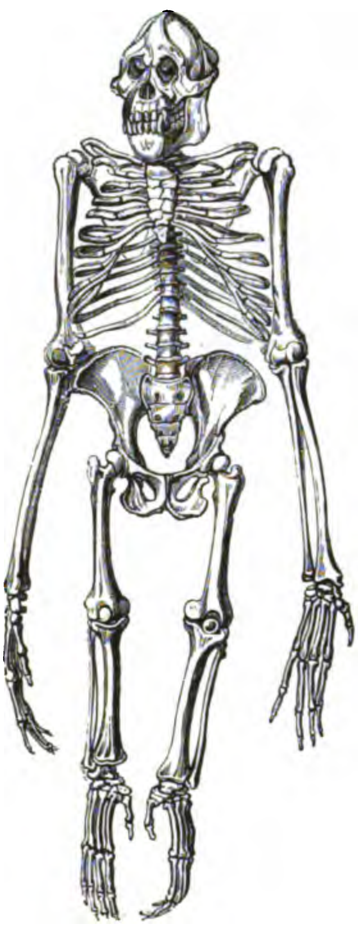
Skeleton of Man. Skeleton of Chimpanzee. From Owen.

The Chimpanzee differs osteologically from the Orang:—1. In having the cranium flatter and broader in proportion to the face. 2. In having the supraciliary ridges more developed, and in the absence of the interparietal and sagittal crests. 3. In the junction of the temporal with the frontal bones. 4. In the greater proportional breadth of the interorbital space. 5. In the more central position and less oblique plane of the occipital foramen. 6. In having but one anterior condyloid foramen on each side, while the orang has two. 7. In having generally but one suborbital foramen on each side, while the orang has three or more. 8. In the persistence of the cranial sutures. 9. In the earlier obliteration of the maxillo-intermaxillary sutures. 10. In the smaller proportional size of the incisive and canine teeth, and consequent smaller development of the jaws, especially of the intermaxillary bones. 11. In the smaller proportional size of the cervical vertebræ, and larger proportional size of the lumbar vertebræ. 12. In the additional dorsal vertebra corresponding to the additional pair of ribs. 13. In the more complete composition of the sternum, which consists of a single and not double series of bones, as in the orang. 14. In the greater sigmoid curve of the clavicle, which in the orang is nearly straight. 15. In the less proportional breadth of the scapula, and the more lateral aspect of the glenoid cavity. 16. In the less proportional breadth and greater length of the sacrum. 17. In the less proportional breadth of the ilium, and greater expansion of the ischium. 18. In the comparative shortness of the upper extremities, more especially of the fore-arm and hand. 19. In the non-division of the pisiform bone of the wrist. 20. In the greater proportional length of the femur and tibia, and the less proportional length of the foot. 21. In the presence of a ligamentum teres, and consequent depression in the head of the femur. 22. In the greater proportional size of the tarsus as compared with the phalanges of the toes. 23. In having constantly two phalanges in the hallux or great toe with a nail, while the ungueal phalanx and nail are often wanting in the hallux of the orang, especially in that of the female.

The chimpanzee approximates more nearly to the human structure in those deviations which are numbered 4, 5, 6, 7, 8, 9, 10, 12, 13, 17, 18, 19, 20, 21, 22, 23.

The orang has a nearer resemblance to man:—1. In the junction of the sphenoid with the parietal bones. 2. In having twelve pairs of ribs. 3. In the form of the scapula, especially in its greater breadth.

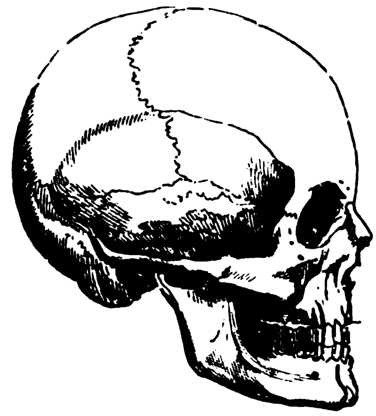
Owen well observes that it is a result of the preceding comparison that the chimpanzee ought to rank above the orang in a descending series, and not below it as in the 'Règne Animal' of Cuvier. Linnæus, as we have seen, gave the chimpanzee that superiority of rank, but erred as much on the other side by placing it under the genus *Homo*, for both the chimpanzee and orang, according to Owen, differ in structure from the human subject:—1. In the diastema, or interval between the cuspidati and incisors in the upper jaw, and between the cuspidati and bicuspides of the lower jaw. 2. In the greater magnitude of the intermaxillary bones, indicated in the adult by the distance of the foramina incisiva from the incisive teeth; both of which differences result from the greater proportional development and different forms of the cuspidati and incisors. These, as the author observes, are differences of generic value. 3. In the more backward position and oblique plane of the occipital foramen. 4. In the smaller proportional size of the occipital condyles. 5. In the larger proportional size of the petrous bones. 6. In the greater proportional development of the jaws. 7. In the flatness of the nasal bone, which is rarely divided in the mesial line, while in man the nasal bones are as rarely consolidated into one. 8. In the presence of the ant-auditory process of the temporal bone, and the absence of the mastoid and styloid processes. 9. In the absence of the process of the ethmoid, called crista galli. 10. In the shortness and comparative weakness of the lumbar region of the spinal column; which is also composed of four instead of five vertebræ. 11. In the narrowness and proportional length of the sacrum. 12. In the flatness of the ilia, and the larger development and outward curvature of the ischia. 13. In the position of the pelvis in relation to the spine. 14. In the larger proportional development of the chest. 15. In the greater length of the upper extremities. 16. In the wider interval between the ulna and radius. 17. In the shortness and weakness of the thumb, and narrowness of the hand in relation to its length. 18. In the shortness of the lower extremities. 19. In the greater proportional length and narrowness of the foot. 20. In the small size of the os calcis. 21. In the shortness and opposeable condition of the hallux.



Skeleton of Orang-Outan. From Owen.

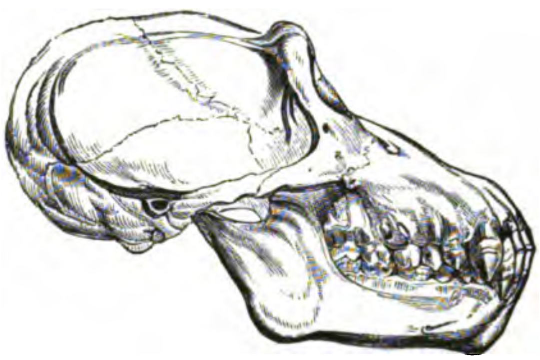
"These differences," adds Professor Owen, "result from original formation, and are not liable to be weakened in any material degree, either on the one hand, by a degradation of the human species, or, on the other hand, by the highest cultivation of which the anthropoid apes are susceptible."

In following out this osteological comparison it becomes necessary, for the assistance of the student, to give a sketch of the cranial

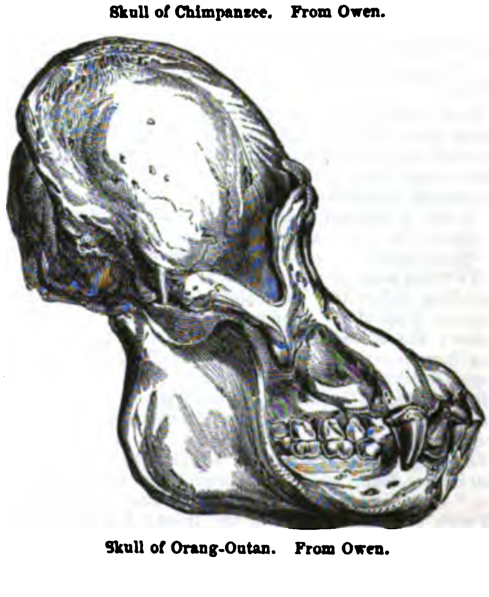


Well-developed Human Skull.

Skull of Human Idiot. From Owen.



Skull of Chimpanzee. From Owen.



Skull of Orang-Outan. From Owen.

development in man and in the anthropoid apes, so that he may have under his eye the comparative form of each.

We cannot do better than give the following conclusive statements of Professor Owen.

"Certain modifications in the form of the human pelvis have been observed to accompany the different forms of the cranium which characterise the different races of mankind; but there is nothing in the form of the pelvis of the Australian or Negro which tends to diminish the wide hiatus that separates the bimanous from the quadrumanous type of structure in regard to this part of the skeleton. Observation has not yet shown that the pelvis of the orang, in a state of captivity, undergoes any change approximating it towards the peculiar form which the same part presents in the human subject. The idea that the iliac bones would become expanded and curved forwards, from the pressure of the superincumbent viscera, consequent on habitual attempts at progression on the lower extremities, is merely speculative. Those features of the cranium of the orangs which stamp the character of the irrational brute most strongly upon their frame, are however of a kind, and the result of a law, originally impressed upon the species, which cannot be supposed to be modified under any circumstances, or during any lapse of time; for what external influence operating upon and around the animal can possibly modify in its offspring the forms, or alter the size, of the deeply-seated germs of the permanent teeth? They exist before the animal is born; and let him improve his thinking faculties as he may, they must, in obedience to an irresistible law, pass through the phases of their development, and induce those remarkable changes in the maxillary portion of the skull which give to the adult orangs a more bestial form and expression of head than many of the inferior *Simiæ* present. It is true that in the human subject the cranium varies in its relative proportions to the face in different tribes, according to the degree of civilisation and cerebral development which they attain; and that in the more debased Ethiopian varieties, and Papuans, the skull makes some approximation to the quadrumanous proportions: but in these cases, as well as when the cranium is distorted by artificial means or by congenital malformation, it is always accompanied by a form of the jaws, and by a disposition and proportions of the teeth, which afford unfailing and impassable generic distinctions between man and the ape. To place this proposition in the most unexceptionable light, I have selected the cranium of a human idiot, in whom nature may be said to have performed for us the experiment of arresting the development of the brain almost exactly at the size which it attains in the chimpanzee, and where the intellectual faculties were scarcely more developed; yet no anatomist would hesitate in at once referring this cranium to the human species. A detailed comparison with the cranium of the chimpanzee or orang shows that all those characters are retained in the idiot's skull which constitute the differential features of the human structure. The cranial cavity extends downwards below the level of the glenoid articulatory surfaces. The nasal bones are two in number, and prominent. The jaws and teeth exhibit the bimanous characters as strongly as in the most elevated of the human race. The cuspidati do not project beyond the contiguous teeth, and consequently there are no interruptions in the dental series, as in the orangs, where they are required to lodge the disproportionate crowns of the canine teeth."

M. Geoffroy St. Hilaire characterised the sub-genus *Troglodytes* from immature Chimpanzees; and as Professor Owen's observations were made upon the skeleton of an adult individual, and he has consequently altered the zoological characters given by Geoffroy, we follow Professor Owen's definition.

Sub-Genus *Troglodytes.*

Dental formula the same as in the human subject; namely, incisors, $\frac{4}{4}$; canines, $\frac{2}{2}$; bicuspids, $\frac{4}{4}$; molars, $\frac{6}{6} = 32$.

The teeth approximate in their proportionate size much more nearly than those of the orang to the human teeth; but they manifest in their relative position the absence of the character which, with one anomalous exception—that of the fossil genus *Anoplotherium*—is peculiar, among mammifers, to man; namely, unbroken proximity. Muzzle long, truncated anteriorly; strong supraciliary ridges, behind which the forehead recedes directly backwards; no cranial ridges. Facial angle 35°, excluding the supraciliary ridges. Auricles large. Thirteen pairs of ribs; bones of the sternum in a single row. Arms reaching below the knee-joint. Feet wide; hallux extending to the second joint of the adjoining toe. Canines large, overpassing each other; the apices lodged in intervals of the opposite teeth. Intermaxillary bones anchylosed to the maxillaries during the first or deciduous dentition.

Troglodytes niger (Geoffroy), *Simia Troglodytes* (Blumenbach), the Chimpanzee, Black Orang, or Pigmy. In the young state the animal has been named Jocko.

The following is the description by Dr. Traill of a young female, about 30 inches high, which was brought to Liverpool by Captain Payne:—"The skin appears of a yellowish-white colour, and is thinly covered with long black hair on the front; but it is considerably more hairy behind. The hair on the head is rather thin, and is thickest on the forehead, where it divides about an inch above the orbital process of the frontal bone, and running a little backwards falls down before the ears, forming whiskers on the cheeks. Here the hair measures nearly two inches long; but that on the occiput is not above an inch in length. There are a few stiff black hairs on the eyebrows, and a scanty eyelash. A few whitish hairs are scattered on the lips, especially on the under one. The rest of the face is naked, and has whitish and wrinkled skin. There is scarcely any hair on the neck; but, commencing at the nape, it becomes somewhat bushy on the back. The abdomen is nearly naked. The hair on the back of the head, and the whole trunk, front of the lower extremities, back of the legs, and upper part of the superior extremities is directed downwards, while that on the back of the thigh and fore-arms is pointed upwards—appearances well represented in Tyson's figure. The longest hair is just at the elbows. There is none on the fingers or palms of either extremity. The ears are remarkably prominent, thin, and naked, bearing a considerable resemblance in shape to the human, though broader at the top. The projection of the process above the eyes is very conspicuous, but has not been sufficiently marked in any engraving or drawing which has fallen under my observation. The nose is quite flat, or rather appears only as a wrinkle of the skin with a slight depression along its centre. The nostrils are patulous and open upwards, which would be inconvenient did the animal usually assume the erect posture. The projection of the jaws is excessive, and though much less so than in the baboon, yet the profile of the face is concave. It may be remarked however that the projection of the lower jaw is caricatured in the first and second figures of Camper's second plate. The mouth is wide, the lips rather thin, and destitute of that recurvation of the edges which adds so much to the expression of the human countenance. The spread of the shoulders is distinctly marked, but the width of the lower part of the chest is proportionally greater when compared to the upper than in man. From the lower ribs the diameter of the abdomen decreases rapidly to the loins, where the animal is peculiarly slender—a circumstance in which it approaches the other *Simiæ*. The pelvis appears long and narrow, another approximation to the rest of the genus. With regard to the limbs, the chief difference between our specimen and Dr. Tyson's figure consists in the excessive length of the arms, which in this animal descend below the knees, by the whole length of the phalanges of the fingers, which are above three inches in length. The same observation applies to almost every figure of this animal which I have seen. The proportions in the work of Camper approach nearest, in the present instance, in this particular. The hand differs from the human in having the thumb by far the smallest of the fingers. The foot is more properly a hand appended to a tarsus. The thumb of this extremity is very long, powerful, and capable of great extension. The legs are certainly furnished with calves; but they scarcely resemble the human in form, because they are continued of equal thickness nearly to the heel. When this animal is erect the knees appear considerably bent, as is the case with the other *Simiæ*, and it stands with the limbs more apart than man." This description applies to the various specimens of this creature which have been exhibited in the Gardens of the Zoological Society in Regent's Park, London. At the present time (November 1853) a young male is in the collection. The last specimens were a male and female; the latter died of consumption, and her disconsolate companion soon followed.

Africa is the only part of the world known to be the residence of the Chimpanzee, which it should be remembered has been confirmed, as Cuvier observes, by almost all zoologists. The specimen described by Dr. Traill was procured in the Isle of Princes, in the Gulf of Guinea, from a native trader, who had carried it thither from the banks of the Gaboon. The individual exhibited in the Egyptian Hall, Piccadilly, in 1831, had been obtained by a trading vessel on the river Gambia; and those exhibited at the Gardens of the Zoological Society have all been brought from the coast of Africa. Cuvier gives Guinea and Congo as its localities. The subject of Professor Owen's paper was shot by a European at Sierra Leone.

Habits.—The habits of the Chimpanzee in a state of nature are but imperfectly known. Cuvier states that the Chimpanzees live in troops, construct themselves huts of leaves, arm themselves with sticks and stones, and employ these weapons to drive man and the elephant from their dwellings. He also repeats the story of their pursuit of the negresses and carrying them off into the woods. This report is still credited in the country where they are found. Speaking of Captain Payne, Dr. Traill, in his interesting paper in the 'Wernerian Transactions,' says, "The natives of Gaboon informed him that this species attains the height of five or six feet; that it is a formidable antagonist to the elephant; and that several of them will not scruple to attack the lion and other beasts of prey with clubs and stones. It is dangerous for solitary individuals to travel through the woods haunted by the orang, and instances were related to Captain Payne of negro girls being carried off by this animal, who have sometimes escaped to human society after having been for years detained by their ravishers in a frightful captivity. These reports confirm the narratives of the early voyagers, who have often been suspected of exaggeration; and similar facts have been recently stated, very circumstantially, by gentlemen who have lived in Western Africa." As it is now however well made out that there are two species of Chimpanzee inhabiting the Gaboon, and the larger of the two has not been seen alive in Europe, it is probable the habits of the two animals have been confounded.

In a state of captivity its manners have been the theme of many a tale and much admiration; and as most of the individuals described have died very young, conjecture has been busy as to the progress the animal might make if its education were continued to the adult state. "Deductions," says Professor Owen in his paper above referred to, "in favour of the anthropomorphous character of the orangs have been derived from observation of the living habits of young orangs; but these cannot be regarded as affording a type of the nature of the adults, since it is well known that the docility and gentle manners of the young ape rapidly give way to an unteachable obstinacy and untameable ferocity in the adult; at least of those species to which, as I shall afterwards show, the full-grown orangs have the nearest resemblance in the form of the head."

Chimpanzee (*Troglodytes niger*).

Captain Payne thus describes the manners of the animal which formed the subject of Dr. Traill's paper. "When our animal came on board," says Captain Payne, "it shook hands with some of the sailors, but refused its hand with marks of anger to others without any apparent cause. It speedily however became familiar with the crew, except one boy, to whom it never was reconciled. When the seamen's mess was brought on deck it was a constant attendant; would go round and embrace each person while it uttered loud yells, and then seat itself among them to share the repast." It sometimes expressed its anger by a barking noise like a dog; at others it would cry like a froward child, and scratch itself most vehemently. When any favourite morsel was given to it, sweetmeats more especially, it expressed its satisfaction by a sound like 'hem,' in a grave tone. The variety of its tones seems to have been small. It was active and cheerful in warm latitudes, but languor came on as it left the torrid zone; and on approaching our shores it manifested a desire for warm covering, and would roll itself carefully up in a blanket when it went to rest. It generally progressed on all fours, and Captain Payne particularly observed that it never placed the palms of the hands of its anterior extremities on the ground, but closing its fists rested on the knuckles. This mode of progression noticed by Tyson was confirmed to Dr. Traill by a young naval officer who had been for a considerable time employed in the rivers of Western Africa, and had opportunities of observing the habits of this species. Captain Payne's animal did not seem fond of the erect posture, which it rarely affected, though it could run nimbly on two feet for a short distance. In this case it appeared to aid the motion of its legs by grasping the thighs with its hands. It had great strength in the four fingers of its superior extremity; for it would often swing by them on a rope upwards of an hour without intermission. When first procured it was so thickly covered with hair that the skin of the trunk and limbs was scarcely visible until the long black hair was blown aside. It ate readily every sort of vegetable food; but at first did not appear to relish flesh, though it seemed to have pleasure in sucking the leg-bone of a fowl. At that time it did not relish wine, but afterwards seemed to like it, though it never could endure ardent spirits. It once stole a bottle of wine, which it uncorked with its teeth and began to drink. It showed a predilection for coffee, and was immoderately fond of sweet articles of food. It learned to feed itself with a spoon, to drink out of a glass, and showed a general disposition to imitate the actions of men. It was attracted by bright metals, seemed to take a pride in clothing, and often put a cocked hat on its head. It was dirty in its habits, and never was known to wash itself. It was afraid of fire-arms; and on the whole appeared a timid animal. It lived with Captain Payne seventeen weeks, two of which were spent in Cork and Liverpool. At the former place it was exhibited for the benefit of the soup-kitchen for a few days, but seems to have been there neglected. On coming to Liverpool it languished for a few days, moaned heavily, was oppressed in its breathing, and died with convulsive motions of the limbs.

T. Gorilla, Savage (*T. Savagei*, Owen), the Gorilla, or Great Chimpanzee. In the 'Proceedings of the Zoological Society' for 1848 a description is given by Professor Owen of the skulls of adult and aged male and female Chimpanzees from the Gaboon River, much exceeding in size, and specifically distinct from the previously known *T. niger*. At that time Professor Owen proposed to call the species *T. Savagei*, in honour of Dr. Savage, an American missionary, who had first obtained specimens of this Chimpanzee, and described its character and habits. In a letter to Professor Owen, dated "Protestant Mission House, Gaboon River, West Africa, April, 1847," Dr. Savage, after describing the existence of this Chimpanzee, says, "As yet I have been unable to obtain more than a part of a skeleton. It belongs to the *Simiadæ*, and is closely allied to the orangs proper. It reaches nearly, if not quite, the height of five feet in the adult state, and is of a large size. I am considerably in doubt in regard to its identity with an animal said to have been known to Buffon as a large species of orang-outan under the name of Pongo." After the receipt of Dr. Savage's letter and specimens, Professor Owen received skulls from Mr. Stutchbury, of Bristol, which had been collected by Captain Wagstaff, who shortly after died. "The only information which Mr. Stutchbury was able to obtain from him was, that the natives, when they succeed in killing one of these chimpanzees make a 'fetish' of the cranium. The specimens bore indications of the sacred marks in broad red stripes, crossed by a white stripe, of some pigment which could be washed off. Their superstitious reverence of these hideous remains of their formidable and dreaded enemy adds to the difficulty of obtaining specimens."

The following are the points by which the *T. Gorilla* is distinguished from *T. niger*:—

"1. By its greater size. 2. By the size and form of the superciliary ridges. 3. By the existence of the large occipital and interparietal crests in the males, and by rudiments of the same in females. 4. By the great strength and arched form of the zygomatic arches. 5. By the form of the anterior and posterior nasal orifices. 6. By the structure of the infra-orbital canal. 7. By the existence of an emargination on the posterior part of the hard palate. 8. The incisive alveoli do not project beyond the line of the rest of the face, as in the chimpanzee and orang. 9. The distance between the nasal orifice and the edge of the incisive alveoli is less than in the chimpanzee. 10. The ossa nasi are more narrow and compressed superiorly."

Professor Owen concludes his paper on the anatomy of this creature by the following remarks:—"The analogy which the establishment of the second and more formidable species of chimpanzee in Africa has brought to light between the representation of the genus *Troglodytes* in that continent and that of the genus *Pithecus* in the great islands of the Indian Archipelago, is very close and interesting. As the *T. Gorilla* parallels the *Pithecus Wurmbii* [PITHECUS], so the *T. niger* parallels the *P. morio;* and an unexpected illustration has thus been gained of the soundness of the interpretation of the specific distinction of that smaller and more anthropoid orang. It is not without interest to observe that as the generic forms of the *Quadrumana* approach the Bimanous order, they are represented by fewer species. The Gibbons (*Hylobates*) scarcely number more than half a dozen species; *Pithecus* has but two species, or at most three; *Troglodytes* is represented by two species.

"The unity of the human species I regard as demonstrated by the constancy of those osteological and dental characters, to which my attention has been more particularly directed in the investigation of the corresponding characters in the higher *Quadrumana*, and the importance of the comparison will justify the minuteness with which they have been detailed.

"Man is the sole species of his genus, the sole representative of his order; he has no nearer physical relations with the brute kind than those which mark the primary (unguiculate) division of the placental sub-class of *Mammalia*." ('Tran. Zool. Soc.' vol. iii.)

CHINA-BARK, a name given to the bark of *Buena hexandra*, a plant belonging to the natural order *Cinchonaceæ*. It is used as a febrifuge, but is less powerful than the barks obtained from the species of *Cinchona*. [CINCHONACEÆ.]

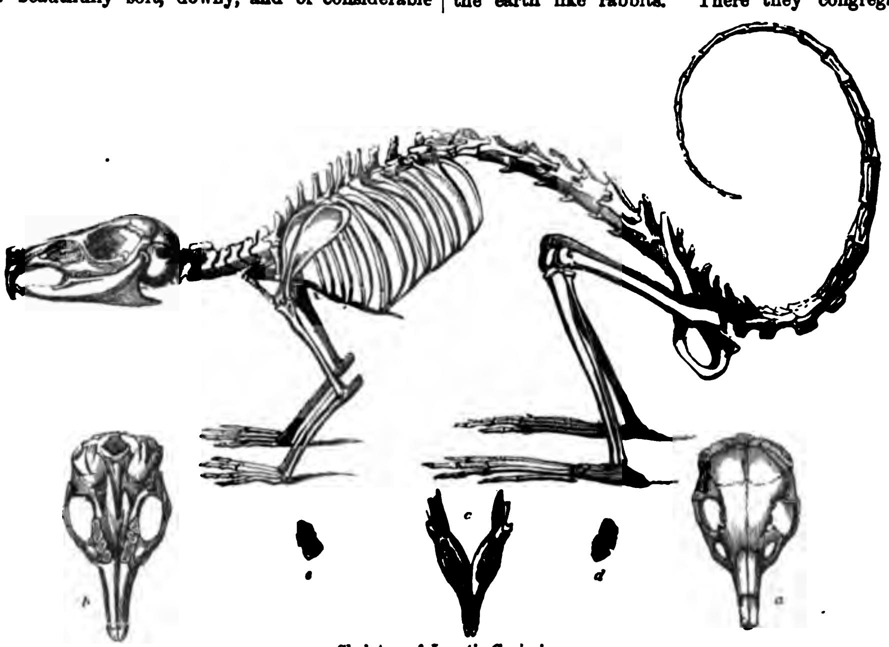
CHINCHI'LLIDÆ, a family of animals belonging to the order *Rodentia*.

This family is defined by Mr. Bennett, to whom we are principally indebted for our knowledge of the species, as follows:—

Upper incisors simple; molars, $\frac{4-4}{4-4}$, consisting of two or three tænial or riband-like bony lamellæ or plates, parallel with each other, entirely surrounded with a vitreous substance; the crowns exactly opposite to each other and flattened by attrition. The posterior limbs nearly twice as long as the anterior. The tail produced, with long and somewhat bristly hairs above and at the tip. The *Chinchillidæ* are gregarious and subterranean in their habits, and mild in disposition. Mr. Waterhouse, in his 'Natural History of Mammalia,' makes the *Chinchillina* a sub-family of the family *Hystricidæ* of the *Rodentia*. It embraces the following genera,—*Lagidium*, *Lagostomus*, and *Chinchilla*.

Lagidium (*Lagotis*, Bennett). Incisors, $\frac{2}{2}$; molars, $\frac{4-4}{4-4} = 20$. The incisors are sharpened, and each molar consists of three complete oblique plates. Skull arched posteriorly and above; the superior cellules of the tympanum inconspicuous. All the feet 4-toed, the great toe being entirely absent; nails long and subfalcular. Ears very long. Tail long. Fur soft, but caducous.

L. Cuvieri, Wagner (*Lagotis Cuvieri*, Bennett). Size and much of the general form of the rabbit. Posterior limbs twice the length of the anterior: tail about equal in length to the body, excluding the head. Whiskers very numerous, closely set, jet black, ten or twelve of the longest on each side being exceedingly thick and rigid, and seven inches long. Ears nearly like a long parallelogram, rounded at the tip, three inches long and one inch broad, with the margins rolled in below, so sparingly furnished with short scattered hairs as to appear almost naked. Fore feet like the hinder, with four toes only, there being no vestige of a thumb; claws small, slightly sharpened, and entirely concealed by long and somewhat bristly hairs; those of the hinder feet similar in shape and rather larger, but that of the inner toe flattened, curved inwards, and exposed, the immediately adjoining hairs giving place to a tuft of about eight rows of short stiff horny curved bristles, approaching nearly in rigidity to the comb-like appendage found in almost the same situation in the *Ctenomys Massonii* of Gray. A similar structure occurs in the *Chinchilla*. The fur is beautifully soft, downy, and of considerable length, but so loosely attached to the skin that it readily falls off, unless handled with care. It is dusky at the base and to within a short distance of the tip, where, for an extent of from one to three lines, it is dirty-white, more or less tinged with yellowish-brown. A few long black hairs, most numerous posteriorly, protrude through it. The general tone of colour is a mottled grayish-ash. On the sides of the neck and body, where the tips of the fur merge more into yellowish-brown than on the back, and where they are also of greater length, as well as on the haunches and beneath, the latter tinge appears rather more predominant. There is little of the dusky colour visible on the under surface. The hairs of the tail below are extremely short, closely depressed, and of a brownish-black; on its sides they are of two kinds, black and white; and this is also the case with the very long rigid and erectile hairs which form a crest along its upper surface. The very long bristly hairs which project in a tuft at the tip are wholly black.



Skeleton of *Lagotis Cuvieri*.

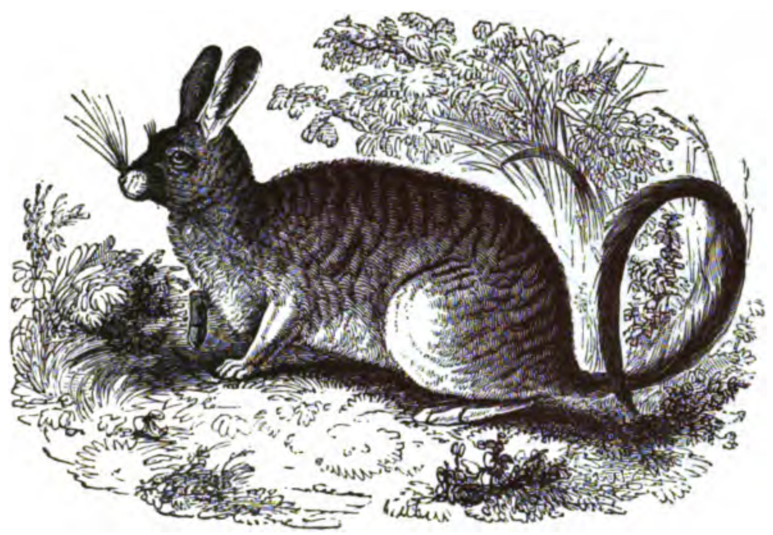
a, Skull seen from above; *b*, the same seen from below; *c*, lower jaw seen from above; *d*, crowns of the two anterior molar teeth of the lower jaw enlarged; *e*, crowns of the two posterior molar teeth of the upper jaw enlarged.

Mr. Bennett believes this species to be the Viscacha of all the writers from Pedro de Cieça downwards, including Acosta, Garcilasso, Peter de Laet, Nieremberg, Feuillée, Ulloa, Vidauré, Molina, Schmidtmeyer, and Stevenson, who have stated that animal to be an inhabitant of the western or Peruvian declivities of the Andes. Messrs. Blainville, Desmarest, and Lesson are among the modern zoologists who have noticed the Viscacha; Lesson, in his 'Manuel,' apparently confounding the eastern and western species, gives it as the *Lepus Viscaccia* of Gmelin, places it among the hares, and quotes Desmarest, as expressing his opinion in his 'Mammalogie,' that it ought to be the type of a new genus under which the *Chinchilla* might be perhaps arranged.

L. pallipes (*Lagotis pallipes*, Bennett). The fur of this species, he observes, is perhaps even softer to the touch than that of *L. Cuvieri*; a feel which is probably owing to its being less dense, on account of the comparative shortness of the hairs composing it; the fur of *L. Cuvieri* imparting to the hand the sensation of fulness and consequent firmness, while that of *L. pallipes* is yielding with its softness. The hairs in both species, especially those which form the mass of the fur, are wavy for the great part of their length, their tips only being straight; those of the middle of the sides measure, when their natural waves are not interfered with, three-quarters of an inch in *L. pallipes*, and an inch and a quarter in *L. Cuvieri*. In neither of these species however is the quality of the fur at all comparable to that of *Chinchilla lanigera*.

The following is the English version (1709) of the passage in Pedro de Cieça's 'Chronica del Peru' (1554), descriptive of the habits of these animals:—"There is another sort of creature they call viscacha, about the bigness of and resembling a hare, but that it has a long tail like a fox. These breed in stony places and among rocks, and many of them are shot with guns and crossbows, and taken by the Indians in gins (with the lasso), they being good to eat after hanging to tender; and of their hair or wool the Indians make large mantles, cloaks, or blankets, as soft as silk, and very valuable." Ulloa's account ('Noticias Americanas,' 1772) is, in the opinion of Mr. Bennett (whose translation we adopt), the best history that has been given of its habits and manners. "Taking the place of the rabbit, which is wanting in Peru, there is another kind of animal called viscacha, which is not found in Quito. In form, and in the colour of its fur, it is similar to the rabbit, but differs from it in having a long tail furnished with tufted hair (like that of the squirrel), which is very thin towards the root, but thick and long as it approaches the tip. It does not carry its tail turned over the head like the squirrel, but stretched out, as it were, in a horizontal direction; its joints are slender and scaly. These animals conceal themselves in holes of the rocks, in which they make their retreats, not forming burrows in the earth like rabbits. There they congregate in considerable numbers, and are mostly seen in a sitting posture, but not eating; they feed on the herbs and shrubs that grow among the rocks, and are very active. Their means of escape do not consist in the velocity of their flight, but in the promptitude with which they run to the shelter of their holes. This they commonly do when wounded; for which reason the mode of killing them is by shooting them in the head; as, if they receive the charge in any other part, although much injured, they do not fail to go and die in the interior of their burrows. They have this peculiarity, that as soon as they die their hair falls off; and on this account, although it is softer and somewhat longer and finer than that of the rabbit, the skin cannot be made use of for common purposes. The flesh is white but not well flavoured, being especially distasteful at certain seasons, when it is altogether repugnant to the palate." Molina speaks of the employment of its wool among the ancient Peruvians, adding that the Chilians of the present day (his work was originally published in 1782, and reprinted with additions in 1810) use it in the manufacture of hats.

Its burrows, according to the report of eye-witnesses, have two flats, communicating by a spiral staircase; in the lower it deposits its food, while it lives in the upper, which it seldom quits except at night. It collects round the mouth of its burrow whatever has been left behind or lost by travellers: and its flesh, which is white and tender, is preferred to that of the rabbit or hare. But this account is liable to the same objections as that in the 'Journal de Physique.' Dr. Tschudi, in his 'Fauna Peruana,' has comfirmed most of these particulars, with regard to the habits of the Viscachas, and also the distinction between the two species above named. *L. Peruanum* of Meyer, and *Callomys aureus* of Geoffroy and D'Orbigny, are probably varieties of *L. Cuvieri*.



Lagotis Cuvieri.

Chinchilla. Incisors, $\frac{2}{2}$; molars, $\frac{4-4}{4-4} = 20$.

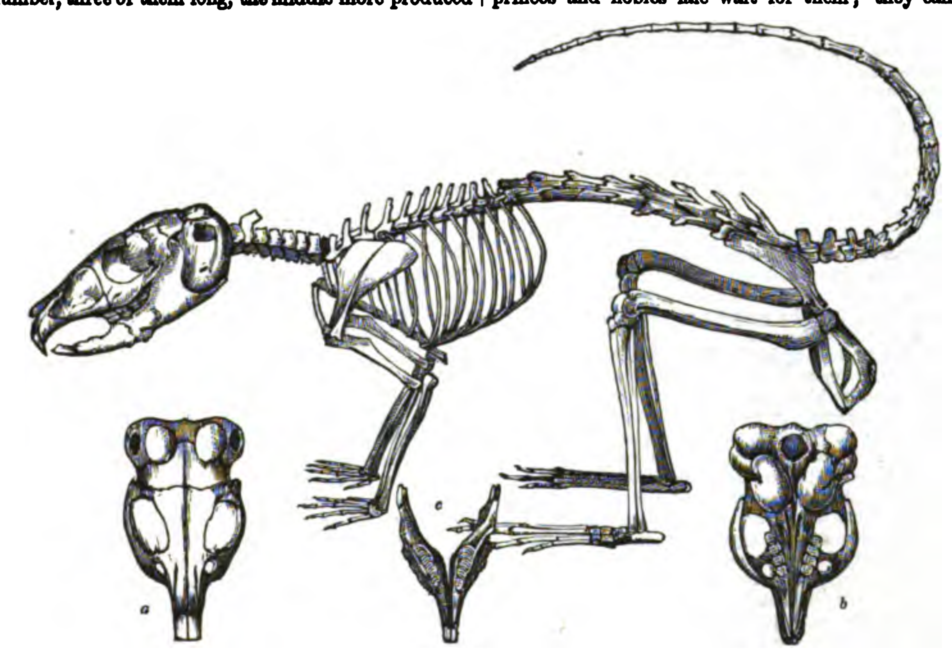
The molars generally consist of three complete oblique plates, except the anterior lower molar, which has but two lamellæ, the anterior lamella being deeply bilobated. Skull posteriorly retuso-truncated, above depressedly flattened; cellules of the tympanum conspicuously inflated. Anterior feet 5-toed, posterior feet 4-toed, the nails small and subfalcular. The ears ample. The tail rather long.

C. lanigera. The length of the body is about nine inches, and that of the tail nearly five. Its proportions are close-set, and its limbs comparatively short, the posterior being considerably longer than the anterior. The fur is long, thick, close, woolly, somewhat crisped, and entangled together, grayish or ash-coloured above, and paler beneath. The form of the head resembles that of the rabbit; the eyes are full, large, and black; and the ears broad, naked, rounded at the tips, and nearly as long as the head. The moustaches are plentiful and very long, the longest being twice the length of the head, some of them black and others white. Four short toes, with a distinct rudiment of a thumb, terminate the anterior feet; and the posterior are furnished with the same number, three of them long, the middle more produced than the two lateral ones, and the fourth, external to the others, very short and placed far behind. On all these toes the claws are short, and nearly hidden by tufts of bristly hairs. The tail is about half the length of the body, of equal thickness throughout, and covered with long bushy hairs; it is usually kept turned upwards towards the back, but not reverted as in the squirrels.

The best account of the anatomy of this animal, from the dissection of one which died in the menagerie of the Society, was given by Mr. Yarrell, in the 'Proceedings of the Zoological Society,' in 1831. In this paper Mr. Yarrell remarks that in some previously published observations, he had stated that the *Chinchilla* appeared to be closely allied to Mr. Brooke's *Lagostomus*, but that the more complicated structure of the teeth, and the existence of an additional toe on each of the feet, require for the *Chinchilla* the generic distinction claimed for it by Mr. Bennett and Dr. J. E. Gray. He adds that the resemblance of the skeleton to that of the *Jerboa* is also remarkable, particularly in the form of the head, in the excessive development of the auditory cavities, and the small size of the anterior extremities compared with the hind legs.

Although an extensive trade has been carried on in the skins of this interesting little animal, it is only within the last few years that it has been seen alive in this country.

The earliest account of this animal, as cited by Mr. Bennett, is an English translation (London, 1604) of Father Joseph Acosta's 'Natural and Moral History of the East and West Indies,' published at Barcelona, in Spanish, in 1591. "The Chinchilles is another kind of small beasts, like squirrels; they have a woonderfull smoothe and soft skinne, which they (the natives) weare as a healthfull thing to comfort the stomacke and those parts that have neede of a moderate heate." Sir John Hawkins, in his 'Voyage into the South Sea, A.D. 1593' (London, small folio, 1622, reprinted in 'Purchas his Pilgrims'), says, "Amongst others they have little beastes, like unto a squirrell, but that he is grey; his skinne is the most delicate, soft, and curious furre that I have seene, and of much estimation (as is reason) in Peru; few of them come into Spaine, because difficult to be come by, for that the princes and nobles laie wait for them; they call this beast Chinchilla, and of them they have great abundance." Alonso de Ovalle, in his 'Historical Relation of the Kingdom of Chili' (Rome, 1646), calls them squirrels. "The squirrels (Ardas) which are found only in the valley of Guasco, are ash-coloured, and their skins are in great

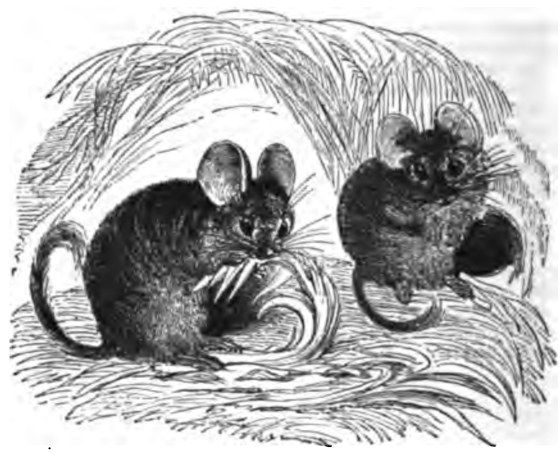


Skeleton of *Chinchilla lanigera.*
a, Skull seen from above; *b*, the same seen from below; *c*, lower jaw seen from above.

esteem for the fineness and softness of the fur." An anonymous Italian author, supposed by some bibliographers—erroneously, as Mr. Bennett thinks—to be the Abbé Vidauré, who published at Bologna, in 1776, a 'Compendium of the Geographical, Natural, and Civil History of the Kingdom of Chili,' speaks of the Arda (Spanish for a squirrel) as a species of rat, or campagnol, of the size of a cat, found only in the province of Copaipo, moderately docile, and covered with ash-coloured wool, as close and delicate as the finest cotton. Buffon, and that too after quoting Feuillée's excellent description, confounded it with the Chinche, the most stinking of beasts. D'Azara corrected this error, but falls into another himself, in regarding the Chinche of Feuillée and Buffon as his Yagouaré. Molina ('Natural History of Chili'—Italian, Bologna, 1782) describes the Chinchilla as a species of Linnæan *Mus*, under the name of *Mus laniger*. Gmelin adopted the appellation, but M. Geoffroy St. Hilaire considered that it ought to be regarded as one of his Hamsters. Zoologists generally took up this opinion, and Molina, in a second edition of his Essay (1810) seems to have entertained it. "The Chinchilla," says Molina, "is another species of field-rat, in great estimation for the extreme fineness of its wool, if a rich fur as delicate as the silken webs of the garden-spiders may be so termed. It is of an ash-gray, and sufficiently long for spinning. The little animal which produces it is six inches long from the nose to the root of the tail, with small pointed ears, a short muzzle, teeth like the house-rat, and a tail of moderate length, clothed with a delicate fur. It lives in burrows underground, in the open country of the northern provinces of Chili, and is very fond of being in company with others of its species. It feeds upon the roots of various bulbous plants which grow abundantly in those parts; and produces twice a year five or six young ones. It is so docile and mild in temper that if taken into the hands it neither bites nor tries to escape, but seems to take a pleasure in being caressed. If placed in the bosom it remains there as still and quiet as if it were in its own nest. This extraordinary placidity may possibly be rather due to its pusillanimity, which renders it extremely timid. As it is in itself peculiarly cleanly, there can be no fear of it soiling the clothes of those who handle it, or of its communicating any bad smell to them, for it is entirely free from that ill odour which characterises the other species of rats. For this reason it might well be kept in the houses with no annoyance, and at a trifling expense, which would be abundantly repaid by the profits on its wool. The ancient Peruvians, who were far more industrious than the modern, made of this wool coverlets for beds and valuable stuffs. There is found in the same northern provinces another little animal with fine wool, called the Hardilla, which is variously described by those who have seen it; but as I have never observed it myself, I cannot determine to what genus it belongs." Upon this, Mr. Bennett, whose translation we have given, remarks that there can be little doubt that this animal is identical with the Chinchilla, the latter being frequently spoken of by the name of Arda, the same with Harda, the diminutive of which is Hardilla. Schmidtmeyer ('Travels into Chile over the Andes,' London, 4to, 1824), thus describes the animal:—"The Chinchilla is a woolly field-mouse, which lives underground, and chiefly feeds on wild onions. Its fine fur is well known in Europe; that which comes from Upper Peru is rougher and larger than the Chinchilla of Chile, but not always so beautiful in its colour. Great numbers of these animals are caught in the neighbourhood of Coquimbo and Copiapo, generally by boys with dogs, and sold to traders who bring them to Santiago and Valparaiso, from whence they are exported. The Peruvian skins are either brought to Buenos Ayres from the eastern parts of the Andes, or sent to Lima. The extensive use of this fur has lately occasioned a very considerable destruction of the animals."

Captain Beechey, R.N., on his return from his expedition to the north-west coast of America, presented a living specimen to the Zoological Society; and an entire skin, rendered particularly valuable in consequence of its having the skull preserved in it, was at the same time brought home by Mr. Collie, the surgeon of Captain Beechey's ship, and deposited in the British Museum.

"To the account of its habits given by Molina," says Mr. Bennett, "we can only add, that it usually sits upon its haunches, and is even able to raise itself up and stand upon its hinder feet. It feeds in a sitting posture, grasping its food and conveying it to its mouth by means of its fore paws. In its temper it is generally mild and tractable, but it will not always suffer itself to be handled without resistance, and sometimes bites the hand which attempts to fondle it when not in a humour to be played with. Although a native of the alpine valleys of Chili, and consequently subjected in its own country to the effects of a low temperature of the atmosphere, against which its thick coat affords an admirable protection, it was thought necessary to keep it during the winter in a moderately warm room, and a piece of flannel was even introduced into its sleeping-apartment for its greater comfort. But this indulgence was most pertinaciously rejected, and as often as the flannel was replaced, so often was it dragged by the little animal into the outer compartment of its cage, where it amused itself with pulling it about, rolling it up, and shaking it with its feet and teeth. In other respects it exhibits but little playfulness, and gives few signs of activity; seldom disturbing its usual quietude by any sudden or extraordinary gambols, but occasionally displaying strong symptoms of alarm when startled by any unusual occurrence. A second individual of this interesting species has lately been added to the collection by the kindness of Lady Knighton, in whose possession it had remained twelve months previously to her presenting it to the Society. This specimen is larger in size and rougher in its fur than the one above described; its colour is also less uniformly gray, deriving a somewhat mottled appearance from the numerous small blackish spots which are scattered over the back and sides. It is possible that this may be the Peruvian variety, mentioned in the extract from Schmidtmeyer's 'Travels,' as furnishing a less delicate and valuable fur than the Chilian animal. It is equally good-tempered and mild in its disposition, and, probably in consequence of having been exhibited in a public collection, is much more tame and playful. In its late abode it was frequently suffered to run about the room, when it would show off its agility by leaping to the height of the table. Its food consisted principally of dry herbage, such as hay and clover, on which it appears to have thriven greatly: that of the Society's original specimen has hitherto been chiefly grain of various kinds and succulent roots. When the new-comer was first introduced into Bruton Street, it was placed in the same cage with the other specimen; but the latter appeared by no means disposed to submit to the presence of the intruder; a ferocious kind of scuffling fight immediately ensued between them, and the latter would unquestionably have fallen a victim had it not been rescued from its impending fate: since that time they have inhabited separate cages, placed side by side; and although the open wires would admit of some little familiarity taking place between them, no advances have as yet been made on either side. Such an isolated fact can, of course, have little weight in opposition to the testimony of Molina, that the Chinchilla is fond of company. It is nevertheless a remarkable circumstance, and deserves to be mentioned in illustration of the habits of these animals." It breeds freely in confinement, the oldest pair at present in the Zoological Gardens, Regent's Park, having produced seven young ones.



Chinchilla lanigera.

The fur of this species is a considerable article of commerce. In muffs, tippets, linings to cloaks and pelisses, and trimmings for the same, it is sold extensively, and at a comparatively high price. The annual import of the skins of Chinchillas into England in 1851 was 85,000: about 18,000 of these were re-exported.

C. brevicaudata, Waterhouse (*Eriomys Chinchilla*, Lichtenstein and Wagner). Mr. Waterhouse, in his 'Natural History of the Mammalia,' says, "I feel little doubt that further investigation will prove this to be a distinct species from the *C. lanigera*." This species inhabits Peru, and is larger than the last.

Lagostomus. Incisors, $\frac{2}{2}$; molars, $\frac{4-4}{4-4} = 20$.

The incisors are sharpened; the molars each consists of two complete oblique lamellæ, the upper posterior one being trilamellar. Anterior feet 4-toed, the thumb being altogether deficient, the nails small and falcular. Posterior feet 3-toed, the nails produced, straight, and robust. Ears moderate. Tail moderate.

L. trichodactylus, Brookes (*Callomys Viscacia*, Is. Geoffroy and D'Orbigny; *Dipus maximus*, De Blainville). It is La Viscache of D'Azara, and the Marmot Diana of Griffiths, translator of Cuvier's 'Animal Kingdom.' The following are the characters as given in Mr. Waterhouse's work:—Body stout; limbs powerful; tarsi long; ear nearly half as long as the head, broad at the base, narrow at the opposite extremity, being distinctly emarginated behind; fur soft and moderately long. General line of the upper parts of the animal gray, somewhat mottled with dusky, and distinctly pencilled with black; the whole of the under parts white or yellow-white; a broad dusky or black band extends on either side, from the muzzle to the back part of the cheek; an equally broad white band crosses the muzzle and terminates on each side beneath the eye, and a third narrow band passes across the forehead which is of a dusky hue; tail about half the length of the body, for the most part of a dusky brown-blackish colour, and clothed with long hairs on the upper surface.

Skeleton of Marmot Diana (*Lagostomus trichodactylus*).

a, Upper jaw; *b*, lower jaw; *c*, crown of the second molar tooth of the left side of the lower jaw; *d*, crown of the last molar tooth of the right side of the upper jaw.

This animal appears to be the Viscacha described by so many travellers as colonising the vast plains eastward of the great chain of the Andes. Dobrizhoffer, Jolis, D'Azara, Proctor, Head, Miers, and Haigh, all mention it. Captain (now Sir Francis) Head gives a picture of these animals, sitting solemnly at the entrance of their burrows, quite in his peculiar style. Biscacho is the name he assigns to them, and according to his account, the Biscachueras, or Biscacho burrows, which perforate the plains, are terrible traps for the unwary horsemen.

The following extracts are from the accounts of two foreign travellers (whose works are not in the hands of every one) of the habits of this species :—" The Biscacha, called by the Abipones Neheláterek," says Dobrizhoffer in his curious 'Historia de Abiponibus' (Viennæ, 1784), " digs its burrows in the more elevated parts of the plains with so much art, that no aperture is left by which the rain can penetrate; and these burrows are divided into distinct settlements, numerous families inhabiting the same locality. On the surface of the ground are several entrances to the burrows, at which, towards sunset, they are seen seated in crowds, diligently listening for the sound of any person approaching. If everything remains quiet, they seek their food in the obscurity of the night, and commit grievous devastation on the neighbouring fields, devouring both wheat and Indian corn with extreme avidity, and when either is to be had despising grass. For this reason the stations of the Biscachas are rarely to be seen in the desert plains, but indicate with certainty the near neighbourhood of the Spanish settlements. I have often wondered never to have seen the Biscacha in the territories either of the Abipones or the Guaranis, although well supplied with all kinds of crops. They daily heap up, at the entrances of their burrow, dry bones, chips of wood, or whatever other refuse they may meet with, but for what purpose they collect such things it is impossible even to conjecture. The Spanish colonists amuse themselves with hunting them; pouring many buckets of water into their subterraneous retreats, until, to avoid drowning, the animals come forth into the plain, where, no means of escape being afforded them, they are killed with sticks. Their flesh, unless when very old, is not considered despicable even by the Spaniards."

The Abbé Jolis dwelt for twelve years in South America, and made three journeys into the remote districts of the interior. His work, 'Saggio sulla Storia Naturale della Provincia del Granchaco' (Faenza, 1789), is so little known, and his description in some particulars differs so much from that of Dobrizhoffer, that we give Mr. Bennett's translation of it :—" The Biscachas live in society in burrows underground, which they form for themselves, excavating in all directions to the extent of a mile in circumference, with various exits and separate retreats, in which the old live distinct from the younger. The soil in which these are usually made is that which is hard and barren, and destitute of everything, but with bushes (boscaglie) at no great distance, and pasture of tender grass, roots, and the bark of trees. They collect around their retreats bones, dried leaves, and whatever they find in the neighbourhood: if anything is missing in their districts, it is to be found with certainty piled up in these situations the following day. As they are animals that avoid the light, having little power of vision, they are not to be seen in the day-time, unless at dawn, or towards evening after sunset. The night, and especially when the moon shines, is the proper time for seeking their food. Those among the Biscachas which are called Chinchillas, and which may be said to belong to the first species, inhabit only the mountains and cold situations; in size they are like a rabbit, and are clothed with a fine long fur. Their agility is surprising; they are seen leaping from rock to rock as if they had the faculty of flight. The others, indicated above, inhabit the level country in warm situations. . . . Fierce and courageous, they defend themselves with all their might against the dogs, and sometimes even attack the legs of the hunters. I shall speak in my travels, as a fitter place, of the three curious modes in which they are driven out of their retreats; that is to say, with water, with fire, and by rubbing sticks together."

But neither of those authors mentions the somewhat anomalous companions with which the Biscachoes are associated, and we select from the travels of Proctor, Head, Miers, and Haigh, the account of the first-named traveller, which, as Mr. Bennett observes, gives nearly all the particulars which are to be found in the rest. " The whole country, from Buenos Ayres to San Luis de la Punta, is more or less burrowed by an animal between a rabbit and a badger, called the Biscacho, which renders travelling dangerous, particularly by night, their holes being so large and deep that a horse is almost sure to fall if he steps into one of them. The Biscacho never ventures far from its retreat, and is seldom seen till the evening, when it comes out to feed, and hundreds may be observed sporting round their holes and making a noise very similar to the grunting of pigs. Their flesh is much liked by the people, and they are remarkably fat, and on that account, when caught at any distance from their holes, are easily run down; they will however defend themselves from a dog a considerable time. The holes of these animals are also inhabited by vast numbers of small owls, which sit during the day gazing at the passing travellers, and making a very ludicrous appearance. The parts of the road most frequented by the Biscacho are generally overrun by a species of small wild melon, bitter to the taste; whether it thrives particularly on the manure of the animal, or whether the Biscacho chooses his hole nearer this running plant, does not seem to have been ascertained."

The following account of the habits of this creature, from Mr. Darwin's interesting journal, is one of the most recent contributions published on this subject :—" The Viscacha is well known to form a prominent feature in the zoology of the Pampas. It is found as far south as the Rio Negro, in lat. 41°, but not beyond. It cannot, like the Agouti (*Dolachotis Patachonica*), subsist on the gravelly and desert plains of Patagonia, but prefers a clayey or sandy soil, which produces a different and more abundant vegetation. Near Mendoza, at the foot of the Cordillera, it occurs in close neighbourhood with the allied alpine species. It is a very curious circumstance in its geographical distribution that it has never been seen, fortunately for the inhabitants, in Banda Oriental, to the eastward of the river Uruguay; yet in that province there are plains which appear admirably adapted to its habits. That river has formed an insuperable obstacle to its migration, although the broader barrier of the Parana has been passed; and the Viscacha is common in Entre Rios (the province between the two rivers), directly on the opposite shore of the Uruguay. Near Buenos Ayres these animals are exceedingly common. Their most favourite resort appears to be those parts of the plain which, during one-half of the year, are covered with great thistles to the exclusion of other plants. The Guachos affirm that it lives on roots, which, from the great strength of its gnawing teeth and the kind of localities frequented by it, seems probable. As in the case of the rabbit, a few holes are commonly placed together. In the evening the Viscachas come out in numbers, and there quietly sit on their haunches. They are at such times very tame, and a man on horseback passing by seems only to present an object for their grave contemplation. They do not wander far from their burrows. They run very awkwardly, and when hurrying out of danger, from their elevated tails and short front legs, much resemble great rats. Their flesh when cooked is very white and good, but it is seldom used. The Viscacha has one very singular habit, namely, dragging every hard object to the mouth of its burrow. Around each group of holes many bones of cattle, stones, thistle-stalks, hard clumps of earth, dry dung, &c., are collected into a heap, which frequently amounts to as much as a wheelbarrow would contain. I was credibly informed that a gentleman, when riding in a dark night, dropped his watch; he returned in the morning, and by searching in the neighbourhood of every Viscacha hole on the line of road, as he expected, soon found it. This habit of picking up whatever may be lying on the ground anywhere near its habitation must cost much trouble.

For what purpose it is done I am quite unable to form even the most remote conjecture; it cannot be for defence, because the rubbish is chiefly placed above the mouth of the burrow, which enters the ground at a very small inclination."

CHIOCOCCA (from χιὼν and κόκκος), a genus of plants belonging to the natural order *Cinchonaceæ*. Calyx with an oval tube and an acutely 5-toothed permanent limb. Corolla funnel-shaped, with an obconical tube or throat, and five acute lobes. Stamens with the filaments hardly adnate to the bottom of the corolla, downy, and shorter than the anthers, which are inclosed and linear. Style rather clavate at the apex, entire or slightly 2-lobed. Berry somewhat didymous, compressed, crowned by the teeth of the calyx, containing two chartaceous 1-seeded pyrenæ. Seeds pendulous. Embryo with a long superior radicle. Albumen cartilaginous. Shrubs generally with a somewhat climbing habit. Leaves opposite, ovate or oblong acute, glabrous. Stipules broad at the base, permanent, more or less apiculated. Racemes axillary, opposite, simple or panicled. Flowers pedicellate, of a yellowish-white colour. Roots emetic and alexiteric.

C. racemosa, Racemose Snow-Berry, has oval leaves acuminated at both ends, smooth; stipules broad at the base, and apiculated by a long point at the apex; filaments of stamens downy. It is a native of the West Indian Islands and Carthagena, on hills. It is a very variable shrub. The corollas at first are white and scentless, but at length become yellowish and sweet-scented. The berries are snow-white, hence the English name. The root has an acid bitter taste, and has long been used as a strong resolutive or attenuant; it is administered in obstinate rheumatisms, and is also an excellent emetic. This is a plant commonly cultivated in gardens, and there are several varieties of it.

C. densiflora, Dense-Flowered Snow-Berry, has ovate rather coriaceous leaves, many-flowered racemes, the corolla much longer than the calyx, the filaments densely-bearded. It is a native of Brazil, in woods at Almeida and Serradas, on the mountains of Bahia, and at the port of St. Catherine.

C. anguifuga, Anguifuge Snow-Berry, has ovate acuminated leaves; stipules very broad, short, each ending in a short point; racemes panicled; corolla not quite three times longer than the calycine teeth. It is a native of Brazil in woods, French Guyana, Trinidad, Peru, Cuba, and on the Spanish Main. Both this and the former species are used in Brazil as a certain remedy for serpent bites. An infusion of the bark produces the most violent purgative and emetic effects.

C. odorata, Sweet-Scented Snow-Berry, has broad oval leaves, rather coriaceous, very blunt, acute at the base, and running down the short petioles; peduncles axillary, solitary; 3-4-flowered corolla, with a bearded throat. It is a native of Elizabeth Island, one of the Society Islands. The flowers are described as smelling like cowslips.

C. barbata, Bearded Flowered Snow-Berry, has oval leaves, acute at the base, and tapering into short petioles, acuminated and obtuse at the apex; peduncles axillary, solitary; 1-3-flowered; corolla with a bearded throat; 5-cleft. It is a native of the Society and Friendly Islands.

C. Javana, Java Snow-Berry, is a parasitical shrub, with oblong lanceolate leaves, acuminated at both ends, glabrous, velvety, and shining above; corymbs terminal, trichotomous. This is a native of Java, on the mountains, upon trees.

All the species of *Chiococca* grow best in a mixture of loam, peat, and sand, and strike freely in sand under a hand-glass.

CHIOLITE, a Mineral found in Siberia. It has a hardness=3·5, and a specific gravity=2·6 to 2·77. It is near *Cryolite* in composition and characters, and appears to be a fluoride of aluminum and sodium.

CHIO'NEA (Dalman), a genus of Dipterous Insects belonging to the section *Tipulariæ terricolæ*.

One species of this genus is remarkable both in its structure and habits. It is less than half an inch in length; the head is of a brownish-yellow colour; the thorax and abdomen are ashy-brown; the latter is of an oval form and rather hairy; the legs are very long, rather thick and covered with hairs, not unlike the legs of a spider, and of a yellowish colour. It is perfectly destitute of wings, and is found upon the snow in the woods of Sweden throughout the winter. The generic characters are:—Body apterous; joints of the palpi nearly equal; antennæ setaceous, 10-jointed, and covered with fine hairs at the extremity; the abdomen of the male terminated by a forceps-like appendage composed of two horizontal jointed processes, and that of the female is terminated by a boring instrument, or ovipositor, consisting of two valvules, placed one upon the other, of which the upper one is the longer, and composed of two plates.

There is another insect which, though it belongs to a different order (*Neuroptera*), resembles this species in its habits of appearing during the winter, and crawling upon the snow, as well as in being apterous, a character which is of rare occurrence in either tribe. [BOREUS.]

Two other species of *Chionea* are given in the 'British Museum Catalogue,' both of them inhabitants of North America.

CHIROCEPHALUS, a genus of Entomostracous *Crustacea* belonging to the division *Branchiopoda*, the order *Phyllopoda*, and the family *Branchipodidæ*. In this family two British genera are included—*Artemia* [BRANCHIOPODA] and *Chirocephalus*. *Artemia* is distinguished from the latter by having the caudal segment of the body simply bilobed, and not divided into plates, and has no appendages at the base of the cephalic horns, which are characteristic of *Chirocephalus*. The following are the characters of *Chirocephalus*:—Abdomen large, consisting of nine divisions, and terminated by two well-developed caudal plates or lamellar appendages; cephalic horns of a cylindrical shape, and furnished with fan-shaped and digitiform appendages in the male.

C. diaphanus is the only species. It was apparently first noticed by Linnæus, and called by him *Cancer stagnalis*.

The following synonyms from Dr. Baird's 'History of the British Entomostracous Crustacea,' will give some idea of the history of this curious animal, as of the interest it has created:—

Chirocephalus diaphanus, Prevost, 'Journ. de Phys.' 1803; Jurine, 'Hist. Monoc.'

Branchipus Prevostii, Fischer, 'Bull. Soc. Imp. Nat.' Moscow, 1834.

Chirocephalus Prevostii, Thompson, 'Zool. Researches,' 1834.

Branchipus Chirocephalus, Guerin, 'Icon. Reg. An. Crust.'

Branchipus diaphanus, Milne-Edwards, 'Hist. Crustacées.'

Branchipus paludosus, Desmarest, 'Consid. gen. Crust.'; Lamarck, 'Hist. An. s. Vert.,' 2nd ed.

Cancer stagnalis (Linn. ?), 'Linn. Trans.,' vol. i.

Cancer paludosus (?), Müller, 'Zool. Dan. Herbst. Krabben.'

Branchipus stagnalis, Milne-Edwards, Cuv. 'Règne Animal,' edit. Crochart.

Ino piscina, Schrank, 'Faun. Boic.,' 1803.

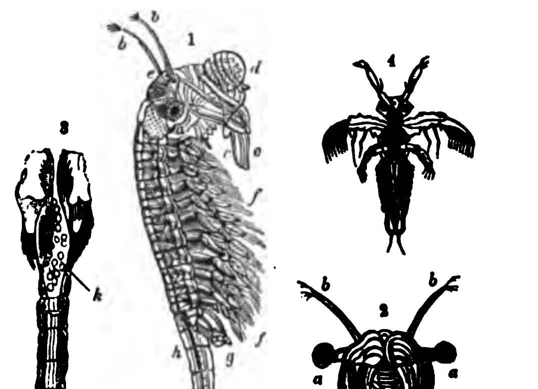
Marteau d'Eau douce, Duchesne, 'Man. du Naturaliste.'

Remarkable Aquatic Insect, King, 'Phil. Trans.,' 1762.

Squilla lacustris minima, Petiver, 'Gazoph. Nat.,' 1709.

The following is Dr. Baird's description of the species:—

"When full grown it is upwards of an inch in length, slender, of a cylindrical form, and nearly perfectly transparent. The male is more so than the female, but with a slight reddish tinge throughout. The tail is of a bright-red; the large basal joint of the prehensile antennæ of a beautiful transparent bluish-green colour, tipped at the extremity, where the second joint arises, with a fine red hue. The back of the female is of a blue colour; and the ovary, when full of ova, of a reddish-brown."



Chirocephalus diaphanus.

1, Male, magnified; *a a*, composite or network eyes; *b b*, antennæ; *c c*, mandibuliform horns; *d*, proboscidiform moveable tentacula, rolled spirally; *e*, simple rudimentary eye; *f f*, leaf-like natatory feet or oars; *g*, male organs; *h h*, tail; *i*, terminating filaments; 2, front view of the head; 3, tail of the female; *k*, egg-pouch; *l*, female organ; 4, a young *Chirocephalus* after the first moult.

This beautiful little creature is not often met with, and when found is always an inhabitant of dirty, stagnant water. The places in which it is found have also another peculiarity—that of being dried up for the greater part of the year. Thus, the most common places for it are ditches by road-sides, and cart-wheel ruts. Several localities have been given for it in England; the most common is that of Blackheath, where in a few of the pools by the roadside, which are mostly dried up during the greater part of the year, it is very abundant after rain. It has also been found near Epping, near Brighton, near Bristol, near Hammersmith, and in Devonshire. In the description given of them by King in the 'Philosophical Transactions' for 1767, they were found in a ditch of standing water near Norwich. "They were discovered," says Mr. King, "by a poor man, now dead, whose genius was very extraordinary, and much superior to what is usually found in his rank. He was indefatigable in his searches after everything curious, and, without ever having had any advantages of education, had acquired a degree of knowledge by no means contemptible."

Schœffer discovered them in a pool of water near Ratisbon. Prevost found his specimens at Montaubon, and at Jurine's request sent some ova in moist paper to Geneva, where Jurine succeeded in hatching them and making those observations which are published in his 'Monocles qui se trouvent à Geneve.' Dr. Baird says, "It is rarely to be met with in this country, compared with the *Daphniæ* and many other *Entomostraca;* the only place near London where I have met with it being on Blackheath. They swim upon their backs, and in fine warm weather, when the sun is not too strong, they may be seen balancing themselves, as it were, near the surface by means of their branchial feet, which are in constant motion. On the least disturbance, however, they strike the water rapidly with their tail from right to left, and dart away like a fish, and hasten to conceal themselves by diving into the soft mud or amongst the weeds at the bottom of the pool. They are nearly transparent, and are of a very light reddish colour, with a slight tinge of blue on some parts. 'When placed in a glass of clear water,' says Prevost, 'the elegance of its form, the ease and softness of its movements, its silvery transparency, or its brilliant colours, its large black eyes, the small spot which it carries on its head, the crown of the male—are a beautiful sight which the most indifferent observer cannot see without pleasure.'

"It is certainly the most beautiful and elegant of all the *Entomostraca.* The male is especially beautiful. The uninterrupted undulatory wavy motion of its graceful branchial feet, slightly tinged as they are with a light reddish hue, the brilliant mixture of transparent bluish-green and bright-red of its prehensile antennæ, and its bright-red tail, with the beautifully plumose setæ springing from it, render it really exceedingly attractive to the view.

"The undulatory motion of its branchial feet serves another purpose in addition to that of keeping the animal suspended in the water. The thorax or body of the animal has been described, when floating on its back, as like the cavity of a little boat, the feet representing oars. When these are in motion, they cause the water contained in this boat-like cavity to be compressed, and to mount up as along a canal, carrying in the current the particles destined for its food towards the mouth. It seems to be constantly, when in this position, employed in swallowing and digesting its food, its masticatory organs being in perpetual motion. Shaw imagined this little creature to be a fierce and voracious beast of prey, but it is not so; he was misled in so thinking by not understanding the true nature of its prehensile antennæ. These he imagined were organs for seizing its victims and crushing them to death, though he candidly admits that he never saw them attack other animals, and even says that he has seen them succumb to the assaults of the *Cypris.* According to Prevost, they live upon dead animal or vegetable matter, but they have apparently little taste, for they swallow every sort of thing that comes in their way, however hurtful it may be. Schœffer says that he found great difficulty in keeping the *Branchipus* alive after having been taken out of the water in which they were found, and also says that they are incapable of bearing any degree of cold. Jurine, however, found no difficulty in hatching the ova of the *Chirocephalus* sent to him by Prevost, and keeping the animals so hatched till they reached maturity; and Shaw distinctly asserts that he has found them in this country, in shallow pools, in the months of December and January, even after pretty sharp frosts, as lively almost as in spring or summer. I have always found them in the months of October, November, and December, and even after frosts of short continuance though of considerable severity. In general they have been very short-lived after being removed from their native habitat, but I have been able to hatch the young and watch their progress to maturity. Though they do not appear destructive to other animals, they fall an easy prey themselves to various enemies. Frogs, salamanders, the larvæ of the *Dytisci,* the *Cyprides,* and other such inhabitants of the water, kill them in vast numbers; and they seem besides, according to Prevost, to be specially infested by a species of *Vorticella,* or wheel-animalcule, which attaches itself to the body of the animal in great numbers, and would very soon, were it not for their moulting frequently, completely destroy it. I have found them very liable to a peculiar disease which seems very frequently to terminate fatally. It attacks their body near the external ovary, the lower part of the abdomen, &c., and the branchial feet are not exempt from it. It consists of a white growth, composed of a fatty sort of substance, and when once this appears, the poor animal almost always soon after dies."

After impregnation "the ova appears at first as small white spherical bodies lying in the internal ovary, which stretches along the abdomen, and then passing from it into the external ovary already described. When the proper time arrives the mother deposits these ova loose in the water, the ovary opening at the point, and the eggs being thrown out by a sudden jerk to the number of 10 or 12 very rapidly. The whole process of laying lasts several hours, sometimes, according to Prevost for a whole day, and the number of ova excluded vary from 1 to 400. At first the egg is yellowish spherical, beset all round with short setæ, but when it has been for a short time exposed to the action of the air and the water, it assumes an irregular hexagonal figure and a greenish hue. In about a fortnight or so the egg is hatched and the young one issues forth, but very unlike its parent. It consists of two nearly equal oval portions, head and body."

According to the recent observations of Dr. Zenker ('Physiological Remarks on the Daphnidæ,' translated in vol i. of 'Microscopical Journal') and others, it appears that the female *Daphnidæ* have the power of producing eggs which are fertile without access to the male. This is what occurs in some of the *Aphides* for a given number of generations. In the *Daphnidæ* it appears to be without limit. This reproduction from unimpregnated ova is quite analogous to the process of gemmation amongst the lower animals. The great difference is that it takes place from the ovary and not from some more general tissue of the body. In the *Daphnidæ,* however, ova are produced after impregnation, which differ from the other in being enveloped in a fine corneous saddle-shaped shell which is called an 'ephippium,' and such ova, as they are now known to occur in other animals, are called 'ephippian ova.' Mr. Huxley however, who has described them in *Lacinularia socialis,* a species of *Rotifera,* says they "probably do not require fecundation, and are thence to be considered as a mode of asexual reproduction."

In reference to this curious subject, Mr. Busk has added the following note to Zenker's remarks on *Daphnidæ,* in the first volume of the 'Microscopical Journal':—

"The number of males is very considerable, and pretty nearly equal to that of the females at all times of the year. This fact seems to afford a curious confirmation to Dr. Zenker's opinion, that the chief object of male impregnation is the production of ephippian, or winter ova. In the case of *Chirocephalus* this provision becomes repeatedly necessary during the year, and not towards winter only; for it is a remarkable fact, on Blackheath at all events, that the *Chirocephalus* is never found in any of the several ponds on the heath, except in those which dry up completely, at least once, but in some years several times, or for the whole summer continuously. The ponds inhabited by the *Chirocephalus,* in fact, are merely pools formed by the drainage from the roads. Now, it is manifest under these circumstances that were not provision made by the formation of winter ova, or ova having a thick double coat, for the revival of the race after the drying up of their habitation, it would become extinct. We accordingly find that such provision is made in the numerous males at all times present.

"The extraordinary power possessed by the ova of the *Chirocephalus* of resistance to the effects of desiccation is very remarkable, as is also the readiness and rapidity with which they are developed when again subjected to the influence of water. If the basin of a small pool which has been dry and even dusty for months becomes filled after a few days' rain, the water will be found swarming with myriads of *Chirocephali* in about ten days or a fortnight; or if a piece of the dried bottom of such a pool be placed in a pailful of water, numerous *Chirocephali* will be hatched from it in the same time. The reason for this curious arrangement with respect to the *Chirocephali* is obvious enough. These delicate creatures, themselves vegetable feeders, are the prey of innumerable enemies; among the chief of which are the larvæ of *Dytiscus,* and of Dragon-Flies, &c. In ponds which never dry up, these voracious enemies have time and opportunity to destroy the whole race of *Chirocephali;* but in the favourite haunts of the latter, their enemies not being able to survive the drying up of the water, are cleared off on each such occasion, and the *Chirocephali* being rapidly hatched, have, as a race, time to propagate and deposit their posterity in safety for another resurrection."

Another point of interest with regard to *Chirocephalus* is, that it affords an instance of the nearest living type, to the extinct family of *Trilobites.* [TRILOBITES.] Professor Burmeister, at the conclusion of his laborious investigation into the structure and affinities of this family, in his work on the 'Organisation of Trilobites' (translated into English and published by the Ray Society), says, "The *Trilobites* were a peculiar family of *Crustacea,* nearly allied to the existing *Phyllopoda,* approaching this latter family most nearly in its genus *Branchipus* (*Chirocephalus*), and forming a link connecting the *Phyllopoda* with the *Pœcilopoda.*"

CHIRO'NOMUS, a genus of Dipterous Insects of the family *Tipulidæ.* This genus was established by Meigen, and is principally distinguished by the following characters:—Fourth joint of the palpus longer than the rest; antennæ 13-jointed, in the male, and furnished with long hairs; the antennæ of the female are 6-jointed, and the hairs are short; the anterior legs are inserted at some distance from the others, and the anterior tarsi are generally very long; the wings when closed lie parallel, and they have three posterior cells; the body is long, slender, and hairy.

Mr. Stephens, in his 'Catalogue of British Insects,' enumerates upwards of eighty species of this genus: they are all of small size, frequent marshy situations, and very much resemble gnats. The worm known to anglers by the name of Blood-Worm is the larva of one of the species of this genus—the *Chironomus plumosus.* This worm is about half an inch in length; the body consists of numerous segments, and is furnished at the tail with several appendages which constitute the breathing apparatus. It is seen during the summer months on the mud near the edges of ponds and ditches; when thus seen however it is only shifting from one place to another, its natural locality being in the mud, where it may generally be found in great numbers, living for the most part under water. This larva is much sought after and devoured by birds and fishes; but during the summer of 1836 we discovered that it had a very formidable enemy in an insect of its own order. A fly, which closely resembled the house-fly, was observed in great abundance on the mud which had just been left by the retiring water, and we found them assembled in little groups of five or six, in the act of extracting the blood-worms from their holes, using the proboscis for this purpose: but no sooner was the worm fairly dislodged than a battle ensued, for each apparently wished to have the worm to itself; those that kept possession sucked out the fluids from the worm.

The pupa is of a brownish colour; the body is cylindrical, the head, thorax, wings, and legs are inclosed in separate sheaths, and, with the exception of the two fore legs, lie in a close and compact mass; the fore legs, covered by their sheaths, project from each side of the thorax. In this as well as in the larva state, the animal lives in the water. The breathing apparatus consists of two appendages, one on each side of the thorax, and each is composed of five branches which spring from a common centre.

When the insect is ready to quit its pupa case, it gains the surface of the water, and there remains suspended for some little time with the disc of the thorax slightly protruded; this part bursts down the middle, and the insect, which is hairy, and hence does not easily wet, places its feet upon the surface of the water, where it floats (if the weather be calm) with the greatest safety. We observed, upon taking one upon our finger, that the wings are at first opaque and white, and filled with a fluid; but in a minute this fluid was expelled, and the sides of the wings collapsed and became transparent. The fluid thus ejected we perceived on our finger beneath the insect, but could not ascertain from what part of the wing or body it made its escape.

Discussions have arisen on the means which this animal possesses of suspending itself at the surface of the water without motion, its specific gravity being supposed to be greater than water.

Messrs. Kirby and Spence account for it by a kind of propelling power which the centre of the thorax possesses, and state that this part being thus protruded and drying, the attraction of the air to the dry portion of the thorax is sufficient to overcome the slight difference in the specific gravity between the animal and the element; but it is further stated that if a drop of water fall upon the insect at this time it will immediately sink.

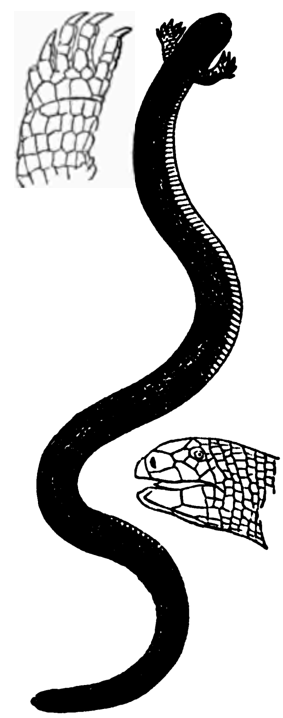
We have kept these insects in a glass jar for the purpose of observing their habits, and are very much inclined to doubt that the specific gravity of the pupa is greater than that of the water, at the time just previous to the transformation from pupa to the imago state. Indeed at this time it appeared that they could not keep from the surface, unless they were in motion. Whenever we approached the jar, being at the top, they immediately descended by a quick zigzag movement of the body; but upon our remaining quiet for a moment they ceased all motion and rose to the surface again. We imagine that at this time the animal within having become partially disengaged from the pupa case, the space between the two is filled with air, that this would be sufficient to overcome the difference of specific gravity between the animal and the water, and that there would most probably be more air in the region of the thorax than elsewhere; and hence this part is protruded from the water.

The perfect insect is of a pale-ash colour, and is a little larger than the common gnat, which it resembles. This, as well as others of the genus, is remarkable for its habit of carrying the two fore legs in a horizontal position; they project in front, and might be mistaken for antennæ; these latter organs however are very beautiful, and in the males resemble little plumes.

CHI'ROTES, a genus of Saurians separated by Cuvier, and, according to him, resembling the *Chalcides* in their verticillated scales, and the *Amphisbœnæ* still more in the obtuse form of their head; but distinguished from the first by their want of posterior feet, and from the last by their possession of anterior limbs. The same author adds, in a note to the last edition of the 'Règne Animal,' that the genera which terminate this order of Saurians are interposed in various manners between the ordinary Saurians and the genera which are placed at the head of the order Ophidians to such a point, that many naturalists are now of opinion that the two orders ought no longer to be separated, or rather that one order should be established, comprising on the one part the Saurians, with the exception of the *Crocodilidæ*, and on the other the Ophidians of the family *Anguidæ*. But he observes that there exist, among the fossil forms of the ancient calcareous beds, two very extraordinary genera (*Ichthyosaurus* and *Plesiosaurus*), which, with the head and trunk of a Saurian, have feet attached to short limbs, and formed of a multitude of small articulations conjoined so as to form a kind of paddle or fin, like the anterior paddles or fin-feet of whales. These ought, he adds, to form a very distinct family. In their osteology they approach the Saurians, properly so called, much nearer than the Crocodiles, with which Fitzinger associates them in his family *Loricata*; though in the fossils there is no trace either of scales or of the tongue, the two parts on which the characters of the *Loricata* rest.

These Bimanous Reptiles, as Cuvier terms them, include, according to him, but one species, which is a native of Mexico. This is the Bimane Cannelé (*Chirotes canaliculatus*) of Cuvier, Bipède Cannelé of Lacépède, *Chamæsaura propus* of Schneider, and *Lacerta lumbricoides* of Shaw. The animal has two short feet with four toes on each (and the vestige of a fifth) sufficiently organised internally, and attached by means of scapulæ, clavicles, and a small sternum; but the head, the vertebræ, and, in short, all the rest of the skeleton resemble that of the *Amphisbœnæ*. Dr. J. E. Gray refers *Chirotes* to a third family of the Amphisbænians which he calls *Chirotidæ*.

Chirotes canaliculatus (*C. lumbricoides*, Fleming; *C. Mexicanus*, Bory; *Bipes canaliculatus*, Bonnaterre; *Chamæsaurus propus*, Schultz; *Chalcides propus*, Daudin), is about the size of a human little finger, and is from eight to ten inches long. It is of a flesh-colour, and covered with about 220 demi-rings on the back, and as many under the belly, which meet, in alternating, on the side. The tongue is but little extensile, and is terminated by two small horny points. The eye is very minute. The tympanum is covered with skin and invisible externally. Above the vent are two lines of pores. It is a native of South America.



Chirotes canaliculatus.

CHI'RUS, a genus of Fishes belonging to the section *Acanthopterygii* and the family *Gobioidæ*. The species of this genus have the body considerably elongated, furnished with ciliated scales, and the mouth not deeply cleft; the teeth are small and conical; but the most remarkable character consists in the body being furnished with several longitudinal lines of pores, similar to the ordinary lateral line. Some of the species have appendages over the eyes, as observed in the Blennies; their ventral fins have each five soft rays: the spines of the dorsal fin are slender, and this fin extends nearly the whole length of the back.

Cuvier says that it is with hesitation that he places this genus with the family above mentioned, and that it will probably one day form the type of a separate family. All the species as yet discovered inhabit the seas of Kamtchatka—they are included in the genus *Labrax* by Pallas, who describes several of the species in the 'Memoirs of the Academy of St. Petersburgh,' vol. ii.

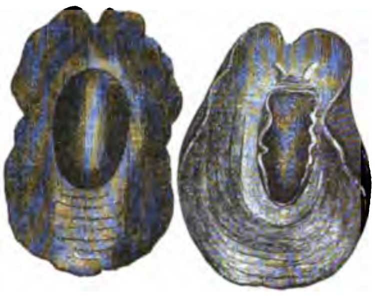
CHISMOBRANCHIA'TA, an order of *Mollusca*, forming, in De Blainville's system, the second order of his second sub-class, *Paracephalophora Monoica*. The following is his definition of the order:—Organs of respiration aquatic, branchial or pectinated, situated at the anterior part of the back, in a large cavity communicating with the ambient fluid by a wide oblique anterior slit. Mouth toothless, but provided with a long lingual riband-like organ. Shell either none, or internal, or external, very much depressed, with a very large entire aperture, and without any pillar (columella).

This definition is incorrect, in so far as it states that in some instances there is no shell; for *Coriocella*, the only genus described by De Blainville as being without any shell, has a horny one, as Cuvier observes, though it is very delicate and flexible and nearly membranous. Cuvier, who places three of the genera, *Sigaretus*, *Coriocella*, and *Cryptostoma*, under his *Capuloides*, a family of his order *Gasteropoda pectinibranchiata*, observes that De Blainville places the greater part of the *Capuloides* under his non-symmetrical

Hermaphrodite paracephalophora, or Calyptracians; but that they appear to him (Cuvier) to be all diœcious.

The geographical distribution of this order, which, according to De Blainville, is marine and probably herbivorous, is wide.

Coriocella.—Body elliptical, very much depressed, having the borders of the mantle very delicate, notched in front, and spreading out very largely on all sides. Foot oval, very small. Head scarcely distinct; two tentacula hidden under the shield of some size, but short and contractile. Eyes at the external base of the tentacula. Back somewhat rounded, and, according to De Blainville—but this as we have already seen is an error—without any shell, external or internal.



Coriocella nigra.

C. nigra, Blainville. The only species of the genus, and described by De Blainville from a specimen in his collection. Locality, seas of Mauritius. Cuvier places this and the two following genera under his *Gasteropoda pectinibranchiata.*

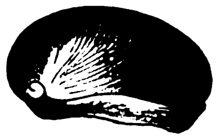
Sigaretus.—Shell more or less thick, flattened, with an ample and round aperture and but little spire, the whorls of which increase very suddenly; and enveloped during life in a spongy shield, which considerably encompasses its borders as well as the foot, and which is the true mantle. In front of this mantle there is a notch and a demi-canal, which serve to conduct the water into the branchial cavity. The tentacula are conical, and the eyes are placed at their external base. The male organ, according to Cuvier, is very large.

De Blainville thus subdivides the genus:—

a. Species with a very delicate and smooth shell.

Example, *S. convexus.*

Sigaretus convexus, seen from below.



Sigaretus convexus, side view.

b. Species with a thick and solid shell.

Example, *S. haliotoideus.*

Sigaretus haliotoideus.

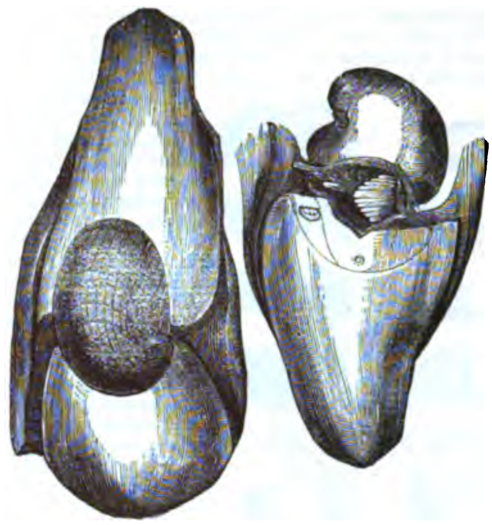
The species of *Sigaretus* have been found at depths varying from 5 to 15 fathoms on sandy bottoms.

Fossil Sigareti.

Defrance enumerates three fossil species, one from the Plaisantin, one from Grignon, and another from the environs of Bordeaux. G. B. Sowerby says that the fossil species are few and rare, and that they occur in the London Clay at Barton, and in the contemporaneous formations in France and Italy. The species in the Calcaire Grossier at Grignon, he adds, has a small umbilicus. Deshayes in his 'Tables' gives eleven living species and four fossil (tertiary); one, *S. depressus*, living in the seas of the Molucca Islands. The fossils occur in the Pliocene, Miocene, and Eocene periods of Lyell. *S. excavatus* is found in the Crag.

Cryptostoma.—Shell very like that of *Sigaretus*, carried with the head and abdomen, which it covers, upon a foot four times its size, cut almost squarely behind, and which produces anteriorly a fleshy and oblong part, which makes nearly one-half of the mass. The animal itself has a flat head, two tentacula, and a large pectinated branchia on the plafond of its dorsal cavity. The male organ is placed under the right tentaculum.

Example, *C. Leachii.*



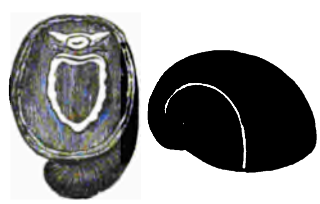
Cryptostoma Leachii.

Oxynöe.—Body gasteropod, with a large dorsal shell, anterior, bulliform, and with a simple spire. Foot narrow. Branchiæ marginal, striated transversely. Mantle widened into two lateral wings. Tentacula two, not retractile.

Example, *O. olivacea.*

Velutina.—Animal oval, sufficiently protuberant (bombé), hardly spiral; border of the mantle simple anteriorly, and double for the whole of its circumference; the internal lip thickest and tentacular. Foot thick. Tentacula large, obconical, distant, with a small frontal veil between them. Eyes black, sessile at the external side of the base of the tentacula. Mouth large, at the extremity of a sort of muzzle. Respiratory cavity large, without any trace of a tube, and containing two unequal pectinated branchiæ; orifice of the ovary at the base of the male organ, situated at the root of the right tentaculum. Muscular attachment of a horse-shoe shape, very slight behind and open before. Shell external with an epidermis, patelliform, with a small lateral spire, and without a columella. Aperture large, the edges almost continuous, and sharp: the right border united to the left by a lamellar calcareous deposit.

Example, *V. capuloidea* (*Helix lævigata*. Linn.). [Velutinidæ.]



Velutina capuloidea.

CHITON. [Chitonidæ.]

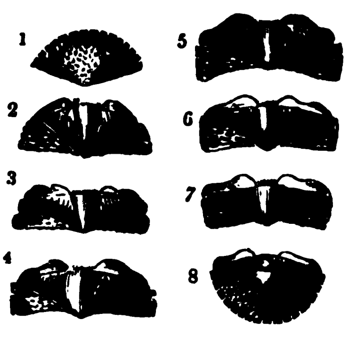
CHITONELLUS. [Chitonidæ.]

CHITONIDÆ, a natural family of Gasteropodous *Mollusca*, affording the only known instance of a protecting shell formed of many portions, or, as they have been somewhat incorrectly termed, valves, often in contact and overlapping each other, but never truly articulated. The following cut will give some idea of the structure of this shelly covering.

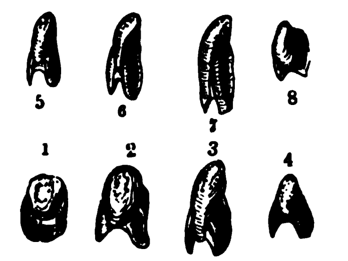
These plates are bound together by a coriaceous border, which, as we shall presently see, is either plain or beset with bristles, spines, &c.

The early naturalists took these shells for the peculiar armour of certain serpents, a conclusion to which they were doubtless helped by the love of the marvellous, so strongly shown in the accounts of the older travellers. By degrees the true condition of these mollusks became better known; and the opposite opinions of Linnæus and Adanson divided the naturalists of their age. The former arranged these shells among his Multivalves, a class entirely artificial, and like all artificial classifications comprising the most heterogeneous forms. Adanson, on the contrary, took nature for his guide, and carefully observing the animal itself, while he regarded the shell as of comparatively small importance, placed *Patella* and *Chiton* side by side in his method. But the Linnæan school long reigned paramount; and Adanson's labours were comparatively forgotten, when Cuvier began to reform the crude state in which he found the *Mollusca*, and Lamarck and others aided in the work. Cuvier, who made anatomical investigation the basis of his opinions, at once pronounced in favour of Adanson. Lamarck afterwards adopted the same conclusion, but not till he had previously placed the Chitons at the end of th–

Acephalous Mollusks, between *Fistulana* and *Balanus*. Poli, in his magnificent work on the 'Testacea utriusque Siciliæ,' in giving the anatomy of a Mediterranean species, became a valuable ally; for although he still retained Linné's class of Multivalves, and although in his anatomical details he said nothing of the nervous system, a branch of animal organisation essentially necessary to be known for assigning an animal its true place, he demonstrated enough clearly to show that the *Chiton* bore no relation to the other Multivalves of Linnæus. M. De Blainville however, resting upon the generative faculty of the Chitons, proposed, in opposition to these views of Cuvier and Lamarck, which had been adopted by almost all zoologists, to form a sub-type of Mollusks under the name of *Malentozoaria*, in which each of the Linnæan genera *Lepas* and *Chiton* constitutes a class; the first the Lepadians, or *Lepadicea*, the second the Polyplaxiphores, or *Polyplaxiphora*. These almost singular views of De Blainville have not prevailed among zoologists; and Cuvier, in the last edition of the 'Règne Animal,' arranges the Chitons at the side of the *Patellæ*, forming from these two genera his small family of Cyclobranchians.



Shelly plates or valves of *Chiton*.



Shelly plates or valves of *Chitonellus*.

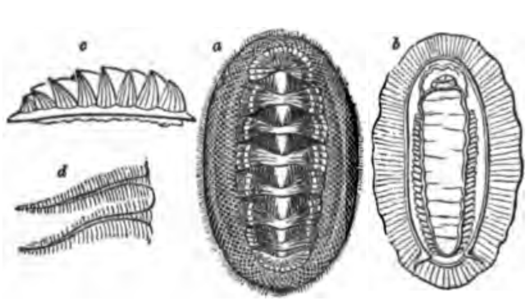
Deshayes, in the article 'Oscabrion,' in the 'Encyclopédie Méthodique,' enters at large into the organisation of the Chitons, and discusses with much learning and acuteness the conflicting opinions of Cuvier and De Blainville.

The following is a summary of the structure of this family:—

Digestive Organs.—No projecting head, in which the Chitons resemble the Phyllidians. No tentacula, which are replaced by a kind of veil which surrounds the mouth. Eyes, as in many other Mollusks, the *Pteropoda* for example, wanting. Mouth and œsophagus furnished with a very long tongue rolled spirally and armed with horny teeth, a good figure of which is given by Poli. Loven has pointed out that the teeth, especially the central one on the lingual riband, are of great importance in determining the species. Stomach intestine, and liver like those of the other Gasteropods. Vent at the posterior extremity of the body, as in the Phyllidians, *Doris*, &c.

Respiratory and Circulating Organs.—The branchiæ of the Chitons consist of a range of small triangular leaflets placed, as in the *Patella* and *Phyllidia*, in the furrow which separates the foot from the mantle. The number and extent of the branchial laminæ are of importance in determining the species. The heart is situated posteriorly in the mesial and dorsal line; it is symmetrical, and composed of a single ventricle and two auricles.

Their organs of generation are symmetrical, and repeated on each side of the mesial line, and there are a pair of sexual orifices.



Animal of *Chiton squamosus*.

a, the animal and shell seen from above; *b*, the animal seen from below; *c*, side view of the shell and animal in a creeping or adhering state; *d*, portion of branchiæ magnified.

The nervous system consists of what may be termed a complete œsophagean ring, and of various branches, which are given off divergingly towards the several organs.

The locomotive organs consist of an oval foot, more or less wide, according to the species, and extends the whole length of the animal.

The shell is composed of eight narrow, transverse, calcareous pieces, overlapping each other, and strongly implanted on each side in a thick and fibrous border of the mantle, which surrounds the whole body, and is sometimes, as we have observed, naked, but more generally covered with small scales, spines, or hairs. These pieces are not immoveable, as the animal can roll itself up or stretch itself out again for the purpose of progression or adhesion. To work this machinery, there are three muscles given off from the first piece to the second, three others given off from the second to the third, and so on throughout, so as to make the mechanism of this scale-armour complete. One of these muscles occupies the mesial and dorsal line, the other two are lateral and oblique. Dr. J. E. Gray regards the posterior plate as the homologue of the limpet shell.

The Chitons then resemble the other Mollusks: 1, in the general form of the body; 2, in the organ of locomotion; 3, in the nature, form, and position of the branchiæ; 4, in the heart, and in the distribution of the circulating vessels; 5, in the mouth and its veil; 6, in the tongue and the rest of the digestive organs; 7, in the position of the vent; and 8, last, but not least, in the nervous system.

What, then, are the differences? 1, the form of the shell composed of eight pieces instead of one; 2, the mantle, which is more fleshy and fibrous than in the other mollusks; 3, the myology; 4, the double issue of the organs of generation, allowing this difference to be established, whereas it is doubted. With regard to the absence of eyes, that defect exists in a considerable number of mollusks.

Professor E. Forbes and Mr. Hanley place the family *Chitonidæ* next before the *Patellidæ*. They say: "As our knowledge stands at present, we prefer to regard them as an abnormal family of *Prosobranchiata*, and trust before long that some active observer resident by the coast will occupy himself with studying the development of the Chitons, and endeavour to ascertain the form they assume in their larval condition. Whoever does so will make an important discovery, and do more towards fixing the true position of these anomalous creatures than all cabinet examinations of them have yet enabled us to effect."

Geographical Distribution.—The species are numerous, and there are few rocky shores without some of them. As a general rule, the largest are found in warm climates, but there are exceptions; for instance, *Chiton setiger* and *Chiton Bowenii* (King), are found on the shores of Tierra del Fuego, and in the Straits of Magalhaens; the former of these species grows to the length of 2⅝ inches, and the breadth of 1⅝ inches, and the latter to the length of 3¼ inches, and the breadth of 1¼ inches.

The species are found on rocky shores, where they adhere, and also on stones and other submarine bodies. They are found at depths varying from the surface to 25 fathoms. A few are found creeping on the sand.

Most zoologists are agreed that there are no differences sufficiently strongly marked to make a generic distinction between *Chiton* and *Chitonellus*; and, indeed, the gradations from the one to the other are so imperceptible, that there is no point where the line can be satisfactorily drawn. In the most completely-developed form of *Chiton* the shelly secretion greatly preponderates; in *Chitonellus* that secretion is comparatively small, and the great development is in the border of the mantle, which, in some instances, almost hides the comparatively-minute shelly pieces.

a. Species with the Mantle-Border, or marginal ligament, coriaceous and naked. Examples, *C. Chilensis*, Frembley, and *C. Blainvillii*, Broderip.

C. Chilensis. Shell oblong-ovate, opaque, thick, dark brown, smooth, dull; inside white, with pink markings on the first, second, and last valves. Valves with longitudinal striæ, crossed by irregular concentric ridges. Anterior and posterior valves semilunate, slightly punctated; second valve subcarinated, the front margin obtusely angled, lateral margins arcuate, and the posterior with a prominent beak, on each side of which diverges a rather elevated granulated ridge; the next five valves alike, bow-shaped, with a granulate ridge on each side. Border smooth, coriaceous, tough, thick, darker coloured than the shell, semipellucid, broad at the sides and narrow at the extremities. Locality, Valparaiso, in crevices of rocks and under stones. (Frembley.)

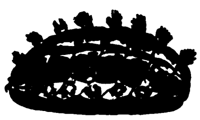
C. Blainvillii. In this species the shape of the coriaceous border itself is not only very remarkable, but it is here and there fringed, though not with hair. M. Deshayes has placed this under his section of those species which have the border of the mantle fringed with hair or spines, probably from not having seen a good specimen. Shell roundish, anterior valve obscurely rayed, the posterior one very small and abrupt; the others concentrically lineated, the whole being rosy, variegated with white brown, and greenish, and internally white. The mantle-border orange-red, very narrow posteriorly, and enormously produced anteriorly, rounded and fringed here and there, especially on its anterior margin, with some short coriaceous processes. Locality, Inner Lobos Island, coast of Peru.

Chiton Chilensis.

Chiton Blainvillii.

β. Mantle-Border smooth, with tufts of hair at the lateral extremities of each plate.

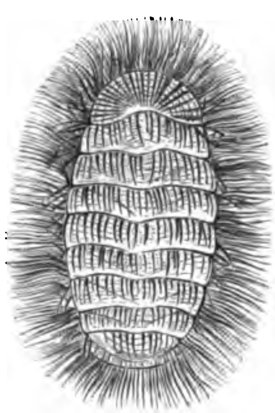
C. fascicularis, Linnæus. Shell, apparently smooth, but when examined with a glass, proving to be rough like shagreen, except on the elevated dorsal ridge; margin surrounded with tufts of whitish hair, one at the junction of each valve, and two in the front, making 18 in number. Colour brown or dark cinereous; length ⅜ths of an inch; breadth rather more than ¼th. Montagu, who gives this description, says, that on the coast of Barbary it is not unfrequently an inch long. It is found under stones at low water, and on stones and shells to a depth of 25 fathoms, all round the British shores. It ranges northward to the shores of Norway, and southward to the Mediterranean. Some remains of *Chiton* in the Crag have been referred by Mr. Searles Wood to *C. fascicularis.*



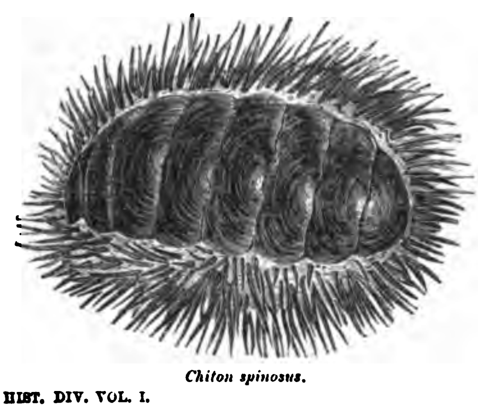
Chiton fascicularis.

γ. Mantle-Border hairy.

C. Peruvianus, Lamarck. Shell oblong-ovate, opaque, dirty-yellowish, green, or yellowish-brown, inside white. Valves thin, slightly elevated; posterior compartments of the dorsal valves a little raised and striated, with minute granulated striæ, and in like manner the other parts of the shell; under each valve is inserted a series of short black hairs, which lie on the back of the shell. Border narrow, coriaceous, thickly set with coarse black hairs. Length 2 inches, breadth 1¼ inch. Found under stones at low water on the shores of Valparaiso Bay. There is a variety with the anterior valves much narrower than the posterior. (Frembley.)



Chiton Peruvianus.

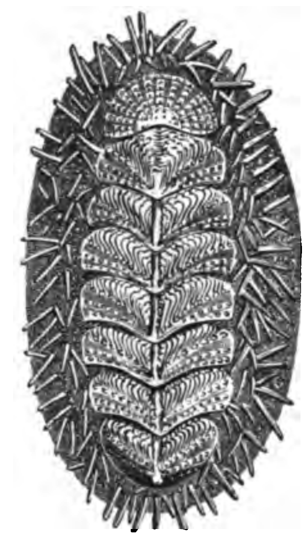


Chiton spinosus.

δ. Mantle-Border beset with spines.

C. spinosus. Shell brownish-black, valves opaque, moderate, with the sides granulated, the anterior valves entirely granulated. Mantle-border wide, and beset with long aculeated blackish spines, very much resembling those of certain *Echini.* Locality, South Seas, according to Péron. Length 3 inches.

C. spiniferus (*C. aculeatus*, Barnes; *C. tuberculiferus*, Sowerby, in 'Tankerville Catalogue'). Shell opaque, oblong ovate, reddish-brown, glossy; inside reddish-white. The posterior angles of the valves do not cover the anterior ones. Anterior valve with generally nine rows of raised dots diverging from the apex, but the number perhaps varies with the age of the shell. Second valve rather acutely beaked and carinated, longer than the five following, which are striated and shaped alike; these all rise into a rather acute beak, are carinated, each side of the carina being divided into two distinct portions, the anterior one the largest, and bearing broad irregular longitudinal striæ; a prominent row of raised dots, extending from the apex to the anterior angles of the valves, separates the compartments; the posterior portion glossy, with fine concentric striæ; the posterior margins with tooth-like granulations. Last valve striated, like the anterior compartments of the others, and rising into a rather prominent beak, leaning towards the posterior margin; from under the beak are raised dots, disposed in a similar manner to those on the anterior valve. Border coriaceous, thick, broad, rough, greenish or orange-coloured, and in the younger specimens thickly studded with blunt spines; but in the old shells the spines are short and scanty, and generally covered with corallines; the inner edge of the border, inserting itself under the posterior angles of the valves, has the appearance of being deeply separated. (Frembley.) This species grows to the length of 5 or 6 inches, but has then generally lost all its external beauty. We have seen many individuals in all the stages of growth, and have invariably found the spines of the aged ones covered with that calcareous matter which is so frequently found adhering to shells and submarine bodies, but we have never detected anything organic about that which was attached to the spines of this species. Locality, Chili and Valparaiso, where Mr. Frembley found several specimens in very exposed situations; so much so, that collecting them was attended with much difficulty, and not unfrequently with danger, from the violence of the sea breaking on the rocks to which they attach themselves very strongly. They are generally covered with sea-weed.



Chiton spiniferus.

ε. Mantle-Border scaly.

C. Coquimbensis, Frembley. Shell ovate, narrow, opaque, greenish-brown, shining; inside blackish: the anterior valves with numerous undulated, concentric ridges; the next rather acutely keeled; the five following alike: carina broad and smooth, on each side of which is a similar ridge diverging from the beaks, and forming with the carina a sagittate figure, and connected with it by several strongly marked ridges: from under the beaks to the anterior angles of the valves extend sharp moniliform ridges, each side of which is coarsely striated longitudinally. Border thick, moderately broad, and covered with coarse seed-like scales, which are attached laterally. Length 3 inches, breadth 1¼ inch. Mr. Frembley says, that the only part of the coast where he found this species was the south side of Coquimbo Bay: their habits, he adds, are very similar to those of *C. spiniferus*, with the exception that they seem more gregarious.

Chiton Coquimbensis.

ζ. Mantle-Border granulous.

C. magnificus, Deshayes (*C. olivaceus*, Frembley; *C. latus*, Sowerby). Shell opaque, ovate, olivaceous, dull, dotted with lighter coloured spots: inside glaucous. Anterior valve with regular radiating striæ, crossed by concentric ridges; posterior margin nearly straight. Dorsal valves obtusely beaked, divided laterally into two compartment-anterior having regular longitudinal striæ, crossed with others very minute and concentric; from under the beaks diverge to the lateral margins of the valves coarse and more irregular striæ, which raise the posterior compartment above the other. The posterior valve has a well-defined apex, leaning towards the posterior margin. Border thin, moderately broad, and covered with fine shining bead-like granulations, of the same colour as the shells, divided into two distinct portions, the upper of which is composed of finer beads than the lower, and which are placed transversely. (Frembley.) The species grows to the length of 4 or 5 inches: we have seen one that reached 4½ inches when dead. There is another variety narrower than the ordinary individuals, and Mr. Frembley observes that, among the very young shells, some of them have their borders of a lighter colour than their shells, and spotted with black. Locality, Chili.

Chiton magnificus.

Species with the Mantle-Border highly developed, and the valves very small. (*Chitonellus*).

These are more or less cylindrical, and vermiform, the valves being very small, and in some species almost entirely hidden under the skin of the border, giving the animal an almost naked appearance.

Examples, *Chitonellus lævis*, and *C. larvæformis*.

a, Chitonellus lævis; b, Chitonellus larvæformis.

The following species are noted as British in Messrs. Forbes and Hanley's 'History of Mollusca':—*C. fascicularis, C. discrepans, C. Hanleyi, C. ruber, C. cinereus, C. albus, C. asellus, C. cancellatus, C. lævis, C. marmoreus*, and *C. punctatus*.

Above 200 species of this family have been described. The genus *Chiton* is divided by Dr. J. E. Gray and others into numerous sub-genera.

Fossil Chitonidæ.

Although from their fragility it might be supposed that few remains of these animals would be found, indications of their existence have been discovered as far back as the Palæozoic period. About 24 fossil species have been discovered. Three of these are given in Mr. Searles Wood's account of the Crag Mollusca, published by the Palæontographical Society.

CHIVES, the common name of *Allium schœnoprasum*. Its bulbs have the usual garlic odour of the genus, and are used in soups and stews: they are but little cultivated. [ALLIUM.]

CHLÆNA'CEÆ, *Chlenads*, a natural order of Polypetalous Exogenous Plants, by some accounted allies of *Malvaceæ*, but more correctly referred to the vicinity of *Cistaceæ*, from which, and all those associated with them in the Gynobasic Group, they differ in having an involucrum to each calyx, or to each pair of calices. They are handsome trees or shrubs, but of no known use. Their leaves are alternate and undivided, their stipules deciduous, and their flowers in panicles or racemes, always showy, and often red. There are four genera, *Sarcolæna, Leptolæna, Schizolæna, Rhodolæna*. The whole of the species, about eight in number, are wild in Madagascar.

Sarcolæna multiflora.

a, flower-bud; *b*, flower; *c*, vertical section of flower; *d*, the calyx; *e*, the involucrum; *f*, base of the flower, showing the spiral tube formed by the union of the filaments; *g*, *h*, back and front views of anthers; *i*, pistil; *k*, transverse section of ovary; *l*, fruit; *m*, transverse section of fruit; *n*, vertical section of fruit; *o*, pericarp, splitting and discharging its seed; *p*, seed; *q*, vertical section of seed; *r*, transverse section of seed; *s*, embryo.

CHLÆ'NIUS, a genus of Coleopterous Insects, of the family *Harpalidæ*, and section *Patellimanes* (Dejean).

The species of this genus are all of tolerably large size, very elegant in form, and generally adorned with various hues of green, the colours being rich, but not glossy, owing to the upper parts being more or less covered with a very delicate pubescence, which produces a silk-like appearance. Very many of the species have the legs and antennæ of a pale yellow colour, and the outer margin of the wing-cases of the same tint, and some have the elytra adorned with large yellow spots.

The genus *Chlænius* constitutes a very large group of the *Harpalidæ*, which, according to our views, embraces the genera *Epomis* and *Dinodes*. We will therefore briefly notice the distinguishing characters of these three groups.

All three of the genera agree in having the tarsi of the anterior pair of legs dilated in the males, and a bifid tooth in the middle of the emargination of the mentum; but they differ chiefly in the form of the terminal joint of the palpi, and the difference may be thus expressed:—

Terminal joint of the palpi.

- Elongated and truncated at the apex, *Chlænius*.
- Elongated and distinctly securiform, *Epomis*.
- Short and slightly securiform, *Dinodes*.

As regards the form of these insects, the body is generally more or less oval, and very slightly convex: the thorax is almost always considerably narrower than the elytra, broad towards the anterior part, and diminishing in width towards the posterior. The head is rather long, the eyes project considerably, and are rather remote from the base of the head; the portion of the head before the eyes is rather pointed.

The species are found under stones, weeds, and almost any rubbish which will afford them shelter; sometimes under the loose bark of old trees near the root, but they must be sought after in the vicinity of water.

Of the genus *Chlænius* M. Le Comte Dejean enumerates 115 species, a great portion of which are European; many are from Africa, the East Indies, and North America, but South America and Australia appear to be almost destitute of these insects.

Several species have been discovered in England. Of these however two only have been found in any abundance. *Chlænius vestitus* (*Carabus marginatus*, Linn.) is very common in the south of England, and is found under stones by the edges of ponds where gravel abounds. It is nearly half an inch in length, black beneath, and of a rich green colour above: the elytra are distinctly striated, very finely punctured, and covered with a delicate pubescence of a golden hue: their outer margin is of a pale yellow colour: this tint is confined to a narrow line towards the base of the elytra, but forms a broad patch at the apex; the head and thorax are rather glossy; the latter is finely punctured throughout, and has the margin slightly tinted with yellow: the legs, antennæ, and palpi are yellowish-white when the insect is alive.

Of the genus *Epomis* M. Dejean enumerates six species, one of which has been found in England. It is about three-quarters of an inch in length; the head and thorax are of an obscure brassy-green colour and slightly punctured; the elytra are black, with the outer margin pale yellow; the legs and antennæ are also yellow. This species is not uncommon in France and Italy.

The genus *Dinodes* only embraces four species. *D. rufipes* is about half an inch in length, of a rich blue colour above, and finely punctured throughout: the legs and base of the antennæ are of a reddish-yellow colour.

The thorax in this genus (taking *D. rufipes* as the type) is broader and more rounded than in the genera *Chlænius* and *Epomis*. The species described is found in France and Italy.

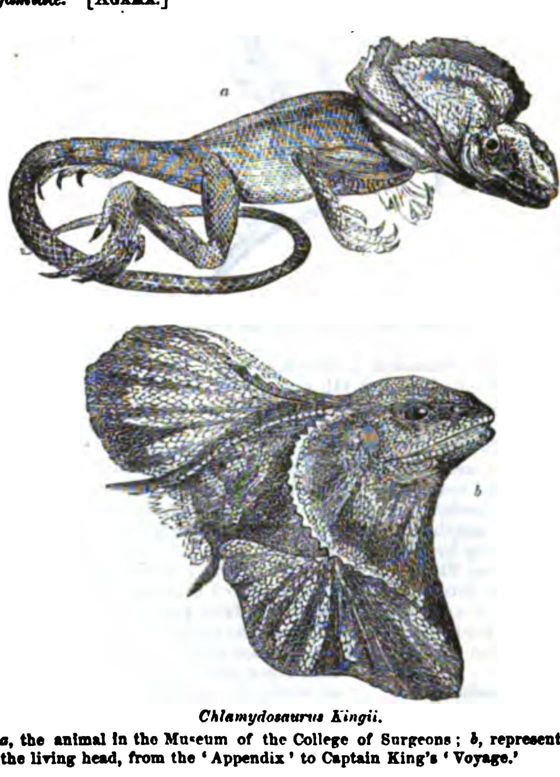
CHLAMYDOSAURUS, a genus of Saurian Reptiles, founded by Dr. J. E. Gray upon a specimen brought home by Captain Phillip Parker King, R.N., F.R.S., &c., on his return from his survey of the intertropical and western coasts of Australia, performed between the years 1818 and 1822. The following is Dr. Gray's description:—

Animal scaly; the head depressed; the nostrils placed on the side, midway between the eyes and the end of the head; the drum of the ear naked; the front teeth conical, awl-shaped (eight in the upper and four in the lower jaw), the hinder ones longest; the side or cheek teeth compressed, short, forming a single ridge, gradually longer behind; tongue short, fleshy, with an oval smooth disc at each side of the lower part of its front part; neck rather long, furnished on each side with a large plaited frill, supported above by a crescent-shaped cartilage, arising from the upper hinder part of the ear, and in the middle by an elongation of the side fork of the bone of the tongue; body compressed; legs rather long, especially the hinder ones; destitute of femoral pores; feet four, with five toes, the first having two, the second three, the third four, the fourth five, and the little finger and toe three joints; claws compressed, hooked; tail long, nearly round, scaly.

Chlamydosaurus Kingii. Colour yellowish-brown, variegated with black. Head depressed, with the sides erect, leaving a blunt ridge on the upper part wherein the eyes are placed. The ridge over the eyes is covered with larger scales than those over the head. The eyes are rather small, with a fleshy ridge above them, and the eyelids are covered with minute scales, and surrounded by a delicate serrated ridge of small upright ones. The lips are surrounded by a row of oblong 4-sided scales, arranged lengthways, the front scale of the upper lip being the largest. The chin is covered with narrow mid-ribbed scales, with a 5-sided one in the centre, and several of larger size just over the front of the fork of the lower jaw. The nostrils are surrounded by a rather large orbicular scale, situated nearly midway between the eye and the end of the upper-jaw, the tubes pointing forwards. The side of the face has a very obscure ridge extending from the angle of the mouth to the under part of the ear. The neck is covered with small scales. The frill arises from the hinder part of the head, just over the front of the ears, is attached to the sides of the neck, and extends down to the front part of the chest, supported above by a lunate cartilage arising from the hinder dorsal part of the ear, and in the centre by a bone which extends about half its length. Each frill has four plaits which converge on the under part of the chin, and fold it up on the side, and a fifth where the two are united in the centre of the lower part of the neck. The front part of its upper edge is elegantly serrated, but the hinder or lower part is quite entire: the outer surface is covered with carinated scales, those in the centre being the largest. The inner surface is quite smooth. The scales of the back are oval, and nearly smooth; those of the lower part of the body and upper part of the legs have a short mid-rib, and those of the sides and joints of the limbs are minute. The tail is twice as long as the body, roundish, covered with scales which have each a sharp mid-rib, and towards the termination, which is blunt, form six rows, so as to render that organ obscurely hexagonal. The toes are long, very unequal, compressed, and scaly. The claws are hooked, and horn-coloured.

Dimensions.—Length of the tail 12 inches; of the body 5 inches; of the head $5\frac{1}{3}$ inches. Breadth of the head over the eyes one inch. Length of the thigh $1\frac{8}{10}$ inch; of the foot and sole $2\frac{1}{3}$ inches; of the outer edge of the frill 10 inches.

Locality and Habits.—We owe the discovery of this extraordinary Saurian to Mr. Allan Cunningham, who accompanied Captain King's expedition as his Majesty's botanical collector for Kew Gardens, and to whom naturalists in general are so much indebted for the zeal displayed by him in the pursuit of natural history, and for the liberality with which he has communicated the results of his labours. He found the specimen from which the description was taken on the branch of a tree in Careening Bay, at the bottom of Port Nelson, and sent it to Sir Everard Home, by whom it was deposited in the Museum of the Royal College of Surgeons. The following is the account of the capture in Mr. Cunningham's Journal:—"I secured a lizard of extraordinary appearance, which had perched itself upon the stem of a small decayed tree; it had a curious crenated membrane, like a ruff or tippet round its neck, covering its shoulders, and when expanded, which it was enabled to do by means of transverse slender cartilages, it spreads 5 inches in the form of an open umbrella. I regret that my eagerness to secure so interesting an animal did not admit of sufficient time to allow the lizard by its alarm or irritability to show how far it depended upon, or what use it made of, this extraordinary membrane when its life was threatened. Its head was rather large, and eyes, whilst living, rather prominent; its tongue, although bifid, was short and thick, and appeared to be tubular." According to Captain King, the colour of the tongue and inside of the mouth was yellow. Dr. J. E. Gray arranges this genus under the family *Agamidæ*. [AGAMA.]

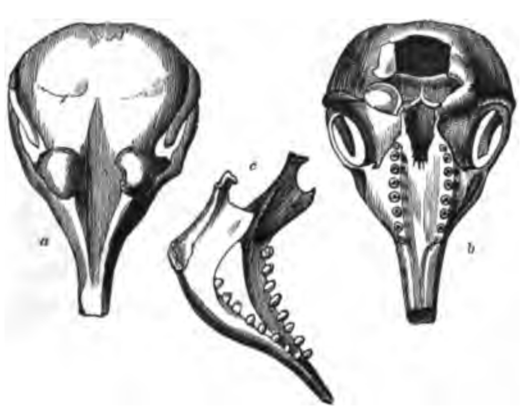


Chlamydosaurus Kingii.

a, the animal in the Museum of the College of Surgeons; *b*, representation of the living head, from the 'Appendix' to Captain King's 'Voyage.'

CHLAMYPHORUS (Harlan), a genus of *Mammalia* belonging to the order *Edentata*. It was first described by Dr. Harlan in the 'Annals of the New York Lyceum of Natural History,' vol. i., from a specimen presented to the Philadelphia Museum. It is the Pichiciago of the Indians in Mendoza (its native place), on the east of the Cordilleras, in lat. 33° 25′, and long. 69° 47′. It had been obtained on the spot in a living state, but lived in confinement only a few days. The viscera and the greater portion of the skeleton had been removed before the animal came into Dr. Harlan's possession. In March 1828 the council of the Zoological Society of London placed in the hands of Mr. Yarrell a specimen of this rare and new animal, and to his dissection we are chiefly indebted for our knowledge of its structure. The following account is an abstract of Mr. Yarrell's paper in the 'Zoological Journal.'

The form of the head presents the figure of an irregular cone, the base of which is turned towards the spine; the cranium does not exhibit any sutures; the cavity capacious; the frontal bone supporting two rounded processes projecting upwards and somewhat outwards; the space between them occupied by a substance resembling in appearance adipose matter, from which issued a fluid like oil. From the anterior part of the base of these two rounded processes, a narrow ridge of bone extends forwards on each side converging towards the nose. The nasal bones elongated, the orifice opening downwards. No incisor nor canine teeth in either jaw; molars $\frac{8}{8}$, cylindrical, separate, encircled with enamel, but none on the crowns: the first tooth on each side in the lower jaw, having no opponent, is the longest, the remaining seven opposed to the first seven of the upper jaw, and taking angular impressions on their surfaces by contact; the direction and depth of the alveolar cavities of the upper jaw distinctly marked on the outside by parallel ridges; in the lower jaw the alveolar cavities are pierced the whole depth. The anterior portion of the lower jaw is elongated; the inferior edge concave the first half of its length, then convex; the plate broad, rising at right angles with the line of the teeth; the condyloid process longer than the coronoid, the condyle itself elongated transversely. The external meatus auditorius is extended in the form of a semicircular cylindrical tube of bone, curving round the base of the zygoma, and passing forwards terminates in an aperture immediately behind the eye. The orbits and temporal fossæ united; the zygomatic arch is slender posteriorly, but becomes much stronger towards the front, expanding downwards, and furnished with an acute descending process. The occipital foramen is of great size.



Skull of *Chlamyphorus truncatus.*
a, Skull seen from above; *b*, the same seen from below; *c*, lower jaw.

The cervical vertebræ 7, the first large, the articulating surface broad; the 2nd, 3rd, and 4th very firmly ossified together, pierced with foramina for the passage of the cervical vessels; the 5th united to the 4th on the under surface only; the 6th and 7th slender and separate, allowing the head great freedom of motion upwards; the whole of the last six grooved on the under surface, in the line of the passage of the œsophagus. Dorsal vertebræ 11, the spinous process of the first slender, three-eighths of an inch long, the others diminish gradually in length, but increase in size; all directed backwards. The first rib is very broad, and from the 2nd to the 8th the ribs of the *Chlamyphorus*, like those of birds, are firmly united to the sternum without the intervention of an elongated cartilage; and, again like those of birds, are also supplied with a false joint, at the distance of about two-thirds of their length from the spine to the sternum. The 9th, 10th, and 11th being false ribs are united in the usual way to each other, and to the 8th by elongations of cartilage from their extremities. The portions of ribs intervening between the false joints and the sternum are in the 6th, 7th, and 8th ribs, consolidated, broad, flattened portions of bone, which form the boundary of the anterior and lateral parietes of the thorax. The first bone of the sternum is broad and flat, the superior surface regularly concave, the inferior irregularly convex. Upon the anterior edge of the sternum are two prominences to which are attached the extremities of each clavicle. From each of these articulations a slightly elevated ridge proceeds backwards along the inferior surface of the sternum, converging towards the centre, where they become united, and form a prominent crest. The lateral edges of this first bone of the sternum are articulated at its anterior extremity to the first and broadest rib; from this part the bone suddenly becomes narrowed posteriorly, and terminates in a concave articular surface to which the second bone of the sternum is attached. Judging from the imperfect remains of the second bone, of which the upper part only was distinguishable, it would appear that its form was oblong, the superior surface concave. The remaining portion of the sternum was too much mutilated to admit further description.

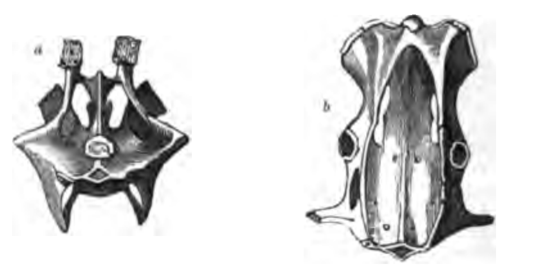
Cervical Vertebræ, first bone of the sternum, with parts of the first and second ribs, seen from below.

Lumbar vertebræ 3, the spinous processes short and flattened; the last two dorsal vertebræ, as well as the lumbar, furnished with long oblique processes directed forwards, upwards, and outwards; the transverse processes of the first two lumbar vertebræ considerably elongated, the last possessing a rudiment only.

The whole of the sacrum and innominata is so peculiar and unique in character, that it is scarcely possible to give any correct idea of this part without the assistance of accurate representations. The superior part of the ilium is flattened, the upper part bent to form an arched plane of bone, the concavity of which faces downwards and outwards; the crista of great length from before backwards. The inferior portion of the ilium is much stronger, inclining outwards, from its junction with the sacrum to the acetabulum.

The transverse and spinous processes of the sacrum are represented by three slender plates of bone, which, approximating as they pass backwards, are united to form a septum, extending down the median line of the sacrum to the tail. A channel is formed on each side of this septum by a thin flat plate of bone, which, arising from the posterior and superior part of the ischium on each side, is bent over the back part of the sacrum and fixed to an arched and prominent plate of bone, which is extended from this septum outwards to form a junction with it. The channels thus produced are bounded below by the sacrum, on the inner sides by the septum, on the outer sides by the ascending plates of bone just described, and above by the junction of both. From this union a short osseous stem issues horizontally on each side, and expands into a flattened circular plate of bone, to the rough surface of which, as well as to the tuberosity of the ischium below, portions of the truncated exterior of the animal are firmly attached.

The under surface of the sacrum is broad and flattened, and marked by an indistinct central ridge. The pelvis is open in front, the ossa pubis on each side do not incline inwards, but descend at right angles from the horizontal surface of the sacrum. In the circumstance of the pelvis being open there is a second resemblance to the bony structure in birds.



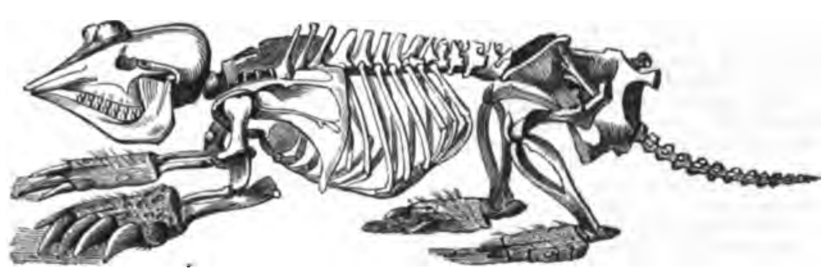
a, the Pelvis seen from behind; *b*, the same seen from below.

The caudal vertebræ are 14 in number; the transverse processes of the last four are elongated, to support the thin dilated lateral edges of the paddle or spatular extremity of the tail. Large muscles are imbedded in the two cavities formed on the upper surface of the sacrum by its septum and the two lateral elevated portions of the ischium before described; and there are antagonist muscles of equal size on the under surface. The tendons of these muscles were inserted on the upper and under parts of the caudal vertebræ, giving great power to the tail, which is probably exercised in removing backwards the loose earth accumulated under the belly of this burrowing animal by the action of the fore legs, and for which purpose the expanded and flattened extremity seems well calculated.

Vertebræ of the tail.

The scapula has its superior margin straight, ending in a notch of great size; the base rounded; the inferior margin concave, and the posterior inferior angle considerably elongated; the coracoid process but little produced, the spine elevated, the acromion very long, passing forwards, downwards, and inwards, over the head of the humerus, to be articulated to a long and slender but perfect clavicle. There is a second spine of smaller size, parallel to but beneath the true spine. The humerus is three-fourths of an inch in length, large, and broad; the deltoid crest prominent; between which and the external condyle a deep groove is formed for the lodgment of muscles, &c.; both condyles very much elongated transversely; the inner condyle perforated above; the edge rising from the external condyle acute. The radius small, and seven-sixteenths of an inch in length; the ulna flattened, concave upwards, the olecranon nearly as long as the ulna, horizontally flattened also, and presenting a superior concave surface, ending in a curve pointing downwards. The feet furnished with sesamoid bones for the insertion of the tendons of the flexor muscles.

The femur, thirteen-sixteenths of an inch long, large and strong; the length of the neck considerable; the great trochanter elongated backwards beyond the line of the articulation of the head of the femur with the acetabulum, and ending in a tuberosity; the lesser trochanter directed downwards; a trochanter projecting from the outer side of the shaft of the femur somewhat above the middle; the condyles moderately elongated transversely, the outer having a crest directed backwards. The tibia and fibula fifteen-sixteenths of an inch, flattened, concave inwards, firmly anchylosed at each extremity, and arched in opposite directions, giving an appearance of great size and strength to the leg. The os calcis elongated backwards, flat, and ending in a curve slightly inclined upwards. Hind feet plantigrade.



Skeleton of *Chlamyphorus truncatus*, with the exception of the feet, which are covered with the integuments.

Mr. Yarrell observed the following points of resemblance between the skeleton of *Chlamyphorus* and that of other *Mammalia*:—1. Beaver (*Castor Fiber*), in the form and substance of some of the bones of the limbs, in the flattened and dilated extremity of the tail, and the elongation of the transverse processes of the lower caudal vertebræ, but no further. 2. Mole (*Talpa Europæa*), in the shortness and great strength of the legs, and in the articulation of the claws to the first phalanges of the toes; but in the form of the bones of the anterior extremity, as well as in the compressed claws, it is perfectly different, nor do the articulations of the bones, nor the arrangement of the muscles, allow any of the lateral motion so conspicuous in the mole. The hinder extremities of *Chlamyphorus* are also much more powerful. 3. Sloth (*Bradypus tridactylus*), in the form of the teeth, and in the acute descending process of the zygoma, but not otherwise. 4. Armadilloes (*Dasypi*), in the coat of mail, in the peculiar ossification of the cervical vertebræ, in possessing the sesamoid bones of the feet, and in the general form of the bones, except those of the pelvis; they differ however in the form and appendages of the head and in the tail. 5. *Orycteropus Capensis* and *Myrmecophaga jubata*, in some of the bones. 6. *Echidna* and *Ornithorhynchus*, in the form of the first bone of the sternum, and in the bony articulations as well as the dilated connecting plates of the true and false ribs. 7 and 8. *Ruminantia* and *Pachydermata*, in the form of the lower jaw, and in other points equally obvious. The unique points in its structure appear to be the form of the head and the open pelvis.

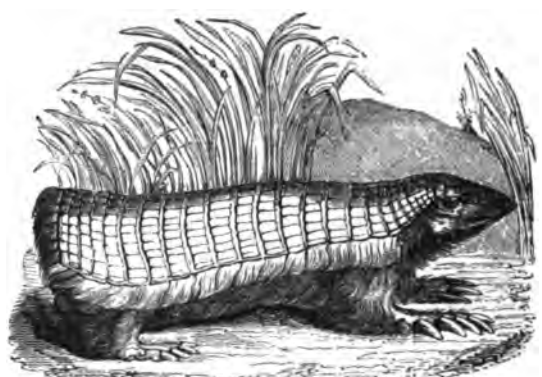
According to Dr. Harlan, the total length of the entire animal is 5¼ inches. The shell which covers the body is of a consistence somewhat more dense and inflexible than sole-leather of equal thickness, and is composed of a series of plates of a square, rhomboidal, or cubical form, each row separated by an epidermal or membranous production, which is reflected above and beneath, over the plates: the rows include from 15 to 22 plates, the shell being broadest at its posterior half, extending about one-half round the body. This covering is loose throughout, excepting along the spine of the back and top of the head, being attached to the back immediately above the spine by a loose cuticular production, and by the two remarkable bony processes on the top of the os frontis, by means of two large plates, which are nearly incorporated with the bone beneath; but for this attachment the covering would be very easily detached. The number of rows of plates on the back, counting from the vertex, where they commence, is 24; at the twenty-fourth the shell curves suddenly downwards, so as to form a right angle with the body; this truncated surface is composed of plates, nearly similar to those of the back; they are disposed in semicircular rows, five in number; the lower margin, somewhat elliptical, presents a notch in its centre, in which is attached the free portion of tail, which makes an abrupt curvature, and runs beneath the belly parallel to the axis of the body, the extremity of the tail being depressed, so as to form a paddle; the rest of the tail compressed. The superior semicircular margin of the truncated surface, together with the lateral margins of the shell, are beautifully fringed with silky hair.

The posterior half of the head broad, anterior half, before the eyes, tapering; the occiput is covered by the first five rows of the back plates with which they are continuous; the occiput not distinguishable externally. The anterior half of the top of the head is covered, first, by a row of large plates, five in number, which are firmly attached to the bone beneath, particularly the two outer; secondly, by a smaller row, six in number, anterior to which, that is to say, the top of the snout, is covered with smaller plates irregularly disposed.

Mr. Yarrell observes that when separating the skin from the muscles of the back the fibres (described by Dr. Harlan) by which the outer coat was attached in the line of the vertebræ were found to be adherent to the muscles immediately investing the spinous processes, and each of them, Mr. Yarrell supposes, probably affords a nidus for vessels nourishing the external covering; but these attachments did not extend below the dorsal vertebræ. Proceeding from thence forwards the great size of the muscles of the scapulæ and neck was apparent, filling up the whole space, the back and upper portion of the head forming one continued line. The thick plate of scales covering the frontal portion of the head was without difficulty separated from the surfaces of the singular bony processes of the os frontis; the projecting cartilaginous portion of the nose was removed with the skin, and the tendons of several muscles giving motion to the snout were cut through.

The hinder portion of the body still remained to be separated from the skin, and this was found to be a matter of some difficulty. The posterior and inferior portions of the sacrum on each side were firmly united by distinct attachments, differing in form, to certain scales of the truncated extremity of the outer covering.

The necessity of preserving this outer covering entire rendered a division of these portions of bone necessary, and from the particular form of the part this was attended with some hazard, but was ultimately accomplished without injury, the bones being cut through as



Chlamyphorus truncatus.

Truncated extremity and tail.

near to and as parallel with the inner surface of the plates as their confined situation would admit. The covering of the tail was separated from the vertebræ as far as the flattened extremity, where the greater elongation of the transverse processes of the last four vertebræ and the tenuity of this flattened portion made further separation difficult. The tail was then divided between the tenth and eleventh vertebræ, and both parts of the animal entirely separated.

On the inner surface of the removed skin were two long broad and thin muscles extending the whole length of the back; each muscle was divided as it approached the shoulder into two portions; the outer one was attached to the superior and greater spine of the scapular bone; the inner and longer slip proceeded forwards, and was inserted into the transverse occipital ridge. The posterior extremity of each muscle was attached to the superior edge of the spine of the ilium. The external ear, according to Dr. Harlan, consists of a circular somewhat patulous opening, directly posterior to the eye, surrounded with an elevated margin, and communicating with a bony canal. The eye is minute, totally black, and, like the ear, nearly hidden by long silky hair. The mouth is small. The nose is furnished with an enlarged cartilage, as in the hog, the anterior nares opening downwards at the inferior border.

The whole surface of the body is, it appears from the same author, —and the correctness of his description is proved by an inspection of the stuffed specimen—covered with fine silk-like hair, longer and finer than that of the mole, but not so thick set. The anterior of the chest is large, full, and strong; the anterior extremities short, clumsy, and powerful; the hair is continued for some distance on the palm—the phalanges of the hand united; five powerful nails rising gradually one above the other, the external shortest and broadest; the whole so arranged as to form a sharp cutting instrument, rather scooped, very convenient for progression under ground, and such as must very much impede motion on the surface. Hind legs weak and short; feet long and narrow; the sole resembles considerably the human foot, having a well-defined heel, which rests flat upon the ground, and being arched in the middle; toes separate, nails strong.

In the specimen dissected by Mr. Yarrell the abdomen and thorax had been opened throughout their whole length, and the viscera from both cavities had been entirely removed. Adhering to the skin lining the truncated portion of the animal were two sacs, which had been lodged in cavities on each outer side of the sacrum, immediately under the superior projection, made evident by the corresponding depression in the investing muscle of that part. These globular bags were lined with a secreting surface, but having suffered some mutilation in removal, the mode by which the secretion passed, or its particular use, could not be ascertained. Mr. Yarrell thinks that they are probably analogous to the well-known anal glands of various other quadrupeds.

According to Mr. Closeberry, who first discovered this animal, the habits of *Chlamyphorus* resemble those of the mole, as it lives for the most part under ground. He adds that the animal is reputed to carry its young beneath the scaly cloak with which it is covered, and that the tail possesses little or no motion.

CHLAMYS. [CHRYSOMELIDÆ.]

CHLENACEÆ. [CHLÆNACEÆ.]

CHLORA, a genus of plants belonging to the natural order *Gentianaceæ*. It has 8 sepals, a rotate corolla with 6-8 segments withering round the capsule, the stigma bi-lamellate, the anthers not altering, the capsule 1-celled with spongy placentæ, the seeds angular.

C. perfoliata, Yellow-Wort, has the lowermost leaves elliptico-oblong, narrowed below; the leaves of the stem broadly perfoliate. The corollas are of a bright-yellow colour, and the stigmas are scarlet. The whole plant is glaucous, and is very subject to attacks of mildew. It is a native of chalky hills and banks in most countries of Europe. It is found in England and Ireland, but not in Scotland. Like the whole order to which it belongs it possesses a bitter principle, which renders its action on the system tonic. It may be used in all those cases of debility and in diseases where the roots of the *Gentiana* and *Erythræa* are recommended. Its tonic properties are not however so powerful as in many other species of the order.

(Lindley, *Flora Medica*; Babington, *Manual of British Botany.*)

CHLORANTHA'CEÆ, *Chloranths*, a natural order of Achlamydeous Exogenous Plants allied to the Peppers, and like them having an aromatic fragrant odour. They are known from the orders associated with them by their jointed stems and opposite leaves, with intermediate stipules. Their flowers grow in naked spikes, and consist of an ovary next the axis of inflorescence, and a fleshy anther on the outside. Besides *Chloranthus* [CHLORANTHUS] two other genera, *Hedyosmum* and *Ascarina*, constitute this order. In structure they are allied to *Piperaceæ*, *Urticaceæ*, and *Saururaceæ*. The order contains about 15 species.

CHLORANTHUS, a genus of plants belonging to the natural order *Chloranthaceæ*. It has spiked flowers, each with a bract. Calyx absent. Anther solitary and 2-celled, or triple and 4-celled, with a thick fleshy connective; seated on the exterior side of the ovary. The stigma sessile. Drupe baccate, 1-seeded.

C. officinalis is a smooth shrub 3-4 feet high, with opposite straggling branches, tumid at the articulations, fistular when young. Leaves spreading, opposite, stalked, oblong, acuminated at each end, with glandular serratures, thin, shining, and somewhat blistered; petioles short and taper. Spikes terminal, branched. Bracts dotted with glands. Anther white, changing to yellow. Drupe straw-coloured. All the parts are powerfully aromatic; the roots, if quickly dried, retain their properties for a long time. The plant is a native of Java, in the moist woods, at an elevation of 1500 feet above the level of the sea.

The mountaineers of Java employ the roots in infusion as a remedy for spasms; also when united with Anise or *Ocymum* it is given in small-pox. In fevers and a suppression of the functions of the skin it is said to be of the greatest service. It is no doubt a powerful and active stimulant.

Chloranthus officinalis.

1, Spike, the upper and lower flowers without stamens; 2, flower without its bract; 3, an interior view of the anther; 4, a magnified fruit; 5, the kernel of the fruit; 6, a section of the fruit, showing the embryo; 7, the stone of the fruit, with a portion of the shell removed; 8, a perpendicular section of the ovary, showing the position of the ovule.

C. brachystachys is also a native of the coast of Java. It is an upright bush about 3 feet high, quite smooth in all its parts. Leaves obovate, lanceolate, tapering very much into the petiole, sharply serrate. Spikes short, terminal, branched. Bracts glandular. Anther simple, 2-celled, growing from the side of the ovary. Its properties are like those of the last species.

CHLO'RION, a genus of Hymenopterous Insects of the section *Fossores*. [SPHEGIDÆ.]

CHLORITE, a Mineral of a dark olive-green colour belonging to the talc, or hydrous silicate of magnesia series. It occurs in masses of a granular texture, rarely in hexagonal crystals, foliated like talc. It has a slight pearly lustre, and is sub-translucent or opaque, rarely sub-transparent. Its hardness is 1·5; specific gravity, 2·65 to 2·85. It has the following composition:—

Silica	30·4
Alumina	17
Magnesia	34
Protoxide of Iron	4·4
Water	12·6

It fuses with difficulty on the thinnest edges. Its olive-green colour and granular structure distinguish it from Serpentine. It may be known from Talc by its yielding water on fusion.

Chlorite Slate is an impure variety which occurs abundantly, sometimes in slaty rocks.

CHLORITOID, a Mineral of a greenish-black colour, and coarsely foliated. It is one of the hydrous silicates of alumina. No analysis of it appears to exist. It comes from the Ural Mountains, and has a hardness = 5·5, and a specific gravity = 3·55. (Dana, *Mineralogy*.)

CHLOROMYS. [AGOUTI.]

CHLOROPAL is a Mineral of a greenish-yellow or pistachio-green colour. It is a Silicate of Iron.

CHLOROPHÆITE, a Mineral found by Dr. Macculloch in the Isle of Rum. It occurs in small masses imbedded in basalt or a black indurated ironstone. Its colour when fresh broken is green, which becomes black by exposure to the air. It is brittle and soft enough to be scratched with a quill. Its specific gravity is 2·02. Some specimens are transparent, others are opaque. The lustre is vitreous; the fracture of the transparent sort is conchoidal, of the opaque intermediate between conchoidal and granular. (Phillips's *Mineralogy*.)

CHLOROPHANE. [FLUOR-SPAR.]

CHLOROPHYLE. (*Endochrome, Phytochlore, Chromule.*) The green colouring-matter of plants. It is obtained by bruising, pressing, and then washing leaves with water, and afterwards treating them with alcohol, which dissolves the green colour and wax; when water is added to this solution, and the alcohol distilled, the green substance, which contains wax, floats on the surface of the water; when this is heated with ether, the wax is dissolved, and Chlorophyle remains nearly pure. When exposed to light, or the action of chlorine, it is bleached. Acids produce a similar effect, and by the alkalis it is converted into soap. The red tint which leaves assume in autumn appears to be owing to the formation and action of an acid; the green colour is restored by an alkali.

This substance has been recently investigated with great care by Mulder, and the following account of it is chiefly derived from his researches as given in his 'Chemistry of Animal and Vegetable Physiology.':—

It is a striking fact that young leaves have a much lighter green colour than those which are older, showing that the quantity of Chlorophyle increases with the age of the leaves. If Chlorophyle were a substance poor in oxygen, and were derived from substances rich in oxygen, this fact alone would be sufficient to explain the power which the green parts possess of separating oxygen. This however is not the case: Chlorophyle is rich in oxygen. Nevertheless the leaves give off oxygen not because they are green, but whilst they are becoming green.

When green leaves are digested with ether the liquid becomes green. On evaporating the etherial solution, and treating the residue with hot alcohol, a considerable amount of white fatty matter (wax) separates on cooling, while the green colouring-matter remains in solution. Before proceeding to the consideration of the green colouring-matter, it will be expedient to say a few words respecting the mixture it forms with the wax.

In a physiological or botanical sense this mixture has the name of Chlorophyle; in a chemical sense the term is restricted to the actual green pigment. To prevent confusion, the former is designated as B. Chlorophyle, and the latter as C. Chlorophyle; B. indicating the botanical, and C. the chemical signification of the word.

We find similar mixtures of a waxy fat and colouring-matter in other external parts besides the leaves, namely, in the skins of fruits, especially of such as are coloured; and on digesting them in ether we obtain a large quantity of waxy matter in solution, varying in tint according to the colour of the skin; being gray when obtained from apples, and of a beautiful orange-colour when obtained from the berries of the Mountain-Ash.

The degree in which the action of light contributes to the change of colour in the C. Chlorophyle which exists in the perisperms, and to the production from it of the colouring-matter of the skin of ripe fruits, may be obviously inferred from the green colour which such fruits retain if they do not receive a sufficient supply of solar light, or from the difference of colour exhibited by the opposite side of the same fruit, as well as from the fact that leaves when deprived of the action of light become colourless, while if completely exposed to its action they secrete a considerable amount of B. Chlorophyle.

This apparently anomalous difference in the action of light on the skins of fruits and on leaves is dependent on the same cause as the change of colour in the leaves during autumn; namely, that light can only produce B. Chlorophyle when there is a sufficient supply of materials for its renewed formation as often as the existing quantity is decomposed by the influence of the light; and that as soon as this supply is exhausted the green colouring-matter is itself decomposed, and other compounds are formed from it.

Light acts powerfully in keeping plants green, and likewise exerts a powerful decomposing action upon all colouring-matters, the C. Chlorophyle not excepted; thus asparagus, potatoes, young leaves, &c., become green whenever they are exposed to light, and hence there must be a substance widely diffused through plants, which causes the production of Chlorophyle. The change takes place not merely on the surface, but beneath it as far as light can penetrate through the semi-transparent parts. All plants however are not coloured green; some have no colour at all, while others are speckled or spotted, or of a colour entirely different from green. Hence we conclude that in these plants or parts of plants, the materials yielding Chlorophyle are absent. We may sometimes observe in summer one single spot of a green leaf coloured red by the action of insects or by being injured by hail; the green colouring-matter is at the spot decomposed by the light; no new portion is formed, and the spot acquires the same colour which the whole leaf would have assumed in autumn. From this we infer that the change of colour in the leaves during autumn is simply dependent on a chemical alteration of the green colouring-matter by light.

Mulder, after showing from a large number of facts that wax along with a green colouring-matter exists in leaves and unripe fruits,—wax, with a red colouring-matter, in the red leaves which appear in autumn, and in the red fruits,—and wax with a yellow colouring-matter, in the yellow leaves of autumn, and in the yellow fruits—gives a lengthened chemical description of Chlorophyle, for an account of which we must refer to the original work.

From Mulder's experiments, and those previously instituted by Berzelius, it appears that the green colouring-matter of the leaves is readily decomposed into three different substances, one yellow, another blue, and a third black; and that according to the proportion of these three mixed with the green, a different kind of green must be produced. Hence the difference in the green colour of different leaves depends not only on the presence of more or less Chlorophyle, but also on the different mutual proportions of these three colouring-matters.

The quantity of pure C. Chlorophyle contained in the leaves is exceedingly small; according to Berzelius it is not more than the amount of pigment in dyed cotton.

If a tincture of pure Chlorophyle be exposed to the action of the sun the green colour becomes in a few hours converted into a yellow. When a solution of pure Chlorophyle in ether and hydrochloric acid was kept for five months in a bottle half full, the green was entirely changed into a yellow. From these experiments we learn, first, that the green colouring-matter is decomposed and a yellow one left, both with and independently of the influence of light; and secondly, that in all probability a similar decomposition (accompanied by a reproduction) of green colouring-matter and green leaves is constantly going on under the influence of light. Mulder conceives that the continual decomposition of the green colouring-matter may be in part the origin of the wax, since the quantity of the latter is found to have increased when the same leaves are analysed later in summer. In consequence of the continuance of this reproduction, the leaves remain green; when it stops, the leaves become yellow as in autumn.

It is worthy of notice that decomposed Chlorophyle yields a blue colouring-matter; it is this which is no doubt present in the skins of many fruits, as for instance those of the grape; the exact nature of the chemical change is not clearly understood.

It is very obvious that the influence of light will convert starch into Chlorophyle. Every part of an amylaceous root becomes green on exposure to light. The parts of plants which become green (all without exception) contain starch; and in autumn as this green colour decreases the starch also decreases, and finally cannot be detected by the iodine-test. Hence starch ceases to form B. Chlorophyle under the influence of light, the B. Chlorophyle being a complex substance consisting chiefly of wax. The change of starch into B. Chlorophyle may be explained in much the same manner as its conversion into fat.

The wax contained in the leaves and other parts of plants may be chemically represented by the formula $C_{15}\ H_{15}\ O$. Now if no other products be simultaneously produced we may suppose the wax obtained from the starch in the following manner:—

5 equiv. of starch	$C_{60}\ H_{50}\ O_{50}$
With 10 of water	$H_{10}\ O_{10}$
Make	$C_{60}\ H_{60}\ O_{60}$
And 4 of wax	$C_{60}\ H_{60}\ O_{4}$
Leaving to be given off . . .	O_{56}

That is to say, 5 equivalents of starch yield 4 equivalents of wax, and give off 56 equivalents of oxygen. This fully explains the phenomenon why plants, while becoming green, evolve oxygen, and further indicates the use of starch in the leaves.

Mulder has, as far as we are aware, made only one ultimate analysis of pure C. Chlorophyle—that from poplar leaves; from this analysis he calculated the formula $C_{18}\ H_9\ N\ O_8$.

"Properly speaking," Mulder observes, "the green colouring-matter in the leaves has nothing to do with the evolution of oxygen; on the contrary, the colourless C. Chlorophyle, which seems to be every where present, becomes green by the absorption of oxygen. Hence a small portion of the oxygen produced, from the conversion of starch into wax is employed for this purpose, and is not mixed with the atmosphere. But this is just the reason why C. Chlorophyle is not formed by the exhalation of oxygen; it only becomes green instead of white, as it previously was. This can only happen when there is an abundance of oxygen, and this we have seen to be the case when starch is converted into wax. We may therefore assume as proved that white Chlorophyle diffused throughout the whole plant, will become green in proportion as starch is converted into wax; because it is enabled, in such proportion, to take up oxygen—to become oxidised, just like white indigo.

"Now, the probable composition of green Chlorophyle,—$C_{18}\ H_9\ N\ O_8$ shows that pure white Chlorophyle is not produced from starch. It is necessary that an azotised body in a liquid state should penetrate into the globule of starch, which during this transformation into wax is converted into $C_{18}\ H_9\ N\ O_8$. We do not know yet what that substance is, but it is certain that it must be one which is diffused throughout the plant like starch; hence it is probably protein, which is changed into a most beautiful violet-coloured substance by the influence of hydrochloric acid and oxygen."

At one time it was supposed that the possession of Chlorophyle was characteristic of the vegetable kingdom. The following remarks however of Schultze, in the 'Comptes Rendus' for May 1852, would seem to indicate that the green colouring-matter of some animals closely approaches that of plants. He enumerates several animals of a green colour which are common in ditches and marshes, such as *Hydra viridis*, several green *Turbellarieæ*, *Vortex viridis*, *Mesotonum viridatum*, and *Derostomum cæcum*, and also several green *Infusoria*, such as *Stentor polymorphus*, *Ophrydium versatile*, and *Bursaria vernalis*. The colour in these animals is afforded by minute green globules, about 0·016 inch in diameter, which are situated under the integument in the parenchyma of the animals. They are perfectly spherical, and exhibit within the green substance an extremely minute colourless and homogeneous nucleus; or they may consist of several minute green globules, grouped together in a mulberry form. In this latter case they arise from the division of a homogeneous vesicle. This green colouring substance is not altered by dilute acids or alkaline solutions, by which it is distinguished from the green colouring-matter of several *Algæ*, which according to Nägeli is changed into yellow, orange, or red by the same reagents. Concentrated sulphuric and muriatic acids dissolve the colouring-matter: the solution is of a beautiful green or bluish-green colour, unchanged by the action of heat; it is also dissolved by a concentrated solution of potass, by ammonia, alcohol, and ether, the colour precisely resembling that of a solution of Chlorophyle. Its development also is influenced in the same way as that of vegetable Chlorophyle by light; but animals containing it do not evolve oxygen, and the author thence concludes that the evolution of that gas is not solely dependent upon the Chlorophyle in plants. In *Vortex viridis* the minute green globules, owing to their mutual compression, assume a hexagonal form; the green compartments thus formed are separated by an interstitial colourless substance. The existence of a colourless membrane around each vesicle may thence be deduced. This fact is further demonstrated in vesicles the green matter of which only partially fills the globular cavity.

With respect to the chemical composition of the membrane and of the nucleus of the vesicles in *Vortex viridis*, the results of the author's researches are limited to the following facts:—the solution of potass, and of ammonia and sulphuric acid, after the extraction of the colouring-matter, causes the membrane to swell out, in which the nucleus can no longer be recognised. The membrane becomes pale, and finally disappears entirely, but especially so after long boiling. Acetic and chromic acids and alcohol do not affect the membrane and the nucleus. By solution of iodine the vesicle is coloured brown, the nucleus becomes more distinct, but its colour is unaltered. It cannot consequently be assimilated to the nucleus of the vegetable chlorophyle vesicle, which most frequently consists of amylum.

CHLOROPHYLLITE, a Mineral occurring in 6- and 12-sided prisms, highly foliated, parallel to the base. The folia are soft and brittle, the lustre pearly, the colour grayish-green to dark-olive green. It has the following composition:—

Silica	45·2
Alumina	27·6
Magnesia	9·6
Protoxide of Iron	8·2
Protoxide of Manganese	4·1
Water	3·6

It fuses only at the edges, and yields water before the blow-pipe. It occurs with *Iolite* in granite in the United States. A variety under the name of *Esmarkite* is brought from Brevig in Norway. *Fahlunite*, *Gigantolite*, and *Aspasiolite* are allied to this mineral, and like it probably proceed from the alteration of *Iolite*.

CHLOROSPERMEÆ. [ALGÆ.]

CHLOROSPINEL. [SPINEL.]

CHOANI'TES, a group of Spongoid Fossils from the Chalk of England and France, thus named by Mantell. Analogous living forms occur on the coast of Australia.

CHOCOLATE-TREE. [THEOBROMA.]

CHŒROPOTAMUS, a genus of extinct *Mammalia* belonging to the order *Pachydermata*.

C. Cuvieri (Owen). This animal, the remains of which have been found in the gypsum beds of Montmartre, Paris, and the Eocene Formations of the Isle of Wight, seems to have resembled the Peccari, but must have been about one-third larger, and was the earliest form of the Hog-Tribe introduced upon our planet. Cuvier was the first to recognise the distinct characters of this animal from the remains found at Paris. They were subsequently much more clearly defined by Professor Owen from the portions of the animal discovered in the Isle of Wight. The *Chœropotamus* is one of the links between the existing *Hippopotamus* and Hog-Tribe. Professor Owen in his 'British Mammals and Birds,' remarks, "Nothing as yet is known of the incisors of the *Chœropotamus*, the rest of the dentition closely resembles that of the Peccari; but the premolars are more simple, and the canines by their size, shape, and direction, and the lower jaw by the backward prolongation of its angle, alike manifest a marked approximation to the Ferine type. The occasional carnivorous properties of the common Hog are well known, and they correspond with the minor degree of resemblance which this existing pachyderm presents to the same type. The extinct *Chœropotamus*, still better adapted by its dentition for predaceous habits, presents an interesting example of one of those links, completing the chain of affinities which the revolutions of the earth's surface have interrupted as it were, and for a time concealed from our view." Other links in this chain of affinity are the genera *Anthracotherium* (Cuvier), *Merycopotamus*, and *Hippophyus* (Cautley and Falconer).

CHOIROPOTAMUS, a genus of Hogs found in Africa. [SUIDÆ.]

CHOLÆPUS, Illiger's generic name for the Two-Toed Sloths. [BRADYPUS; EDENTATA.]

CHOLESTERIN, a crystalline matter formerly known as a biliary fat, and supposed on account of its occurrence in biliary concretions to be especially connected with the secretion of the liver. It separates from its solutions in nacreous scales, which under the microscope appear in very thin rhombic tablets. It fuses at 145°, becoming solid and crystalline at 135°. It is found to consist of Carbon, Hydrogen, and Oxygen (C_{37} H_{32} O). In order to prepare it artificially gall-stones should be boiled in alcohol, when the Cholesterin is deposited by evaporation and cooling. Although when dissolved it is not easily detected in the fluids of the body, its presence is easily detected by the form of its crystals.

Small quantities of Cholesterin occur in most of the animal fluids. It is constantly present as a normal constituent of the bile, and also of the blood. The quantity in blood averages 0·088 in 1·000 parts.

It is often found as a morbid product in the body. Its mode of formation is unknown.

CHOMA'TODUS, a genus of Fossil Fishes from the Mountain Limestone of Bristol and Armagh. (Agassiz.)

CHOMORO, a name for *Podocarpus cupressinus*.

CHONDRILLA, a genus of plants belonging to the natural order *Compositæ* and the sub-order *Asteraceæ*, one species of which, *C. juncea*, yields a gum.

CHONDRI'TES. A Fossil Fucoid from the Greensand, named *Fucoides Targioni* by Mantell, is thus entitled by Sternberg. ('Flora der Vorwelt.') It is very widely disseminated in the Greensand deposits of Europe. *Fucoides intricatus* of Brongniart belongs also to the Lower Cretaceous system in the Alps and Carpathians.

CHONDRODENDRON, a genus of plants belonging to the natural order *Menispermaceæ*. One species, *C. convolvulaceum*, is employed as a febrifuge in Peru. Endlicher states that the bark of some of the species is used for dyeing yellow.

CHONDRODITE, a Mineral, containing—

Silica	33·1
Magnesia	55·5
Protoxide of Iron	3·6
Fluorine	7·6

It occurs usually in imbedded grains or small rounded or flattened kernels or nodules in limestone, and appearing brittle. The colour is brownish-yellow or brown. The lustre vitreous. It is translucent or subtranslucent, with an uneven fracture. Hardness, 6 to 6·5; specific gravity, 3·1 to 3·2. It has also been called *Brucite*. Found in granular limestone in the United States.

CHONDROPTERY'GII, or CARTILAGINEI, one of two great sections into which the class of Fishes is divided.

In this section we find species which possess, in most respects, the highest degree of organisation, while others possess the lowest observed in the class.

The principal character which distinguishes this section from the fishes with true bone (which usually come first in arrangement) is the cartilaginous substance of which the bones are composed, a circumstance arising from the very small quantity of earthy matter which enters into their composition. This earthy matter, when observed, is found to be disposed in small granules and not in distinct fibres, as in the first section.

The cranium of these fishes is not divided by true sutures, but is formed of a single piece: the maxillary and intermaxillary bones are either wanting or rudimentary, and their functions are performed by bones analogous to the palatines, and sometimes the vomer. Many of the vertebræ are often consolidated. The gelatinous substance, which in most fishes fills the intervals between the vertebræ (these intervertebral masses being connected only by a small cord), in this section frequently forms a thick cord, which varies but slightly in diameter.

In the Myxine (*Gastrobranchus cæcus*) no distinct vertebræ are perceivable, their place being occupied by a soft gelatinous tube. In the extraordinary little fish described by Mr. Yarrell in his 'History of British Fishes,' the Lancelet (*Amphioxus lanceolatus*), this part is still more rudimentary, consisting only of a slender transparent column. [BRANCHIOSTOMA.]

The *Chondropterygii* are divided by Cuvier into two orders—those which have their gills free, as in the generality of fishes; and those in which they are fixed—that is, the external edge attached to the skin. In the former of these orders the species have but one external gill-opening, and in the latter they have several—generally five. These orders are divided into families and genera, as follows:—

Order 1. *Chondropterygii.* With free Gills.
Family 1. *Sturionidæ* (Sturgeons).
Genus 1. *Accipenser.*
„ 2. *Spatularia.*
Family 2. *Chimæridæ.*
Genus 1. *Chimæra.*
Order 2. *Chondropterygii.* With fixed Gills.
Family 1. *Squalidæ* (Sharks, &c.).
The principal genera are:—
Squalus.
Zygæna (Hammer-Headed Sharks).
Squatina (Angel-Fish).
Pristes (Saw-Fish).
Family 2. *Raiidæ.*
Principal genera:—
Torpedo (Electric Rays).
Raia (Skate-Fish).
Trigon (Sting-Rays).
Mylobates (Eagle-Ray).
Cephaloptera.
Family 3. *Pteromyzidæ* (Lampreys, &c.).
Genus 1. *Pteromyzon.*
„ 2. *Ammocœtes.*
„ 3. *Gastrobranchus.*
„ 4. *Amphioxus* (*Branchiostoma*).

CHONDROSE'PIA, Leuckart's name for a genus of *Cephalopoda*, the *Sepioteuthis* of Blainville. [SEPIADÆ.]

CHONDRUS. [ALGÆ.]

CHONDRUS, a Pulmoniferous Mollusk. [HELICIDÆ.]

CHORDARIACEÆ. [ALGÆ.]

CHOUGH. [CORVIDÆ.]

CHRISTIANITE, another name for *Anorthite.* [ANORTHITE.] It has also been applied to a mineral allied to *Phillippsite.* [PHILLIPPSITE.]

CHRISTMAS-ROSE. [HELLEBORUS.]

CHRISTOPHER, HERB. [ACTÆA.]

CHROMIRON. [CHROMIUM.]

CHRO'MIS, a genus of Fishes. [LABRIDÆ.]

CHROMIUM, a Metal. It does not occur pure in nature. The following are the most important ores containing Chromium:—

Chromate of Lead. *Red Lead.* Occurs massive and crystallised. Primary form of the crystal an oblique rhombic prism. Colour deep orange-red. Lustre adamantine, sometimes translucent, rarely transparent. Specific gravity, 6. Hardness, 2·5 to 3. Brittle; streak orange-yellow. Cross-fracture uneven, passing into conchoidal, with a splendent lustre. With the blowpipe it crackles and melts into a grayish slag. Soluble in nitric acid; solution yellow. Occurs in the gold mine of Berezof in Siberia, in the Ural, and Brazil.

When pure it is composed of—

Chromic Acid	31·71
Oxide of Lead	68·29
	100

Massive varieties amorphous; structure columnar, granular.

Subsesquichromate of Lead. *Monochroite.* Occurs massive and crystallised. Form of the crystal imperfectly described. Colour red. Lustre resinous; translucent on the edges. Specific gravity, 5·75; very soft. Powder tile-red.

Fuses by the blowpipe into a dark mass. Occurs with Chromate of Lead in the Ural. It is composed of—

Chromic Acid	23·31
Oxide of Lead	76·69
	100

Chromate of Lead and Copper. *Vauquelinite.* Occurs massive and in minute crystals. Primary form an oblique rhombic prism. Colour black or greenish-black. Lustre adamantine, nearly opaque. Specific gravity, 5·5 to 5·78. Hardness, 2·5 to 3. Streak greenish. Fracture uneven.

Before the blowpipe it fuses into a dark gray globule of metallic lustre, surrounded with beads of metallic lead.

The massive varieties are amorphous, botryoidal, reniform. Structure compact, fine granular.

Found with Chromate of Lead in Siberia.

Composed of, according to Berzelius,—

Chromic Acid	28·33
Oxide of Lead	60·87
Oxide of Copper	10·8
	100

Chromate of Iron. *Chromiron.* Occurs massive and crystallised. Crystal the regular octahedron. Colour blackish; lustre imperfect metallic; opaque. Hardness, 5·5; brittle. Specific gravity, 4·321. Streak brown. Fracture uneven, imperfect conchoidal. Not attracted by the magnet. Cleaves parallel to all its planes.

Analysis of the crystals from Baltimore, by Dr. Thomson:—

Green Oxide of Chromium	52·95
Peroxide of Iron	29·24
Alumina	12·22
White matter	3·09
Water	0·70
A trace of Silica	
	98·20

The massive is amorphous, with a granular or compact structure. It is found in the island of Unst, in Scotland, and sometimes interspersed with green oxide: it occurs also in France and in North America, especially near Baltimore. Oxide of Chromium has been observed in some aërolites.

CHRYSALIS. [PUPA; INSECT.]

CHRYSANTHEMUM, a genus of plants belonging to the natural order *Compositæ* and the sub-order *Corymbiferæ* or *Asteraceæ.* This genus is known by the receptacle being without scales, the heads of flowers heterogamous, the flowers of the ray containing pistils and those of the disc both stamens and pistils; the involucre hemispherical; the fruit terete, without wings, no pappus; the flowers of the ray ligulate, those of the disc tubular. The species are very numerous in the temperate parts of the earth.

C. Sinense is most extensively cultivated in our gardens. [CHRYSANTHEMUM, in ARTS AND SC. DIV.]

There are two British species:—

C. leucanthemum, Ox-Eye or Ox-Eye Daisy. It is very common in our fields, and is known by the large white ligulate flowers of the ray, and the yellow tubular ones of the disc.

C. Segetum, the Corn-Marigold. It is common in corn-fields, and is easily distinguished from the last species by the flowers of the ray being yellow instead of white.

CHRY'SAOR, one of the numerous genera into which De Montfort divided the Belemnites.

CHRYSA'ORA. [ACALEPHÆ.]

CHRYSI'DIDÆ, a family of Hymenopterous Insects of the section *Pupivora.* Distinguishing characters:—No nervures to the under wings; terminal segments of the abdomen forming a jointed retractile ovipositor; abdomen of the females with only three or four distinct segments, concave or flat beneath; antennæ 13-jointed in both sexes, and geniculated; mandibles slender, curved, and pointed; maxillary palpi filiform, generally longer than the labial palpi, and 5-jointed; the labial palpi are generally 3-jointed.

The *Chrysididæ* are most of them, if not all, of parasitic habits, that is to say, they seek the nests of other insects where they deposit their eggs to the destruction of the rightful owners; each species of this family apparently confining its attacks to the nest of some other hymenopterous insect, and generally selecting those of the same species. They are all of brilliant colouring, very active, and fly about in the sunshine; some are seen upon flowers, and most of them upon old walls, palings, and sand-banks. Some of these species are called Ruby-Tail Flies.

Chrysis ignita will afford a good illustration of this family. This insect is rather less than half an inch in length, has the head, thorax, and legs of a rich blue or green colour, and the abdomen of a burnished golden-copper hue; this part is truncated at the apex, and furnished with four little spines.

It will be perceived that the above is a description of a little four-winged fly, which so often attracts our notice from its brilliant colouring, and is so common on our garden walls when the sun is on them. This little insect is in constant motion, for if it ceases running or flying for a moment its little horns still keep up their vibratory motion. If we watch one of these insects for a short time, we perceive that it thrusts its head into every little hole in the brick-work; it is then searching after the nest of a wasp-like insect which builds in these situations.

The principal genera comprised in the family *Chrysididæ* are *Panorpes*, *Chrysis*, *Stilbum*, *Hedicrum*, *Elampus*, and *Cleptes.* An account of the habits of one of the species of *Panorpes* is given under the head BEMBEX, where the habits of *B. rostrata* are given, that being the species whose nests are subject to the attacks of the *Panorpes* which we are about to describe.

The genus *Panorpes* is distinguished from the other genera above mentioned principally by the elongated maxilla and labium, which appear like a proboscis, and the palpi being very small and two-jointed. *P. carnea* is about half an inch in length, and considerably broader than the *Chrysis ignita* (above described); the head, thorax, and base of the abdomen are of a blue-green colour; the remainder of the abdomen and the legs (with the exception of the thighs, which are blue) are of a reddish-yellow colour. It is found in various parts of Europe.

The characters of the genus *Chrysis* are:—Maxillary palpi 5-jointed, and longer than the labial; labial palpi 3-jointed; thorax not narrowed in front; labium rounded. About six or seven species of this genus are natives of England. *C. bidentata* is rather less than *C. ignita*, and differs from that species in having the thorax as well as the abdomen of a rich copper-like hue: the latter however has the apex blue. *C. cyanea* is entirely of a blue colour.

CHRYSOBALANA'CEÆ, *Chrysobalans*, a natural order of Polypetalous Exogenous Plants, allied to *Rosaceæ* and *Fabaceæ* (*Leguminosæ*), from which it differs in the style proceeding from the base of the ovary, and in its stamens being very irregular, often placed only on one side of the ovary. They are trees or shrubs, with alternate stipulate simple leaves, and flowers in loose racemes, corymbs, or panicles. Many species have no petals. They are exclusively natives of the tropics, where they often bear the name of plums. The gray or rough-skinned plums of Sierra-Leone are produced by species of *Parinarium*, and the Callimato, or Cocoa-Plum of the West Indies belongs to *Chrysobalanus Icaco*. [CHRYSOBALANUS.] The drupes of *Moquilla grandiflora* are edible. The order contains 11 genera and 50 species.

CHRYSOBALANUS, a genus of plants belonging to the natural order *Chrysobalanaceæ*. It has a campanulate 5-cleft calyx. Petals 5, unguiculate. Stamens about 20, nearly equal in length, disposed in one series. Drupe fleshy, plum-formed, containing an ovate 5-furrowed 1-seeded nut. Trees with simple leaves, and racemes or panicles of insignificant flowers. The fruit of all the species is edible.

C. Icaco, Cocoa-Plum, has nearly orbicular or obovate leaves, emarginate; racemes axillary, dichotomous; stamens hairy. It is a native of South America and the West Indies, by the sea-side, as well as of the southern parts of North America. The flowers are white. The fruit is about the size of a plum, ovate, roundish, varying much in colour, white, yellow, red, but most commonly purple, and usually covered with a sort of bloom. The skin is thin and the pulp white; the taste sweet, with some sharpness, but not unpleasant. It is eaten both raw and preserved. The root, bark, and leaves are used in medicine.

Cocoa-Plum (*Chrysobalanus Icaco*).

a, Flowers in different stages of development; *b*, vertical section of the flower; *c*, stamen; *d*, vertical section of the pistil, showing the ovules in the base of the ovary; *e*, horizontal section of fruit, showing the inclosed nut; *f*, transverse section of nut; *g*, a cotyledon, with the plumule at its base.

C. ellipticus, Elliptic-Leaved Cocoa-Plum, has elliptic leaves, obtuse or acute, never emarginate; racemes axillary, dichotomous; stamens hairy. It is a native of Sierra-Leone on the sea-side. The fruit is about the size of a damson, and like the other species is eatable.

The other species are—*C. oblongifolius*, Oblong-Leaved Cocoa-Plum, native of Brazil; *C. ovalifolius*, Oval-Leaved Cocoa-Plum, a shrub, native of Brazil; and *C. macrophyllus*, Large-Leaved Cocoa-Plum, also a native of Brazil.

The species thrive best in sandy loam. The best mode of increasing the plants is by seeds, when they can be procured.

CHRYSOBERYL, a Mineral called *Cymophane* by Haüy. It occurs massive and crystallised. Primary form, a right rhombic prism. Its colour is green, sometimes with a yellow or brown tinge, with occasionally a blue opalescence. Streak white. Lustre vitreous. It is translucent or transparent. Specific gravity about 3·8. Hardness, 8·5. Fracture conchoidal. Before the blowpipe it suffers no change alone; with borax it fuses into a transparent glass.

The massive variety occurs in rounded pieces.

It is found in Brazil, and in Connecticut, North America.

Seybert first found that it contained glucina. The following are his and Dr. Thomson's analyses:—

Seybert.		Thomson.	
Alumina	73·60	Alumina	76·752
Glucina	15·80	Glucina	17·791
Silica	4	Protoxide of Iron	4·494
Protoxide of Iron	3·38	Volatile matter	0·480
Oxide of Titanium	1		
Moisture	0·40		99·517
	98·18		

CHRYSOCHLO'RA, a genus of Dipterous Insects belonging to the family *Stratiomydes*. Characters:—Body elongated; antennæ with the basal joint short, the third long, conical, and compressed; stylet terminal, elongated; third posterior nervure of the wings not reaching the hinder margin.

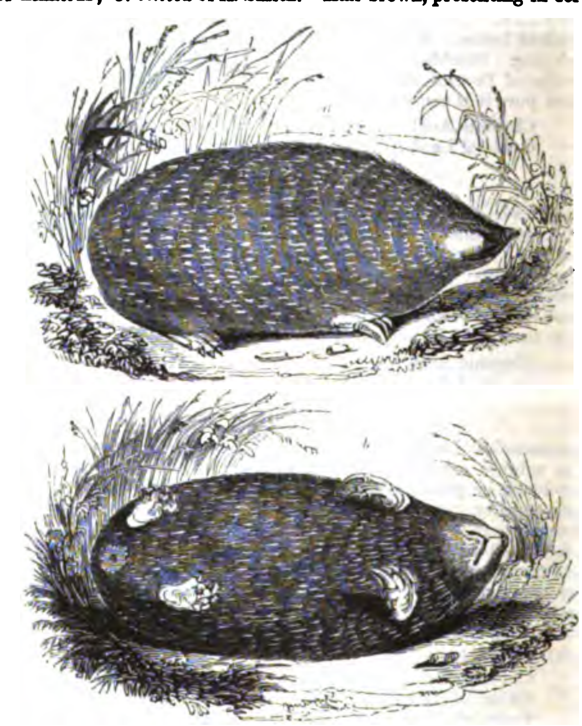
C. amethystina is about three-quarters of an inch in length; the head and antennæ are black; there is a white spot at the base of each antenna; the thorax and abdomen are of a violet-blue colour, the latter has a yellow spot on each side of the second, third, and fourth segments; the legs are black.

It inhabits the island of Mauritius and the East Indies.

CHRYSOCHLO'RIS (Lacépède), a genus of animals belonging to the class *Mammalia*, and allied to the Moles (*Talpa*), but differing from them in their dentition and in other particulars. Dental formula:— Incisors, $\frac{2}{4}$; canines, 0; molars, $\frac{9-9}{8-8} = 40$. The true molars are long, distinct, and nearly all in the shape of triangular prisms.

The muzzle is short, wide, and reflected. There is no external ear, nor any appearance of the eye externally. The fore feet have three claws only; the exterior claw is very large, arched, and pointed, forming a powerful instrument for penetrating and digging the earth; the other two diminish gradually. The hind feet are furnished with five claws of ordinary size. The fore-arm is supported by a third bone placed under the ulna to strengthen it when the animal is employed in excavation. The body is thick and short. The hair, or rather fur, which is thick set, has a metallic lustre.

C. Capensis, Desmarest; Taupe Dorée of the French; *Talpa Asiatica* of Linnæus; *C. villosa* of A. Smith. Hair brown, presenting in certain



Chrysochloris Capensis.

a, the animal on its feet; *b*, the same turned up to show the claws, &c.

lights very brilliant changeable green, bronze, and coppery tints. Cuvier says that it is the only quadruped whose covering reflects those metallic tints which render so many birds, fishes, and insects brilliant. There is no apparent tail.

This creature inhabits the Cape of Good Hope, where it is said to live much in the same way as the mole, and to prey like it upon worms, &c.

C. holosericia, the Changeable Mole, is a species also found at the Cape.

CHRYSOCO'LLA (from χρυσὸς, gold, and κόλλα, glue), is a name which the Greeks appear to have applied to Borax, perhaps from its use as a flux in melting gold.

CHRYSOCOMA, a genus of plants belonging to the natural order *Compositæ*. *C. Linosyris*, a British plant, is now referred to *Linosyris*. [LINOSYRIS.]

CHRY'SODON (Oken), a name given to the *Pectinaires* of Lamarck, the Amphictènes of Savigny, and the *Cistenes* of Dr. Leach, forming a part of the genus *Amphitrite* of Cuvier. [ANNELIDA.]

CHRYSOGA'STER, a genus of Dipterous Insects of the family *Syrphidæ*. Characters:—Body much depressed; no false nervures to the wings; third joint of the antennæ oval or orbicular.

About fourteen species of this genus have been discovered in England; they are all of moderate size, and their colouring is metallic. *C. splendens* is about one-third of an inch in length; the head is green; antennæ yellow; thorax golden-green; abdomen purple-black, greenish towards the sides; the legs are black; wings brownish. This and all the other species recorded as British have been found in the neighbourhood of London.

CHRYSOLITE, a Mineral called *Peridot* by Haüy. *Olivine* is a variety of this mineral, and *Chusite* also, according to Dr. Thomson.

It occurs massive and crystallised. Primary form a right rhombic prism. Colour green, sometimes brownish or yellowish; streak white. Lustre vitreous, translucent, transparent, double refracting. Specific gravity, 3·33 to 3·41. Hardness, 6·5 to 7. Fracture conchoidal.

The massive varieties are amorphous, granular.

The *Chrysolite* used in jewellery is brought from the Levant, and is supposed to be found in Upper Egypt. The variety on account of its colour called *Olivine*, occurs in basalt in Bohemia, Hungary, and on the banks of the Rhine. The following are analyses:—

	Klaproth.	Vauquelin.
Silica	39	38
Magnesia	43·5	50·5
Protoxide of Iron	19	9·5
	101·5	98·0

Some varieties contain small portions of alumina and of the oxides of nickel and manganese. It does not fuse or lose its transparency before the blow-pipe. With borax it fuses into a coloured glass, and with soda into a brown scoria.

CHRYSOME'LIDÆ, a family of Coleopterous Insects of the section *Cyclica*. Characters:—Antennæ wide apart at the base, and inserted before the eyes; body generally short and convex; tarsi short and rather broad, 4-jointed, the penultimate joint bilobed; all the joints, excepting the terminal joint, covered beneath with a velvet-like substance.

The *Chrysomelidæ* constitute a very numerous and beautiful family of the Beetle Tribe: they are generally of moderate size, and frequently very brilliant in colouring.

Between seventy and eighty species have been discovered in England, and the number of species contained in collections from various parts of the world may probably amount to four or five hundred.

This group may be divided into two sections: those in which the head is hidden beneath the thorax, and the body is frequently somewhat cylindrical; and those in which the head projects from the thorax so as to be distinctly seen when the insect is viewed from above, and where the body is generally rounded, or oval, and convex.

The first of these sections may again be readily subdivided according to the proportions of the antennæ. In some the antennæ are short, and more or less serrated; here belong the genera *Clythra*, *Lamprosoma*, and *Chlamys*. The species of this last genus are among the most remarkable of Coleopterous Insects. They are of small size, the largest being about half an inch in length, and the thorax and elytra are generally very uneven, and studded with numerous angular projections. This circumstance, together with the extremely brilliant colouring with which they are adorned, has caused them to be compared to pieces of minerals; indeed, one which is now before us, and which is of a beautiful red hue, we have known to be mistaken at first sight for a piece of copper-ore. Most of the species of *Chlamys* inhabit Brazil, and none are found out of the western hemisphere. The generic characters are:—Head vertical; thorax humped; the posterior margin produced in the region of the scutellum; body somewhat cube-formed; antennæ with the basal joint rather long, the second very small; the remaining joints dilated, and more or less serrated; labial palpi sometimes forked.

The remainder of the *Chrysomelidæ* of the first section have the antennæ long and slender. The genera are *Cryptocephalus*, *Choragus*, *Euryope*, and *Eumolpus*.

The second section, or those in which the head is apparent when the insect is viewed from above, comprises the genera *Colaspis*, *Podontia*, *Phyllocharis*, *Doryphora*, *Cyrtonus*, *Paropsis*, *Apamæa*, *Timarcha*, *Chrysomela*, *Phædon*, and *Prasocuris*.

The genus to which the name *Chrysomela* is now restricted, is principally distinguished by the following characters:—Maxillary palpi with the terminal joint as large or larger than the preceding one, and of the form of a truncated cone, or nearly oval; the elytra are separate, that is, not joined at the suture; no sternal projection.

Upwards of forty species of this genus have been discovered in England.

C. Banksii is one of the largest species of the genus: it is rather less than half an inch in length, and of a brown colour with a metallic lustre; the thorax has an indentation running parallel with and close to the lateral margins; the elytra are coarsely punctured; the legs and antennæ are ochre-coloured. It is found on nettles in the neighbourhood of London and elsewhere, but is rather local. *C. sanguinolenta* is about three-eighths of an inch in length, and of a dull blue-black colour; the elytra are rather rough. *C. Graminis* is about the same size as the last, and of a bright-green colour; this species is abundant in various parts of Cambridgeshire. *C. polita* is about a quarter of an inch in length, and very glossy; the head, thorax, and legs are green, and the elytra are of a reddish-ochre colour. This species is very common in marshy situations. *C. cerealis* is about the same size as *C. sanguinolenta*. This is one of the most beautiful species of the genus. It is tolerably common in France and Germany, but till found on the summit of Snowdon (about twenty years ago), was scarcely known as a British insect. It is very glossy; the legs, antennæ, and under parts are blue; the elytra are adorned with longitudinal stripes of blue, green, and red; and the same colours are observed on the head and thorax. *C. Goettingensis* is of a purple colour, and the elytra are very finely punctured. This species is very common in chalk districts. [CYCLICA.]

CHRYSO'PHILA, a genus of Dipterous Insects. [LEPTIDES.]

CHRYSO'PHORA, a genus of Coleopterous Insects of the section *Lamellicornia* and family *Xylophili*. The principal generic characters consist in the immense size of the hind legs of the males. The sternum is produced into a somewhat pointed process between the second pair of legs; the posterior thigh of the male is very thick; the tibiæ are curved, and produced at the apex internally into a long bent process; the hind legs of the female are thick, but comparatively short, and the hinder tibiæ are abruptly terminated; the outer claws of all the tarsi are larger (in both sexes) than the inner; they differ in the male, however, in being broader than in the female, and those of the anterior pair of legs are bifid; their outer claws are very long, and the insect has the power of bending them under so as to fix their points beneath a projection of the fourth joint of the tarsus: they are probably used for clinging to the slender branches or leaves of trees.

But one species of this genus is known—*C. chrysochlora*. It is of a rich metallic green colour; the head, thorax, and scutellum are shagreened; the elytra are rugose throughout; the tibia of the hind leg is of a brassy or copper-like colour; all the tarsi are blue-black. The length of the hind leg of the male exceeds that of the body, which is about one inch and a half; the female is rather less. This beautiful insect inhabits Venezuela.

CHRYSOPHRYS, a genus of Acanthopterygious Fishes belonging to the family *Sparidæ*. The body is deep, compressed; dorsal fin single, the rays partly spinous, the posterior rays flexible; teeth of two kinds, six incisors in each jaw, conical, with rounded and oval molar teeth in four rows above and three rows below; cheeks and operculum with scales; branchiostegous rays six.

C. aurata, Gilt-Head, is one of the fishes most abundant in the Mediterranean. From Gibraltar it is found as far south as the Cape of Good Hope, and northward along the coast of France and Spain. It has been recently taken on the British coasts. These fishes were so called by the Greeks on account of their golden-coloured eyebrows. They are said to spawn in the summer: their food consists of molluscous and testaceous animals. The Gilt-Head has peculiar rounded teeth. The body is deepest at the commencement of the dorsal fin. The head short and elevated; the back silvery gray, shaded with blue; the belly like polished steel, with longitudinal gold-coloured bands on the sides; the fins are a grayish-blue; the tail darker; the dorsal and anal fins appear as if placed in grooves from the rising edges of the scales on each side. This fish seldom exceeds 12 inches in length.

CHRYSOPHYL'LUM, a genus of Plants belonging to the natural order *Sapotaceæ*. *C. Cainito* yields a West Indian fruit commonly called the Star-Apple. Like the rest of its kindred it abounds in a sweet harmless milky juice, that flows most copiously when the tree is beginning to mature its fruit, which grows on a moderately-sized spreading tree with very slender flexible branches. The leaves are dark-green on their upper surface, and are covered beneath with a remarkably satiny ferruginous pubescence. The flowers grow in small purplish bunches, and are succeeded by a round fleshy smooth fruit, resembling a large apple. In the inside it is divided into ten cells, each containing a black shining rhomboidal seed, and surrounded by a white, or sometimes purplish, gelatinous pulp, traversed with milky veins, and of a very sweet agreeable flavour. In an unripe state the taste is said to be astringent and unpleasant. When cut across, the seeds, which are regularly disposed round the axis of the fruit, present a stellate figure, from whence the name of Star-Apple is derived. There is a smaller species, which produces the fruit called the Damson-Plum. The tree is common in the hot-houses about

London, and is well represented in a fruit-bearing state in Sloane's 'Jamaica,' plate 229.

CHRYSOPLE'NIUM, a genus of plants belonging to the natural order *Saxifragaceæ*. It has a 4-fid half-superior calyx, no corolla, 8 stamens (rarely 10), 2 styles, a 1-celled capsule with two beaks opening in the form of a cup. There are two species of this genus found in Great Britain, and known under the name of Golden Saxifrage. One is *C. alternifolium*, and is characterised by alternate leaves. It has an erect stem 4 or 5 inches high, with umbellate, nearly sessile, deep yellow flowers. It is a native of boggy places. *C. oppositifolium* has opposite leaves. The stem is decumbent and straggling, about 6 inches long. The flowers are paler and more scattered than in the last species. The leaves are usually glabrous, but sometimes they are slightly hairy. It is a native of damp shady places. (Babington, *Manual of British Botany*.)

CHRYSOPRASE. [AGATE.]

CHRY'SOPS, a genus of Dipterous Insects of the family *Tabanidæ*. Characters:—Head hemispherical; antennæ elongated, second joint nearly as long as the first, both covered with fine hairs; third joint equal in length to the first and second taken together, and having five false joints or divisions; eyes of a golden green colour, with purple lines or spots.

Upwards of thirty species of this genus have been discovered.

C. cæcutiens is a British form. It is rather larger than the common house-fly, the expanded wings measuring about two-thirds of an inch. It is black; the male has a yellow spot on each side of the first segment of the abdomen; the female, in addition to these spots, has the second segment yellow, with two diverging black lines in the middle; the wings are whitish; the anterior border is broadly margined with black, and there is a broad black band near the middle: the wings of the male are nearly all black.

Most persons undoubtedly have been troubled more or less with the insect above described when walking in the country, especially in the neighbourhood of water. Three or four will sometimes settle on us at the same time, and if on the arm their presence is soon discovered by a sharp prick, caused by their thrusting the proboscis through the sleeve; the bite however is not venomous, and for the slight pain caused by it we are repaid by a sight of the little insect. Nothing can be more beautiful than its large eyes, which seem to reflect all the colours of the rainbow: they may be described as green with purple spots, but the green varies to golden and red hues in certain lights. When it first settles, this fly is not easily caught, but it soon becomes so engaged in its occupation that it may almost be touched before it will move.

CHUB. [LEUCISCUS.]

CHUSITE, a Mineral found by Saussure in the porphyritic rocks near Limbourg. It occurs massive, granular, translucent, and of a greasy lustre. Dr. Thomson refers it to *Chrysolite*.

CHUSSALONGA. [MIKANIA.]

CHYDORUS, a genus of Entomostracous *Crustacea* belonging to the section *Branchiopoda*, the order *Cladocera*, and the family *Lynceidæ*. The species are nearly spherical in shape; the beak is very long and sharp, curved downwards almost into the shape of a crescent; the inferior antennæ are very short. There are two British species—

C. sphæricus, Baird (*Lynceus sphæricus*, Müller; *Monoculus sphæricus*, Gmelin; *Chydorus Mülleri*, Leach). It is very common in ponds and ditches all the year round. It has a round smooth shell, of an olive-green colour, slightly ciliated on the anterior margin. Through this shell can be seen its convoluted intestine. The eye is areolar, and the black spot accompanying it large. It rather rolls than swims through the water.

C. globosus, Baird, has a more globular shell, and is six times larger than the last. The shell is of a reddish hue, and has a large irregular dark band running across the centre of the shell. It is not so common as the last species.

CHYLE (χυλός), the product of digestion formed by the action of the pancreatic juice and the bile on the chyme in the duodenum. [DIGESTION.]

CHYME (χυμός), the product of digestion formed by the action of the stomach on the food. [DIGESTION.]

CICADARIÆ. [HOMOPTERA.]

CICADE'LLA, Latreille (*Cercopidæ*, Leach), a family of Insects of the order *Hymenoptera* and section *Cicadariæ*. This family is synonymous with the *Cicada Ranatra* of Linnæus. The species may be distinguished from those of allied groups by their having the antennæ situated between the eyes. These insects are generally small, and leap by means of their hind legs. The genera may be arranged under two heads or sections.

1. In the first section the head is hidden by the pro-thorax, which is always very large, generally much humped, and has the posterior portion produced over the abdomen, sometimes so as to completely cover that part, or even extend beyond its apex; the antennæ are very small, and inserted in a cavity on the head. To this section belong the genera *Membracis*, *Tragopa*, *Darnis*, *Bocydium*, and *Centrotus*.

There are perhaps no insects more remarkable in structure, and whose appearance is more grotesque, than most of the species of this group. Their peculiarity arises from the great development of the pro-thorax: this part is sometimes so large as greatly to exceed in size all the other parts taken together. We have selected for illustration two species of the genus *Bocydium*, as being the most remarkable; one of these is the *Bocydium tintinnabuliferum*. In this species the thorax is black and glossy; the posterior part is elongated and pointed, and from the disc there arises a vertical appendage, the summit of which bears four slender horizontal stalks, each of which is furnished with a little round black spherical body: these little globes are covered with fine hairs; the abdomen is reddish, and the wings are variegated with the same colour.

Fig. 1.

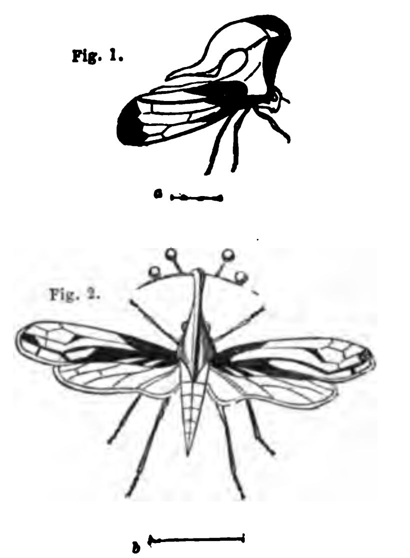


Fig. 2.

Fig. 1. *Bocydium galeritum*. *a*, Natural length.
Fig. 2. *Bocydium tintinnabuliferum*. *b*, Natural length.

The other species is the *Bocydium galeritum*. This species, as well as the one just described, inhabits Brasil; the pro-thorax is of a dark reddish-brown colour; the posterior part is elongated; the disc is elevated into a process which is at first compressed, but at the summit becomes dilated into a broad angular mass, and throws out a flattened portion, which suddenly bends downwards towards the body, and then runs parallel with it. The wings are transparent, with the exception of the basal and apical portion of the upper ones. The principal distinguishing characters of the genus *Bocydium* consist in the elytra being wholly or partially exposed, that is, not covered by the pro-thorax; and the posterior prolongation of the pro-thorax narrowed and pointed.

Of the genus *Centrotus* two species are found in England; the more common species is *Centrotus cornutus*. This little insect is found on the leaves of the hazel and other shrubs, in the early summer months. It is about one-third of an inch in length, and of a brown colour; the pro-thorax is prolonged posteriorly (this part is compressed and pointed, and extends nearly to the apex of the abdomen), and the sides are dilated, and form two horn-like projections: a character from which the insect has received in France the name of 'le petit Diable.' The wings are brownish and semi-transparent. In this genus the wings are exposed, as in the last, but the species differ in having a visible scutellum.

2. In the second section of the *Cicadellæ*, the head is on a line with the upper surface of the pro-thorax, or nearly so; the latter part is of moderate size, and without the extraordinary processes which characterise the former division—the wings are consequently always entirely exposed; the scutellum is distinct and of a triangular form. To this division belong the genera *Ætalion*, *Ledra*, *Ciccus*, *Cercopis*, *Eulopa*, *Euplex*, *Penthimia*, *Jassus*, *Tettigonia*, and some others.

Of the genus *Cercopis* (Latreille) we have many species in this country. They are all small. The largest and most beautiful of the British species is the *Cercopis vulnerata*. This insect is about one-third of an inch in length; black; the upper wings are obscure, and have each two large red spots (one at the base and another in the middle), and a fascia of the same colour near the apex, the black and the red being about equally divided; the under wings are transparent. This species is not uncommon in various parts of the country, and is found on the herbage in woods. *Cercopis spumaria* is one of the most common insects we have, being found in abundance on the various plants in our gardens. It is sometimes called the Frog-Hopper, from its habit of leaping when approached. Its colour is brown, the under wings are transparent, the upper wings have two white spots, one in the middle and another towards the apex. The larva in form resembles the perfect insect, except that it is destitute of wings; it is soft and of a greenish colour, and is always found on the leaves of plants, inclosed in a frothy liquid, with which it surrounds itself, probably as a protection against the sun's rays. This frothy liquid is commonly known in England by the name of Cuckoo-Spit, and in France it is called Crachat de Grenouille. The pupa differs only from the larvæ in having rudimentary wings; the perfect insect is about three-sixteenths of an inch in length.

The characters of the genus *Cercopis* are:—Antennæ with the third joint conical, and terminated by an inarticulate seta; head furnished with ocelli. This genus was established by Fabricius, and has lately been subdivided. The insect last described belongs to one of these sub-genera (*Aphrophora* of Germar), in which the head has the posterior margin concave, and the ocelli are more widely separated than in the genus *Cercopis* as now restricted. The characters of some other sub-genera will be found in a paper by Mr. Lewis, in the first part of the 'Transactions of the Entomological Society.'

The genus *Ciccus* differs from *Cercopis* principally in the species having the seta of the antennæ articulated, and composed of five joints; the anterior part of the head usually projects.

CICELY. [MYRRHIS.]

CICE'NDIA, a genus of plants belonging to the natural order *Gentianaceæ*. It has a 4-parted funnel-shaped corolla, without glands or any corona, eventually twisted over the capsule; the calyx 4-lobed, tubular; the stamens 4; the anthers erect, not twisted; the stigma capitate, undivided; the capsule single, or imperfectly 2-celled. The species of this genus were formerly referred to *Gentiana* and *Exacum*.

C. hyssopifolium has an herbaceous stem 4-sided, with the angles slightly winged; the flowers 6 or 8 together in axillary whorls, each furnished with a linear spathulate bract; the calyx 5-cleft, permanent, and closely embracing the base of the mature capsule. This is a common plant in many parts of the East Indies, and, like the whole of the order to which it belongs, the plant possesses a bitter principle, though not so intense as some of its allies. It is employed by the natives of India as a stomachic, and is administered in the form of decoction or powder. In addition to the tonic action, it is said to act as a laxative.

C. filiformis (*Exacum filiforme* of Smith and others) has the calyx 4-lobed, half-tubular, adpressed to the subglobose tube of the corolla; lobes ovate, acute; stem thread-shaped, forked; flowers solitary, on long stalks. It has yellow flowers, and is a native of Europe. It is found in damp sandy places in England and Ireland.

In their cultivation the species of *Cicendia* require the same treatment as Gentians.

(Babington, *Manual;* Lindley, *Flora Medica*.)

CICE'R, a genus of Leguminous or Fabaceous Plants allied to the Vetch. A 5-lobed calyx which projects on the upper side, and an inflated 2-seeded pod with tuberculated seeds, give its character. One species, *Cicer arietinum*, the Chick-Pea, a native of Egypt and the Levant, is cultivated in the south of France for its seeds, which bear a striking resemblance to a ram's head. They have for ages been a common food in the eastern parts of the world, but their taste is unpleasant to Europeans. It is an annual, and bears pale violet solitary flowers. Two or three other species are known to botanists.

The most remarkable circumstance about *C. arietinum* is, that during the heats of summer its leaves and stem exude little viscid drops, which, on evaporation, leave behind crystals, nearly pure, of oxalic acid. Its grateful refrigerating qualities are owing to this acid. Persons who walk through the fields where it grows, with common leather shoes, find them destroyed by the acid.

CICHORA'CEÆ, one of the primary subdivisions in the system of Jussieu of the natural order *Compositæ*. It is characterised by the absence of albumen in the seed; the seeds are erect, the corollas ligulate, the juice milky. The plants included under this division by Jussieu belong to De Candolle's *Liguliflorœ*. The *Cichoraceæ* in their anatomical structure closely resemble the *Campanulaceæ;* they also resemble that order in their physical properties. Both orders produce a milky juice, possessing in some species powerful medical properties. This juice in the *Cichoraceæ* has a bitter and astringent taste, and possesses narcotic properties. It is found in the *Cichorium Intybus*, the common Succory [CICHORIUM], and in the cultivated and wild Lettuce. [LACTUCA.] From the latter plants the juice has been obtained under the name of Lactucaricum, and used as a narcotic, instead of opium. Many of the species of *Cichoraceæ* secrete starch in large quantities, and are used as articles of diet, as the Endive, *Scorzonera*, *Tragopogon*, or Salsafy, &c. The root of the Dandelion (*Taraxacum Dens Leonis*) is used as a tonic and purgative, and has been recommended in disorders of the stomach. [LEONTODON.] The British genera of *Compositæ* belonging to this division are as follows:—

Section I. *Lapsaneæ*.
Lapsana.
Section II. *Hyoserideæ*.
Arnoseris.
Cichorium.
Section III. *Hypochærideæ*.
Hypochæris.
Achyrophorus.
Section IV. *Scorzonereæ*.
Thrincia.
Leontodon.
Oporinia.
Tragopogon.
Picris.
Helminthia.
Section V. *Lactuceæ*.
Lactuca.
Leontodon.
Barkhausia.
Crepis.
Sonchus.
Mulgedium.
Section VI. *Hieraceæ*.
Hieracium.

The geographical distribution of *Cichoraceæ* is generally similar to that of *Compositæ*, but they are found in greatest numbers in cold climates, and in this respect are the representatives of the *Corymbiferæ*, which are most abundant in hot climates. [CORYMBIFERÆ.]

(Lindley, *Natural System;* Babington, *Manual of British Botany*.)

CICHORIUM, a genus of plants belonging to the tribe *Cichoraceæ* and the natural family *Compositæ*. The species are known by the common names Chicory, Succory, and Wild Endive. De Theis derives the name from Chikouryeh, stated by Forskäl to be the Arabic name. The name Endivia seems to be derived from another Arabic name, Hindibeh. The genus *Cichorium* consists of only a few species found in the temperate parts of Asia, the Mediterranean region, and in Europe. It has a double involucre, of which the exterior is 5- and the interior 8-leaved, with the leaflets united at the base; pappus crown-like, formed of many paleæ, shorter than the achenium. Receptacle naked or pitted. Flowers blue.

C. Intybus, found in uncultivated places, dry pastures, and roadsides in Europe, has two or more heads of flowers, crowded, sessile or stalked, floral leaves lanceolate, subamplexicaul, broader at the base, pappus much shorter than the achenium.

C. Endivia, the Common Endive, cultivated throughout Europe, is supposed to have been introduced from India, where it is well known by its name of Kasnee. This species, like the former, has two or more heads, sessile or stalked, but with the floral leaves broad-ovate, cordate at the base and amplexicaul, pappus four times shorter than the achenium. [CHICORY; ENDIVE, in ARTS AND SC. DIV.]

CICINDE'LIDÆ, a family of Coleopterous Insects of the section *Adephaga* and sub-section *Geodephaga*. The true Carnivorous Beetles are included in a large section called *Adephaga*, all the species of which group may be distinguished by their having six palpi. The section *Adephaga* is divided into two sub-sections, the *Geodephaga* and the *Hydradephaga*. The former obtain their subsistence on the land and the latter in the water. The structure of the insects in these two groups, in order to suit them to their habits, is therefore of necessity essentially different (as far as secondary characters of form, &c., are concerned), the former being formed for running and the latter for swimming. In the number of joints to the tarsi (which is always five), and the antennæ (which is eleven), and the parts of the mouth, they are however alike; these latter are generally considered primary characters. To make ourselves more clearly understood, we may compare the section *Adephaga* among Beetles to the *Carnivora* among the *Mammalia;* the *Geodephaga* to the bears, weasels, dogs, and cats; and the *Hydradephaga* to the seals and otters. We may again carry our simile further by comparing the *Cicindelidæ* to the cats or tigers, the beetles belonging to this family being pre-eminently voracious.

The *Cicindelidæ* are divided into two groups—those species in which the emargination of the mentum is furnished with a tooth or pointed process in the middle, and those in which this process is wanting. To the first group or section belong the genera *Manticora*, *Platycheile*, *Megacephala*, *Oxycheila*, *Iresia*, *Cicindela*, *Dromica*, *Euprosopus*, and *Ctenostoma;* and to the second section belong the genera *Therates*, *Tricondyla*, and *Colliurus*.

The typical genus of the family we are treating of is *Cicindela*, and in this genus, as is generally (if not always) the case in typical genera, the species have a wide geographical range, and are very numerous. Taking Dejean's 'Catalogue' as our guide, we find the genus *Cicindela* containing upwards of 200 species, and the number of species contained in all the other genera taken together is about forty. The species of *Cicindela* are found in every quarter of the globe, whereas the other genera mentioned are very local; they are all extra-European, some being entirely confined to Africa, several to South America, and others to India.

The technical generic characters of *Cicindela* are:—Labial palpi moderately long, in this respect not exceeding the maxillary palpi; last joint of all the palpi truncated at the apex, and about the same width as the preceding joints; three basal joints of the anterior tarsi dilated in the males, and covered beneath with a velvet-like substance.

As regards the form, the most striking character of the *Cicindelæ* is the great projection of the eyes; the jaws are very long and sharply pointed, and furnished on the inner side with three tooth-like processes; the head is generally equal in width to the thorax, or sometimes exceeding it; the thorax is either somewhat cylindrical or rather depressed and nearly square, and is transversely indented before and behind. The elytra are generally rather depressed, and almost double the width of the thorax; the legs and antennæ are long and slender.

The colouring of the *Cicindelæ* is generally rich and metallic; the upper surface is usually more or less shagreened, and hence is not glossy; the under surface is glossy, and generally sparingly covered with hairs of a pale colour.

With respect to their habits, it has been before remarked that the *Cicindelæ* are extremely voracious; we may add, they are very active, and almost always take to the wing when approached, and hence are caught with difficulty; their flight is however short. The situations which they inhabit are generally sandy plains or heaths, and sometimes the sea-shore or the shores of rivers, &c.; but some of the other genera of the *Cicindelidæ*, from their form and colouring, appear to be more particularly adapted to these last-mentioned situations.

Six species of the genus *Cicindela* have been found in England, of which the most common is *Cicindela campestris*. This insect is found more or less abundantly throughout the country, and is very common in the neighbourhood of London; it is rather more than half an inch in length, and of a bright green colour; the anterior and posterior margins of the thorax, the legs, and the basal joints of the antennæ are of a rich copper-colour; the under side of the body is glossy and of a blue-green colour; the wing-cases are each adorned with six cream-coloured spots, one on the shoulder or outer angle, another at the apex, three on the outer margin at nearly equal distances apart, and one on the disc, a little lower down than the third marginal spot from the shoulder.

The larva of this insect is very well known, and may be found almost at any time during the summer in sandy situations. It lives in cylindrical burrows, varying from six inches to a foot in depth, these burrows being excavated by itself. Like the perfect insect, it is very voracious, and in fine weather may be seen with its head on a level with the surface of the soil, lying in wait for any insect which may happen to crawl over its cell. Its form is remarkable: the head is very large and slightly concave; the jaws are also large and curved upwards; the body is furnished with six legs, attached to the first three segments, and is humped near the middle of the back, at which part there are two tubercles, each of which is furnished with a horny hook; these hooks and the body being naturally of a bent shape, enable the animal to sustain its position at the top of the cell, or to ascend and descend very quickly: the concave head and the recurved mandibles form a kind of natural basket, in which the soil is brought to the mouth of the cell during the progress of its excavation.

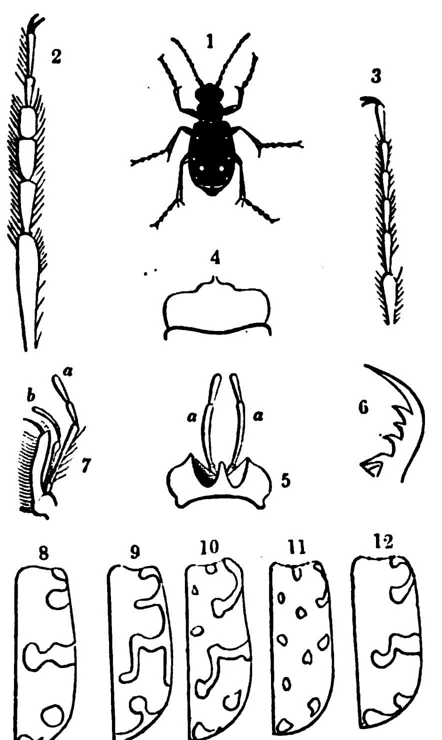


Fig. 1, *Cicindela campestris*. Fig. 2, anterior tarsus of the male. Fig. 3, anterior tarsus of the female. Fig. 4, labrum of another species of *Cicindela*. Fig. 5, mentum of the same; *a a*, labial palpi. Fig. 6, mandible. Fig. 7, maxilla; *a*, external maxillary palpi; *b*, internal maxillary palpi. Figs. 8, 9, 10, 11, and 12, wing-cases of five different species of *Cicindela*, to show the variation in the markings.

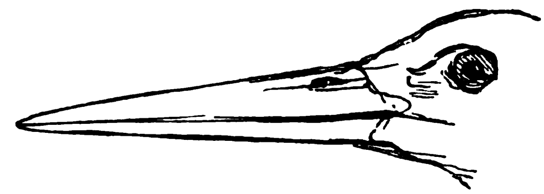
Four other British species of the genus *Cicindela* — *C. sylvatica*, *C. maritima*, *C. aprica*, and *C. sylvicola*, have white or cream-coloured spots in the same situations as in *C. campestris*, but they are joined together in pairs; the two towards the base of the wing-case form a curved dash which surrounds the shoulder; the one on the disc of the elytron and that at the margin nearest it are also joined, and form a bent fascia, and the two at the apex form a bent dash, which follows the outline of that part of the wing-case. This disposition of the markings, namely, a lunular spot at the shoulder, a bent fascia in the middle, and another lunular spot at the apex of the elytron, is that which is most commonly found in the species, and the most common colour is brownish-bronze; such is the colour of *C. maritima*, *C. riparia*, and *C. sylvicola*; the latter sometimes varies to a green hue.

In some exotic species of *Cicindela* the elytra are adorned with numerous spots; eleven is the greatest number we have found; of these, however, three or four are often obliterated, and the others are joined (two or three together) so as often to form three irregular-shaped oblong dashes or fasciæ.

In some instances the markings run one into the other, so that there is more white than ground-colour; and in one species, now before us, the wing-cases are entirely white. These markings vary but slightly in individuals of the same species.

The *Cicindelidæ*, in most arrangements of insects, form the first family of the *Coleoptera*.

CICONIA (Brisson), a genus of Birds belonging to the family *Ardeidæ*, and including the species popularly called Storks. The genus has the following characters:—Bill long, straight, subcylindrical, in form of an elongated cone, pointed, trenchant, butt (arête) rounded, of equal height with the head; lower mandible a little curved upwards. Nostrils slit longitudinally in the horny substance of the bill, placed near the base. Eyes surrounded with a naked space, which does not communicate with the bill; the face, the space round the eyes, or a part of the neck, often naked. Feet long; three toes forward, united by a membrane up to the first joint, the posterior toe articulated on the same level with the others; nails short, depressed, without dentilations. Wings moderate; the first quill shorter than the second, which is rather shorter than the third, fourth, and fifth, which are the longest. (Temminck.)



Bill of Stork.

M. Temminck observes that the Storks live in marshes, and feed principally on reptiles, frogs and their spawn, as well as fishes, small mammiferous animals, and young birds. They are, in all the countries of the world where they occur, a privileged race on account of their utility and of the havoc they make among noxious animals. Their migration takes place in great flocks: they are easily tamed. The moult is autumnal. The sexes do not differ. All the species make a clattering noise with their bills.

The species best known are the White Stork (*Ciconia alba*), and the Black Stork (*C. nigra*), both of which are British birds. We select the former as an example of that part of the genus which consists of the Storks properly so called.

The White or Common Stork is the Πελαργὸς of Aristotle and the Greeks; *Ciconia* of the Romans; Cicogna, Cicogna Bianca, and Zigognia of the Italians; Cicogne and Cigogne Blanche of the French; and Weisser Storch of the Germans.

Common Stork (*Ciconia alba*).

C. alba (*Ardea Ciconia*, Montague), the White Stork, or Common Stork. It has the bill straight, smooth; naked skin of the cheeks very small, and not communicating with the bill. Plumage white. Head, neck, and all the parts of the body, pure white; scapulars and the wings black; bill and feet red; naked skin around the eyes black; iris brown. Length 3 feet 5 or 6 inches.

Young.—The tarnished black of the wings is tinged with brown in the young birds, and the bill of a reddish-black.

Habits, Food, Reproduction, &c.—Assured by the kindness with which it is treated, in requital for its services in clearing the land of dead as well as living nuisances, the White Stork approaches the dwellings of man without fear. In Holland and Germany especially, the bird is treated as a welcome guest, and there, as indeed elsewhere, it annually returns to the nest which has cradled many generations, on the steeple, on the turret, on the false chimney that the Hollander has erected for its site, in the box, or on the platform which the German has placed for its use. The stump of a decayed tree is sometimes chosen by the bird, and the nest is made of sticks and twigs, on which are laid from three to five cream-coloured or yellowish-white eggs, about the size of those of a goose. The incubation continues for a month, at the expiration of which period the young are hatched, and carefully attended to by the parents until they are fully feathered and able to procure food for themselves. Frogs, lizards, snakes, and other reptiles, mice, moles, worms, insects, eels, the young of ducks and other waterfowl occasionally, and even partridges, according to M. Temminck, are devoured by these birds. In the continental towns domesticated Storks, which have been taken from the nest when young, may be often seen parading about the markets, where they are kept as scavengers to clear the place of the entrails of fish and other offal, which they do to the satisfaction of their employers.

Geographical Distribution.—The arrival of the Stork in Europe takes place in the spring. In Seville it is very common; but, according to the Prince of Canino, it is very rare and only an accidental visitor near Rome. Though so common in Holland, it very rarely arrives in Britain. The general drainage of our marshes may have something to do with this, but is hardly sufficient to account for so striking a difference in the migratory distribution of the bird, more especially as it proceeds to higher latitudes; for it regularly visits Sweden and the north of Russia, and breeds there. The winter is passed by the bird in the more genial climates of Asia, and in the northern part of Africa, Egypt especially. Those who have seen these birds in the act of migration, speak of their numbers as very large: thus Belon remarks, that the Storks are never seen in flocks except when they are in the air; and he relates how, being at Abydos in the month of August, a great flight of Storks came from the north, and when they reached the commencement of the Mediterranean Sea they there made many circuitous turns, and then dispersed into smaller companies. When Dr. Shaw was journeying over Mount Carmel he saw the annual migration of those which had quitted Egypt; and he states that each of the flocks was half a mile in breadth, and occupied three hours in passing over. They have been occasionally seen in considerable numbers in Great Britain, but the instances in which they have been killed are few.

Utility to man.—The utility of this bird to man in clearing away noxious animals and filth has given it a claim to protection, that has rendered it quite at its ease in his presence wherever that protection has been afforded.

C. nigra (*Ardea nigra*), the Black Stork, Cigogne Noir of the French. Like the last this species is a migratory bird. It passes the winter in the southern parts of Europe, and in spring advances to high northern latitudes to spend the summer. Mr. Yarrell says that he can make out only four authentic instances in which this bird has been shot in England.

M. Temminck remarks that all those gigantic species of foreign Storks arranged by systematists under the name of *Mycteria*, have the same external characters with the European Storks, the same manners and the same habits, and he further refers to the fact that Illiger in his 'Prodromus' has given his opinion that the genera *Mycteria* and *Ciconia* ought to be united.

Mr. Selby, after giving the characters of the genus *Ciconia*, says, "My readers will observe that these generic characters are not applicable to all the species of the genus *Ciconia*, of Bechstein, Cuvier, Temminck, and Wagler, but only to that group of which *C. alba* may be considered the type. The larger species, namely, *C. Marabou*, *Argala*, *Mycteria*, &c., seem to me possessed of characters sufficiently distinct to warrant such a separation, a fact indeed admitted by the necessity under which these authors have found themselves of subdividing their genus into sections."

Of these, the three gigantic species of Stork remarkable for the comparative nakedness of the head and neck, a kind of pouch which hangs externally in front of the neck, and a sort of vesicular apparatus or portion of skin at the back of the neck which can be inflated by the bird, and the greater enlargement of the bill, deserve especial notice. These extraordinary and uncouth-looking birds are natives of Africa and the eastern parts of Asia, and have only been known to modern naturalists within the last fifty or sixty years.

Ives in his voyage to India (1773) made known a gigantic grallatorial bird, from which Dr. Latham described the Adjutant of the British residents at Calcutta (the Argala of the natives), with the name of the Gigantic Crane. At the same time he noticed the observations made by Smeathman, the African traveller, on the habits of a bird seen by the latter on the western coast of that quarter of the globe. Gmelin upon this information founded a species, *Ardea dubia*, and Latham, who had figured the bird, and related some additional particulars of its habits in the first supplement to his 'Synopsis' (1787), changed the name in his 'Index Ornithologicus' to *Ardea Argala*. Mr. Bennett, who adverts to these points, proceeds thus: "Mr. Marsden, in his 'History of Sumatra,' makes mention of a bird, called by the natives of that island Boorong-Cambing, or Boorong-Oolar, which was generally believed to be of the same species with the Adjutant of Bengal. Dr. Horsfield however, in a paper published in the 13th volume of the 'Linnæan Transactions,' separates a Javanese bird, which is probably the same with the Sumatran, as a distinct species. Subsequently M. Temminck, in his 'Planches Coloriées,' has shown that the African species differs in several essential particulars from that of the continent of India, and still more remarkably from that of Java and the neighbouring islands. By his figures of the three species, all taken from living specimens, he has so clearly determined their characters that it is scarcely possible they should ever again be confounded. In one point however he has himself given rise to a different kind of confusion, that of their nomenclature. They all furnish, in more or less perfection, the beautiful plumes, superior in estimation even to those of the ostrich, known by the name of Marabous, from their appellation in Senegal. But those of the Indian species being far superior to the others, M. Temminck has thought fit to transfer to that bird the name of *C. Marabou*, and to rob it of its native appellation, Argala, which he has bestowed upon the African. The consequence of this perversion of their native names has been such as might have been expected. In the late edition of his 'Règne Animal,' M. Cuvier quotes the *C. Marabou* of Temminck, with the characters of the Indian bird, as a native of Senegal; while he states the *C. Argala* of the same author, to which he attributes the characters of the African species, to be brought from India. Nothing could more strongly evince the necessity of restoring, as Mr. Vigors had previously done, in the Appendix to Major Denham's 'Travels in Africa,' the name of *Argala* to the Indian, and that of *Marabou* to the African species."

C. Marabou, Vigors. M. Temminck has clearly pointed out the differences between this species and the Indian *Argala*. The African

Bill of African Gigantic Stork (*Ciconia Marabou*).

Marabou is less in size than the Indian *Argala*, the latter sometimes reaching six or even seven feet in height, while the former seldom exceeds five feet, even when the neck is elongated. The bill of the *Argala* is enlarged in the middle, the culmen of the upper mandible and the edges of the lower form a curved line from the base to the apex; in the *Marabou* the lines are straight and the bill is regularly conical; the nostrils of the Indian bird are ovate, those of the African species are oblong. The iris of the former approaches to pure white; that of the latter is dull-brown. The cervical or sternal pouch often hangs down more than a foot in the *Argala*; in the *Marabou* it is much shorter. The back and wings of the *Argala* are dull-black; in the *Marabou* there is a greenish tinge on the black of the back, with the exception of the larger wing-coverts and the secondaries, which are of a more decided black, edged more or less broadly and distinctly, according to the age of the individual, with pure white bands.

African Gigantic Stork, or Crane (*Ciconia Marabou*).

In the young birds these last distinctions are imperceptible. In both species the bill is inclined to livid yellow in colour, and is more or less spotted with black towards the base, as is the head, which is dusky. When the bird is at rest the pouch as well as the neck are of a pale flesh-colour, but when it is excited they acquire a redder tinge. These parts are sparingly covered with a few scattered brownish hairs, most numerous in the young birds, and resembling down in the early stages of its growth. The tail is black; the under parts pure white, more especially the under tail coverts, which afford the beautiful plumes. These are sometimes of a grayish slate-colour in the Indian species; but the white of the African feathers is not so clear and brilliant as that of the Indian plumes, to which a decided and just preference is given. The natural colour of the legs is dusky black, but in living birds these limbs are generally whitened by the dust shaken out of the plumage and other excrement.

Geographical Distribution of the Marabou.—Nearly the whole of Tropical Africa to the Cape of Good Hope, where it is not common. (Temminck.) Banks of the Nile. (Rüppell.) Neighbourhood of the large towns of the interior. (Denham.) Western coast. (Smeathman.)

Habits, Food, &c.—Nearly resembling those of the White Stork, like which it is privileged, on account of its utility as a scavenger in freeing the villages and towns of offensive substances, like its Indian congener. Its omnivorous voracity is well described by Denham. Where carrion and filth are scarce, reptiles, small birds, and small quadrupeds fall victims to its appetite. These are usually swallowed entire. Smeathman gave to Dr. Latham an anecdote of a domesticated individual which roosted very high among the silk-cotton trees, and would descry the servants bringing the dishes to the dinner-table, from a distance of two or three miles from its perch. It stood behind its master's chair waiting to be fed, and occasionally helped itself, notwithstanding the guardianship of the servants who carried switches to prevent its snatching the meat, which it nevertheless sometimes contrived to do: in this way it had been known to swallow a boiled fowl at a single mouthful. Besides the pouch, the skin at the back of the neck can be inflated so as to have somewhat the appearance of a counterpoise to the former. When the sun is shining upon the bird we have observed this latter pouch, if pouch it may be called, very prominent, apparently from the rarefaction of the air. The bird flies high and roosts high, probably for the purpose of taking in a large area of observation, to enable it to perceive those objects on which it feeds. May not these pouches assist, balloon-like, in supporting or balancing the great head and bill? Living specimens of the White and Black Stork, the Marabou, Jabiru, and American Maguari are now in the Gardens of the Zoological Society, Regent's Park.

CICU'TA, a genus of plants belonging to the natural order *Umbelliferæ*, the sub-order *Orthospermeæ*, and the tribe *Ammineæ*. It has a calyx of 5 leaf-like teeth; the petals obcordate, with an inflexed point; the fruit subdidymous; the carpels with 5 equal broad flattened ridges, the lateral marginal; the vittæ solitary.

C. virosa, the Water-Hemlock, is a wild poisonous plant found

Water-Hemlock (*Cicuta virosa*).
1, a flower; 2, a young fruit.

occasionally by the sides of ditches and ponds. It is a perennial plant, with a large fleshy white root covered externally with fibres, and divided internally into several low chambers filled with a milky or yellowish juice. The stem is erect, hollow, cylindrical, striated, and 2 or 3 feet high. The leaves, especially the lower ones, are decomposed or thrice-pinnated; the leaflets are narrow, lanceolate, deeply and irregularly toothed. The umbels are usually destitute of involucre, or if they have one it is nothing but a single linear bract; the partial umbels have several such bracts. The flowers, which are white, have the ordinary umbelliferous structure. They are succeeded by globular double fruit, crowned by the style and five teeth of the calyx, and showing on each of their convex faces five salient simple angles. Its medicinal properties are similar to those of common Hemlock [Conium], but more energetic. Its roots have been mistaken by children and country folks for parsnips, and have been eaten with fatal consequences.

CIDARIS, a genus of Star-Fishes belonging to the family *Echinidæ*. It has a globose body; mouth and anus nearly equal; ambulacra continuous from mouth to anus, which are both central, the former below, the latter above; the spiniferous tubercles perforate, the spines of several forms.

C. papillata, the Piper, is a British species, and is the most elegant of our native sea-urchins, but at the same time the rarest. It is found off the island of Zetland. It is always found in company with the Tusk (*Gadus brosmus*), a fish that is never found but on rocky ground. It is covered with two sorts of spines; one set long, the other short. The longer ones are ordinarily an inch or an inch and a half in length. In Zetland it is said they have been caught with the spines a foot long. (Forbes, *British Star-Fishes*.)

CI'LIA, in Anatomy, small moving organs found on the surface of the tissues of most animals, resembling hairs, and requiring the use of the microscope to be distinctly observed. They are mostly found on tissues which are in contact with water, or which produce fluid secretions. They are constantly in a state of active movement, and impart to the fluid with which they are in contact the same motion. This is called vibratory or ciliary motion. The best time for observing Cilia with the microscope is when their movement begins to slacken. Their figure is generally that of slender conical or sometimes flattened filaments, which are broad at the base or root and gradually taper to the point. Their size differs greatly on different parts of the same animal. "The largest I have measured," says Dr. Sharpey, "are those on the point or angle of the branchial laminæ in the *Buccinum undatum*; they are at least $\frac{1}{500}$ of an inch long. I have not attempted to determine the exact size of the smallest, but Purkinje and Valentin state it at 0.000075 of an inch, while they make the largest they have met with only 0·000908 of an inch, which is considerably less than I have found them; but they had no opportunity of examining marine animals, in which generally speaking the largest cilia are met with. In the sea-mussel the darker coloured cilia are about $\frac{1}{1000}$ of an inch long, the others considerably less." The substance of the Cilia is for the most part transparent and colourless, in some however a slight colouring may be observed. They assume also various forms, and Ehrenberg has described compound Cilia in the *Infusoria*. In the Ciliograde *Medusæ* the Cilia consist of rows of broad flattened organs, each of which is made up of several simple filaments joined together by a connecting membrane throughout their whole length. In most cases the Cilia are arranged in regular order. On the gills of the mussel they are placed in straight rows; in many of the *Infusoria* they are arranged in circles or spiral lines. In some instances they are oblique, but in others they are placed at right angles to the surface on which they are seated.

The movement of the Cilia is not very rapid, and may be easily observed with a lens of ¼ inch focus. Their most obvious movement is of a fanning lashing kind, the Cilium being bent in one direction and returning to it again. In addition to this movement Professor Quekett detected another in the Cilia of the gill-rays of the common mussel. This consists of a slight movement of the Cilia on themselves, each Cilium turning on its own axis through the space of a quarter of a circle, with a movement like that of the feathering of an oar in rowing. This observation of Mr. Quekett's is of importance, as it explains how it is that the Cilia are capable of propelling bodies over their points which could not be effected by the first-observed up and down movement. When the surface of an organ is examined on which are seated a large number of Cilia, a wave-like motion in the whole is observed, which arises from the regularity with which each Cilium is affected with the movement.

The Cilia were first observed as present on the external surface of the bodies of infusory animalcules. Leeuwenhoek seems to be one of the earliest observers who described the presence of the Cilia in animalcules. In his 'Continuatio Arcanorum Naturæ' he describes in many places the nature of the Cilia in the common polygastric animalcules as well as in the wheel-animalcules. He also pointed out the probable use of these organs, for he says, "Moreover it is necessary that these animals, and in general all such as are fixed and cannot change their place, should be provided with an apparatus for stirring up motion in the water, by which motion they obtain any matters that float in the water for their nourishment and growth, and for covering their bodies." Since the period that Leeuwenhoek wrote they have been observed in almost every species of *Infusoria*, and seem to be the active organs by means of which these animals move from place to place and carry their food into their stomachs. In the Polypes they are found in great numbers covering the surface of the tentacula by which these animals obtain their food. Although they have not been observed on the full-grown Sponges they have been described by Dr. Grant as existing upon the ova of these animals before they become fixed. Though not abundant in the *Acalephæ*, they have been seen by Dr. Grant and others in the *Beröe pileus* and other *Medusæ*. Dr. Sharpey has observed them in the various forms of the *Echinodermata*, and also in the *Annelida*. In the *Mollusca* they are very abundant, and one of the best means of examining these organs is afforded by the common mussel. Till within a recent period it was supposed that Cilia were confined to the Invertebrate classes of animals, or at least the observation of their existence to any extent in the *Vertebrata* was very limited. One of the earliest observations of their presence in Vertebrate animals was by Steinbuck, a German anatomist, who found them upon the gills of the Salamander. Within the last few years Purkinje and Valentin have devoted much attention to the subject, and have found that Cilia exist very generally on the moist surfaces of the membranes of all the higher animals. The systems of organs on the surface of which Cilia have been detected are as follows :—

1. The Surface of the Body.—In this situation Cilia have been detected in the *Infusoria*, *Polypi*, *Medusæ*, *Actinia*, *Echinodermata*, and in the larvæ of the Batrachian Reptiles.

2. The Respiratory System.—Cilia have been detected in the lining membrane of the air-passages of reptiles, birds, and *Mammalia*, in the gills of the larvæ of the *Batrachia*, and on those of the *Mollusca* and *Annelida*. Those on the external surface of the *Infusoria*, Polypes, and *Medusæ* must also be regarded as belonging to the respiratory system.

3. Alimentary System.—They are found in the mouth, throat, and gullet of Reptiles, in the entire alimentary canal of *Mollusca*, in the stomach of the *Asterias*, &c.

4. Reproductive System.—Ciliary movements have been observed in the mucous membrane of the Fallopian tubes, in the uterus and vagina of *Mammalia*, and in the oviduct of Birds and Reptiles. A peculiar ciliary movement has been observed in the embryo of many animals. This movement occurs while the embryo is in the ovum, the Cilia producing a current in a certain direction along its surface, or causing the whole embryo to move in an opposite direction. In many instances when the embryo has escaped the egg it moves about by means of Cilia in the same way as occurs in the naked gemmules of the Sponge.

There can be little doubt that the functions performed by the Cilia in these various parts of the body of animals are important; at the same time their absence in a great number of cases, in organs which perform the same functions as those which possess them, must lead to some hesitation before pronouncing a decided opinion with regard to their use. Where they are situated on the external surface of the bodies of animals they seem to be the active organs of movement. Where respiration is carried on by means of the external surface, as in the *Infusoria* and *Polypifera*, the Cilia assist this process by removing the used water and bringing fresh currents to the surface containing the matter to be oxygenated. They may undoubtedly perform the same office when seated on internal respiratory membranes. On the surface of the reproductive organs of the higher animals they may also assist in bringing the unimpregnated ovum in contact with the fertilising cells of the male fluid. The movement in the embryo has probably the same object in view as that on the respiratory membranes, the bringing the surface in contact with currents of oxygenated water.

In coming to the conclusion that the motions of fluids on the surfaces of membranes are produced by Cilia where these organs exist, Dr. Sharpey observes, "The currents cease when the motion of the cilia stops, they are strong and rapid when it is brisk, and feeble when it languishes; and though there are modifying circumstances or perhaps exceptions, yet in general the magnitude and velocity of the current seem to be proportioned to the size and activity of the cilia. It is true that while doubts remained as to the existence of cilia in several well-marked instances where the water unequivocally received its motion from the surface over which it flowed, and independently of any visible contractions of the animal tissue, there was always considerable room to doubt, whether, even in the cases where cilia were manifest, the effect of these organs was wholly mechanical, and whether the motion of the water was not rather due to some peculiar impulsive power in the tissue differing from mechanical action. But more extended observation has almost wholly removed these exceptions, while it has considerably increased the number of conforming instances, insomuch that there seems at present no necessity for having recourse to any other explanation of the motion of the fluids than that it is produced by the action of the cilia, and that their action is the result of muscular contractility, a known property of animal tissues."

There are however some remarkable exceptional cases. Currents are observed in the Sponge, in the stem and branches of the *Sertulariæ*, but no Cilia. There are also a number of remarkable cases of the movements of fluids in cells in the vegetable kingdom, which cannot be ascribed to the existence of Cilia, as those seen in the cells of *Chara*, *Vallisneria*, the hairs of *Tradescantia*, &c.

When first discovered the Cilia were supposed to be confined to the organs of animal bodies. In 1843 Meyer and Thuret announced that they had discovered Cilia on the spores of several species of *Confervæ*. They were subsequently discovered on the surface of several species of unicellular plants, as also on the spermatozoids, which occur in the Ferns and many of the lower forms of *Cryptogamia*.

For further information consult the article 'Cilia,' by Dr. Sharpey, in the 'Cyclopædia of Anatomy and Physiology,' to which we are much indebted in drawing up this article; also the paper of Purkinje and Valentin, entitled 'Commentatio Physiologica de Phænomeno Motus Vibratorii continui,' &c., translated in the 'Dublin Journal of Medical and Chemical Science' for May, 1835, and in 'Edinburgh New Philosophical Journal,' vol. xix.; also 'On Unicellular Plants and Animals,' 'Microscopical Journal,' vol. i.

CILIATA. [MOTELLA.]

CILICÆA. [ISOPODA.]

CILIOGRADA. [ACALEPHÆ.]

CIMBEX, a genus of Hymenopterous Insects of the section *Terebrantia*, sub-section *Securifera*, and family *Tenthredinidæ*.

The genus *Cimbex*, as it formerly stood, has been subdivided (principally by Dr. Leach) into the following sub-genera: *Cimbex*, *Perga*, *Syzygonia*, *Trichiosoma*, *Clavellaria*, *Zarea*, *Abia*, and *Amasis*. All these sub-genera have the antennæ short, and terminated by thickened joints, which are nearly of an oval form; the third joint of the antennæ is long, forming a knob: the superior wings have two marginal and three sub-marginal cells.

The antennæ of these insects generally present six distinct joints, of which the two basal joints are very short, and almost concealed by the hair on the head; the third is long, the fourth and fifth are of moderate length, and the sixth is elongate (or moderate), rounded at the apex, and tapers more or less towards the base; this last joint is, however, evidently composed of two or three joints consolidated. All the joints of the tarsi have a membranous pad attached to their under side, and protruding from their apex.

The genus *Cimbex*, as now restricted, may be known by the following characters:—Body slightly hairy; abdomen with the basal segment emarginate above (that is, it appears as if a semicircular piece had been removed); the space thus left unprotected by the horny covering filled up with a membrane. Thighs of the four posterior legs of the males very thick, those of the females moderate. Tarsi of the males with a tooth-like projection on the under side of the basal segment.

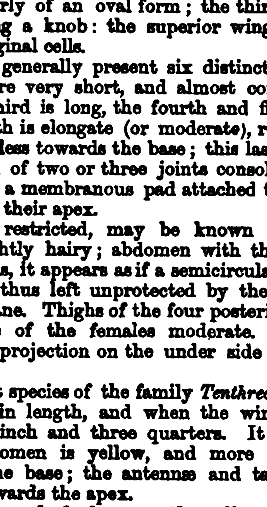
This genus includes the largest species of the family *Tenthredinidæ*.

C. Griffinii is about an inch in length, and when the wings are expanded its width is about one inch and three quarters. It is of a reddish-brown colour; the abdomen is yellow, and more or less clouded with brown towards the base; the antennæ and tarsi are yellow, the former is brighter towards the apex.

The larva, we have been informed, feeds upon the sallow, and is not uncommon in the neighbourhood of Cambridge. Mr. Stephens enumerates eight British species of this genus, some of which however, it is thought, will eventually prove to be mere varieties.

CIMEX. [BUG; CIMICIDÆ.]

CIMI'CIDÆ, a family of Hemipterous Insects, the species of which may be distinguished by their having the rostrum short, and consisting of two or three joints only; the labrum also short, and without striæ; the eyes are moderate; the body is generally very much depressed. The principal genera are *Cimex*, *Aneurus*, *Aradus*, *Agramma*, *Tingis*, and *Dictyonota*, all of which are found in England. The genus *Cimex* is distinguished principally by the extreme slenderness of the two terminal joints of the antennæ, which are not thicker than a hair. The body is very much depressed: the thorax is transverse; antennæ 4-jointed; basal joint very short, second long, the third of about equal length, the fourth rather shorter. Labrum rather long, somewhat pointed, and, when the proboscis is not in use, recurved under the head; proboscis 3-jointed, and, when at rest, lies along the under side of the thorax, its apex being between the two fore legs at their base.



1, Bed-Bug (*Cimex lectularius*) magnified 2, natural length of the same; 3, head of the same, highly magnified; *a*, the labrum; *b*, the proboscis; *c*, base of the antennæ.

The most common species is the *Cimex lectularius*, the Bed-Bug. [BUG.]

CIMICI'FUGA (*cimex*, a bug, and *fugo*, to drive away), a genus of Plants belonging to the natural order *Ranunculaceæ*. The calyx is composed of four deciduous sepals; corolla of four petals; styles one to fifteen; the carpels dry, dehiscent, many-seeded. The species are perennial herbs, with divided leaves, and racemes of whitish flowers; the roots act as drastic purgatives and are poisonous.

C. fœtida, Stinking Bug-Wort, has four almost sessile and very villous ovaries; the racemes panicled; the leaves terminate or biternate; the leaflets ovate-oblong, deeply-toothed. It is a native of the Carpathian Mountains, Dauria, Eastern Siberia, and the north-west coast of America. It is a very fetid plant, and is used in Siberia for driving away bugs and fleas, just as tansy and wormwood are used in this country.

C. serpentaria, Black Snake-Root or Bug-Wort, has compound very long racemes; the leaves triternate, with serrated or rather cut leaflets. It is a native of North America, from Canada to Florida. It has white flowers, and resembles the species of *Actæa*, to which genus it was formerly referred under the name of *Actæa racemosa*. Like many other plants possessing active properties, it has a reputation in America for healing the bites of snakes and preventing their poisonous effects on the system. There is one species, *C. Japonica*, a native of Japan; the rest are American plants. They are easily cultivated, preferring a moist shady situation, and may be propagated by dividing the roots, or by seeds.

(Don, *Gardener's Dictionary*.)

CIMOLITE, a hydrous silicate of alumina found in the Island of Cimola. It occurs in amorphous earthy masses, the structure of which is rather slaty. Colour grayish-white. Fracture earthy, uneven. It is soft and opaque, and its specific gravity is 2·0. It is used for the same purposes as Fuller's Earth. It is allied to Halloysite. [HALLOYLITE.]

CI'NCHONA, a genus of Monopetalous Exogenous Plants, the different species of which have a great reputation in medicine. It constitutes the type of the natural order *Cinchonaceæ*. It is known by the following characters:—Tube of the calyx top-shaped, with a permanent 5-cleft limb. Corolla with a taper tube, and a 5-parted limb, which is valvate in æstivation. Filaments short, inserted into the middle of the tube, within which the linear anthers are altogether inclosed. Stigma 2-cleft, a little clavate. Capsule ovate or oblong, slightly marked on each side by a furrow, 2-celled, crowned by the calyx, dividing through its dissepiments into two halves. Placenta long. Seeds numerous, erect, imbricated upwards, compressed, with a broad membranous winged border; albumen fleshy. Trees or shrubs, with a bitter aromatic astringent bark. Leaves on short stalks, with flat edges. Stipules ovate or oblong, leafy, separate, deciduous. Flowers in terminal panicled corymbs, white, or of a rosy-purple colour.

By whom the important properties of the various species of this genus were first made known to Europeans is unrecorded; for it is not worth repeating the fables that have been invented upon the subject. The native Peruvians, who call the trees Kina, or Kinken, attach no febrifugal importance to the bark, but are said even to have a prejudice against its employment. Its introduction to Europe took place through the Spaniards in the year 1640, and it is pretended that a certain countess Chinchon, vice-queen of Peru, having experienced the good effects of the bark as a febrifuge, it gained the name of Pulvis Comitissæ, and under that name, or as Pulvis Jesuiticus, was vended by the Jesuits, who derived a considerable part of their wealth from its trade. Humboldt regards a tradition still current in Loxa as a more probable explanation of the discovery of the properties of *Cinchona*. It is said that the Jesuit missionaries there had endeavoured, according to the custom of the country, to distinguish the different kinds of trees by chewing their bark, and that this had led them to observe the remarkable bitterness of *Cinchona*. Those who were medical among them were thus led to try an infusion of the bark in tertian agues, which are very common at Loxa, and thus the discovery of its power was made. Little was known of the tree producing this substance till the voyage of La Condamine, who, in 1738, first printed a detailed account of Quinquina, as it was then called. Since that time the attention of botanists has been constantly directed to the subject, and a good deal of information has upon the whole been collected; the general facts connected with the habitation, geographical range, modes of preparation, and botanical distinctions of the species have been ably stated by Humboldt, Ruiz and Pavon, Fée, De Candolle, Lambert, Pöppig, and Lindley, and will form the basis of the succeeding short account; but in all the minor details regarding the barks themselves, and the species that furnish them, Europeans are still much in the dark.

To this genus botanists have from time to time referred plants which, upon a more careful examination, have been ascertained not to belong to it; West Indian, Brazilian, and even East Indian Cinchonas, thus have found a place in books, but they are really referrible to other genera. Circumscribed within the limits of the preceding character, *Cinchona* will be found a mountainous genus confined to the Cordilleras, between La Paz, in about 22° S. lat., and Santa Martha, near 10° N. lat.; a line having these northern and southern limits, and bounded by the most eastern part of the Cordilleras on the one hand and the Pacific on the other, will very nearly define the corner of the globe inhabited by true Cinchonas. Within these limits they occur on the plains, but chiefly on mountain sides as far as 10,000 feet of elevation above the sea, the principal zone being at from 1800 to 6600 feet of elevation. In these places the mean temperature is estimated by Humboldt at from 17° centigrade, or 62·6° Fahrenheit, to 12° centigrade, or 53·6° Fahrenheit.

The manner of collecting the Huanuco Bark of commerce is thus described by Pöppig ('Companion to the Botanical Magazine,' vol. i. p. 249). "In the month of April the preparations for an expedition commence; and in May the people start for the forest, whence the last green bales are transmitted home in November. They fell the trees close to the root, sparing those trunks which appear too young (palos verdes), as, till they have attained maturity, the bark is of no value. The next process is to divide (trozar) the stems into pieces of uniform length, rejecting only the very smallest branches. With a peculiar kind of knife, made for the purpose, the bark is cut lengthwise, and a certain degree of practice is necessary to perform this operation properly so as to remove the rind without injuring the wood or severing any of the fibres. With the same instrument they take off the stripes (longos) of the bark as broad as possible; but this however is not done for three or four days after the tree is felled, as before that time the moisture that exists between the cuticle and the wood would prevent the bark from severing into such large pieces as fetch the highest price. A worse consequence ensues from stripping the stems too quickly, as then the thin grey or blackish epidermis shivers off; and from the presence of this outward rind, covered with many cryptogamia, the value of the bark in the European market is mainly estimated. The English purchasers in particular hold the notion that the bark is most powerful according as its epidermis is covered with spots.

"On the celerity with which the article is dried depends the price which it commands; but there are few instances where prejudice is so powerful as in the trade of the Cinchonas. In the dense forests it is impossible to perform this operation properly, and therefore the bundles of green bark are dispatched with all speed to the nearest inhabited place, where the person appointed to take the charge of them is stationed. Without any preparation they are laid in a spot exposed to the full action of the sun, the greatest care being requisite to protect them from wet, as even a few hours' dew falling on the half-dried bark will give to the cinnamon-brown interior of the finest sort a blackish appearance, and lessen its value about one-half. The quickness of the drying and the general excellence of the article are indicated by the pieces being rolled up into several spiral windings, which form so solid a cylinder as to exhibit no cavity (canuto) within; but such portions are rarely seen unfractured in Europe. The Cinchona barks are no less sensible of atmospheric moisture than the Coca, which I formerly described, so that the collectors always hasten to send them to the dry climate of the Andes, or the principal towns. An unavoidable loss however hence accrues: however perfectly the bark may have been dried in the woody region, it still loses, in three or four days after its arrival in Huanuco, 12 to 15 per cent. on its weight. The packages are made up into bales of four or five arrobas each, and with the greatest possible care, in order that the beautiful canes of two feet long, into which the bark was coiled on the Montaña, may not be broken in the carriage. Trailing plants (bejucos) are used to tie up the bundles, and when they arrive in Lima they are undone, and sorted into lengths of different pieces previously to dispatching them in chests to Europe. The trade in Huanuco Bark was very brisk twenty years ago at Lima, and the article went to the Spanish market under the name of *Cascarilla rosea*, without being confounded with the *Cortex Chinæ ruber*, as it is called by us. The barks from the districts of the Lower Huallaga, of Huambo and Chachapoyas, &c., are, on the other hand, very little prized in Cadiz, and called *Cascarilla arollada*."

Books and memoirs without end have been written to determine the different species of *Cinchona* that yield the barks of commerce, but with very little result. There are difficulties in the way of this which persons unacquainted with the bark trade can hardly estimate. For example, the bark of the same species may be weak and valueless in warm lowland districts, and of the greatest price in alpine or mountainous regions. The bark of the low country about S. Jaen de Bracamorros has uniformly proved worthless, although the same species which grow there afford a fair bark at Mayobamba, Chachapoyas, and Lamas in the mountains; and others which at Maynas are perfectly inert, are energetic enough upon the sides of the mountains. It is related by Pöppig that, in ignorance of this, many speculating merchants have been ruined by the purchase of the bad lowland bark of Peru. The rule is, that the best bark always comes from mountain tops, from single trees growing in the coldest and most elevated spots. Some of the finest kinds are procured near the mountain villages of Cayambe and Pillao, and from the mountains of Panataguas and Pampayaco.

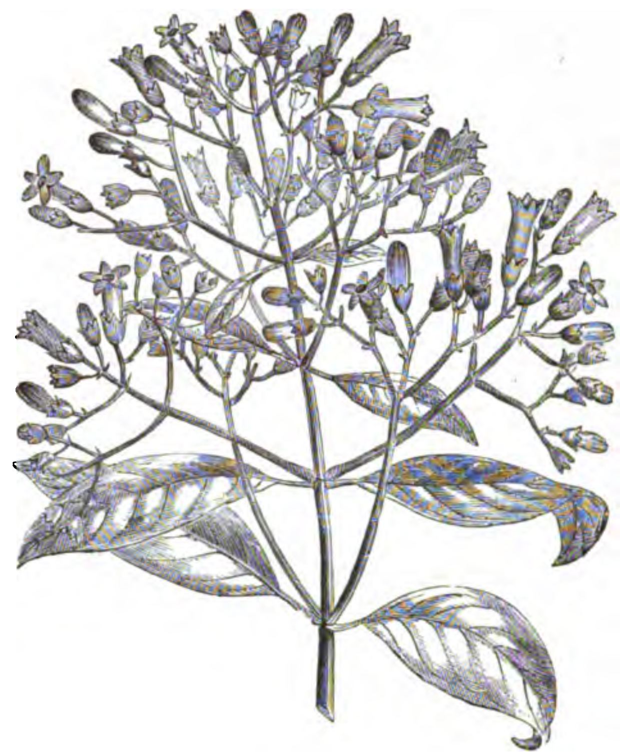
To pretend to reduce to their botanical species, in the existing state of knowledge of Cinchona barks, all the varieties that are known in shops or in commerce, would be a vain and hopeless task. Nothing can well be more startling than the discrepancies that exist upon the subject in books and collections; every collector, every writer, has his own set of specimens and opinions, and there is no possibility of reconciling them. There is not a chest of bark which, although called of one sort, has not probably been furnished by many different species; and there is much reason to believe that many of the best known sorts of barks of the shops are in reality furnished by the same species under different circumstances. Fée asserts that gray Quinquina passes into yellow by shades that cannot be distinguished; that yellow approaches the red both in colour and flavour; and that nobody knows to this day with any certainty the origin of even the barks of Loxa, Lima, Huanuco, or Carthagena. Pöppig, who has so long lived in the Cinchona countries, seems to be of the same opinion, notwithstanding the details he has given respecting certain species—details of which we have availed ourselves in the following observations. In particular, with reference to this subject, to which a vast deal more importance is attached than it deserves, when speaking of the Huanuco Bark of commerce, Pöppig's remarks are highly deserving of attention. He observes that as to the various species of trees that produce bark, and the different quality of the article itself, much prejudice exists. Without cause one species is rejected, and another prized for its imaginary qualities; and the same species is unmeaningly divided by the bark-collectors into several, upon no known or intelligible principle. *Cinchona glandulifera* has three names, although scarcely the least trace even of varieties can be detected upon the closest botanical examination.

It is doubtful whether the species of any genus of plants are more variable in their appearance than those of *Cinchona;* and hence those who have been acquainted with them from dried specimens only, or who have not been aware of their tendency to vary, have multiplied the species far beyond their true number, and an inextricable confusion would have been the result in any genus less constantly before the eyes of the botanist. Thus the authors of the 'Flora Peruviana' in that work added thirteen supposed new species, and introduced many more into their Herbarium; Mutis, on the other hand, who had ample means of studying Cinchonas in New Granada, declares that he was acquainted with seven only. Zea asserts that all the efficacious species of the 'Flora Peruviana' are reducible to four. Fée admits eighteen certain species; and De Candolle reduces the number to fifteen, although he introduces two species unknown to Fée. Humboldt states that he has himself seen *C. pubescens*, the yellow bark, with ovate-oblong, ovate-lanceolate, and ovate-cordate leaves on the same plant; he adds, that some species, such as *C. macrocarpa*, have either leaves entirely smooth or downy on each side, and that even *C. Condaminea* has extremely different leaves, according to the elevation at which it grows. These statements alone are sufficient to show how much caution is required in distinguishing species in this genus; but to this it is necessary to add, that there is too much reason to suspect that the authors of the 'Flora Peruviana,' in creating spurious species, were influenced by a wish to please the Spanish court, by appearing to prove that the barks of Peru, from which the Spaniards exclusively derived so large a revenue, were altogether different from those of New Granada, which other nations could easily procure direct from Carthagena. Humboldt adds, that mercantile cunning with reference to this subject was carried so far, that at the royal command a quantity of the best orange-coloured Cinchona bark from New Granada, which Mutis had caused to be picked at the expense of the king, was burned, as a decidedly inefficacious remedy, at a time when all the Spanish field-hospitals were in the greatest want of this indispensable product of South America. It should however be observed that some of Ruiz and Pavon's species have been restored by a recent writer upon the authority of dried specimens; but it appears to us safer in such a case as this to take the opinion of a man like Humboldt, who studied Cinchonas in their native forests, than that of a botanist who can be acquainted with them only from Herbaria.

In the following enumeration of the species we take De Candolle as our guide in the systematic distinctions of the species, and Humboldt and Pöppig principally for the practical observations upon them. After every specific name we have added the synonymous names that occur in books, for the information of those of our readers who may possess Materia Medica works whose nomenclature is different from that of De Candolle.

* Corollas downy on the outside or silky.

1. *C. Condaminea.* Leaves oblong, tapering to each end, smooth and shining, pitted on the under surface at the axils of the veins. Limb of the corolla woolly. Capsules ovate, twice as long as broad. This is the *C. officinalis*, Linn. Humboldt states this to be the fine Uritucinga Bark originally seen by La Condamine. It is one of the sorts imported in quantity to Europe, and is said to furnish the pale bark of the English apothecaries. It is readily known, notwithstanding the variable figure of its leaves, by their having at the axils of their veins on the under side little pits not bordered with hairs, and secreting a transparent bitter fluid matter. Grows wild near Loxa, in the mountains of Cajanuma, Uritucinga, Boqueron, Villonaco, and Monje. It also occurs near Guancabamba and Ayavaca in Peru. It is always found among micaceous schist, at elevations of from 5400 to 7200 feet; and, according to Humboldt, requires a milder climate than the *C. lancifolia* of Santa Fé. The temperature of the regions which it inhabits is about that of the Canary Islands. This is the *C. lancifolia* of the 'London Phamacopœia' of 1836, and is now recognised as yielding the pale bark (*Cinchona pallida*) of the London College of Physicians.



Cinchona Condaminea.

2. *C. scrobiculata* (*C. micrantha*, 'Fl. Peruv.,' Ruiz and Pavon). Leaves oval, acute at each end, smooth, shining on the upper side,

Cinchona scrobiculata.

pitted underneath at the axils of the veins. The tube of the corolla downy on the outside; its limb woolly. Capsule ovate-oblong, three times as long as broad. This is distinguished from the last not only by the form of its leaves, which never taper to the point, but also by the pits at the under side of the leaves being bordered with inflected hairs; in *C. Condaminea* they are quite hairless. It is also allied to *C. rosea*, but that species has a smooth corolla and glandless leaves. In the quality of its bark it is not distinguishable from *C. Condaminea*. Immense forests of this species exist in the province of S. Jaen de Bracamorros. It is the commonest of all the Quinas in that part of Peru, and the most esteemed; in commerce it has the name of Quina Fina. Dr. Lindley says this species is the origin of the Seloa, or Gray Cinchona of English commerce.

3. *C. lancifolia* (*C. angustifolia*, Pavon; *C. Tunita*, Lopez). Leaves obovate-lanceolate, very smooth on each side, without glands; panicle large, brachiate; corolla silky on the outside; capsules oblong, smoothish, five times as long as broad. Next to *C. Condaminea* this is accounted the most efficacious of all the species. It furnishes the orange-coloured bark, or the Quina Naranjanda of Santa Fé de Bogota, and is obviously different from the two former species in its leaves being destitute of glands. Humboldt states that it prefers an inclement climate, on mountainous declivities from 4000 to 9000 feet high, where the mean temperature is about that of Rome. In the alpine forests of the upper limits of the zone inhabited by this species the thermometer falls for hours as low as the freezing point. The plants are more rare than those of *C. pubescens* and *C. magnifolia*, always growing singly, and not increasing readily by the root. A kind of bark, bearing a high reputation at Cadiz, and called Calisaya, is referred to this species. It derives its name from the province where it grows, which is situated in the most southern part of Peru, in La Paz.

Another variety of this, according to Humboldt, a distinct species according to others, the *Cinchona nitida* of the 'Flora Peruviana,' is found only upon the coldest parts of the mountains of Peru, where it becomes a tree with a stem scarcely eight feet high. Its flowers are bright red, covered inside with a white down, and do not appear till May. Its bark, the Cascarilla Hoja de Oliva, although of the finest quality, is never seen in commerce.

4. *C. pubescens* (*C. cordifolia*; *C. ovata*, Ruiz and Pavon; *C. pallescens*, Ruiz; *C. hirsuta*, Ruiz and Pavon). Leaves ovate, very seldom sub-cordate, leathery, downy or nearly smooth on the upper side, tomentose on the under side; panicle brachiate; corolla downy outside, the limb hairy inside; capsules ovate, oblong, ribbed externally, three times as long as broad. A most variable plant, yielding what is called Yellow Bark. It is found in the republic of New Granada, in 4° N. lat., at heights between 5400 and 8650 feet; it has the name of Quina Amarilla.

5. *C. purpurea*. Leaves broadly oval, somewhat wedge-shaped at the base, shortly cuspidate at the point, on the upper side smooth, on the under rather downy upon the principal veins; panicle large, brachiate; flowers somewhat corymbose; corolla slightly downy externally, its limb hairy inside; capsules cylindrical, becoming ovate-oblong, with longitudinal ribs, four times as long as broad. A native of the Peruvian Andes, in the coldest and deepest parts of the forests, about Chinchao, Pati, and elsewhere. It is also apparently one of the wild roots of Santa Fé de Bogota.

The very considerable size of the trees of this species, and its large membranous leaves, covered on the under side with prominent violet-coloured veins, are said by Pöppig to mark it readily. The bark, called Cascarilla Boba Colorada, is not in much esteem; but as it is readily collected it can be sold at a low price, and is used for adulterating other sorts. According to Reichel it is undoubtedly the Huamala Bark of trade. Dr. Lindley regards this and the foregoing species as identical.

6. *C. macrocalyx*. Leaves ovate, roundish, hardly acute, quite smooth on both sides; their principal veins close together; panicles corymbose; corolla slightly downy externally, with the lobes hairy on the upper side; limb of the calyx smooth, bell-shaped, acutely 5-toothed. A species distinguished by De Candolle by the above characters, but only known to him from specimens. It is found on the mountains of Peru. Nothing is known of its sensible properties.

7. *C. Humboldtiana* (*C. ovalifolia*, Bonpland). Leaves oval, rather obtuse, on the upper side shining, on the under between silky and downy; panicle brachiate, 4-flowered; corolla silky on the outside, smooth in the throat, with its lobes shaggy inside at the point; capsules ovate, longitudinally ribbed, about twice as long as broad. First described by Bonpland as identical with *C. ovalifolia* of the 'Flora Peruviana,' but afterwards recognised by him as distinct. It forms forests in the province of Cuença in Peru. In commerce it is called Cascarilla Peluda, which signifies Velvet-Leaved Quina. Its bark is not in much estimation; it is however a good deal collected for mixing with other sorts, and Bonpland suspects it to be of good quality.

8. *C. magnifolia* (*C. lutescens*; *C. grandifolia*; *C. oblongifolia*). Leaves broadly oval, somewhat acuminate, smooth; principal veins of the under side shaggy at the edges; panicle brachiate; corollas silky externally; capsules oblong, tapering, seven times as long as broad. According to Ruiz, Humboldt, and De Candolle, the *C. oblongifolia* of Mutis, which produces the Red Bark of Santa Fé is identical with the *C. magnifolia*, or Flor de Azahar, of the 'Flora Peruviana.' The former grows in 5° N. lat., at the height of from 3600 to 7800 feet

Cinchona Humboldtiana.

above the sea, and is particularly common about Mariquita; the latter occurs in the hottest parts of the Andes of Peru, about 10 degrees south of the line. *C. oblongifolia* of Santa Fé produces a bark which, although less efficacious than that of *C. Condaminea* and *C. lancifolia*, is nevertheless better than that of *C. pubescens*; but this is hardly reconcilable with Pöppig's statement that the *C. magnifolia* has a woody bark, not very astringent, and is chiefly used for purposes of adulteration: he adds, that the bark-peelers do not even reckon it a fever bark, or Cascarilla, but name it simply Corteza del Azahar. This last-mentioned author describes the tree as very stately, with unusually large white flowers, diffusing a delicious odour like that of orange-blossoms; possibly the differences adverted to are the result of climate.

9. *C. macrocarpa* (*C. ovalifolia*, Mutis). Leaves elliptical, leathery, on the upper side perfectly smooth, on the under between hirsute and pubescent; panicle trichotomous; corollas with closely pressed down on the outside; the lobes hairy inside; capsules cylindrical, twice as long as broad. The White Bark of Santa Fé. The tree grows between 3° and 6° N. lat., at heights between 4200 and 8400 feet. A variety of it, with leaves quite smooth on both sides, is common near Santa Martha.

10. *C. crassifolia*. Leaves oblong, rather blunt, tapered to the base, leathery, smooth on each side; when young shaggy in the axils of the veins; stipules membranous, grown together; corymbs terminal, trichotomous; branches 2-edged, few-flowered; fruit oval-oblong, three times as long as broad, crowned by the calyx. Found about Quito and Loxa; distinguished from *C. macrocarpa* by its peculiar membranous stipules. Nothing is known of its bark.

11. *C. dichotoma*. Leaves oblong-lanceolate, smooth, when first unfolding rather silky; peduncles terminal, dichotomous, in loose few-flowered corymbs; capsules linear, cylindrical, slender, fourteen times longer than broad. Found on the Andes of Peru, in groves near Pueblo-Nuevo, in the district of Chicoplaya. Its bark is described as brown, intensely bitter, with a little acidity. This and the foregoing species Dr. Lindley places with those imperfectly known.

12. *C. acutifolia*. Leaves ovate, acute, smooth, the veins of their under side somewhat shaggy; panicle brachiate, stalked; corolla silky outside, woolly inside; capsules oblong, tapering to the base, four times as long as broad. A native of the lower woods of the Andes of Peru, in Chicoplaya. The bark is stated to be called Cascarilla de Hoja Aguda: it is moderately bitter. Ruiz says it does not deserve any attention for medical purposes.

13. *C. micrantha* (*C. parviflora*). Leaves broadly oval, blunt, smooth, rather downy underneath at the base of the veins; panicle very large, brachiate, many-flowered; corollas densely silky; capsules oblong, three times as long as broad. A species inhabiting the cold elevated parts of the Andes of Peru, especially about the village of San Antonio de Playa Grande; the inhabitants call its bark Cascarilla Fina. The tree is of considerable circumference, flowers in February, and frequently yields eight to ten arrobas of dry bark, sometimes

called Cascarilla Provinciana, which differs from that of Huanuco by its decided whitish colour and greater roughness of the surface. It is thicker and more woody, the fracture is more fibrous, and the colour is of a bright cinnamon-brown. A bark, called Pata de Gallinazo, from the numerous specimens of Graphis, a forked sort of Lichen, found on its surface, is yielded by this sort, as well as three others. Reichel considers the samples which Pöppig brought home as undoubtedly belonging to the Huanuco Bark of commerce. Its taste, which is at first acid, becomes afterwards a powerful and permanent bitter. Lindley regards this species as identical with *C. scrobiculata*.

14. *C. glandulifera* (*C. glandulosa*). Leaves ovate-lanceolate; on the upper side smooth and shining, with glands at the axils of the veins; on the under side shaggy, especially upon the principal veins; panicles somewhat corymbose; corolla velvety on the tube, woolly in the inside of the limb; capsules oblong, three times as long as broad. The flowers are three lines long, and of a pale rose-colour. This tree only inhabits the higher mountains of Peru, and is more scarce than many of the other kinds; its trunk is from 12 to 15 feet high, and its flowers, in the month of February, fill the forests with their perfume. On the colder parts of the mountains it becomes a bush, the greatest produce from which is five or six pounds of bark. It is considered, according to Pöppig, one of the finest sorts of *Cinchona;* he says that the Peruvians distinguish it by its blackish rind, which is only here and there interrupted by small shagreen spots when in a fresh state. The common people consider these blotches an integral part of the bark, and look upon it as the more valuable if beneath the larger spots there appears a black shining velvety substance dispersed in ovals of some lines broad; this is probably caused by some Byssus. The bark-gatherers hence call it Cascarilla Negrilla. When broken, it exhibits a glossy, shining, almost resiny fracture of a ripe orange-colour passing into a fiery-brown. A variety of it, called Casc. Provinciana Negrilla, is obtained from the trees growing in warm valleys. According to Mr. Reichel, this bark is equal to the finest sort from Loxa, but it is not known in Europe, except in mixture with other kinds.

** Corollas smooth externally.

15. *C. caduciflora* (*C. magnifolia*, Humb.). Leaves oval, smooth, erect, hairy in the axils of the leaves; panicle brachiate, with corymbose branches; corolla smooth, falling off very quickly; capsules oblong, four times as long as broad. Found near Jaen de Bracamorros, a hot damp country, where it is called *C. bora*. The tree is described by Bonpland as being above 100 feet high; its bark is not employed.

16. *C. rosea* (*C. fusca*). Leaves oval, tapering to the base, bluntly acuminate at the point, smooth on each side; panicles clustered, branches corymbose; corolla smooth on the outside, its limb downy above; capsules oblong, three times as long as broad. This occurs not unfrequently about Cuchero, where it forms a highly beautiful tree, which in its size and ramification may be justly compared with the White Beech of Europe. In July it is covered with innumerable pale violet flowers, whence it has obtained the name of Palo de San Juan. Its bark is not collected, but Pöppig thinks it would be found to possess good qualities.

In addition to these species, Dr. Lindley recognises in his 'Flora Medica' the following:—

C. lucumæfolia, Pavon (*C. stupea*). A species said to furnish a part of the Loxa Bark.

C. lanceolata 'Fl. Per.' Ruiz suspects this species to be the true source of the Calisaya Bark. It is found in the districts of Muña, Panas, Pillao, and Cuchero.

C. rotundifolia, Ruiz and Pavon, MSS. From a specimen in Mr. Lambert's Museum. Found at Loxa in Quito.

C. cordifolia, Mutis, MSS. Found in the mountains of New Granada, at an elevation of from 5000 to 8000 feet above the sea.

C. hirsuta, 'Fl. Per.' It is probable this species yields some of the fine Yellow Bark of the shops. It is found in high and cold places near Pillao and Acomayo.

C. villosa, Pavon (*C. Humboldtiana*, Lambert). Found at S. Jaen de Loxa.

C. oblongifolia, Lambert. Although nothing is known of this plant beyond the specimens in the Lambertian Museum, the London College of Physicians, in their 'Pharmacopœia' of 1836 recognised it as yielding one of the barks of commerce.

C. acutifolia, 'Fl. Per.' It is found in the lower groves of the Peruvian Andes, in Chicoplaya, by the river Taso. It yields very poor bark.

C. stenocarpa, Lambert. From Jaen, in the mountains of Loxa.

C. cava, Pavon. From Quito.

Whatever may be the botanical history of the different kinds of bark, on their arrival in Europe they are known by names which have reference rather to their physical appearance or the place whence obtained, than to the botanical characters of the trees which furnish them. In England they are classed under three heads—pale, yellow, and red barks. Of each there are several varieties, which comprehend however, various barks, not the produce of any of the genuine species of *Cinchona* above enumerated, but obtained from species of *Exostemma*, *Buena*, and *Strychnos* (according to Mr. Burchell). These last, called false or spurious Cinchona barks, are all distinguished from the true Cinchona barks by the absence of Cinchonia, Quinia, and Aricina (or Cusco-Cinchonia), a principle found in the Cusco or Arica Bark, referred to the *Cinchona rubiginosa*, Bergen). Several of these spurious barks are employed in fever and other diseases, but they are chiefly used to adulterate the more valuable kinds of Cinchonas. Even when there is no intermixture of these inferior sorts, a variableness in quality occurs in the bark of the same species, according to its place of growth. The finer kinds are known by experienced persons by a glance of the eye; but it is extremely difficult to indicate, by any description, the marks by which they are guided. All kinds arrive in Europe in the same package, either a chest or serone, which is formed of pieces of wood rudely fastened together, and covered with the hides of animals. They are afterwards sorted, and bring very different prices in the markets, according to the degree of estimation in which each kind is held. We shall describe the best kind only of each; but we must remark, that much prejudice exists on this point, and sometimes excellent kinds are rejected, while inferior sorts are prized. To meet these prejudices, the barkers employ various artifices, more or less injurious. The most useful classification of barks is that proposed by Geiger, which has reference to the relative proportions of their alkaloids:—1. Those in which Cinchonia predominates: chiefly pale or brown barks.—2. Those in which Quinia predominates, of which there is only one—the yellow bark of English commerce, called *China regia vera*, *China Calisaya*.—3. Those in which Cinchonia and Quinia exist in nearly equal proportions, red barks, and the yellow bark of continental writers; the China of Carthagena of the French, *China flava dura*, *Quina amarilla*. This last is also called orange bark (*Quina aurantiaca* of Mutis), which is not the yellow bark of English commerce, though by some it is erroneously so considered; and hence the frequent error in the British Pharmacopœias of referring yellow bark to the *C. cordifolia* (Mutis).

Of the Pale Barks three varieties are known in English commerce:—1. Crown or Loxa Bark.—2. Gray, Silver, or Huanuco Bark.—3. Ash Bark. These are always quilled, and never in flat pieces. The powder, which gives the name, varies from gray to fawn-colour.

1. The first variety, Crown or Loxa Bark, called also True Loxa Bark, is obtained either exclusively from the *C. Condaminea*, or from it and *C. scrobiculata*. It occurs in pieces from six to fourteen inches long, the quills varying in diameter from the fourth or even smaller part of an inch to nearly half an inch; the rolls are sometimes double, meeting at the centre: the diameter of the bark is from a quarter of a line to a line and a half. The colour of the exterior is marked dark gray, in some specimens verging to brown. A shining but peculiar appearance is observable upon it, owing to the thallus of the lichens spreading over it. This commonly alternates with the colours of other lichens, grayish-white, yellowish-white, bluish-white, so that the bark acquires an appearance as if it were painted. Numerous transverse cracks, often extending from one side of the bark to the other, with the edges a little raised, are seen, sometimes close to each other, sometimes more remote, especially in the larger pieces, in which also they rarely extend to the whole circumference of the piece. In the larger pieces longitudinal cracks are observed, and between these warts or knots frequently arise, which give a very rough feel to such specimens. The *Usnea florida*, and some foliaceous lichens, such as *Parmelia perforata* (Ach.), often remain attached to it. The inner surface is smooth, except some delicate, irregularly-longitudinal fibres: the colour is a cinnamon or darker brown. The fracture of the smaller quills is even, or slightly fibrous; that of the larger pieces more so, the fibres firm, but neither oblique nor vitreous, as in the yellow bark (*China regia*); but the outer circle presents a resinous aspect. The odour resembles that of tan. The taste at first is slightly astringent, and faintly acid; afterwards very astringent, somewhat bitter, but not acrid.

In respect to its chemical composition, this variety is commonly supposed to contain Cinchonia (discovered in pale bark by Dr. Duncan, jun.) only; but this is a mistake, and it is most probable that the specimens which, when analysed, yielded no Quinia, were either very thin quills obtained from young branches or trees, or were specimens of Huanuco Bark. Bucholz analysed sixteen ounces of the Loxa Bark of commerce, yet found no Quinia, but some error is reasonably suspected; the other constituents were found to be—

	Drachms.	Grains.
Fatty matter, with Chlorophylle	1	0
Bitter soft Resin (Geiger thinks this contained Quinia)	2	0
Hard Resin (red insoluble colouring-matter)	12	0
Tannin (with trace of Acetic Acid)	3	0
Cinchonia	0	28
Kinic Acid	1	30
Hard Resin, with Phyteumacolla	1	49
Tannin, with Chloride of Lime	4	25
Gum	5	40
Kinate of Lime	1	40
Starch, a trace		
Woody Fibre		

The Cinchonia exists in combination with the kinic acid, in the form of kinate of cinchonia. A prejudice exists in favour of the thin quilled pieces, but they are not so well adapted to form extracts, &c., nor to be employed as medicine. Mutis many years ago stated that the thick pieces obtained from branches of middle-aged trees were the most efficacious; and the analysis of Von Santen (in Von Bergen's 'Versuch einer Monographie der China') confirms the correctness of this statement, as far as the relative amount of Quinia yielded by barks of different ages is concerned. From 100 lbs. of Loxa Bark, he obtained of Quinia—

	Ounces.
Thin selected quills	1·042
Moderately thick pieces	4·444
Selected thick pieces, with rough cracked bark	11·104

2. The second kind, Huanuco Bark, termed also Silver or Gray Cinchona, has been known in European commerce only since 1799. The majority of writers on the origin of the barks refer it to the *C. glandulifera*. (Ruiz and Pavon, 'Fl. Peruv.') As it is sent from Huanuco to Lima for shipment, it is also called Lima bark, though some apply the term Lima to a bark supposed to come from the *C. lancifolia* (Mutis). It is likewise called Havanna bark. We have the authority of Pöppig, as stated above, for considering it one of the finest sorts of Cinchona. The variety of it termed Casc. Provinciana Negrilla (the Quinquina Huanuco Noirâtre of the French) is likewise stated by Reichel to be equal to the finest from Loxa, yet it is not known in Europe except in mixture with other kinds. The explanation of which is two-fold: first, that though the trade in this bark was at first very brisk, owing to its excellent quality, the subsequent shipments of it being very inferior, it fell into disrepute; and though it is now again pure and good, still it is necessary to introduce it as Crown Bark. Farther, as the French give the name Lima bark to another kind as above mentioned, probably the dark-ash bark, the dark Ten (*China Pseudo-Loxa*), the false Loxa bark, confessedly a very bad bark, it has caused the genuine Lima bark to be little esteemed. Farther, as the Huanuco Bark is in quills which are larger and coarser than those of the Crown Bark, the prejudice in favour of thin quills operates to the disadvantage of this very excellent sort.

The quills are from three to fifteen inches, generally from four to ten inches long, with a diameter from a few lines to one or even two inches. They are in single rolls, or double and inclosed rolls; the inclosed rolls exhibit spiral windings, and frequently traces of a sharp oblique incision of the knife. This incision is not observed in the case of any other kind, and it is probably made by the Cascarilleros to facilitate the separation of the bark from the trunk of the tree. The diameter of the bark varies from one-fourth of a line to five lines. The epidermis is seldom absent, but now and then portions of it have been rubbed off, and then the rusty surface of the liber is seen. The epidermis is a whitish-gray, but often covered with numerous lichens, chiefly *Glyphis cicatricosa*, *Graphis duplicata*, *Porina granulata*, *Pyrenula discolor*, *Mastoidea*, *Pupulo*, *Lecanora punicea*, *Parmelia perforata*, *Sticta aurata*, and *Usnea florida*.

The character of the cracks is more variable than in Loxa Bark, few extending to the whole circumference of the bark; in the young pieces the cracks are not so deep as in the older, in which also the edges are raised, giving a rough appearance to it. Some specimens also between the large and extensive cracks present spaces very slightly cracked, of a golden-straw or leaden-gray colour. Huanuco Bark is distinguished by the brighter colour of its surface, the multitude of its small cracks, and the sharp oblique incisions above mentioned, from the yellow or Calisaya bark (*Quina regia*), and the Loxa bark, to both of which it bears considerable resemblance. The inner surface is of a bright-cinnamon, passing into an ochre-yellow or rusty hue, and is generally rough, and, especially in the thicker quills, fibrous, frequently with portions of the wood of the stem adhering to it. Though no satisfactory chemical analysis has been made of it, exhibiting its entire composition, yet the relative proportions of its alkaloids have been stated. It is the richest in Cinchonia of all the barks hitherto examined. Goebel, Kirst, and Von Santen say that it yields this alkaloid only. Michaelis maintains that two specimens analysed by him yielded, in addition, a little Quinia. The quantity of Cinchonia is very variable. Kirst and Goebel obtained from one pound 168 grains; Von Santen from nine different specimens examined by him, from one pound a quantity varying from 106¾ grains to 210 grains. The fracture of the bark is either fibrous or splintery; that of the outer portion resinous. The odour resembles that of clay. The taste acid, astringent, somewhat aromatic; then bitter, acrid, and enduring. The powder is a deep cinnamon-brown.

3. The third kind of pale bark, called Ash, Jaen, or by corruption Ten-Bark, is by Von Bergen referred to *C. ovata* (R. and P.), which he considers synonymous with the *C. pubescens* of Vahl. It is likewise called Pale Ten-Bark to distinguish it from the Dark Ten-Bark, or False Loxa Bark. The quills of this kind are always crooked, frequently also twisted. The epidermis is frequently absent; when present, it presents faint transverse cracks, the edges of which are somewhat raised, and a few longitudinal cracks or warts. The bark itself is of an ash-gray, whitish-gray, or light-yellow colour, with brown or blackish spots. It has often a slightly shining aspect. The inner surface varies very much, sometimes smooth, sometimes with long fibres attached to it, sometimes splintery, of a cinnamon or dark-brown colour. The fracture is sometimes even, sometimes slightly fibrous, with a faint external resinous circle. The odour is a little like tan, and pleasant. The taste slightly acid and moderately astringent, a pure but not disagreeable bitter. The accounts of its chemical composition differ much. Von Santen says it contains neither Cinchonia nor Quinia. Goebel and Kirst from one pound obtained no Cinchonia, but 12 grains of Quinia; while Michaelis says in two specimens examined by him, he found both Quinia and Chinchonia; of the former, even 80 grains; of the latter, 12 grains. Notwithstanding this last statement, this is generally and justly regarded as a very bad sort of pale bark, and was chiefly used to adulterate the true Loxa Bark.

The Dark Ten-Bark, or China Pseudo-Loxa, occurs generally in thin or middle-sized, but seldom thick, quills. The surface exhibits transverse cracks and longitudinal wrinkles, which often form rings a line or more broad. The colour is milk-white, but covered with so many lichens as to have a dark appearance. The under surface is uneven, fibrous or splintery, the fibres often very long: the colour a rusty brown. The fracture is fibrous or splintery: it exhibits a resinous appearance only when cut. Smells strongly like tan. The taste at first enduringly acid, afterwards astringent. This bark is frequently purchased instead of the true Loxa Bark, and is at present of frequent occurrence in the market. Bergen considers it to be produced by the *C. nitida* (R. and P.) and the *C. lancifolia*: these are perhaps only varieties the one of the other; but whencesoever obtained it is very poor in alkaloids, one pound yielding only 9 grains of Kinia and 12 of Cinchonia. It is held to be one of the worst kinds of pale bark.

The lichens and epidermis should be scraped off all pale barks before they are reduced to powder: though they increase the bulk, they diminish the efficiency of the powder.

The Yellow Barks.—There are only three kinds; the Yellow Bark of English commerce, which by continental writers is called merely *China regia*, *Quina Calisaya* (the Quinquina Royal, Gelbe Königschina), and the Yellow or Carthagena Bark of the Continent comprehending two sorts:—1. China flava fibrosa, China de Carthagena fibrosa, the Quina Naranjada (of the natives); the Quina de Santa Fé fibrosa, or Quina de Carthagena lenosa (fibrosa), of the Spanish; Quina de Carthagena amarella lenhosa (fibrosa) of the Portuguese; Quinquina de Carthagene fibreux, ligneux, Quinquina Orange (of the French); Holzige Gelbe China, Holzige Carthagenarinde (of the Germans). 2. China flava dura, China lutea, China de Carthagena dura, Quina Naranjada de Santa Fé, Quina aurantiaca, Quina de Santa Fé, or Quina de Carthagena dura (Spanish); Quina de Cartagena amarilla dura (Portuguese); Quinquina de Carthagene, or Quinquina flava dura (French); Harte Gelbe China, Harte Carthagenarinde. This is the Orange Bark of Mutis, which he says is obtained from *C. lancifolia*. Bergen and Goebel ascribe it to *C. cordifolia* (Mutis), which some deem synonymous with *C. pubescens* (Vahl.), which species is therefore stated alone to yield the yellow bark; but this only applies to the yellow bark of the Continent, for the source of the Yellow Bark of English commerce must be considered as yet undetermined. We shall limit our description to this last kind, as the best known in this country, and at the same time the most valuable. This occurs in two forms—quills and flat-pieces; the quills were formerly most prized, but all well-informed persons now prefer the flat pieces as much richer in Quinia. The quills are in general in single, seldom in double rolls, the diameter of which is mostly greater than even the largest quills of pale Loxa Bark, being from a quarter of an inch to an inch, the length from 4 to 24 inches, occasionally containing smaller quills inside the larger. The thickness of the bark varies from one-eighth to one-fourth of an inch. The external surface is generally grayish-brown, inclining to blackish, yellowish, or whitish, according to the kind of lichen by which it is beset. Few pieces are quite free from lichens; many specimens exhibit the wax-yellow thallus of *Lepra flava* (Acha.), which appears as if fused upon it: this is a very characteristic mark, when present, of Calisaya bark. The quills seldom have the epidermis removed, which has both transverse and longitudinal cracks, which penetrate down to the bark itself, as their traces can be perceived upon it even when the epidermis has been removed. The transverse cracks frequently extend over the whole circumference of the piece, yet they are much interrupted by longitudinal cracks and furrows (this is more especially the case with the thinnest quills); but all of them have raised edges, resembling those of Loxa Bark. Where the epidermis is wanting, the colour of the exposed part is of a cinnamon or rusty-brown hue. The colour of the inner surface varies according to the age of the bark. Generally it is a deep cinnamon, in recent barks verging to reddish; in older specimens it is paler, or a rusty-yellow. The transverse fracture is in the thinner quills smooth, in the larger fibrous, splintery, or vitreous; a resinous circle is under the epidermis. The longitudinal fracture is generally uneven, and delicately fibrous: this kind of bark is easily broken.

The flat Yellow Bark, or that in splints, occurs either with the epidermis, or divested of it (*China regia nuda*). Pieces retaining the epidermis are generally from one to five inches broad, generally quite flat, but sometimes slightly curved, from three to fifteen inches long, and from one quarter to three-quarters of an inch thick. The characters of the epidermis correspond with that above described: the uncoated kind is most frequent, and occurs in splints from one to eight lines thick. The colour varies, but is generally a reddish or rusty-brown, and is nearly the same on both surfaces, so that in pieces which have become convex on the inner side, and concave on the outer, as often happens, it is difficult to determine which was the exterior; this is by far the best kind of yellow bark.

Adulteration of Yellow Bark is not very easy, but a kind of humalia-like bark used to be substituted for it.

The odour of genuine Yellow Bark is slightly that of tan. The taste is faintly acid, strongly but not unpleasantly bitter, aromatic, stimulating, and slightly astringent.

The analyses of uncoated Yellow Bark (Calisaya) by Pelletier and Caventou show its composition to be super-kinate of quinia, fatty matter, slightly soluble red colouring-matter (red cinchonic acid), soluble red colouring-matter (more than in gray bark), tannin, kinate of lime, lignin, amylum. When the uncoated kind is analysed, some Cinchonia is obtained. By a comparative analysis it is found that a pound of flat uncoated yellow bark yields nearly twice as much Quinia as the quilled sort, a point of much importance to the preparers of that alkaloid. The Carthagena yellow barks both contain Quinia, but in less quantity than the Calisaya bark; the hard Carthagena bark, in addition, yields Cinchonia, but not the fibrous kind.

The Red Bark, of which one kind only is known in English trade, is generally referred to *C. oblongifolia;* though many doubts may be held on this head. Bergen is much more disposed to consider the *C. oblongifolia* as the source of the China Nova, or Surinam bark, which is not officinal in Britain; this also is doubtful. Red bark has been known for 130 years, but was not much used in Europe till 1779. It occurs in quills and flat pieces, most frequently in the latter form. The quills are rolled singly, or doubly, from 4 to 15, but generally from 4 to 6 inches long, and from a few lines to 1 inch in diameter, the bark being from 1 to 4 lines thick. The figure of the flat pieces is variable, being generally very much broken, frequently with the epidermis entire; but this is often partially, seldom or never completely, absent. The length is generally from 4 to 24 inches, the thickness from ¼ to 1 inch, and the breadth 1 to 3 inches. The quills most frequently have the epidermis entire; some of them have a whitish-yellow, or grayish-white epidermis (interrupted by longitudinal and irregularly transverse cracks), a red hue shining through it. In fact, even in pieces with the epidermis entire, and covered with many lichens, the red hue is seen ever shining through —a characteristic mark of this kind of bark. The flat pieces have generally an amazing number of lichens upon them. In these pieces also what is called the rete mucosum is often very spongy. Warty bodies are found on some varieties. The inner surface is a reddish-brown, varying in intensity. The fracture in thin quills is smooth, in those of a moderate thickness fibrous, and in thick quills and flat pieces fibrous and splintery: the epidermis, when penetrated by the resinous principle, exhibits a vitreous shining ring.

Pelletier and Caventou analysed a specimen of the variety free from warts, and found it to contain—

Superkinate of Quinia } in large quantity.
Superkinate of Cinchonia }
Slightly soluble red colouring-matter, or red Cinchonic Acid.
Soluble red colouring-matter (tannin).
Yellow colouring-matter; fatty matter.
Kinate of Lime. Woody Fibre. Starch.

The relative proportions of Quinia and Cinchonia differ in different specimens; a pound of bark yielding in some instances 70 grains of Cinchonia and 77 grains of sulphate of quinia, in others 184 grains of Cinchonia and only 9 grains of sulphate of quinia.

The Humalies, or Brown Bark, is not known in English commerce; its source is not accurately determined.

Several inferior kinds, and others erroneously reputed to be Cinchona barks, are met with, either accidentally or fraudulently mixed with or passed for the genuine; but they may be known by not possessing the characters of the best kinds as given above.

Dr. Lindley, in his 'Flora Medica,' gives the following as the result of his inquiries with regard to the barks used in medicine :—

(a). *Pale Barks :—*	
Crown, or Loxa Bark	*C. Condaminea.*
Silver, Gray, or Huanuco Bark	*C. micrantha.*
Ash-Bark	(?)
White Loxa Bark	(?)
(b). *Yellow Barks :—*	
Yellow Bark	*C. lanceolata.* *C. hirsuta.* *C. nitida.*
Calisaya	*C. lanceolata.*
Carthagena Bark	*C. cordifolia.*
Cusco Bark	(?)
(c). *Red Barks :—*	
Red Cinchona, or Bark of Lima	(?)
Cinchona Novex	*C. magnifolia.*
(d). *Brown Barks :—*	
Humalies Bark	*C. purpurea.*

In the 'London Pharmacopœia,' published by the College of Physicians for 1851, the following Barks are recognised :—

C. flava (*regia*), (*C. cordifolia*, 'Ph.' 1836)	*C. Calisaya*, Weddell.
C. pallida (de Loxa), (*C. lancifolia*, 'Ph.' 1836)	*C. Condaminea*, Weddell.
C. rubra (*C. oblongifolia* 'R.' 1836)	*C. species incerta.*

CINCHONA'CEÆ, *Cinchonads*, the Cinchona-Tribe, a natural order of Monopetalous Exogenous Plants, with an inferior fruit, a regular corolla, seeds containing a small embryo in the midst of horny albumen, and opposite undivided leaves with stipules placed between their petioles. This brief character distinguishes a most extensive and important assemblage of plants, comprehending many of the most useful species we are acquainted with. The bark of the order is very generally tonic, aromatic, and febrifugal, and its energy is attested by the well-known use of that of *Cinchona* itself, to say nothing of the numerous other genera fit to be employed as substitutes for Jesuit's Bark. [CINCHONA.] The albumen of the seeds when roasted affords, in the case of coffee, a fragrant, stimulating, and agreeable principle [COFFEA]; and the roots of many herbaceous kinds possess active emetic properties. True Ipecacuanha is the produce of *Cephaëlis Ipecacuanha* [CEPHAELIS], but many other Cinchonaceous plants resemble it in their medicinal qualities, and are perhaps mixed with it in commerce. *Cinchonaceæ* are the *Rubiaceæ* of many botanists; but as it appears advisable to separate *Rubia* and its allies into a distinct order, on account of the absence of stipules, and for other reasons [STELLATÆ], it is necessary to alter the name of the remainder of the group; and as a type of the order, when circumscribed, *Cinchona* is unexceptionable.

The Honeysuckles were also referred to *Rubiaceæ*, but are now separated under the name of *Caprifoliaceæ*. With these two orders *Cinchonaceæ* has undoubtedly the greatest affinity. It is also related to the *Compositæ*, and through the genus *Lygodysodea* to the *Umbelliferæ*. Some of the genera of this order exhibit a tendency in their sepals to revert to the foliar condition after the petals have fallen. This is the case with *Mussænda* and *Calycophyllum*. [CALYCOPHYLLUM.]

Cinchonads are found exclusively in the hotter parts of the world, where they are so common as to constitute not less than one-twenty-ninth part of the whole of the vegetation. The order comprises 269 genera and 2500 species. The most valuable of these are undoubtedly the species of *Cinchona*, but many important plants besides these are yielded by this order. The genera *Pinckneya*, *Condaminea*, *Guettarda*, *Antirrhea*, *Morinda*, *Hymenodictyon*, and *Ophiorhiza*, all afford species which yield barks regarded as febrifuge and astringent in the treatment of disease. Some of the species yield tannin, as the *Uncaria Gambier*, from which a kind of Catechu or Kino is prepared. The species of *Chiococca* [CHIOCOCCA] have active properties. Only a few species yield food. "The Genipap, a South American fruit, as large as an orange, of a whitish-green colour, but containing a dark purple juice, with an agreeable vinous taste, is borne by *Genipa Americana*. *Sarcocephalus esculentus* is the edible peach of Sierra-Leone. *Vangueria edulis*, or Voa-vanga is said to be a good dessert fruit in Madagascar. *Genipa Brasiliensis* is also eaten in Brazil, but Martius says that it is only fit for table after becoming bletted, and that it is better when preserved with sugar than when fresh. Some of the bushes called in Tasmania native currants are Coprosmas, but they are not of good quality." (Lindley).

Several genera, as *Oldenlandia*, *Psychotria*, *Genipa*, *Condaminea*, and *Hydrophylax*, yield colouring-matters used in dyeing. Some species are remarkable for their fragrance and beauty, especially amongst the genera *Gardenia*, *Hindsia*, *Posequeria*, *Ixora*, *Bouvardia*, *Catesbæa*.

(Lindley, *Vegetable Kingdom.*)

CINCINNURUS. [BIRDS OF PARADISE.]

CINCLOSO'MA, a group of Thrushes, characterised by Dr. Horsfield and Mr. Vigors. [MERULIDÆ.]

CINCLUS, a genus of Insessorial Dentirostral Birds, belonging to the family *Merulidæ*. *C. aquaticus* is the Common Dipper of British ornithologists. [MERULIDÆ.]

CINERA'RIA, a genus of Plants belonging to the natural order *Compositæ*, the sub-order *Corymbiferæ*, the tribe *Eupatoriaceæ*, the sub-tribe *Senecioneæ*, and the division *Eusenecioneæ*. It closely resembles *Senecio* [SENECIO], and differs from that genus in its involucre being composed of one row of equal scales only. Two species are found in Great Britain.

C. palustris, a shaggy plant with a much branched stem which is corymbose above; leaves broadly lanceolate, half-clasping, the lower leaves sinuate-dentate. It has a stem 3 feet high, thick, hollow, and leafy. The florets are of a bright-yellow colour. It inhabits ditches in fenny districts, and was at one time a more abundant plant in England than it is at present.

C. campestris, a shaggy plant, with a simple stem; the root-leaves oblong, nearly entire, narrowed below; the stem-leaves lanceolate, heads corymbose, involucre woolly below nearly glabrous in the upper half; the fruit hispid. It has a stem 6 or 8 inches high with yellow florets. It is found mostly on chalk downs. A variety, *C. c. maritima*, occurs near the sea in very wet seasons; it is then twice or three times as large as usual, and the lower leaves are dentate.

(Babington, *Manual of British Botany*; Lindley, *Natural System*.)

CINERAS, a genus of Barnacles. [CIRRIPEDIA.]

CINNABAR. [MERCURY.]

CINNAMODENDRON, a genus of Plants referred to Von Martius's doubtful order *Canellaceæ*. This genus has been separated from *Canella* which is well represented by *C. alba*, a common West Indian aromatic shrub with evergreen coriaceous obovate alternate stalked leaves, no stipules, and corymbs of purple flowers. *C. alba* is often called Wild Cinnamon in the West Indies, on account of its warm aromatic fragrant properties. [CANELLA, in ARTS AND SC. DIV.] There is but one other species of *Canella*. *Cinnamodendron* has but one species, *C. axillare*. It is a Brazilian tree with aromatic properties. Its bark is used as a tonic and stimulant. It is administered in low fevers and relaxed sore throat.

CINNAMO'MUM, a genus of Plants belonging to the natural order *Lauraceæ*. It is confined to the East Indies, and distinguished from the rest of its natural order by the following technical character:—Flowers hermaphrodite; abortive stamens perfect; anthers with four cells; limb of the perianth articulated, deciduous; buds of the leaves incomplete; leaves evergreen, often approximated in pairs, 3-ribbed or triple-ribbed. It contains several species, some of which yield Cinnamon, and others Cassia, two aromatic barks which appear to differ from each other in little, except in the degree in which the aromatic principle exists in them. Till lately it was understood that a Ceylon plant called *Laurus Cinnamomum* yielded true Cinnamon, and another, called *Laurus Cassia*, produced the inferior Cassia bark on the coast of Malabar; but, according to Nees von Esenbeck, at least two distinct species yield the Cinnamon of the shops, and it is altogether uncertain which out of several yields Cassia.

Cinnamon has been known to European nations from very high antiquity. The Greeks procured it, together with the name, as Herodotus (iii. 111) remarks, from the Phœnicians, who are by some supposed to have formed the name Kinnamomon from Kagu-manis, or Kaschu-mania, two Malayan words signifying sweet wood ('Annals of Philosophy,' 1817); and Cassia itself may have originated in the same word Kaschu, 'wood.' That which is now chiefly consumed in England is the aromatic bark of a small tree found in the Island of Ceylon.

C. Zeylanicum, the Ceylon Cinnamon-Tree. Its leaves are of an oblong figure, generally more or less heart-shaped at the base; of a thick leathery texture, very smooth and shining on the upper side,

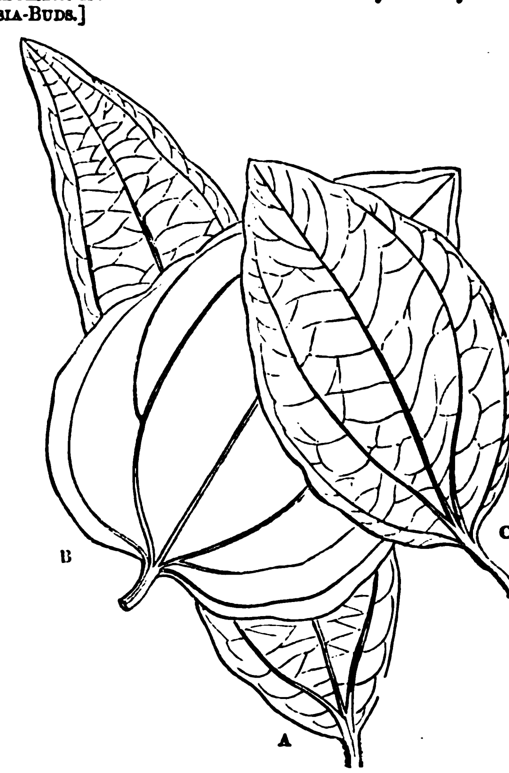
Ceylon Cinnamon-Tree (*Cinnamomum Zeylanicum*).

1, a perfect stamen, with one of the abortive stamens at its base; 2, a pistil; 3, ripe fruit.

glaucous and beautifully marked with prominent netted veins on the under side; they are always blunt, and seldom even tapered to the point; they are nearly opposite on the branches, and are traversed by from three to five ribs, of which the lateral ones run in a curved direction from the base to the point. The flowers are greenish-white, and appear in threes, collected in clusters, in small terminal panicles; they are composed of a downy calyx divided into six parts, and containing nine perfect stamens and nine others which are imperfect and resemble yellow triangular-stalked glands. Their pistil is a roundish 1-celled body terminating gradually in a style with a white downy capitate triangular stigma. The fruit is an oval berry, not unlike an acorn, seated in the calyx, which is enlarged and converted into an angular 6-toothed cup. The tree is supposed to produce a considerable number of varieties to which native names are given, but it is uncertain whether these are not, in part at least, distinct species. In addition to the aromatic oil contained in its bark, the root of the Cinnamon-Tree yields camphor; the liber, oil of cinnamon; the leaves, oil of cloves; and the fruit a peculiar terebintaceous ethereal oil. When the branches are peeled the finest sticks of Cinnamon are said to be obtained from the liber of the middle-size branches, an inferior sort from the youngest shoots, and that which is produced by the thickest branches is considered of very little value.

It is said to require a rich sandy soil mixed with vegetable earth. Some degree of shade is necessary to the young plants, which therefore are not cultivated in open plains, but in spaces in the woods where a few large forest-trees are left scattered about to shade them. In about six or seven years from the time they are sown, young cinnamon bushes are from four to six feet high; they are not however generally barked before the ninth year. The cinnamon peeling begins in May, at the end of the rains, and lasts till November; the operation of peeling consists in nothing more than slitting the bark longitudinally and then cutting it across, so that it can be readily turned back from the wood, and it is the more easy in consequence of the shoots which are cut for peeling not being more than three years old.

C. aromaticum (Esenbeck), is the species which is believed to be the Cinnamon of China and Cochin China. This plant, which is not uncommon in the hot-houses of Europe, has long been reputed the kind that yields cassia, but that opinion appears to be altogether unfounded. It is said to grow in the dry sandy districts, lying north-west of the town of Faifoe, between 15° and 16° N. lat. The leaves are very much larger than in the true Cinnamon, they usually hang down from the stalks, have never more than three ribs, and never are in any degree cordate at the base; sometimes they are taper-pointed, sometimes blunt. A, in the following figure, is a leaf of this species; B and C are different forms of the leaf of the *Cinnamomum Zeylanicum*, The aromatic fruits called Cassia-Buds are also yielded by this species. [CASSIA-BUDS.]



With regard to *Cassia lignea*, or Cassia-Bark, it seems altogether uncertain what it is that yields it; whether it is some peculiar species, as it has long been supposed to be, or inferior samples of Cinnamon gathered in unfavourable seasons, or from trees growing in bad situations. The differences in Cassia-Bark are of such a nature as to render the last the most probable conjecture; it possesses less aromatic oil, a circumstance likely to occur to trees in unfavourable situations; and in proportion as the oil disappears there is an increase in mucilaginous and resinous matter. But on the other hand there are so many inert or comparatively inert species of *Cinnamomum*, that Cassia may very well belong to one of them. There is *C. dulce* in China, *obtusifolium*, *iners*, *Basania*, and others, any of which may possibly yield such a bark. The question is however one more of curiosity than real consequence. The only important thing about Cassia was the supposing it to be furnished by what is really a most valuable species, and that error is now removed.

Cinnamon of the genuine Ceylon kind is cultivated in Guyana, the island of St. Vincent, the Cape de Verd, Brazil, the Isle of France, Pondicherry, Guadaloupe, and elsewhere, and it is said that plants obtained from Paris by the Pasha of Egypt have thriven when transported to Cairo. There is however no probability that the tree will succeed as an article of commerce in any country that has not the hot damp insular climate and bright light of Ceylon.

C. Tamala is a native of the continent of India, wild in Derwanee and Gongachora, cultivated in the gardens of Rungpoor. The taste of the leaves when dried is aromatic; they are sold in the shops under the name of Folia Malabathri Tamalapathri or Indi.

C. Loureirii grows on the lofty mountains of Cochin China, to the west towards Laos, Japan. The flowers of Cassia are produced by this species. The old and young branches are worthless, but the middle-sized shoots are superior to that of Ceylon, and are sold at a much higher price.

C. Culilawan is a native of Amboyna, especially in Leitimoo near the villages of Saya, Rutton, and Ema. The bark when dry is aromatic like cloves, but less pungent and sweeter. It has some astringency, and owes its medicinal activity to a combination of volatile oil, resin, and bitter extractive. It is useful in dyspeptic complaints, diarrhœas, &c. The natives of Amboyna use it both as an internal medicine and as a stimulating linament.

C. rubrum grows in Cochin China, and contains an essential oil, like the last species, smelling of cloves, but not so agreeable.

C. Sintoc grows on the Nilgherry Mountains in Hindustan, and the higher mountains of Java. It is a tree 80 feet high. The bark is in quality very like the true Culilawan, but not so agreeable; it is more bitter and drier, and more powdery when chewed.

C. xanthoneuron is a tree growing on the Papuan Islands and the Moluccas. The bark has great fragrance when fresh, but loses this quality in time. It is so extremely like Mapoy Bark as to be confounded with it.

C. nitidum is a shrub or small tree growing on the continent of India. It is the plant which furnished the principal part of the 'Folia Malabathri' of the old pharmacologists.

C. Javanicum is a tree with a trunk 20 feet to 30 feet high, growing in Java and Borneo. The bark is of a deep cinnamon-brown colour, more bitter than Culilawan Bark, and the leaves when rubbed have a very sharp aromatic odour. Blume says the bark deserves the attention of medical men on account of its powerful anti-spasmodic properties.

With regard to Cinnamon and Cassia Barks as they occur in commerce, we are most indebted to Nees von Esenbeck, who has paid great attention to the subject. According to him, the finest or Ceylon Cinnamon is procured from the three-year-old branches of the *Cinnamomum Zeylanicum* (Blume), which is found native in the island of Ceylon only; the cultivation however has been extended to Java and to South America. Though found in various parts of the island, it is most abundant in the south-west part, near Colombo, and yields the best Cinnamon when growing in a sandy quartz soil. The time for stripping off the bark is from May to October. The bark, after being removed from the branches, is tied up in bundles for twenty-four hours, during which time a sort of fermentation takes place, which greatly facilitates the separation of the outer part of the bark from the cuticle and epidermis, which is very carefully scraped off the Ceylon Cinnamon. It is then rolled up into quills, or pipes, about three feet in length; the thinner or smaller quills being surrounded by larger ones—a mark which always distinguishes Cinnamon from Cassia. It is then conveyed to Colombo, where it is sorted by government inspectors into three kinds, of which the two finest alone were allowed to be exported to Europe, while the third, or inferior kind, was reserved to be distilled along with the broken pieces of the other two for the purpose of obtaining the oil of cinnamon. The select Cinnamon is formed into bales of about 92½ lbs. weight, containing some pepper or coffee, and wrapped in double cloths made of hemp, and not, as stated by some writers, of the cocoa-tree.

This fine Cinnamon occurs in pieces about forty inches in length, generally containing from six to eight rolls or quills in each, one within the other, of the thickness of vellum paper, of a dull golden-yellow colour, smooth on both outer and inner surface. It is very fragrant, agreeably aromatic, taste pleasant, warm, aromatic, slightly astringent. Analysed by Vauquelin, it yielded volatile oil, tannin in large quantity, an azotised colouring-matter, a peculiar acid, mucilage, and fæculum.

The root of the Cinnamon tree yields a kind of camphor, and the leaves yield an oil which resembles oil of cloves, which it is often used to adulterate. This is quite distinct from the oil of cinnamon obtained from the bark. The ripe berries yield by decoction a solid volatile oil, similar to the oil of juniper. Cassia, according to Marshall and others, is the bark of the old branches and trunk of the *Cinnamomum Zeylanicum* already mentioned, while others assert that it is the bark of an entirely different species, namely, of the *Cinnamomum Cassia* (Nees Fratres, et Blume), a native of China, but cultivated in Java. This last view is much the more probable; for not only is no Cassia exported from Ceylon (except the rejected or third sort of Cinnamon, which is introduced into England incorrectly under that name), but almost all the Cassia which reaches Europe comes from Canton. Reagents produce very different effects both on the infusion and oil of these two barks, which is a rational ground for believing them to be obtained from different species.

Cassia is easily distinguished from Cinnamon. The bales in which it arrives are much smaller, containing only from two to four pounds, bound together by portions of the bark of a tree. The quills are thicker, rolled once or twice only, and never contain thinner pieces within; the diameter of the bark is much thicker than that of Cinnamon, and harder, the outer rind less carefully removed (large patches of the cuticle and epidermis often remaining upon it), the colour deeper, of a brownish fawn-colour (that raised in Guyana is yellowish), with the odour of Cinnamon, but fainter and less grateful; the taste more acridly aromatic, pungent, less sweet, at the same time more powerfully astringent, yet mucilaginous.

Cassia is often substituted for Cinnamon, and it is also frequently adulterated with Cassia Lignea (which is the bark of a degenerate variety of the *Cinnamomum Zeylanicum* (Blume) growing in Malabar, Penang, and Silhet), with the bark of *Cinnamomum Culilawan*, and with portions which by distillation have been deprived of their volatile oil.

Oil of Cinnamon is obtained chiefly from the fragments which fall from the quills during the inspection and sorting at Colombo. These fragments are coarsely powdered, and after being immersed for forty-eight hours in sea-water, are distilled, when a milky fluid comes over, which separates into two parts, a light oil which floats, and a heavy one which sinks in the water. Eighty pounds weight of Cinnamon yield about two ounces and a half of light oil, and five ounces and a half of heavy oil. About 100 gallons of oil of cinnamon are annually obtained at Colombo. As the oil which is met with in commerce is a mixture of these two, the specific gravity is variable, 1·035 to 1·090. In time a spontaneous separation takes place, and there are formed beautiful transparent crystals of a stearopten, or Cinnamon-Camphor. Sometimes benzoic acid is formed. Oil of Cassia is also obtained by distillation; at first it is whiter than oil of cinnamon, afterwards it becomes yellow, but never of such a fiery yellow as cinnamon-oil. The odour is agreeable, but not so delicate and cinnamon-like: taste, acrid, burning, but different from cinnamon. Specific gravity 1·0608; it reddens litmus paper. At a low temperature crystals show themselves, which disappear with an increase of heat. Some consider these a camphor, others benzoic acid. Benzoic acid unquestionably exists in this oil. Oil of cinnamon is adulterated with oil of cassia, with the oil of cassia-buds, with the oil of the *Cerasus lauro-cerasus*, or Cherry-Laurel, and it is also said with oil of bitter-almonds, an exceedingly dangerous intermixture.

CINNAMON-STONE. [GARNET.]

CINNAMON, WILD. [CINNAMODENDRON.]

CINNYRIDÆ, a family of Passerine Birds of brilliant plumage, living upon the juices of flowers, and representing in the Old World the *Trochilidæ*, or Humming-Birds of the New Continent and its islands. They are known by the common names of Sun-Birds and Soui-Mangas.

Cuvier, in defining his genus *Cinnyris*, states that the species composing it have the tail no longer worn; the bill long and very slender, with the edge of the two mandibles finely serrated; and the tongue, which can be protruded from the bill, terminating in a fork. They are, he observes, small birds, the plumage of whose males glitters in the season of love with metallic colours, approaching in splendour that of the Humming-Birds, which they represent in this respect in the Old Continent, where they are found principally in Africa and the Indian Archipelago. They live, he adds, on flowers, from which they pump the juices: their nature is gay, and their song agreeable. Their beauty makes them much sought after in our cabinets; but as the plumage of the females and that of the males during the interval between the seasons of love is entirely different from its nuptial brilliancy, it is difficult to characterise the species. ('Règne Animal.')

Cinnyris, in Cuvier's arrangement, stands between *Melithreptus* and *Arachnothera*.

Mr. Vigors considers the *Tenuirostres*, or Suctorial Birds, the most interesting group perhaps of the animal world. "Deriving," says that author, "their subsistence for the most part from the nectar of flowers, we never fail to associate them in idea with that more beautiful and perfect part of the vegetable creation, with which, in their delicacy and fragility of form, their variety and brilliancy of hues, not less than by their extracting their nourishment from vegetable juices, they appear to have so many relations. As the tribe is confined exclusively to the torrid zone and the southern hemisphere, the naturalists of our northern latitudes have little opportunity of observing their manners or of inspecting their internal construction. Much confusion has consequently arisen in assigning them their respective stations, more particularly among the Honey-Suckers of Australia, which have been indiscriminately scattered among every group of the order. In the absence of that certain and perfect information which alone can authorise us to decide upon the station of any bird in nature, I cannot, at present, undertake to fill up the details of this tribe with much pretension to accuracy. The following sketch however of the Suctorial Families will, I imagine, be found to afford some approach, in its general outline, to the natural divisions into which the tribe branches out, and to the order in which they succeed each other:—*Nectariniadæ (?), Cinnyridæ, Trochilidæ, Promeropidæ, Meliphagidæ.* Arranged according to their typical characters, they thus succeed each other:—

Normal Group.

Bills and feet comparatively slender (gracilioribus) . . . . { *Cinnyridæ.* *Trochilidæ.*

Aberrant Group.

Bills and feet comparatively strong (fortioribus) . . . . { *Promeropidæ (?).* *Meliphagidæ (?).* *Nectariniadæ (?).*"

Mr. Vigors then proceeds to state that Illiger was the first who separated the true *Certhia* of the present day from the groups of the Linnæan *Certhia,* which feed upon vegetable juices, and which he therefore distinguished by the generic name of *Nectarinia.* This latter genus, observes Mr. Vigors, comprising two distinct and strongly marked groups, has again been separated by Cuvier into two divisions: for the first of which, consisting of birds whose bills are shorter and stronger than those of the second, and whose feet are also in general more robust, he has retained the name of *Nectarinia;* while he has distinguished the latter division, where the bills are longer and more attenuated, and the legs and feet are proportionally more delicate, by the appellation of *Cinnyris.* The first two families in the arrangement of Mr. Vigors accord with these views; and he remarks that, besides the difference in their structure, the two groups may be separated by their geographical limits. The *Nectariniadæ,* as far as Mr. Vigors can trace out their extent, are confined to the New World; while the *Cinnyridæ* are circumscribed within the bounds of the ancient continent and its adjoining islands. In looking to the succession of affinities in the tribe, Mr. Vigors remarks that the *Nectariniadæ* appear to hold, by the comparative strength of their feet and bill, an intermediate rank between the Creepers and the typical groups of the present tribe. The *Certhiadæ,* as we have seen [CERTHIADÆ], employ, he observes, the feet in climbing; the *Nectariniadæ* hop from flower to flower, seeking the nectar of each; while the *Cinnyridæ* and *Trochilidæ* make no use whatever of the foot as they extract their food, but during the process of feeding are poised entirely on the wing. The two last-mentioned families, he adds, again approach each other in the slenderness of their bill, the vividness and changeable lustre of their plumage, and the habit of hovering on the wing when they feed. They are chiefly separated by the comparatively stronger foot and bill of the *Cinnyridæ;* but the geographical distribution of the two families points out a line of demarcation. Mr. Vigors concludes this part of his observations by acknowledging that these two typical families are the only groups in the tribe of whose situation he can speak with any confidence; and these two families form the subject of this article. ('Natural Affinities that connect the Orders and Families of Birds,' in 'Linn. Trans.,' vol. xiv.)

Mr. Swainson considers the *Cinnyridæ,* or Sun-Birds—so called by the natives of Asia in allusion to their splendid and shining plumage—the subtypical family of the *Tenuirostres.* He observes that the affinity is obvious between this family and the *Meliphagidæ;* but whether the direct passage is made by the short-billed Honey-Suckers (*Dicæum,* Cuv.) or by the Spider-Suckers (*Arachnothera,* Temm.) is uncertain. "The plumage of the meliphagous birds of Australia," says Mr. Swainson, "is almost universally dull, or at least destitute of those gay and beautiful tints which are so strikingly developed in the sun-birds: a rich golden-green, varied on the under parts with steel-blue, purple, bright-orange, or vivid-crimson, decorates nearly all the species, and produces a brillancy of colours only rivalled by those of the humming-birds. The bill is very long, slender, and acutely pointed, the margins being dentated in the most regular and delicate manner: yet these teeth are so small as scarcely to be seen by the naked eye; the tongue is formed into a bifid tube, or rather, as we suspect, into two flattened filaments; thus differing materially from that of the honey-suckers, which always ends in a brush: the bill also is never notched. The difference between the two structures is softened down by the intervention of the nectar-birds (*Nectarinia,* Ill.), whose bill shows a union of both characters, the margins being finely dentated, and the tip distinctly notched. The species of the latter are few; and while *Cinnyris* is restricted to the tropics of the Old World, *Nectarinia* represents them in the New. Some few other forms, found in Australia and in the Oceanic Islands, belong to this group, and they are arranged in the genera *Melithreptes* and *Dicæum,* but their habits are imperfectly understood."

The genera arranged by Mr. Swainson under the family *Cinnyridæ* are *Melithreptes, Cinnyris, Anthreptes, Nectarinia,* and *Dicæum.* The family stands between the *Meliphagidæ* and the *Trochilidæ.*

Mr. G. R. Gray makes the *Nectarinidæ,* as he writes the word, the second family of the tribe *Tenuirostres,* placing it between the *Upupidæ* and the *Trochilidæ.*

The *Nectarinidæ,* in his arrangement, comprise the following sub-families and genera:—

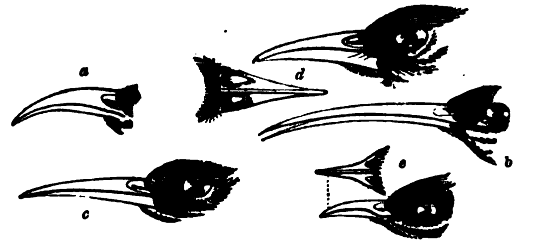
Sub-Family 1. *Nectarininæ.*

Genera:—*Moho,* Less. (*Merops, Certhia,* Gm.; *Gracula,* Merr.; *Meliphaga,* Temm.). *Drepanis,* Temm. (*Certhia,* Gm.; *Melithreptus,* Vieill.; *Vestiaria,* Flem.). *Arachnothera,* Temm. (*Cinnyris,* Horsf.; *Certhia,* Lath.). *Nectarinia,* Ill. (*Certhia,* Linn.; *Mellisuga,* Vieill.; *Cinnyris,* Cuv.; *Rhundace,* Mœhr.). *Ptiloturus,* Sw. (*Promerops,* Less.; *Upupa,* Gm.). *Anthreptes,* Sw. (*Mellisuga,* Vieill.; *Cinnyris,* Sw.). *Certhionyx,* Less. (*Certhia,* Cuv.). *Dicæum,* Cuv. (*Certhia,* Gm.).

Sub-Family 2. *Cærebinæ.*

Certhiola, Sundev. (*Furnarius,* Steph.; *Nectarinia* (Ill.), Less.; *Certhia,* Linn.). *Dacnis,* Cuv. (*Certhia,* Linn.). *Uncirostrum,* Lafr. and D'Orb.

Upon the whole we take the arrangement of Mr. Swainson. The following cut is after his figures in the 'Classification of Birds.'



Bills of *Cinnyridæ.*

a, Melithreptes; b, Cinnyris; c, Anthreptes; d, Nectarinia; e, Dicæum.

The *Cinnyridæ* have the following characters:—Wings with the outermost quills more or less shortened or graduated. Bill more or less curved, generally entire. Nostrils short, oval, membranaceous, opening by a lateral slit. Feet moderate. Bill entire. (Sw.)

Melithreptes, Vieill.—Bill long, sickle-shaped; the sides considerably compressed; the culmen elevated, and the tips entire. Nostrils very short, opening by a semicircular slit. Tongue long; the tip only terminated by a bunch of short filaments. Wings moderate; the first three quills nearly equal. Feet robust, long; lateral toes equal; tarsus almost twice as long as the hind toe. Pacific Islands. (Sw.)

Example, *Melithreptes Pacifica.*

Cinnyris, Cuv.—Bill long, slender; the tips very acute and entire; the margins minutely denticulated; base of the upper madible folding over, and partly concealing that of the lower. Nostrils short, oval. Tongue retractile, simply forked; First quill spurious, second shorter than the third. Tail even or rounded. India and Africa. (Sw.)

C. chalybeia. It is golden-green, with brown wings and tail, and narrow pectoral red band bordered above by another of steel-blue;

Lesser Collared Creeper (*Cinnyris chalybeia*). (Sw., 'Zool. Ill.')

upper tail-covers blue. This, according to Mr. Swainson, is *Certhia chalybeia,* Linn., Gmel.; Le Soui-manga à Collier, Vieill.; and Collared Creeper, Lath.

Mr. Swainson remarks that another bird very nearly resembling this has been figured by Le Vaillant under the name of Le Sucrier à Plastron Rouge ('Ois d'Afr.,' pl. 300), but that Le Vaillant's reasons for separating them are, he thinks, sufficient, at least until more forcible ones are adduced than mere conjecture.

Anthreptes, Sw.—Bill moderate, rather strong, slightly curved; widening towards the base, which is much broader than it is high. Base of the under mandible thickened, and not partially covered by the upper. Wings, feet, and tail as in *Cinnyris*. (Sw.)

A. Javanica (*Nectarinia Javanica*, Horsf.). It is glossy metallic-purple above, olive-yellow beneath; scapulars, rump, and rather broad lateral stripe extending from the corner of the bill to the breast with a slight curvature, glossy violet; the throat chestnut; tail black.

Anthreptes Javanica. (Sw., 'Zool. Ill.')

Mr. Swainson describes this bird as a *Cinnyris* in the 'Zoological Illustrations,' and by the name here adopted in his 'Classification of Birds.' These changes however leave his declaration that it is not a *Nectarinia* (a genus confined to the New World) untouched.

Nectarinia, Ill.—Bill in general shorter than the head, wide at the base, compressed from the nostrils. Tip of the upper mandible with a distinct notch; the margins entire. Wings long; the first three quills nearly equal. Lateral toes unequal. South America only. (Swainson.)

Blue-Headed Warbler (*Nectarinia cyanocephala*). (Sw., 'Zool. Ill.')
Upper figure, female; lower figure, male.

N. cyanocephala. Male: Changeable blue; throat, back, tail, and wings black; the quills edged with blue. Female: green; head, cheeks, and scapulars bluish; throat gray. (Sw.)

This, according to Mr. Swainson, is (Male) *Motacilla Cayana*, Linn., Gmel.; *Sylvia Cayana*, Lath.; Pepit Bleu de Cayenne (?), Briss.; Cayenne Warbler, Lath.; and *Sylvia Cayenensis cærulea*, Briss. (Female) *Motacilla cyanocephala*, Gmel.; *Sylvia cyanocephala*, Gmel.; *Sylvia viridis*, and Le Pepit Verd, Briss.; Blue-Headed Warbler, and Blue-Headed Creeper (?), Lath.

Mr. Swainson states that the habits of this bird are perfectly the same as those of the rest of the *Nectariniæ*. "It is," he says, "one of the commonest birds of Brazil, and appears spread over the whole extent of that country. It frequents the same trees as the humming-birds, hopping from flower to flower and extracting the nectar from each; but this is not done on the wing, because its formation is obviously different from the humming-birds, which, on the contrary, poise themselves in the air during feeding."

Mr. Swainson remarks that the young males, as usual before moulting, have the colours of the female, and that the rich sky-blue of the male in some lights becomes greenish, and in others dark blue.

Dicæum, Cuv.—Bill short, remarkably broad at the base, and suddenly compressed beyond; the tips entire; the margins minutely denticulated; nostrils triangular. Wings, feet, and tail as in *Nectarinia*. Indian and Australian islands. (Sw.)

The figure referred to by Cuvier, and copied into the article CERTHIADÆ, is evidently a Humming-Bird, and must have been given by mistake. The reader will find a most elegant and characteristic drawing of *D. hirundinaceum* in Mr. Gould's grand work on the 'Birds of Australia.'

Mr. Gould states that the Swallow *Dicæum* has neither the habits of the Pardalotes nor of the Honey-Eaters: it differs, he says, from the former in its quick darting flight, and from the latter in its less prying, clinging, and creeping actions among the leaves, &c. "When perched on a branch," continues Mr. Gould, "it sits more upright, and is more swallow-like in its contour than either of the forms alluded to. The structure of its nest and the mode of its nidification are also very dissimilar. Its song is a very animated and long-continued strain, but is uttered so inwardly that it is almost necessary to stand beneath the tree upon which the bird is perched before its notes can be heard. Its beautiful purse-like nest is composed of the white cotton-like substance found in the seed-vessels of many plants; and among other trees is sometimes appended on a small branch of a *Casuarina* or an *Acacia pendula*. It was on the latter tree that I found a nest containing three or four young: a second nest with the eggs was given to me in Sydney. The ground-colour of the eggs is dull white, with very minute spots of brown scattered over the surface; they are 9 lines long by 5½ lines broad. The male has the head, all the upper surface, wings, and tail black; throat, breast, and under tail-coverts scarlet; flanks dusky; abdomen white, with a broad patch of black down the centre; irides dark brown; bill blackish-brown; feet dark-brown. The female is dull-black above, glossed with steel-blue on the wings and tail; throat and centre of the abdomen buff; flanks light-brown; under tail-coverts a pale scarlet." Locality, the Australian continent generally.

CINNYRIS. [CINNYRIDÆ.]

CINQUEFOIL. [POTENTILLA.]

CI'ONUS, a genus of Coleopterous Insects of the section *Rhyncophora* and family *Curculionidæ*.

Schönherr (in his 'Synonymia Insectorum') links the present genus with the genera *Gymnætron*, *Mecinus*, and *Nanodes*, under the head *Cionides*, which may be considered as a sub-family. We shall therefore briefly state the characters of these genera under this head, first observing that the *Cionides* may be distinguished from allied groups by their having the antennæ 9- or 10-jointed, 5 of which always compose the funiculus, or that portion between the basal joint and the club which terminates the antenna.

The characters of the genus *Cionus* are as follows:—Antennæ short, the two basal joints of the funiculus obconical, the remainder short and truncated at the apex: the club long and indistinctly jointed. Rostrum elongate, curved, inserted in a groove beneath the thorax. Thorax small; elytra nearly spherical, furnished with tufts of a velvet-like nature; femora very thick in the middle; tibiæ simple, truncated at the apex.

Four species of this genus are found in England; they live both in their larva and imago states upon plants, more especially those of the genera *Scrophularia* and *Verbascum*.

Cionus Verbasci is about one-sixth of an inch in length and of a deep ash-colour approaching to black. The thorax is furnished on each side with a buff-coloured patch; the elytra have four longitudinal velvet-like bands, which are black, and interrupted with gray spots; there are two velvet-black spots on the suture, one near the base of the elytra and another near the apex; the former has a yellow spot joining it posteriorly, and the latter has a spot of the same colour before and behind.

These little insects are almost spherical. When touched or approached they apply their long proboscis close to the under side of the body (where there is a groove for its reception) and also the legs, and allow themselves to roll to the ground. Their larvæ, which are of a yellowish colour, and resemble small oblong masses of jelly, may be seen in the month of August on the leaves of the *Verbascum Thapsus* and some few other plants which they feed upon. When about to assume the pupa state they inclose themselves in a little brown spherical cocoon (less than an ordinarily sized pea) formed of a glutinous substance, which is attached to the leaves of a plant; in about a week or ten days after this the perfect insect makes its appearance.

The genus *Gymnætron* differs chiefly from *Cionus* in having the elytra somewhat ovate, sometimes depressed, and not covering the apex of the abdomen; and the anterior tibiæ furnished with a minute hook at the apex. *Gymnætron Beccabungæ* is the only species found in this country.

Mecinus may be distinguished from either of the two last-mentioned by the rostrum being short and thick; the thorax sub-cylindrical, the elytra elongate, nearly cylindrical, and covering the body; the tibiæ are armed with a hook at the apex. Three species of this genus are found in England. *M. semicylindricus* is about one-eighth of an inch in length, and of a blackish colour with ash-coloured pubescence.

The genus *Nanodes* has the antennæ rather long, the club large; rostrum elongate, slightly bent; thorax conical; elytra sub-ovate and humped; the anterior tibiæ unarmed. No species of this genus have yet been found in this country.

(Schönherr, *Synonymia Insectorum,—Genera et Species Curculionidum.*)

CIPOLIN. [MARBLE.]

CIRCÆA, a genus of Plants belonging to the natural order *Onagraceæ*. The species are found in woods and shady places. They have little whitish pink flowers, having a tubular superior calyx with a 2-parted limb, 2 petals, 2 stamens, and an ovary with 2 cells, each of which contains 1 erect ovule. The genus constitutes the type of a section of *Onagraceæ* in a reduced state. The species are commonly called Enchanter's Nightshade; but whatever supposed properties may have given rise to this name are purely imaginary.

C. Lutetiana has ovate leaves, subterete petioles, no bracteoles, petals deeply emarginate, calyx hairy, ovary 2-celled, fruit broadly obovate. It is found in woods and hedge-banks throughout Great Britain, though not an abundant plant.

C. alpina has ovate leaves, flat petioles and setaceous bracteoles, a glabrous calyx, and 1-celled ovary. It inhabits woods and thickets in mountainous districts, and is a rarer plant than the last.

CIRCÆETUS. [FALCONIDÆ.]

CIRCULATION OF THE BLOOD. As the blood is necessary for the nutrition of all the tissues of the body and for the development of the actions of its organs [BLOOD], it must be put in motion in order to be borne to them. "In man and in all the higher animals an apparatus is provided, partly for the purpose of originating an impelling force to put the blood in motion, and partly for the purpose of conveying the blood when put in motion to the different parts of the body."

The organ that puts the blood in motion is the heart; the pipes or conduits which distribute the blood to the different parts of the body are the great vessels in connection with the heart. The course of the circulation, which in all the higher animals is double—namely, one through the lungs, called therefore the Pulmonic, or the Lesser Circulation; the other through the system, called therefore the Systemic, or the Greater Circulation—will be best understood by an examination of the heart and vascular apparatus by which the circulation is carried on. [HEART.] In this place therefore it will be sufficient to refer to the evidence by which it is proved that the blood is really in motion. Dr. Southwood Smith, in his popular work on the 'Philosophy of Health,' thus sums up the proofs that the blood is a flowing stream, and that it constantly pursues a regular and determinate course.

"1. With the microscope, in the transparent parts of animals, the blood can be seen in motion; and if its course be attentively observed, its route may be clearly traced.

"2. The membranes termed valves are so placed as to allow of the freest passage to the blood in the circle described; while they either altogether prevent, or exceedingly impede its movements in any other direction.

"3. The effect of a ligature placed around a vein and an artery, and of a puncture made above the ligature in the one vessel and below it in the other, demonstrates both the motion of the blood and the course of it. When a ligature is placed round a vein, that part of the vessel which is most distant from the heart becomes full and turgid, on account of the accumulation of blood in it; while the part of the vessel which is between the ligature and the heart becomes empty and flaccid, because it has carried on its contents to the heart and it can receive no fresh supply from the body. When, on the contrary, a ligature is placed round an artery, that portion of the vessel which lies between the ligature and the heart becomes full and turgid, and the other portion empty and flaccid. This can only be because the contents of the two vessels move in opposite directions —from the heart to the artery, from the artery to the vein, and from the vein to the heart. At the same time, if the vein be punctured above the ligature, there will be little or no loss of blood; while if it be punctured below the ligature, the blood will continue to flow until the loss of it occasions death; which could not be unless the blood were in motion, nor unless the direction of its course were from the artery to the vein, and from the vein to the heart.

"4. If fluids be injected into the veins or arteries, whether of the dead or the living body, they readily make their way and fill the vessels, if thrown in the direction stated to be the natural course of the circulation; but they are strongly resisted if forced in the opposite direction."

The author concludes his account of the structure of the heart and blood-vessels, and of the course which the stream of blood is ascertained constantly to pursue, with the following reflections:—

"Such is the description, and, with the exception of the first proof, such the evidence of the circulation of the blood in the human body, pretty much as it was given by the discoverer of it, the illustrious Harvey. Before the time of Harvey, a vague and indistinct conception that the blood was not without motion in the body had been formed by several anatomists. It is analogous to the ordinary mode by which the human mind arrives at discovery (chap. iii., p. 103), that many minds should have an imperfect perception of an unknown truth before some one mind sees it in its completeness, and fully discloses it. Having about the year 1620 succeeded in completely tracing the circle in which the blood moves, and having at that time collected all the evidence of the fact, with a rare degree of philosophical forbearance, Harvey still spent no less than eight years in re-examining the subject and in maturing the proof of every point, before he ventured to speak of it in public. The brief tract which at length he published was written with extreme simplicity, clearness, and perspicuity, and has been justly characterised as one of the most admirable examples of a series of arguments deduced from observation and experiment that ever appeared on any subject.

"Contemporaries are seldom grateful to discoverers. More than one instance is on record, in which a man has injured his fortune and lost his happiness through the elucidation and establishment of a truth which has given him immortality. It may be that there are physical truths yet to be brought to light, to say nothing of new applications of old truths, which, if they could be announced and demonstrated to day, would be the ruin of the discoverer. It is certain that there are moral truths to be discovered, expounded, and enforced, which, if any man had now penetration enough to see them, and courage enough to express them, would cause him to be regarded by the present generation with horror and detestation. Perhaps during those eight years of re-examination the discoverer of the circulation sometimes endeavoured in imagination to trace the effect which the stupendous fact at the knowledge of which he had arrived would have on the progress of his favourite science; and, it may be, the hope and the expectation occasionally arose, that the inestimable benefit he was about to confer upon his fellow men would secure to him some portion of their esteem and confidence. What must have been his disappointment when he found, after the publication of his tract, that the little practice he had had as a physician by degrees fell off? He was too speculative, too theoretical, not practical. Such was the view taken even by his friends. His enemies saw in his tract nothing but indications of a presumptuous mind, that dared to call in question the revered authority of the ancients; and some of them saw, moreover, indications of a malignant mind, that conceived and defended doctrines which, if not checked, would undermine the very foundations of morality and religion. When the evidence of the truth became irresistible, then these persons suddenly turned round and said that it was all known before, and that the sole merit of this vaunted discoverer consisted in having circulated the circulation. The pun was not fatal to the future fame of this truly great man, nor even to the gradual though slow return of the public confidence even during his own time, for he lived to attain the summit of reputation."

For an account of the circulating apparatus, see the articles ARTERY, CAPILLARY VESSELS, BLOOD VESSELS, HEART, VEIN. The nature of the circulating fluid is given under BLOOD. For the history of the discovery of the circulation by Harvey, see the article HARVEY, WILLIAM, in the HIST. AND BIOG. DIV.

CIRCUS. [FALCONIDÆ.]

CIRL BUNTING. [EMBERIZA.]

CIRRHIBA'RBA, a genus of Fishes of the family *Gobioidæ* and section *Acanthopterygii*. Only one species of this genus is yet discovered, and this is from India. It has a tentaculum over each eye and nostril, three large tentacula at the end of the muzzle, and eight under the point of the lower jaw. These tentacula constitute the chief distinction between this genus and that of *Clinus*, to which it is closely allied.

CIRRHIGRADA. [ACALEPHÆ.]

CIRRHINUS. [GOBIO.]

CIRRHOBRANCHIATA. [DENTALIUM.]

CIRRHUS. [TENDRIL.]

CIRRI'PEDIA, or CIRRHIPEDA (*Lepas* of Linnæus, *Cirrhopodes* of Cuvier and Férussac, Cirrhipèdes of Lamarck, *Nematopodes* of De Blainville, Cirripèdes of Latreille), a well-defined natural group of Marine Invertebrate Animals, whose place in the system has occasioned much doubt and difference of opinion among zoologists. In the earlier times the most absurd stories were propagated and believed in relation to one of the most common species, *Pentalasmis anatifera*

(*Lepas anatifera* of Linnæus), the Common or Duck Barnacle. To the references on this head in the article BERNICLE-GOOSE, we may add the testimony of Sir Robert Moray to show how long the delusion lasted, and in what positive terms a witness can state the thing that is not. "In every shell that I opened I found a perfect sea-fowl; the little bill like that of a goose, the eyes marked, the head, neck, breast, wings, tail, and feet formed, the feathers everywhere perfectly shaped, and blackish-coloured, and the feet like those of other water-fowl, to my best remembrance." So widely spread has been this delusion, that it is stated that the Roman Catholics are permitted, in France at least, to eat the Bernicle-Goose upon fast days and during the whole of Lent, in consequence of its supposed marine origin.

Organisation, and place in the Natural System.—Linnæus placed the *Cirripedia*, with the generic name of *Lepas*, among the Multivalves of his *Vermes* (*Testacea*), between *Chiton* and *Pholas*; and, supposing that the form existed without a shell, found a situation for it under the name of *Triton*, between *Terebella* and *Lernæa*. Cuvier, in the first and also in the last edition of the 'Règne Animal,' says that the existence of these Tritons is not confirmed, and that we must suppose that Linnæus had only seen the animal of an *Anatifa* (*Pentalasmis*), which had been taken out of its shell. Rang, however, thinks that he has found the Linnæan genus *Triton* in certain specimens brought home by Messrs. Lesson and Garnot, Quoy and Gaimard, and has published it under the name of *Alepas*. Bruguières divided the genus *Lepas* into two; the first, *Anatifa*, a barbarous word for *Anatifera* (the Anatifes of the French), comprising the Pedunculated Cirripedes; and the second, *Balanus*, the Sessile species. Cuvier, under the name of *Cirrhopoda*, made these animals the sixth class of his Mollusks, which he places between the *Brachiopoda* and the first class (Annélides) of his third great division of the animal kingdom, namely, the Articulated Animals, and in the 'Règne Animal' they appear between *Orbicula* and *Serpula*. Lamarck, under the name of *Cirrhipeda*, his tenth class of Invertebrate Animals, arranges them between the sedentary *Annelides* and his *Conchifera*, dividing them into two orders: 1st, the Sessile Cirripedes; 2nd, the Pedunculated Cirripedes. In his system they stand between *Magilus* and *Aspergillum*. Latreille, though he does not disturb this arrangement, evidently considers them as related to the *Ostracoda*, among the Branchiopodous Crustaceans. He says that the Sessile Cirripedes seem to represent the animals which terminate the Acéphales Enfermés of Cuvier. He observes that the two tubular processes of *Otion* represent the two tubes of some of the *Acephala*, though with different uses, the tentacula being converted into jaws. The cirri he considers as a kind of feet analagous to the sub-abdominal appendages of many Crustaceans, especially those of the *Amphipoda*, and is of opinion that we may also compare them to those of many Annelides. The oviduct, he remarks, has some resemblance to that of *Phalangium*. Finally, he expresses a conjecture, that nature, to form the Cirripedes, has borrowed different organs from animals of several classes. Mr. William Sharp M'Leay, in his profound and philosophical work, 'Horæ Entomologicæ,' considers that *Pentalasmis* exhibits the greatest affinity with the *Ostracoda*; but he seems to be of opinion that there exists an affinity between the shell of *Balanus* and that of *Echinus*, and sanctions Latreille's opinion that the articulated cirri have their analogues in the arms of the *Radiata*, particularly of *Comatula*. Dr. Leach, who has described several genera unnoticed till his time, divided the class into two orders: 1st, *Campylosomata*, comprising the Pedunculated section; and 2nd, *Acamptosomata*, including the Sessile species. M. de Blainville makes the Cirripedes the first class (*Nematopoda*) of his sub-type *Malentozoaria*, a group which corresponds to the Multivalves of Linnæus, after separating from them the genus *Pholas*, so that De Blainville's *Malentozoaria* consist of the Cirripedes and Chitons. The Cirripedes, he thinks, have an evident relation to the Bivalve Mollusks, by means of their calcareous envelope, in which he recognises the pieces of the shell of the *Pholades*, and even the analogue of the tube of the neighbouring genera. He also considers the relationship further indicated by the recurved position of the animal fixed head downwards (la tête en bas); but he also considers that their relations to certain animals of the type *Entomozoaria* are numerous, by means of the horny, locomotive, articulated appendages which are branchial, at least at the root, becoming, towards the mouth, true horny denticulated jaws. Mr. Thompson, in his 'Zoological Researches,' considers the Cirripedes to be true *Crustacea*, and that in the first state of these animals they not only possess perfect freedom and power of motion, but organs of sight. On the 28th April 1823, Mr. Thompson states that he took in a small muslin towing-net while crossing the ferry at Passage, among other minute creatures, a small translucent animal, one-tenth of an inch long, of a somewhat elliptical form, but very slightly compressed laterally, and of a brownish tint. When in a state of perfect repose it resembled a very minute mussel, and lay upon one of its sides at the bottom of the vessel of sea-water in which it was placed; at this time all the members of the animal were withdrawn within the shell, which appeared to be composed of two valves, united by a hinge along the upper part of the back, and capable of opening from one end to the other along the front, to give occasional exit to the limbs. These were of two descriptions, namely, anteriorly a large and very strong pair, provided with a cup-like sucker and hooks, serving solely to attach the animal to rocks, stones, &c.; and, posteriorly, six pairs of natatory members, so articulated as to act in concert, and to give a very forcible stroke to the water, causing the animal, when swimming, to advance by a succession of bounds after the same manner as the Water-Flea (*Daphnia*) and other *Monoculi*, but particularly *Cyclops*, whose swimming-feet are extremely analogous. [BRANCHIOPODA.] The tail, usually bent up under the belly, is extremely short, composed of two joints, and terminating in four setæ, and is employed to assist in progression and in changing the position from a state of repose. The greatest peculiarity however in the structure is in the eyes, which, although constantly shielded by the valves of the shell, are pedunculated as in the Crab and Lobster, and placed entirely at the sides of the body. Mr. Thompson observes that this animal, but for its pair of pedunculated eyes, would find a place as a new genus of *Ostracoda*; that its members approximate it to *Argulus* on the one hand and to *Cyclops* on the other—genera which are widely separated; while the eyes show its relationship to the *Decapoda* (crabs, lobsters, &c.) The individuals presented no variation indicative of a difference of sex; and this, with their anomalous organisation, induced a belief that they were the larvæ or disguised states of some crustaceous animal, or (as it had been previously ascertained that the Cirripedes were *Crustacea*) that they were the males of these, Mr. Thompson not being disposed to believe that the two sexes were united in the same individual. What follows being of the last importance, we give in the author's own words:—"Under the foregoing impressions, some of them were collected in the spring of 1826, and, in order to see what changes they might undergo, were kept in a glass vessel, covered by such a depth of sea-water that they could be examined at any time by means of a common magnifying-glass; they were taken May 1st, and on the night of the 8th the author had the satisfaction to find that two of them had thrown off their exuvia (exuviæ), and, wonderful to say, were firmly adhering to the bottom of the vessel, and changed to young barnacles, such as are usually seen intermixed with grown specimens on rocks and stones at this season of the year. (*Balanus pusillus*, Penn.) In this stage the sutures between the valves of the shell and of the operculum were visible, and the movements of the arms of the animal within, although these last were not yet completely developed; the eyes also were still perceptible, although the principal part of the colouring-matter appeared to have been thrown off with the exuvium (exuviæ). On the 10th another individual was seen in the act of throwing off its shell; and attaching itself as the others to the bottom of the glass. It only remains to add, that as the secretion of the calcareous matter goes on in the compartments destined for the valves of the shelly covering, the eyes gradually disappear, from the increasing opacity thence produced, and the visual ray is extinguished for the remainder of the animal's life; the arms at the same time acquire their usual ciliated appearance. Thus, then, an animal originally natatory and locomotive, and provided with a distinct organ of sight, becomes permanently and immoveably fixed, and its optical apparatus obliterated, and furnishes not only a new and important physiological fact, but is the only instance in nature of so extraordinary a metamorphosis."

"During the whole of the spring and summer months," says Mr. Thompson, "the water teems with these exuvia (exuviæ) of *Tritones* (the animal inhabitant, according to Linnæus, of the barnacles): it is impossible to avoid drawing up numbers every time a towing-net is thrown out, nay the tide is at times discoloured from their abundance; but to be certain that these are really such, let a stone with several barnacles upon it be kept in sea-water, regularly renewed, towards the latter end of April or the beginning of May, and with due attention many of them may be observed in the act of throwing off exuvia (exuviæ) in every respect identical; let it be recollected, however, that these are the casts of the animal alone, and not of the valves of the shell or of the operculum." Mr. G. B. Sowerby ('Genera of Shells,' '*Scalpellum*') thus writes on the subject of Mr. Thompson's discovery:—"Without describing the facts, or entering upon the arguments with which he supports this opinion" (that is, that the *Cirripedia* are *Crustacea*), "we must be permitted to say that we do not think that he has fully demonstrated it; at the same time, considering that, as far as we hitherto knew, the Cirripedes were all attached, the circumstance of their being free when very young accounts well to our mind for the fact of each species being found attached to peculiar situations, which would only be compatible with the notion of their being at one time free agents, and possessed of an instinctive volition determining their choice of situation." Professor Owen, in the 'Catalogue of the Museum of the College of Surgeons' ('Cirripeda'), speaks of the discovery without expressing any doubt.

But Mr. Thompson has since, in a paper read before the Royal Society on the 5th of March 1835, declared his "discovery of the metamorphosis in the second type of the Cirripedes, namely, the *Lepades*, completing the natural history of these singular animals, and confirming their affinity with the *Crustacea*;" and the Memoir, with a plate, is published in the second part of the 'Philosophical Transactions' for 1835. The following is the abstract of the paper:—"The discoveries made by the author of the remarkable metamorphoses which the animals composing the first family of the Cirripedes, or *Balani*, undergo in the progress of their development, and which he has published in the third number of his 'Zoological Researches,' (p. 76), are in the present paper, which is intended as a prize essay for one of the royal medals, followed up by the report of his discovery of similar changes exhibited by three species of two other genera of the second tribe of this family, namely, the *Lepades*. The larvæ of this tribe, like those of the *Balani*, have the external appearance of Bivalve Monoculi, furnished with locomotive organs, in the form of three pairs of members, the most anterior of which are simple, and the other bifid. The back of the animal is covered by an ample shield, terminating anteriorly in two extended horns, and posteriorly in a single elongated spinous process. Thus they possess considerable powers of locomotion, which, with the assistance of an organ of vision, enable them to seek their future permanent place of residence. The author is led from his researches to the conclusion that the Cirripedes do not constitute, as modern naturalists have considered them, a distinct class of animals, but that they occupy a place intermediate between the *Crustacea decapoda* (with which the *Balani* have a marked affinity) and the *Crustacea entomostraca*, to which the *Lepades* are allied; and that they have no natural affinity with the Testaceous *Mollusca*, as was supposed by Linnæus, and all the older systematic writers on zoology."

Mr. Thompson does not seem to have been aware of a paper by Dr. J. Martin-Saint-Ange, read at the Academy of Sciences on the 14th July 1834, and published in the 'Savans Etrangers' (tome vi.), and separately by Baillière (1835). The following is the summary of the principal facts stated by him in the course of a very laborious and acute investigation:—The mouth of the Pedunculated Cirripedes is composed of pieces entirely comparable to those of the mouths of many *Crustacea*, and especially of the *Phyllosomes;* the upper lip, the palpi, and the mandibles are so analogous that the resemblance extends even to the form. The three jaw-feet (pieds-mâchoires), which are met with most commonly in the *Crustacea*, are conjoined in a single jaw-foot which receives the nervous trunks; at its base are always found from two to four branchiæ. The ten ordinary feet of the *Crustacea* are faithfully represented in the Anatifes (*Campylosomata*); at the base of many among them are found branchiæ disposed like those of certain *Crustacea*, and the number even is sometimes repeated. There exists in each foot a double canal, fit for establishing a circulating current, and traversing all the articulations of the cirri. The body is composed of a certain number of rings, or of articulations, very distinct, each of which supports a pair of feet. In the interior of the body there are a dorsal vessel (like that in a great number of the Articulated Animals), and a double series of ganglions; of which the number, according to Dr. Martin-Saint-Ange's researches, is equal to that of the feet; there is besides another pair on the lateral parts of the stomach. The pedicle may be regarded as analogous to the tail of many *Crustacea*; it is in this cavity, and not, as has been said, on the back, that the eggs are found; these pass afterwards by a conduit, not yet indicated, in the envelope, which, by its resemblance to the mantle of the *Mollusca*, establishes the only possible analogy between the Cirripedes and the last-named animals. The organs placed upon the back, which Cuvier described as eggs, are the generative apparatus of the male, of which the disposition is very remarkable. Finally, the stomach and intestinal canal inclose in the interior a membranous sac of a retort-shape; the disposition and use of which establish, according to the researches of M. Serres, an additional approximation between the Cirripedes and the Annelides. Dr. Martin-Saint-Ange then proposes, as the last result of his labours, to place the class *Cirripedia* at the end of the *Crustacea*, so as to establish a natural link or passage between the superior Articulated Animals and the *Annelida*. Such are the conclusions drawn in the Memoir of Dr. Martin-Saint-Ange, who refers with approbation to the discoveries of Mr. Thompson, published in 1830; and before we proceed to give a further account of the structure of the *Cirripedia* we will state Mr. Thompson's view of the ovarial system. "In the whole of the tribe of the Cirripedes," observes Mr. Thompson, in his paper in the 'Philosophical Transactions' above quoted, "the ova, after expulsion from the ovarium, appear to be conveyed by the ovipositor into the cellular texture of the pedicle, just beneath the body of the animal, which they fill to the distance of about an inch. When first placed in this situation, they seem to be amorphous and inseparable from the pulpy substance in which they are imbedded; but as they approach to maturity they become of an oval shape, pointed at both ends, and are easily detached. Sir Everard Home has given a very good representation of them, at this stage of their progress, in his 'Lectures on Comparative Anatomy,' from the elegant pencil of Mr. Bauer. During the stay of the ova in the pedicle, they render this part more opaque and of a bluish tint; the ova themselves, and the cellular texture with which they are surrounded, being of a pale or azure-blue colour. It is difficult to conceive in what manner the ova are extricated from the situation above indicated; but it is certainly not by the means suggested by Sir Everard Home in the above-mentioned lecture, namely, by piercing outwards through the membranes of the pedicle, for the ova are subsequently found forming a pair of leaf-like expansions, placed between either side of the body of the animal and the lining membrane of the shells in *Lepas* (*Pentalasmis*), or of the leathery internal tunic in *Cineras*. These leaves have each a separate attachment at the sides of the animal to the septum, which divides the cavity occupied by the animal from that of the pedicle; they are at first comparatively small, have a rounded outline, and possess the same bluish colour which the ova had in the pedicle; but as the ova advance in progress these leaves extend in every dimension, and lap over each other on the back, passing through various lighter shades of colour into pale-pink, and finally, when ready to hatch, become nearly white. These leaves appear to be composed of a layer of ova irregularly placed, and imbedded in a kind of parenchymatous texture, out of which they readily fall when about to hatch, on its substance being torn asunder; indeed, it appears at length to become so tender as to fall entirely away, so that after the period of gestation is past no vestige of these leafy conceptacles is to be found. When the larvæ, barely visible to the naked eye, burst forth from the ova, their development goes on with such rapidity that they seem to grow sensibly while under observation. The larva of the *Lepades* then is a tailed *Monoculus*, with three pairs of members, the most anterior of which are simple, the others bifid, having its back covered with an ample shield, terminating anteriorly in two extended horns, and posteriorly in a single elongated spinous process."

The following observations on the development of the larvæ of these animals, by Mr. Darwin, are amongst the latest contributions to this interesting inquiry:—"The ova, and consequently the larvæ of the *Lepadidæ*, in the first stage, whilst within the sac of the parent, vary in length from ·007 to ·009 in *Lepas*, to ·023 of an inch in *Scalpellum*. My chief examination of these larvæ has been confined to those of *Scalpellum vulgare;* but I saw them in all the other genera. The larva is somewhat depressed, but nearly globular; the carapace anteriorly is truncated with lateral horns; the sternal surface is flat and broad, and formed of thinner membranes than the dorsal. The horns just alluded to are long in *Lepas* and short in *Scalpellum;* their ends are either rounded and excessively transparent, or, as in *Ibla*, furnished with an abrupt minute sharp point. Within these horns I distinctly saw a long filiformed organ, bearing excessively fine hairs in lines, so exactly like the long plumose spines on the prehensile antennæ of the larvæ in the last stage, that I have not the least doubt that these horns are the cases in which antennæ are in process of formation. Posteriorly to them on the sternal surface, near each other, there are two other minute doubly-curved pointed horns, about ·004 in length, directed posteriorly; and within these I again saw a most delicate articulated filiformed organ and a thicker pedicle. In an excellent drawing by Mr. C. S. Bate, of the larvæ of a *Chthamalus* (*Balanus punctatus* of British authors), after having been kept alive and moulted once, these organs are distinctly shown as articulated antennæ (without a case), directed forwards: hence, before the first moult in *Scalpellum* we have two pairs of antennæ in process of formation. Anteriorly to the bases of these smaller antennæ is seated the heart-shaped eye (as I believe it to be), ·001 of an inch in diameter, with apparently a single lens, surrounded, except at the apex, by dark-reddish pigment-cells. In some cases, as in some species of *Lepas*, the larvæ, when first excluded from the egg, have not an eye, or a very imperfect one. There are three pairs of limbs, seated close together in a longitudinal line, but some way apart in a transverse direction. The first pair always consists of a single spinose ramus; it is not articulated in *Scalpellum*, but is multi-articulate in some genera; it is directed forwards. The other two pairs have each two rami, supported on a common haunch or pedicle; in both pairs the longer ramus is multi-articulate, and the shorter ramus is without articulations, or with only traces of them; the longer spines borne on these limbs (at least in *Scalpellum* and *Chthamalus*) are finely plumose. The abdomen terminates a little beyond the posterior end of the carapace in a slightly upturned horny point. A short distance anteriorly to this point, a strong spinose forked projection depends from the abdominal surface. Messrs. V. Thompson, Goodsir, and Bate have kept alive for several days the larvæ of *Lepas*, *Conchoderma*, *Balanus*, *Verruca*, and *Chthamalus*, and have described the changes which supervene between the first and third exuviations. The most conspicuous new character is the great elongation of the posterior point of the carapace into an almost filiform spinose point in *Lepas*, *Conchoderma*, *Chthamalus*, and *Balanus*, but not, according to Goodsir, in one of the species of the latter genus. The posterior point also of the abdomen becomes developed in *Balanus* (Goodsir) into two very long spear-like processes, serrated on their outer sides; in *Lepas* and *Conchoderma*, according to Thompson, into a single tapering spinose projection; and in *Chthamalus*, as figured by Mr. Bate, the posterior bifid point, as well as the depending ventral fork, increases much in size. Another important change, which has been particularly attended to by Mr. Bate, is the appearance of spinose projections and spines (some of which are thick, curved, and strongly plumose or almost pectinated along their inner sides) on the pedicles and lower segments of the shorter rami of the two posterior pairs of limbs." In this stage of the growth of the larva, Mr. Darwin found the mouth in *Scalpellum vulgare* seated on a very slight prominence in a most remarkable situation, namely, in a central point between the bases of the three pairs of legs. Mr. Darwin continues:—"I traced by dissection the œsophagus for some little way, until lost in the cellular and oily matter filling the whole animal, and it was directed anteriorly, which is the direction that might have been expected from the course followed by the œsophagus in the larva in the last stage, and in the mature Cirripede."

The larva, in its second stage of development, is known only from a single specimen described and figured by Burmeister ('Beiträge zur Naturgeschichte der Rankenfüsser,' s. 16). In its general shape and compressed form it seems to come nearer the last than the first stage. It has only three pairs of legs, situated much more posteriorly on the body than in the first stage, and all directed posteriorly. They are much shorter than in their earlier stages. They are undoubtedly the three pairs of limbs of the first stage metamorphosed. The chief development of the larva since its first stage is towards its anterior end.

In the last stage the larvæ have increased many times in size since their exclusion from the egg. They are now much compressed, nearly of the shape of a *Cypris*, or mussel-shell, with the anterior end the thickest, the sternal surface nearly or quite straight, and the dorsal arched. Almost the whole of what is externally visible consists of the carapace, the thorax and limbs being hidden and inclosed by its backward prolongation, and even at the anterior end of the animal the narrow sternal surface can be drawn up, so as to be likewise inclosed. The antennæ are large and conspicuous. They are at first well-furnished with muscles, and serve as organs of locomotion, and apparently as feelers; but their main function is to attach the larva, preparatory to its final metamorphosis into a Cirripede. The disc can adhere even to so smooth a surface as a glass tumbler. The attachment is at first manifestly voluntary, but soon becomes involuntary and permanent. Mr. Darwin makes the following remarks upon the eyes and mouth in their last stage:—

"Eyes.—The posterior and rounded margins of the basal articulation of the above-described prehensile antennæ are reflected inwards, in the form of two forked horny apodemes, together resembling two letters UU close together. These project up inside the animal for at least one-third of its thickness, from the sternal to the dorsal surface. The two great almost spherical eyes in *Lepas australis*, each $\frac{1}{150}$th of an inch in diameter, are attached to the outer arms, thus, •UU•, in the position of the two full stops. Hence the eyes are included within the carapace. Each eye consists of eight or ten lenses, varying in diameter in the same individual from $\frac{1}{3000}$th to $\frac{1}{2000}$th of an inch, inclosed in a common membranous bag or cornea, and thus attached to the outer apodemes. The lenses are surrounded half-way up by a layer of dark pigment cells. The nerve does not enter the bluntly-pointed basal end of the common eye, but on one side of the apodeme. The structure here described is exactly that found, according to Milne-Edwards, in certain *Crustacea*. In specimens just attached, in which no absorption has taken place, two long muscles with transverse striæ may be found attached to the knobbed tips of the two middle arms of the two •UU• and running up to the antero-dorsal surface of the carapace, where they are attached. Other muscles (without transverse striæ) are attached round the bases on both sides of both forks. The action of these muscles would inevitably move the eyes, but I suspect that their function may be to draw up the narrow deeply-folded sternal surface, and thus cause the retraction of the great prehensile antennæ within the carapace.

"Mouth.—This is seated in exactly the same position as in the mature Cirripede, on a prominence fronting the thoracic limbs, and so far within the carapace that it was obviously quite unfitted for the seizure of prey; and it was equally obvious that the limbs were natatory, and incapable of carrying food to the mouth. This enigma was at once explained by an examination of the mouth, which was found to be in a rudimentary condition, and absolutely closed, so that there would be no use in prey being seized. Underneath this slightly-prominent and closed mouth I found all the masticatory organs of a Cirripede in an immature condition. The state of the mouth will be at once understood if we suppose very fluid matter to be poured over the protuberant mouth of a Cirripede, so as to run a little way down in the shape of internal crests, between the different parts, and in the shape of a short, shrivelled, certainly closed tube, a little way (·008 of an inch in *L. australis*) down the œsophagus. Hence the larva, in this, its last stage, cannot eat. It may be called a locomotive pupa; its whole organisation is apparently adapted for the one great end of finding a proper site for its attachment and final metamorphosis." In this stage the thorax is much compressed, the six pairs of legs are all close one behind the other. In all the limbs the obliquely-truncated summit of the terminal segment of the inner ramus bears three very long beautifully plumose spines; in the first pair the summit of the outer ramus bears four, and in the five succeeding pairs six similar spines. The abdomen is small, and consists of only three segments: it contains only the rectum, and two delicate muscles running into two appendages, between the bases of which the anus is situated.

Whilst the young *Lepas* is closely packed within the larva, the capitulum, or shell, about equals the length of the peduncle. Even at this early period the muscles of the peduncle are distinct. The compound eyes, which we have seen are attached to apodemes springing from the sternal surface of the larval carapace, are consequently cast off with it. Whilst the young Cirripede is packed within the larva, the outer integument of its peduncle necessarily forms a deep transverse fold passing over the eyes and apodemes. This determines the position and origin of the sac in the young Cirripede.

"The larva," says Mr. Darwin, "fixes itself with its sternal surface parallel and close to the surface of attachment, and the antennæ become cemented to it: if the Cirripede after its metamorphosis had remained in this position, the cirri could not have been exserted, or only against the surface of attachment; but there is a special provision that the young Cirripede shall assume its proper position at right angles to the position which it held whilst within the larva, namely, with its posterior end upwards. This is effected in a singular manner by the exuviation of the great compound eyes, which we have seen are fastened to the outer arms of the double •UU• like sternal apodemes. These, together with the eyes, stretch transversely across and internally far up into the body of the larva; and as the whole has to be rejected or moulted, the membrane of the peduncle of the young Cirripede has necessarily to be formed with a wide and deep inward fold extending transversely across it; this, when stretched open after the exuviation of the larval carapace and apodemes, necessarily causes the sternal side of the peduncle to be longer than the dorsal, and as a consequence gives to the young Cirripede its normal position, at right angles to that of the larva when first attached."

That the homologies of the larva of the Cirripedes are with the *Crustacea* has before been pointed out. Mr. Darwin says:—"In *Crustacea*, according to the ordinary view, there are twenty-one segments; of these I can recognise in the Cirripede, on evidence as good as can generally be obtained, all with the exception of the four terminal abdominal segments; these do not occur in any species known to me in any stage of its development. If that part of the larva, in front of the mouth, bearing the eyes, the prehensile antennæ, and in an earlier stage another pair of antennæ, be formed, as is admitted in all other *Crustacea*, of three segments, then beyond a doubt, from the absolute correspondence of every part, and even every coloured mark, the peduncle of the *Lepadidæ* is likewise thus formed. The peduncle being filled by the branching ovarian tubes is no objection to this view, for I am informed, on the high authority of Mr. J. D. Dana, that this is the case with the cephalo-thorax in some true Crustaceans; for instance, in *Sapphirina*. To proceed:—the mouth, formed of mandibles, maxillæ, and outer maxillæ, corresponds with the fourth, fifth, and sixth segments of the archetype Crustacean. Posteriorly to the mouth we come, in the larva, to a rather wide interspace, without any apparent articulation or organ; and then to the thorax, formed of six segments, bearing the six pairs of limbs, of which the first pair differs slightly from the others. The thorax is succeeded by three small segments differently shaped, with the posterior one alone bearing appendages. These segments I cannot doubt, from their appearance alone, and from their apparent function of steering the body, are abdominal segments. If this latter view be correct, the thoracic segments are the six posterior ones of the normal seven segments; and there must be two segments missing between the outer maxillæ and the first thoracic pair of legs, which latter, on this view, springs from the ninth segment. Now, in a very singular Cirripede named *Proteolepas*, the two missing segments are present, the mouth being actually succeeded by eight segments, and these by the three usual abdominal segments, every segment in the body being as distinct as in an Annelide; hence in *Proteolepas*, adding the three segments for the mouth and three for the carapace, we have altogether seventeen segments, which, as I have stated, is the full

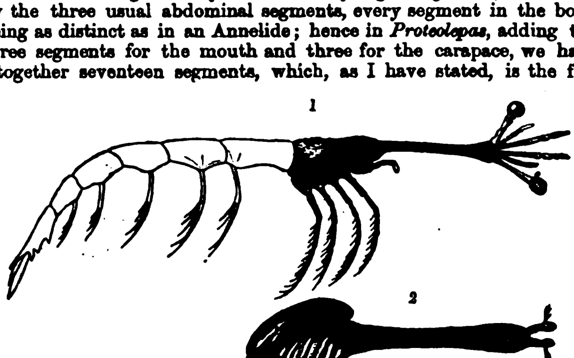


Fig. 1. A Stomapod Crustacean (*Leucifer*, V. Thompson.
Fig. 2. A species of *Lepas*.

number ever observed in any Cirripede; the four missing ones being abdominal, and I presume the four terminal segments. That the cavity in which the thorax is lodged in the larva, and therefore in the mature Cirripede, is simply formed by the backward production of the carapace, does not require any discussion. The valves have no homological signification."

The preceding wood-cut, copied from Darwin's work, will make these homologies clear. The upper figure is a Stomapod Crustacean (*Leucifer*, V. Thompson), and the abdomen, which becomes rudimentary in Cirripedes, is given in faint lines. The lower figure is a mature *Lepas* with the antennæ and eyes which are actually present in the larva, retained and supposed to have gone on growing. All that is seen of a Cirripede, whether pedunculated or sessile, is the three anterior segments of the head of a Crustacean, with its anterior end permanently cemented to a surface of attachment, and with its posterior end projecting vertically from it.

For the observation of the means by which these animals attach themselves after leading a free life we are also indebted to Mr. Darwin. In the larva, two ducts, called cement-ducts, can be traced from within the discs of the antennæ to the anterior or lower ends of the two gut-formed bodies, which are the incipient ovaries. These ducts are filled with an opaque cellular matter in the larva. In the mature Cirripedes, they can be followed in a slightly sinuous course along the muscles on each side within the peduncle, till they expand into two small organs, which Mr. Darwin calls cement-glands. These glands contain a strongly coherent pulpy opaque cellular mass, like that in the cement-ducts; but in some instances this cellular mass becomes converted, within either the ducts or gland, or within both, into a transparent tough yellow cement. Tubes are seen running into these glands, containing ova in every stage of development. From observations made on many species of Cirripedes, Mr. Darwin concludes that the gland itself is part of an ovarian tube specially modified; and further that the cellular matter, which in the ovarian tubes serves for the development of the ova, is, by the special action of the walls of the gland, changed into the opaque cellular matter in the ducts, and this again subsequently into that tissue or substance which cements the Cirripede to its surface of attachment. As the individuals grow and increase in size, so do the glands and cement-ducts; but it often happens that when a specimen is immoveably attached, the cement-apparatus ceases to act, and the cellular contents of the duct become converted into a thread of transparent cement. The cement removed from the outside of a Cirripede consists of a thin layer of very tough bright-brown transparent laminated substance, exhibiting no structure under the microscope. Its chemical reactions are those of Chitine. In the larva, the cement always escapes through the prehensile antennæ, and in most instances it continues to do this throughout the life of the animal. There are however exceptions, and in *Scalpellum vulgare*, and probably others which live attached to coral, the cement soon ceases to debouch from the antennæ, but instead bursts through a row of orifices on the rostral margin of the peduncle, by which means this margin is symmetrically fastened down to the delicate horny branches of the zoophyte.

The external shell, which misled early observers, and induced them to place the Cirripedes among the *Mollusca*, is called, in the *Lepadidæ*, the Capitulum. It is usually much flattened, but sometimes broadly oval in section. It is generally formed of five or more valves, connected together by very narrow or broad strips of membrane. When the valves are numerous, and they sometimes exceed a hundred in number, they are arranged in whorls, with each valve generally so placed as to cover the interval between the two valves above. The upper pair of valves, the peduncle being beneath, are called by Mr. Darwin the *terga*; the pair below it, on the same side, the *scuta*. The upper mesial valve opposed to the two terga is the *carina*, and below this the *subcarina*; and on the opposite side again the *rostrum*. Below this is sometimes a *subrostrum*. Of all the valves the scuta are the most permanent; then come the terga, and then the carina. The others occur only occasionally. The shell is generally white, occasionally reddish or purple; exteriorly the valves are covered by more or less persistent, generally yellow, strong membrane. The scuta and terga are always considerably larger than the other valves. The adductor muscle is always attached to a point not far from the middle of each scutum, which generally has a pit for its attachment. The valves are either placed close together or at some distance. The membrane connecting the valves, where they do not touch, is like that forming the peduncle, and is sometimes coloured brilliantly crimson-red; generally it is bluish-gray. Within the capitulum is the sac, which, together with the upper internal part of the peduncle, incloses the animal's body.

The Peduncle varies in length in different species, and even in the same species, according to the situation occupied by the individual. It is usually flattened, but sometimes quite cylindrical. It is composed of very strong generally thick transparent membrane, rarely coloured reddish, and often penetrated by numerous tubuli. The peduncle is lined within by thin layers of muscles, longitudinal, transverse, and oblique, all destitute of the transverse striæ characteristic of voluntary muscles. They run from the bottom of the peduncle to the base of the capitulum, as in *Lepas*, or half way up it, as in *Conchoderma*. The gentle swaying to and fro movements and the power of longitudinal contraction are produced by these muscles. The interior of the peduncle is filled up with a great mass of branching ovarian tubes.

There are six pairs of cirri. The five posterior pairs are seated close to each other and equidistant; the first pair is generally seated at a little distance and sometimes at a considerable distance from the second pair. The first pair is shortest; the others, proceeding backwards, increase gradually in length. The number of segments in the posterior cirri is very great. The cirri are covered with spines. Most of the genera have caudal appendages.

The alimentary canal consists of an œsophagus, a stomach, and rectum. The œsophagus is of considerable length; it is formed of strong transparent much-folded membrane, continuous with the outer integuments, and moulted with them. At its lower end it expands into a bell with the edges reflexed. This bell lies within the stomach, and keeps the upper broad end expanded. The stomach lies in a much-curved almost doubled course, and is often a little constricted where most bent. It is broadest at the upper end. The stomach is coated by small opaque pulpy slightly arborescent glands, believed to be hepatic. The rectum varies in length, extending inwards from the anus to between the bases of the second and fifth pair of cirri. It is narrow, and formed of much-folded transparent membrane. Within the stomach there can generally be seen, according to the period of digestion, a thin yet strong perfectly transparent epithelial membrane, not exhibiting under the microscope any structure. It enters the branching cæca, and extends from the edge of the bell of the œsophagus to the commencement of the closed rectum. It was this membrane which was supposed by M. Martin-Saint-Ange to be a distinct organ, like the closed tube of certain *Annelidæ*.

The circulatory system is not highly developed. No heart has been discovered. The whole body is permeated by channels which have no proper coat.

In most genera of the *Lepadidæ* the nervous system consists of six main ganglia, namely, the supra-œsophageal and five thoracic ganglia. Of these the first thoracic or infra-œsophageal ganglion is considerably the largest and most massive. It is squarish, or oval, or heart-shaped; it presents no trace of being formed of two lateral ganglia. Two great nerves spring from its under side, and run straight down amongst the viscera. These nerves are about as large as those forming the collar and those running to the second ganglion; hence six great nerves meet here, two in front, two behind, and two on the under side. Nerves are given off from the remaining ganglia to the cirri and other organs. The muscles of the capitulum are supplied from the supra-œsophageal ganglion.

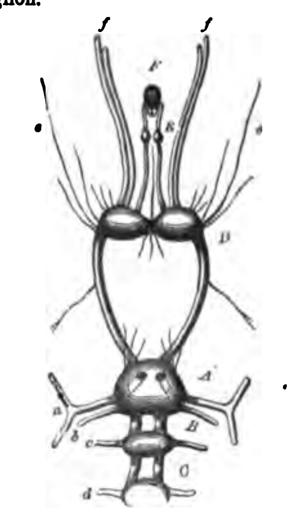


Diagram of the anterior portion of the nervous system in *Lepas fascicularis*. *A*, first thoracic or infra-œsophageal ganglion; *B*, second thoracic ganglion; *C*, third thoracic ganglion; *D*, supra-œsophageal ganglion; *E*, the two ophthalmic ganglia; *F*, double eye; *a*, nerve going to first cirrhus; *b*, to the muscles below the first cirrhus; *c*, to the second cirrhus; *d*, to the third; *e*, nerves running to the ovaria; *f*, double nerves supplying the sac and peduncle.

Nerves proceed from the supra-œsophageal to the double eye of *Lepas fascicularis*. The idea that the whole peduncle and capitulum consists of the first three segments of the head is beautifully supported by the structure of the nervous system, in which these parts are seen to be supplied with nerves exclusively from the supra-œsophageal ganglion. In ordinary *Crustaceæ* the supra-œsophageal ganglion sends nerves to the eyes and the two pairs of antennæ corresponding to the first three segments of the body.

The reproductive system of the Cirripedes has excited much interest from the results of the researches of Mr. Darwin. All the Cirripedes, with few exceptions, are bi-sexual, but Mr. Darwin has found that the masculine power of certain hermaphrodite species of *Ibla* and *Scalpellum* is rendered more efficient by certain parasitic males, which, from their not pairing, as in all hitherto known cases, with females, but with hermaphrodites, Mr. Darwin designates Complemental Males. The ordinary male organs consist of pear- or finger-shaped bodies of a leaden colour, which coat the stomach, enter the pedicles, and even the basal segments of the rami of the cirri, and in some genera occupy certain swellings on the thorax and prosoma.

With regard to the ovaria, M. Martin-Saint-Ange has described how the peduncle is gorged with an inextricable mass of branching ovarian tubes filled with granular matter and immature ova. The ova when excluded remain in the sac of the animal until the larvæ are hatched. They are very numerous, and generally form two concave nearly circular leaves, called by Darwin Ovigerous Lamellæ. The ova lie in a layer, from two to four deep, and all are held together by a most delicate transparent membrane, which separately enfolds each ovum. This membrane is often thicker and stronger round the margins of the lamellæ, where they are united in a peculiar manner, presently to be described, to a fold of skin on each side of the sac; these two folds Darwin calls the Ovigerous Fræna. As the lamellæ are formed without organic union with the parent they would be liable to be washed out of the widely-opened sac of the *Lepadidæ* if they had not been specially attached to the fræna.

The complemental males, to which we have before alluded, occur in the genera *Ibla*, *Scalpellum*, *Alcippe*, and *Cryptophialus*; and these males are permanently attached to the females. In *Ibla* the male is attached within the sac of the female; it has a well-organised mouth supported on a peduncle, but with only a rudiment of the thorax, and with only two pairs of aborted cirri. In *Scalpellum* the males differ in the different species remarkably in structure: in some of the species they are not very unlike ordinary Pedunculated Cirripedes, and are attached between the scuta of the females; in other species the males are very rudimental, extremely minute, and would never without close examination have been thought to have even belonged to the class *Cirripedia*. These males consist of a sac, with rudiments of four valves, inclosing a singularly modified thorax, with only four pairs of appendages (which cannot be called cirri); they are entirely destitute of a mouth or stomach. The males of *Cryptophialus* and *Alcippe* are even more rudimentary than those of the above species of *Scalpellum*: they are reduced to an outer envelope (homologous with the carapace of ordinary *Crustacea*), to a single eye, the testis, vesicula seminalis, and a wonderfully elongated probosciformed male organ. Hence there is no mouth, no stomach, no thorax, no abdomen, and no appendages or cirri. It may be doubted whether in the whole animal kingdom there exists a creature in a more rudimentary condition than these males. As they do not possess a mouth or stomach they are necessarily short-lived. The pupa fixes itself on the female, becomes cemented to her, undergoes its metamorphosis, and becomes a male Cirripede; the spermatozoa become developed and are discharged; the male dies, decays, and generally drops off, and is succeeded, when the ova in the female are next ready to be impregnated, by one or more fresh males. Owing apparently to the small size of the males, there is generally more than one attached to the female at the same time; and in the case of *Alcippe lampas* Mr. Darwin found no less than thirteen of these singular parasitic and rudimentary males attached to a single female!

Remarkable as is the occurrence of the above male parasites on the females, it is a far more singular fact, that in some of the species of *Ibla* and *Scalpellum*, the males are attached, not on females, but on hermaphrodites; and hence they have been called by Mr. Darwin Complemental Males, inasmuch as they are complomentary to the male organs of the hermaphrodite. Mr. Darwin, in his work on the *Cirripedia* (p. 281), published by the Ray Society, enters at length on the evidence in support of this view, and he believes the facts cannot be controverted. (p. 214.) "Although the existence of hermaphrodites and males within the limits of the same species is a new fact amongst animals, it is far from rare in the vegetable kingdom: in such cases the male flowers are sometimes in a rudimentary condition compared to the hermaphrodite flowers, exactly in the same manner as are the males of *Ibla* and *Scalpellum*. If the final cause of the existence of these Complemental Males be asked, no certain answer can be given; the vesiculæ seminales in the hermaphrodite of *Ibla quadrivalvis*, and in some species of *Scalpellum*, appeared to be of small diameter; but on the other hand the ova to be impregnated are fewer than in most Cirripedes. No explanation can be given of the much simpler case of the mere separation of the sexes in the four genera before enumerated; nor can any explanation be given of the much more varied arrangement of the parts of fructification in plants of the Linnean class *Polygamia*."

The following woodcuts will give an idea of the structures above described, more especially in accordance with the views of Martin-Saint-Ange:—

Fig. 1. Anatife jaune sans coquille (Cuvier, *Alepas?*): A, a gelatinous production, the cement, which serves to fix the peduncle; B, the first membrane of the peduncle; B′ a small Cirripede, of the natural size developed upon the peduncle of the parent; C, the capitulum, which contains the body of the animal; D, the fissure of the capitulum from which issue the feet or cirri F. The point E indicates the termination of the peduncle, and the place where the eggs stop; G, the eggs arrived within the sac. *Fig.* 2. The same letters refer to the same parts as in *fig.* 1; H, the pedicles of the cirri, which sustain the rami, F. At the base of the feet (H) are four branchiæ; and between these feet and those placed on the other side is seen the recurved tube which serves to convey the seminal liquor to the ova within the sac. *Fig.* 3. The same Cirripede, from which the half of the first envelope has been taken so as to expose the interior. The peduncle contains a second cylinder terminated in a cul-de-sac by its inferior extremity, and covered at the other by a very delicate membrane; the longitudinal and transverse muscular fibres may be observed; *e*, *e*, indicate the canal which, according to Saint-Ange, carries the eggs of the peduncle within the sac; *b*, that which serves as a nourishing vessel to the peduncle and the eggs; *g*, *g*, the membrane of the sac which intercepts all direct communication between the peduncle and the cavity of the sac. J represents the body of the Cirripede inclosed in its proper envelope. *Fig.* 4. The same situation as the last, representing all the membranes which envelop the

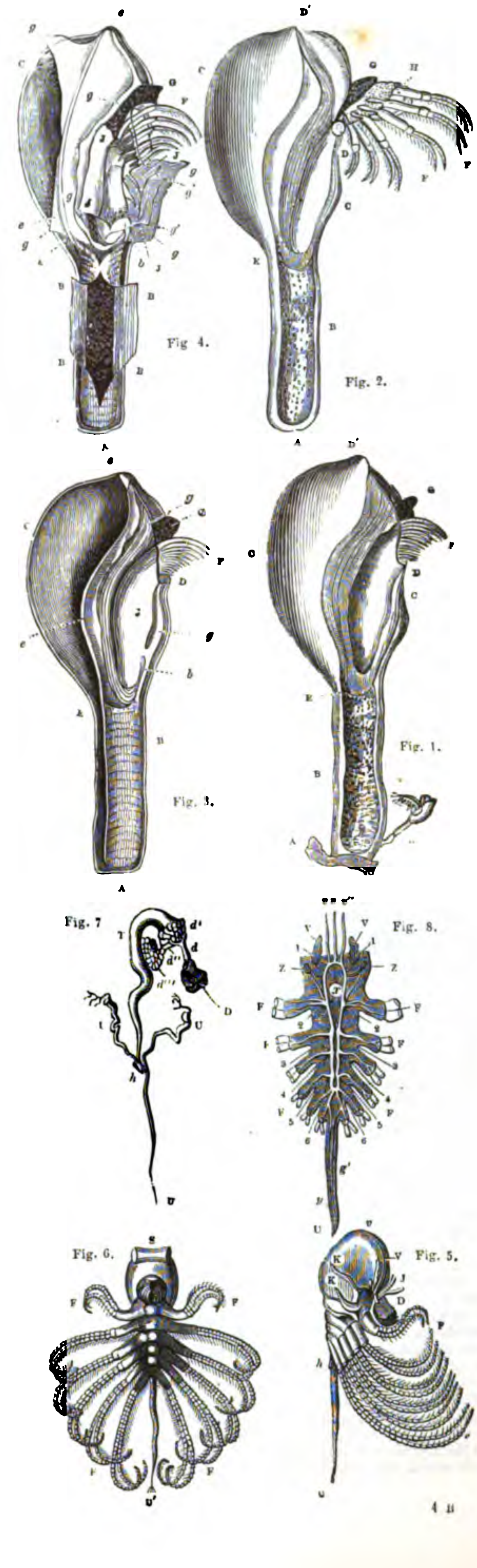


Fig. 4. Fig. 2. Fig. 3. Fig. 1. Fig. 7 Fig. 8. Fig. 6. Fig. 5.

body of the Cirripede; B, B, the muscular cylindrical pipe open, in which the eggs are seen; *e*, *e*, the course of the ovarian tubes in the thickness of the second envelope; *g,g,g*, the envelope opened and turned back; J, J, J, the proper membrane of the body of the animal; it is with this cavity that the canal *b* communicates, and it is between this proper membrane and that of the second envelope *g, g, g*, that the eggs are found: whence it results that the cavity of the mantle has no communication with the peduncle, except by means of the oviduct *e*.

Fig. 5. Side view of the common Duck Barnacle (*Lepas anatifera*) taken out of the shell, enveloped in its proper membrane, under which is found the salivary (?) vesicle; V, the cervical ganglion; *v*, the nerve which is given off from the brain to go to the muscles of the skin; J, the two levator muscles of the upper lip; K K, branchiæ; *h*, a horny tubercle which is formed on each side of the orifice of the vent; U′, the extremity of the tube, bearded with fine hairs. *Fig.* 6. Anterior view of the same, showing the truly articulated disposition of the body, each ring of which corresponds to a pair of feet; S, the adductor muscle of the valves; U′, the articulated tube which contains the spermatic canal. *Fig.* 7. The intestinal canal of the same species; D, the mouth seen from the side; *d*, the œsophagus; *d′*, the stomach; *d″*, the peduncle which makes this organ communicate with a species of cæcum, *d‴*, of the same structure and form as the stomach; T, the intestinal canal, offering two natural curvatures; *h*, orifice of the rectum; U U, vesiculæ seminales, uniting in a single canal very delicate, and terminated at U′ by a small orifice. *Fig.* 8. Disposition of the nervous system: 1. The first œsophageal ganglion, called the brain: from these united ganglions spring the branches *v*, *v′*, *v″*, destined for all the muscles of the dorsal part, and two extremely delicate threads which go on each side, the first to the salivary vesicle V, the second to a new ganglion Z; 2. The second ganglion, sending two nervous branches to each jaw-foot F, and small branches to the œsophagus; 3, 4, 5, 6 correspond to the other ganglions; 6 furnishes the two last pairs of feet. It is from the branches which go to the last feet, and not from the ganglions themselves, that the two threads *y* and *g′*, which go to the extremity, U′, of the tube are detached. The point *x* corresponds to the centre of the œsophagus which has been removed.

The process of exuviation takes place in the *Cirripedia*. Mr. Darwin says, "In the *Lepadidæ*, with the exception of the genus *Lithotrya*, in which the calcareous scales on the peduncle together with the membrane connecting them is cast off, neither the valves nor the membrane uniting them, nor that forming the peduncle with its scales, are moulted; but the surface gradually disintegrates, and is removed, perhaps sometimes in flakes; whilst new, and larger layers are formed beneath. In most Sessile Cirripedes the outside membrane connecting the operculum and shell is regularly moulted. The delicate tunic lining the sac and the integuments of the whole body are periodically shed. With these integuments, the membrane lining the œsophagus, the rectum, the deep olfactory pouches, and the horny apodemes of the maxillæ are all moulted together. The new spines on the cirri are formed within the old ones.

"All *Cirripedia* grow rapidly; the yawl of H.M.S. Beagle was lowered into the water at the Galapagos Archipelago on the 15th of September, and after an interval of exactly thirty-three days was hauled in again. I found on her bottom a specimen of *Conchoderma virgata* with the capitulum and peduncle, each half an inch in length and the former $\frac{1}{20}$ths in width; this is half the size of the largest specimen I have seen of this species. Several other individuals, not half the size of the above, contained numerous ova in their lamellæ, ready to burst forth. Supposing that the larvæ of the largest specimen became attached the first day the boat was put into the water, we have the metamorphosis, an increase of length from about ·05 of a inch, the size of the larva, to a whole inch, and the laying of probably several sets of eggs, all effected in thirty-three days. From this rapid growth repeated exuviations must be requisite. Mr. W. Thompson, of Belfast, kept twenty specimens of *Balanus balanoides*, a form of much slower growth, alive, and on the twelfth day he found the twenty-first integument, showing that all had moulted once, and one individual twice within this period. I may here add that the Pedunculated Cirripedes never attain so large a bulk as the Sessile. *Lepas anatifera* is sometimes 16 inches in length, but of this the far greater portion consists of the peduncle. *Pollicipes mitella* is the most massive kind; I have seen a specimen with a capitulum two-thirds of an inch in width."

The Pedunculated Cirripedes extend over the whole world; and most of the individual species have large ranges, more especially, as might have been expected, those attached to floating objects. Excepting these latter, the greater number inhabit the warmer, temperate, and tropical seas. Of those attached to fixed objects, or to littoral animals, it is rare to find more than three or four species in the same locality. On the shores of Europe Mr. Darwin says he knows of only three, namely, *Scalpellum*, *Pollicipes*, and *Alepas*. At Madeira (owing to the admirable researches of the Rev. R. T. Lowe) two *Pœcilasmas*, a *Dichelaspis*, and an *Oxynaspis* are known. In New Zealand there are two *Pollicipes* and an *Alepas*, and perhaps a fourth form. From the Philippine Archipelago, in the great collection made by Mr. Cuming, there are a *Pœcilasma*, an *Ibla*, a *Scalpellum*, *Pollicipes*, and *Lithotrya*. Of all the *Lepadidæ* nearly half are attached to floating objects or to animals which are able to change their position; the other half are generally attached to fixed organic or inorganic bodies, and more frequently to the former than to the latter. Most of the species of *Scalpellum* are inhabitants of deep water; on the other hand most of *Pollicipes*, of *Ibla*, and of *Lithotrya* are littoral forms. The species of *Lithotrya* have the power of excavating burrows in calcareous rocks, shells, and corals; and the singular manner in which this is effected is described in Mr. Darwin's work. *Anelasma* has its sub-globular peduncle deeply imbedded in the flesh of northern sharks, and instances have occurred of the basal end of the peduncle of *Conchoderma aurita* being sunk into the skin of *Cetacea*; in the same way the point of the peduncle in the male of *Ibla* is generally deeply embedded in the sac of the female. In all these cases the cementing substance affects and injures the corium or true skin of the animal on which the creature is parasitic, while the surrounding parts being not injured continue to grow upwards, thus causing the partial embedment of the Cirripede. In the case of *Anelasma*, we have growth at the end of the peduncle, and consequently downward pressure, and this may possibly cause absorption to take place in the skin of the shark at the spot pressed on.

Arrangement of the Family. *

Class, *Crustacea*; Sub-Class, *Cirripedia*.

Crustacea attached by the anterior end of the head by cement, proceeding from a modified portion of the ovaria: archetype composed of 17 segments, with the first three of large size, and almost always developed into a carapace not wholly exuviated, and capable of various movements; antennæ none; eyes rudimentary; mouth prominent, formed by the partial confluence of the labrum, palpi, mandibles, and two pairs of maxillæ. Thorax attached to the internal sternal surface of the carapace, generally bearing six pairs of captorial, biramous, multi-articulated limbs. Abdomen generally rudimentary. Branchiæ, when present, attached to the under sides of the carapace. Bisexual; when unisexual, males parasitic on the female; male organ single, generally probosciformed, seated at the posterior end of the abdomen. Oviducts none. Metamorphosis complex.

Order I. *Thoracica*.†

Cirripedia having a carapace consisting either of a capitulum on a peduncle, or of an operculated shell with a basis. Body formed of six thoracic segments, generally furnished with six pairs of cirri. Abdomen rudimentary, but often bearing caudal appendages. Mouth with the labrum not capable of independent movements. Larva firstly uniocular, with three pairs of legs; lastly, binocular, with six pairs of thoracic legs.

Family 1.—*Balanidæ*.

Cirripedia without a peduncle; scuta and terga furnished with depressor muscles; other valves united immovably together.

This family was well known to the ancients. The genera seem to have been all confounded under the name of Βάλανος (Balanus) by the Greeks. (Aristotle, 'Hist. Anim.,' book iv. ch. 8, and book v. ch. 15.) Athenæus mentions them more than once; and ('Deipnos,' book iii. ch. 11, p. 88) speaks of the large ones with approbation as an article of food. They are the *Balani* of the Latins; nor did Lucullus disdain them. The Chinese eat the soft parts of one of the species (*Balanus tintinnabulum*), which has the reputation of being like the flesh of the lobster when cooked; and the delicious qualities of another species, and its high estimation for the table, are referred to in another place. [Balanus.]

Sub-Family.—*Balaninæ*.

Shell with the rostrum without alæ, but having radii; the lateral compartments all with alæ on one side and radii on the other; parietes generally either porose or longitudinally ribbed on their inner surfaces.

Section ‡.

Scutum and tergum articulated together or overlapping each other: each branchia composed of a single plicated fold.

Genus, *Balanus* Auctorum.—Compartments six; basis calcareous or membranous; opercular valves sub-triangular. [Balanus.]

* We are indebted to Mr. Darwin for the following arrangement, the first volume of whose great work on the *Cirripedia*, including the *Lepadidæ*, published by the Ray Society has alone at present been published.

† The external parts of Cirripedes consist either of a *Shell* with an *Operculum* and the *Basis*, or of a *Capitulum* (as called by Mr. Darwin), which is homologous with the shell and operculum, mounted on a *Peduncle*, which again is homologous with the basis. The two valves, to which the animal's body is attached, and which have the power of opening and shutting, are called by Mr. Darwin the *Scuta*; a second pair of valves, bounding the orifice, at that end at which the cirri are exserted, are called the *Terga*. At this same end of the shell, or capitulum, the medial valve or compartment is called the *Carina*; the medial valve or compartment at the opposite end is called the *Rostrum*: the principal valves or compartments on each side are called the *rostro-lateral*, *lateral*, and *carino-lateral*, or simply the lateral compartments or *Latera*. In the *Balanidæ* each separate compartment may be said to consist of the *wall* or *parietal* portion (generally wedge-formed, with the apex upwards), and with a *Radius* (either on one or both sides), or with an *Ala* (either on one or both sides): the *Ala* is a quadrangular projection, always overlapped by the adjoining compartment; the *Radius* has usually the shape of a wedge, with the apex downwards; it is exterior, and overlaps the adjoining compartment.

This, the typical genus of the family, includes 89 recent species, which range from 77° in the northern hemisphere to Cape Horn in the south.

Sub-genus, *Acasta*, Leach, 1817.—Compartments six; parietes and basis non-porose; basis calcareous, cup-formed, not elongated: attached to sponges or rarely to the bark of Isis.

This sub-genus, which is a very natural one in habits and appearance, nevertheless can hardly be distinguished from those species of *Balanus* which live attached to *Gorgoniæ*. *Acasta* is found in almost all parts of the world.

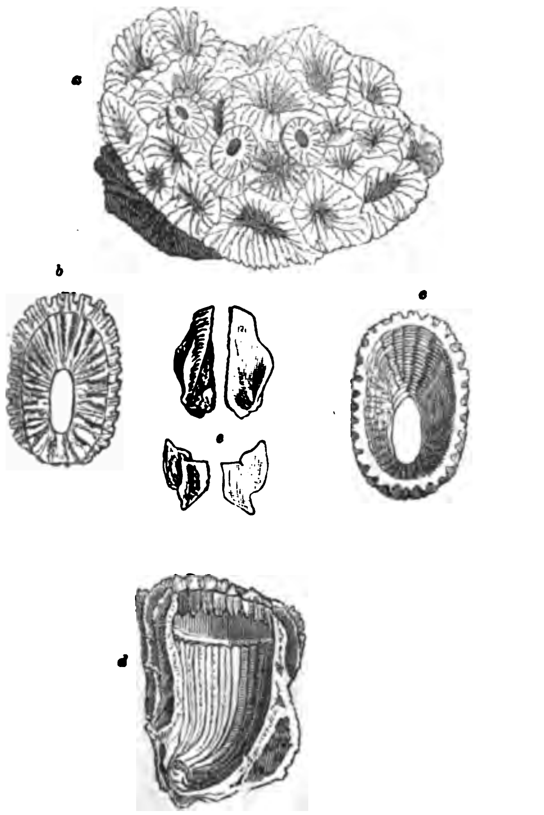
Tetraclita, Schumacher, 1817 (*Conia* of Leach, *Asemus* of Ranzani).—Compartments four, sometimes with their outer laminæ calcified together; parietes permeated by pores, generally forming several rows; basis flat, irregular, calcareous or membranous.

Tetraclita porosa.

Elminius, Leach, 1825.—Compartments four; parietes not porose; basis membranous.

This genus is confined to the southern hemisphere.

Pyrgoma, Leach, 1817 (*Megatrema* of Leach; *Adna* of Leach; *Daracia* of J. E. Gray; *Creusia* of De Blainville; *Nobia* of Sowerby).—Shell formed of a single piece; basis cup-formed or sub-cylindrical: attached to, or imbedded in corals.



Pyrgoma crenatum.

a, specimens of the natural size in *Astræa favosa*; *b*, *c*, *d*, different views and section of the cone; *e*, the opercular valves. *b*, *c*, *d*, and *e*, are magnified.

Sub-genus *Creusia*, Leach, 1817.—Compartments four; furnished with radii; basis cup-formed, imbedded in corals.

This sub-genus is most closely allied to *Pyrgoma*, and its separation is of doubtful propriety.

Chelonobia, Leach, 1817 (*Coronula* of Lamarck; *Astrolepas* of Gray).—Compartments extremely thick, six in number, but the rostrum is internally composed of three compartments united together; basis membranous; scuta narrow, united to the terga by a horny articular ridge.

Two of the three species included in this genus are always attached to turtles; the third adheres to crabs and smooth shells.

Section ††.

Scutum and tergum (when both are present) not overlapping each other; basis membranous; parietes often deeply folded, with the outer lamina towards the basis generally imperfect; each branchia composed of two plicated folds: shell attached to living *Vertebrata*.

Coronula, Lamarck, 1802 (*Diadema* of Schumacher; *Cetopirus* of Ranzani).—Compartments six, of equal breadth, deeply folded, with the folds outwardly pressed together, but inwardly expanded, so as to form cavities open only on the under side; opercular valves much smaller than the orifice of the shell: attached to *Cetacea*.

Coronula balænaris.

Platylepas, J. E. Gray, 1825 (*Coronula* of De Blainville).—Compartments six, each bilobed and inwardly produced, so as to form six mid-ribs, which support the outwardly convex membranous basis.

The species of this genus are attached to turtles, manatees, and sea-snakes.

Tubicinella, Lamarck, 1802 (*Coronula* of De Blainville).—Compartments six, of equal breadth; shell sub-cylindrical, wider at the top than at the basis; belted by several transverse ridges: attached to *Cetacea*.

Tubicinella trachealis.

Xenobalanus, Steenstrup, 1852.—Shell almost rudimentary, star-formed, composed of six compartments, with a long peduncle-formed body rising from the middle of them; opercular valves none: attached to *Cetacea*.

Sub-Family.—*Chthamalinæ*.

Shell with the rostrum having alæ, but without radii; rostro-lateral compartments without alæ on either side; parietes not porose.

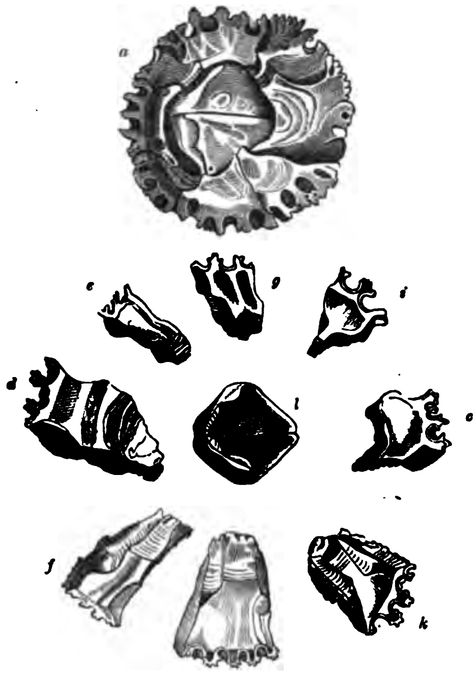
Chthamalus, Ranzani, 1820 (*Euraphia*, Conrad).—Compartments six; basis membranous, but sometimes in appearance calcareous from the inflected parietes.

Chthamalus stellatus.

Chamæsipho, Darwin, 1854.—Compartments four, with the sutures often much obliterated; basis membranous.

Pachylasma, Darwin, 1854.—Compartments, when the shell is very young, eight; when maturer, either six, or in appearance only four, from the close union of the lateral compartments; basis calcareous.

Octomeris, G. B. Sowerby, 1825.—Compartments eight; radii with their edges crenated; basis membranous.

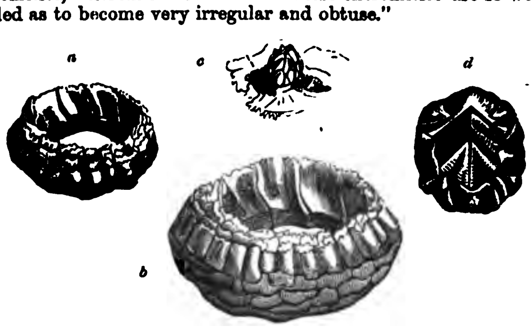


Octomeris angulosa.

a, the outside; below, an internal view of the eight divisions; *c*, the anterior piece; *d*, the posterior piece; *e* to *k*, the lateral pieces; *l*, the operculum, consisting of four pieces, of which the two anterior are the larger.

Catophragmus, G. B. Sowerby.—Compartments eight, with several exterior whorls of small supplemental compartments; basis either membranous or calcareous.

"The shell," says Mr. G. B. Sowerby, "consists in a number of narrow perpendicular valves arranged around the shelly cone, and in rows, like pales, the first row of which consists of eight pieces, placed so as exactly to cover the sutures of the shelly cone immediately surrounding the animal; around this are then placed several sets of more and more numerous pieces gradually decreasing in size, so that the outer row, which is the most numerous, consists also of the smallest pieces. Additional rows seem to be produced as the animal increases in age; for a young specimen in our possession has only one row of eight pieces covering the sutures of the first cone, while a much larger and older specimen still retains part of three rows, and has evidently lost some of the external rows. The young individual also shows that the whole of the pieces are pointed at their superior extremities, whereas in the old shell these extremities are so worn or eroded as to become very irregular and obtuse."



Catophragmus imbricatus.

a, the old shell, natural size; *b*, the same magnified; *c*, the young shell, natural size; *d*, the same magnified.

Family II.—*Verrucidæ.*

Cirripedia without a peduncle; scuta and terga not furnished with depressor muscles, moveable only on one side, on the other side united immoveably with the rostrum and carina into an asymmetrical shell.

Verruca, Schumacher, 1817 (*Clisia* and *Clitia* of Leach, *Creusia* of Lamarck, *Ochthosia* of Ranzani).—This genus is very remarkable in many respects, especially in its asymmetrical shell; sometimes the right side and sometimes the left side being specially modified. It includes four recent species.

Verruca Strömia.

Family III.—*Lepadidæ.*

Cirripedia having a flexible peduncle, provided with muscles; scuta and terga (when present) not furnished with depressor muscles; other valves (when present) not united into an immoveable ring.

The genera of this family affix themselves by means of their peduncle to submarine bodies, forming numerous groups. They are often found on floating substances far at sea: on ships, on logs of timber, on bottles, on net-corks, on fuci, on floating testaceous mollusks, *Ianthina* for instance, and even on some of the vertebrated animals, on whales, turtles, and even serpents—*Hydrophis*, for example. Other testaceous mollusks might be mentioned, and one species has been found parasitical within the umbrella of a *Medusa*. A large log of timber covered with these animals, twisting and diverging in all directions, and so thick as entirely to hide the surface of the log, is a strange sight. They look like an enormous collection of serpents to the ignorant; and we have heard a living mass of this description casually thrown into shallow water and left by the tide so termed. Their growth must be extremely rapid. A ship going out with a perfectly clean bottom will often return from a short voyage covered with them below the water-line. The Blacks of Goree are said to eat a large species of *Pentalasmis*, which is stated to be delicate.

Lepas.—Valves 5, approximate; carina extending up between the terga, terminating downwards in an imbedded fork or in an external disc; scuta subtriangular with their umbones at the rostral angle. The species are found all over the world attached to floating objects.

L. anatifera, the Common Barnacle. It is the *Anatifa*, *Anatifera*, and *Pentalasmis* of many authors. *Anatifa engonata* of Conrad; *A. dentata* (var.) of Bruguières; *Pentalasmis dentatus* of Brown; *Anatifa* of Martin-Saint-Ange. The valves are smooth or delicately striated. Right hand scutum alone furnished with an internal umbonal tooth; uppermost part of peduncle dark-coloured. It is extremely common, attached to floating timber, vessels, sea-weed, bottles, &c., and to each other.

Lepas anatifera.

Mr. Darwin describes also the following species:—*L. Hillii, L. anserifera, L. pectinata, L. australis, L. fascicularis.*

Pœcilasma, Darwin.—Valves 3, 5, or 7, approximate; carina extending only to the basal points of the terga, with its lower end either truncated or produced into a deeply imbedded disc. Scuta nearly oval, with their umbones at the rostral angle. This genus embraces the following species:—*P. Kæmpferi, P. aurantia, P. crassa, P. fissa, P. eburnea.* Four out of the five species live attached to *Crustacea* in the European and Eastern warmer, temperate, and tropical oceans. The fifth species was found attached to the dead species of an *Echinus* off New Guinea. It is probable that several more species may be discovered.

Dichelaspis, Darwin (*Octolasmis*, J. E. Gray; *Heptalasmis*, Agassiz).—Valves 5, generally appearing like 7, from each scutum being divided into two distinct segments, united at the rostral angle; carina generally extending up between the terga, terminating downwards in an imbedded disc or fork, or cup. The following are the species;—*D. Warwickii, D. Grayii, D. pellucida, D. Lowei, D. orthogonia.* The species are very rare. They have been found attached to crabs at Madeira and off Borneo, and attached to sea-snakes in the Indian Ocean.

Oxynaspis, Darwin.—Valves 5, approximate; scuta with their umbones in the middle of the occludent margin; carina rectangularly bent, extending up between the terga, with the basal end simply concave. The only species is *O. celata*, which was found attached in numbers to an *Antipathes* in Madeira, by the Rev. R. T. Lowe.

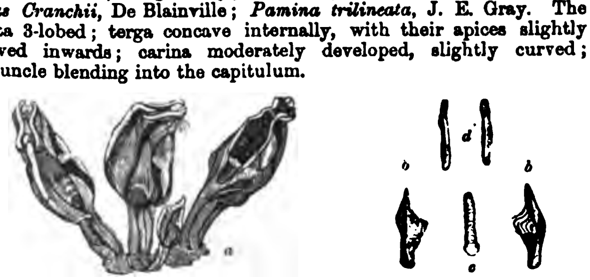
Conchoderma, Olfers (*Lepas*, Linnæus; *Branta*, Oken; *Malacotta* and *Senoclita*, Schumacher; *Otion* and *Cineras*, Leach; *Gymnolepas*, De Blainville; *Pamina*, J. E. Gray).—Valves 2 to 5, minute, remote from each other; scuta with two or three lobes, with their umbones in the middle of the occludent margin; carina arched, upper and lower ends nearly alike.

C. aurita, Darwin. It is the *Lepas aurita*, Linnæus; *Otion Cuvieranus, O. Blainvillianus, O. Bellianus, O. Dumerillianus, O. Rissoanus*, Leach; *O. depressa, O. saccutifera*, Coates; *O. auritus*, Macgillivray; *Lepas Seporina*, Poli; *Lepas cornuta*, Montagu; *Conchoderma auritum, C. leporinum*, Olfers; *Branta aurita*, Oken; *Malacotta bivalvis*, Schumacher; *Gymnolepas Cuvieri*, De Blainville.


Conchoderma aurita.
a, entire animal; *b*, the lateral valves; *c*, the single valve; *d*, the terminal valves.

The capitulum has two ear-like appendages seated behind the rudimentary and often absent terga; scuta bilobed; carina absent or quite rudimentary; peduncle long, distinctly separated from the capitulum. This species is extremely common in every ocean. It is found on ships' bottoms from all parts of the world. It is found in the Arctic and Antarctic Oceans, not unfrequently on the coronulæ on whales, and on slow-moving fish. It is often associated with other species. The earlike appendages are the most extraordinary part of this animal. Mr. Darwin thinks that their function is respiratory.

C. virgata, Darwin. It is the *C. virgatum*, Olfers; *Lepas virgata*, Spengler; *L. coriacea*, Poli; *L. membranacea*, Montagu; *Branta virgata*, Oken; *Senoclita fasciata*, Schumacher; *Cineras vittata*, Leach; *C. membranacea*, Macgillivray; *C. bicolor, C. vittatus*, Brown; *Gymnolepas Cranchii*, De Blainville; *Pamina trilineata*, J. E. Gray. The scuta 3-lobed; terga concave internally, with their apices slightly curved inwards; carina moderately developed, slightly curved; peduncle blending into the capitulum.


Conchoderma virgata.
a, Animal. *b*, the scuta; *c*, the carina; *d*, the terga.

Like the last, this species is extremely common on ships' bottoms from all parts of the world. It also attaches itself to sea-weed, turtles, and other objects.

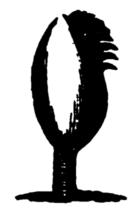
The small valves in *C. aurita* were overlooked by Lamarck, but detected by Leach. In the Museum of the Royal College of Surgeons, 'Nat. Hist.,' No. 265, there is a species named *Cineras Hunteri*, of which two small groups are attached to the tail of *Hydrophis bicolor*, which is figured in Russell's 'Indian Serpents,' 1, tab. xli., and is called by the natives 'Nalla Wahlagillee Pam.' Russell says, "This sea-snake, according to the Vizagapatam fishermen, seldom approaches the shore; several of them had never seen one before. They pretended it was of a very dangerous kind, which is contradicted by the want of poisonous organs."

C. Hunteri is admitted as a species by Mr. Darwin. It has however scarcely more claim to be regarded as a species than some of the varieties of the first two species.

Alepas, Sander Rang (*Anatifa*, Quoy and Gaimard; *Triton*, Lesson; *Cineras*, Lesson).—Capitulum without valves, or with horny almost hidden scuta.

M. Rang has given the generic appellation above stated to the *Cineras parasita* of Lesson, and the *Anatifa univalvis* of Quoy and Gaimard. The species on which the genus was founded was detected attached to the umbrella of a *Medusa*. Rang considers this to be the *Triton* of Linnæus. Cuvier, in the last edition of the 'Règne Animal,' observes that he has not seen the species, but still adheres to his old opinion; for he says that it ought not in any case to be confounded with the *Triton* of Linnæus, which was the animal of an *Anatifa* torn from its mantle and shell.

A. parasita, Sander Rang. It is the *Anatifa univalvis* and *A. parasita*, Quoy and Gaimard; *Triton* (*Alepas*) *fasciculatus*, Lesson. Orifice not protuberant, equalling two-thirds of the length of the capitulum; scuta horny. Total length two inches.


Alepas parasita.

It has been found parasitic on *Medusæ* in the Mediterranean and Atlantic oceans and on the south shore of England.

Three other species—*A. minuta, A. cornuta*, and *A. tubulosa*—are described by Darwin.

Anelasma, Darwin; *Alepas*, Loven.—Capitulum without valves, aperture large, peduncle fimbriated, sub-globular, imbedded.

A. squalicola, Darwin, is the only species of this genus. It was referred by Loven to *Alepas*, but has been separated by Darwin. It lives parasitic, with its peduncle imbedded in the skin of sharks in the North Sea.

Alcippe, A. Hancock, 1849.—Capitulum without valves, with the aperture spinose; peduncle grows at its lower end, rostral surface depressed and covered by a horny disc; capitulum and peduncle imbedded in a self-formed cavity.

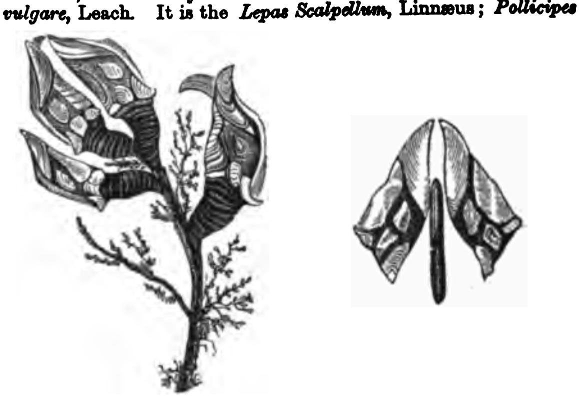
This most remarkable genus bores cavities for itself in shells. It inhabits the shores of England. It has but one species, *A. lampas*, Hancock.

Ibla, Leach (*Anatifa*, Cuvier; *Tetralasmis*, Cuvier).—Female and hermaphrodite with 4 horny valves; peduncle clothed with persistent horny spines.

There are two species of this, *I. Cumingii* and *I. quadrivalvis*. This is one of the genera in which complemental males occur, the structure of which Mr. Darwin has described at great length. *I. Cumingii* inhabits the seas of the Philippine Archipelago, and they are invariably attached to the peduncle of *Pollicipes mitella* in groups of two or three together. *I. quadrivalvis* is found in the Australian seas.

Scalpellum, Leach (*Lepas*, Linn.; *Pollicipes*, Lamarck; *Polylepas*, De Blainville; *Smilium*, Leach; *Calantica*, J. E. Gray; *Thaliella*, J. E. Gray; *Anatifa*, Quoy and Gaimard; *Xiphidium*, Dixon).—Hermaphrodite and female with valves 12 to 15 in number; latera of the lower whorl 4 or 6, with their lines of growth generally directed towards each other; sub-rostrum very rarely present; peduncle squamiferous, most rarely naked.

S. vulgare, Leach. It is the *Lepas Scalpellum*, Linnæus; *Pollicipes*


Scalpellum vulgare.

Scalpellum, Lamarck; *Polylepas vulgare*, De Blainville; *Scalpellum læve*, Leach. Hermaphrodite with capitulum of 14 valves, including the rudimentary rostrum; upper latera irregularly oval. The complemental male flask-formed, with four rudimentary valves.

It is a native of the seas of Great Britain, Ireland, France, Norway, and Naples. Found attached to horny corallines, according to Forbes and MacAndrew, at from twenty to thirty, sometimes even to fifty fathoms in depth. There are five other species of this genus. They are all characterised by the presence of the complemental male.

Pollicipes, Leach (*Lepas*, Linnæus; *Anatifa*, Bruguières; *Mitella*, Oken; *Ramphidionia*, Schumacher; *Polylepas*, De Blainville; *Capitulum*, J. E. Gray).—Valves from 18 to above 100 in number; latera of the lower whorl numerous, with their lines of growth directed downwards; subrostrum always present; peduncle squamiferous.

P. mitella, Sowerby. It is *Lepas mitella*, Linnæus; *Polylepas mitella*, De Blain.; *Capitulum mitella*, Gray. Capitulum with only one whorl of valves under the rostrum; the upper pair of latera viewed internally are three or four times as large as the lower latera, which overlap each other laterally; scales of the peduncle symmetrically arranged in close whorls.

Pollicipes mitella.

This species is found in the seas of the Philippine Archipelago and the Chinese Sea. There are five other species. They are found attached to both fixed and floating objects in the warmer, temperate, and tropical seas.

Lithotrya, G. B. Sowerby (*Litholepas*, De Blainville; *Absia*, Leach; *Brisnæus* and *Conchotrya*, J. E. Gray; *Lepas*, Gmelin; *Anatifa*, Quoy and Gaimard).—Valves 8, including a small often rudimentary rostrum and a pair of small latera; lines of growth finely crenated; peduncle covered with small calcareous scales; those of the upper whorls crenated; attached either to a basal calcareous cup or to a row of discs.

Mr. G. B. Sowerby, who instituted the genus, considers it as intermediate between the Sessile and Pedunculated Cirripedes; and states that it possesses a peculiarity not to be found in any hitherto described genus of this class, namely, that of penetrating stones for its habitation. Rang says that De Blainville is of opinion that the genus is only a true *Anatifa*, which had affixed itself upon the valve of a *Venerupis* at the bottom of one of the cavities which that bivalve hollows out for itself. De Blainville, in his 'Malacologie,' describes it under the name of *Litholepas*, sinking Sowerby's name altogether, though he says the genus was newly established by him, quotes his description, and merely states that he has never seen the Cirripede.

As the means by which many of the *Mollusca* bore into the rocks in which they reside are at present unknown and are matters of much discussion, the conclusions at which Mr. Darwin has arrived with regard to the species of *Lithotrya* are of high interest. After describing accurately the structure of the valves, the peduncle, the muscles of the peduncle, the basal calcareous cups or discs, and the internal structure of the cup, he concludes:—"The several species occur imbedded in soft calcareous rocks, in massive corals, and in the shells of *Mollusca* and of Cirripedes. It has been doubted by several naturalists whether the basal calcareous cup at all belongs to the *Lithotrya*; but after the foregoing microscopical observations on its structure it is useless to discuss this point. So again it has been doubted whether the cavity is formed by the cirripede itself; but there is so obvious a relation between the diameters of specimens of various sizes and the holes occupied by them that I can entertain no doubt on this head. The holes moreover are not quite cylindrical, but broadly oval, like the section of the animal. The simple fact that in this genus alone each fresh shelly layer round the bases of the valves, and therefore at the widest part of the capitulum, is sharply toothed; and secondly, that in this genus alone a succession of sharply-serrated scales, on the upper and widest part of the peduncle, is periodically formed at each exuviation, and that consequently the teeth on the valves and scales are sharp and fit for wearing soft stone at that very period when the animal has to increase in size, would alone render the view probable that the *Lithotrya* makes or at least enlarges the cavities in which it is imbedded. Although it may be admitted that *Lithotrya* has the power of enlarging its cavity, how does it first bore down into the rock? It is quite certain that the basal cup is absolutely fixed, and that neither in form nor state of surface it is at all fit for boring. I was quite unable to answer the foregoing question until seeing the admirable figures by Reinhardt of *L. Nicobarica* still attached in its cavity. Subsequently I obtained from Mr. Stutchbury several pieces of rock completely drilled with holes, many of small diameter, by *L. dorsalis*; and in these I found numerous instances of the linear rows of little discs like those of *L. Nicobarica*, showing in the plainest manner that each time a new disc is formed, that is, at each exuviation, the animal moves a short step downwards; and as the lowest of these little discs in none of the burrows was placed at the very bottom, we see that the lowest point of the peduncle must be the wearing agent. In the peduncle of an individual of *L. dorsalis*, nearly ready to moult, I found, it may be remembered, beneath and round the basal disc, under the old membrane of the peduncle, a new membrane studded with calcified beads, but with the horny star-headed spines not yet developed; whilst on the old outer coat these latter had been worn down quite smooth, and the calcified beads worn entirely away. Here then we have an excellent rasping surface. With respect to the power of movement necessary for the boring action, the peduncle is amply furnished with transverse, oblique, and longitudinal striæless muscles, the latter attached to the basal disc. In all the *Pedunculata* I have reason to believe that these muscles are in constant slight involuntary action. This being the case, I conceive that the small blunt spur-like portion of the peduncle descending beneath the basal rim of the lowest disc would inevitably partake slightly of the movements of the whole distended animal. As soon as the *Lithotrya* has reached that depth which its instincts point out as most suitable to its habits, the discs are converted into an irregularly growing cup, and the animal then only increases in diameter, enlarging its cavity by the action of the serrated scales on the peduncle, and of the serrated lower edges of the valves of the capitulum. With respect to those reversed individuals attached with their capitulums downwards, I suppose that the larvæ had crept into some deep cavity perhaps made originally by a *Lithotrya*, of which the rock in the specimen in question was quite full, and had there attached themselves. Finally, it appears that in *Lithotrya* the burrowing is simply a mechanical action: it is effected by each layer of shell in the basal attached discs overlapping in a straight line the last-formed layer; by the membrane of the peduncle and the valves of the capitulum having excellent and often renewed rasping surfaces; and lastly, by the end of the peduncle (that is, homologically the front of the head) thus roughened, extended beyond the surface of attachment, and possessing the power of slight movement."

L. dorsalis, G. B. Sowerby. It is the *Lepas dorsalis*, Ellis; *Litholepas* de Mont Serrat, De Blainville. Scuta narrowly overlapping the terga; carina internally concave; rostrum as wide as two or three of the subjacent scales; latera with their internal surfaces narrowly elliptical, as long as five of the subjacent scales; upper scales of the peduncle less than twice as large as those in the second whorl.

Lithotrya dorsalis.

This species is found imbedded in limestone at Barbadoes, Venezuela, and the Honduras.

L. cauta, Darwin, named from a unique specimen, was found imbedded in a *Conia* or *Tetraclita* from New South Wales.

L. Nicobarica, Reinhardt, is a rare species occurring in the Nicobar Islands.

L. Rhodiopus, Darwin, is named from a specimen imbedded in a massive coral in the British Museum.

L. truncata, Darwin, found imbedded in coral rock in the Friendly Islands and Philippine Archipelago.

L. Valentina, Darwin, from two specimens imbedded in an oyster-shell, in the British Museum, from the Red Sea.

Order II. *Abdominalia.*

Cirripedia having a flask-shaped carapace. Body consisting of 1 cephalic, 7 thoracic, and 3 abdominal segments, the latter bearing 3 pairs of cirri; the thoracic segments without members; mouth with the labrum greatly produced, and capable of independent movements; œsophagus armed with teeth at its lower end; larva firstly egg-like, without external limbs or an eye; lastly, binocular, without thoracic legs.

This order contains only one genus and one species, *Cryptophialus minutus*, Darwin, 1854. It is very distinct from all other Cirripedes, but more nearly allied to *Alcippe* amongst the *Lepadidæ* than to any other form. It bores cavities in the *Concholepas Peruviana*, and is of very minute size.

Order III. *Apoda.*

Cirripedia with the carapace reduced to 2 threads, serving for attachment. Body consisting of 1 cephalic, 7 thoracic, and 3 abdominal segments, all destitute of cirri; mouth suctorial, with the mandibles and maxillæ, placed back to back, inclosed in a hood, formed by the union of the labrum and palpi; metamorphoses unknown.

This order, like the last, contains only one genus and species, *Proteolepas bivincta*, Darwin, 1854. It was found parasitic within the sac of another Cirripede in the West Indies. Until most closely examined the *Proteolepas* would never have been imagined to have belonged to the class of *Cirripedia*. In external appearance it resembles the larva or maggot of a fly; its mouth is unlike that of any known type in the articulate kingdom.

Fossil Cirripedia.

As with the recent so with the fossil species of this family, we are most indebted for our knowledge of them to the exhaustive labours of Mr. Darwin, whose recent investigations on this subject have thrown all others into the shade. The result of his inquiries into the extinct history of the *Cirripedia* has been given in a work published by the Palæontographical Society, which, although more immediately intended to illustrate the fossil Pedunculated Cirripedes of Great Britain, embraces an outline of the whole subject as far as it is known. In our remarks we shall follow Mr. Darwin. "No true Sessile Cirripede," he says, "has hitherto been found in any Secondary formation. Considering that at the present time many species are attached to oceanic floating objects, that many others live in deep water in congregated masses, that their shells are not subject to decay, and that they are not likely to be overlooked when fossilised, this seems to be one of the cases in which negative evidence is of considerable value." Often observers have searched with great care amongst the Secondary rocks and have met with nothing that bear the characters of the *Balanidæ* of the present day. The Sessile Cirripedes are first met with in the Eocene deposits of the Tertiary formations, and subsequently often in abundance in the same formation. They appear however never to have abounded so greatly as at the present time, so that Mr. Darwin says, "The present period will hereafter apparently have as good a claim to be called the age of Cirripedes as the Palæozoic period has to be called the age of Trilobites." He adds, "There is one apparent exception to the rule that Sessile Cirripedes are not found in Secondary formations, for I am enabled to announce that Mr. J. de C. Sowerby has in his collection a *Verruca* from our English Chalk; but this genus, though hitherto included amongst the Sessile Cirripedes, must, when its whole organisation is taken into consideration be ranked in a distinct family of equal value with the *Balanidæ* and *Lepadidæ*, but perhaps more nearly related to the latter than to the Sessile Cirripedes."

The oldest known Pedunculated Cirripede is a species of *Pollicipes* discovered by Professor Buckman in the Stonesfield Slate in the Lower Oolite, and two species of the same genus have been described by Mr. Morris from the Oxford Clay in the Middle Oolite. No Cirripede has yet been found in the Upper Oolite, or in the Wealden Beds. During the development of the great Cretaceous system, the *Lepadidæ* arrived at their culminating point. At this time there existed 3 genera and at least 32 species, some occurring at every stage of the system. In addition to the species described there are several doubtful, and by future research many more will undoubtedly be added to the present list.

Although rich in species, the individuals in the Chalk oceans seemed to have been rare, if we may judge from the few remains of particular species that exist in any one collection. It is not always the case that a great variety of species is attended with a multiplicity of individuals, although that is frequently observed.

In the Eocene, Miocene, and Pliocene Tertiary deposits, Mr. Darwin has met with but two species of *Scalpellum* and two of *Pollicipes*, distinct from recent forms. Two or three species are doubtful. It is a singular fact that, widely distributed as are the species of *Lepas* at the present day, and the frequency of the individuals, not a single valve known certainly to belong to this genus or to any of the closely allied genera, has hitherto been found fossil.

The following is a table of the species described in Mr. Darwin's monograph:—

Table of Distribution of Species and the Formations where they are found.

Scalpellum magnum	Tertiary.
S. quadratum	Tertiary.
S. fossula	Upper Chalk.
S. maximum	Faxoe. Scania. Maestricht. Upper Chalk.
S. lineatum	Lower Chalk.
S. hastatum	Chalk Marl.
S. augustum	Upper Chalk (?), Lower Chalk (?), Chalk Marl (?).
S. quadricarinatum	Chalk Marl.
S. trilineatum	Chalk Marl.
S. simplex	Lower Greensand.
S. arcuatum	Gault.
S. tuberculatum	Upper Chalk, Lower Chalk, Chalk Marl.
S. solidulum	Scania. Upper Chalk.
S. semiporcatum	Scania. Upper Chalk.
S. Cretæ (?)	Upper Chalk.
Pollicipes concinnus	Lower Greensand.
P. Ooliticus	Lower Oolite.
P. Nilssonii	Scania. Upper Chalk.
P. Hausmanni	Gault.
P. politus	Upper Greensand (?).
P. elongatus	Upper Chalk.
P. acuminatus	Lower Chalk.
P. Angelini	Scania. England. Upper Chalk.
P. reflexus	Tertiary.
P. carinatus	Tertiary.
P. glaber	Upper Chalk, Lower Chalk, Chalk Marl.
P. unguis	Gault, Lower Greensand.
P. validus	Scania. Maestricht. Upper Chalk.
P. gracilis	Upper Chalk, Lower Chalk.
P. dorsatus	Faxoe. Upper Chalk.
P. striatus	Upper Chalk.
P. semilatus	Upper Chalk, Lower Chalk, Chalk Marl.
P. rigidus	Gault.
P. fallax	Scania. England. Hanover. Upper Chalk.
P. elegans	Faxoe. Scania. Upper Chalk.
P. Bronnii	Upper Greensand.
P. planulatus	Lower Greensand.
Loricula pulchella	Lower Chalk. [*See* SUPPLEMENT.]

CIS, a genus of Coleopterous Insects of the family *Ptinidæ* (Leach). They are minute Beetles which infest the various species of *Boleti*. They are of an oblong nearly cylindrical form, and generally of a brown colour: their tarsi are 4-jointed, and the antennæ have the basal joint large, and the three apical joints forming a club. Fourteen species have been discovered in this country, the largest of which is scarcely one-eighth of an inch in length.

CISSA'MPELOS, a genus of Plants belonging to the natural order *Menispermaceæ*. It is diœcious; the sepals 8, in a triple series; the stamens united into a slender column dilated at the apex, bearing two 2-celled anthers opening horizontally. The species are twining shrubs with triangular leaves, shining on the upper and pubescent on the under surface.

C. Pareira, the Pareira-Brava, is a native of several of the West India Islands, of Mexico, and of Brazil. The root of this plant arrives in Europe in pieces from two to three feet long, varying in thickness from that of a finger to an arm, curved, furrowed, and warty, with a thin closely-adhering bark of a grayish-brown colour. The woody part is tough, but so porous that air can be blown from one end to the other of a long piece; the concentric circles are very conspicuous; the axis is not in the centre. The odour is very faint, but the taste is at first sweetish or liquorice-like, afterwards nauseous and bitter. Analysed by Feneuille it was found to consist of—soft resin; a yellow bitter principle (tonic); a brown principle; animalised matter, starch, malate of lime, nitrate of potash, and other salts. The juice of the fresh plant in its native country is said to be a very efficacious application to the bites of serpents; but in Europe the root is employed only as a tonic diuretic.

There is great reason to believe that the roots of several different species of this or closely-allied genera are confounded under the name of Pareira-Brava, especially the root of *C. Caapeba*, also of *C. Mauritanica* (Aubl.), which is much esteemed in the East Indies given along with aromatics in diseases of the intestines. Several other species of *Cissampelos*, on account of their prominent bitter properties, have been used in medicine. Two species of *Abuta*, an allied genus, *A. rufescens* (Aubl.), and *A. candicans* (Decand.), are used in Guyana under the name of White and Red Pareira-Brava.

CISSUS. [VITACEÆ.]

CISTA'CEÆ, a natural order of Polypetalous Exogenous Plants, belonging to Lindley's Calycose Group; among which they are known by their opposite or alternate undivided leaves, generally strongly impregnated with a fragrant resinous secretion, regular flowers with crumpled petals and indefinite stamens, and fruit with parietal placentæ; a simple style, and a large number of seeds containing in the midst of albumen an embryo with the radicle remote from the hilum. They are remarkable for the beauty of their fugitive flowers in the genera *Cistus* and *Helianthemum*. [CISTUS; HELIANTHEMUM; COCHLOSPERMUM.] The relations of *Cistaceæ* are with *Cruciferæ*, *Capparidaceæ*, *Sterculiaceæ*, and *Hypericaceæ*. It contains 7 genera and about 190 species. They are chiefly found in the south of Europe and the north of Africa. They are rare in North America, extremely uncommon in South America, and scarcely known in Asia. (Lindley, 'Vegetable Kingdom.')

CISTELA. [CISTELIDES.]

CISTE'LIDES, a family of Coleopterous Insects of the section *Heteromera* and sub-section *Stenelytra*. The species have the following characters:—Claws of the tarsi pectinated beneath; antennæ with the basal joint free, that is, not covered by a projecting portion of the head; mandibles with the apex entire.

This family includes the genera *Lystronichus*, *Cistela*, *Mycetocharus*, *Allecula*, and some others.

Lystronichus.—Of this genus there are upwards of thirty species known; their colouring is for the most part brilliant and metallic; by far the greater portion of them are found in South America. They have the thorax depressed, and with the posterior part as wide as the elytra, or nearly so; the antennæ are filiform, sometimes growing slightly thicker towards the apex.

Cistela.—The characters of this genus are:—Head long and somewhat pointed in front; labrum in width and length nearly equal; antennæ rather long, sometimes serrated, or with most of the joints triangular; body elongate-ovate; thorax broader behind than before.

Nearly forty species of this genus are known, most of which inhabit Europe, and four or five are found in this country.

C. Ceramboides is nearly half an inch in length; black with ochre-coloured elytra, and, like most of the insects of this section, is found in flowers.

C. sulphurea (*Allecula sulphurea* of some authors) is about one-third of an inch in length, and its colour is pale-yellow throughout. This species is more common in this country than the last, and appears to be confined chiefly to the sea-coast, where, like the one above mentioned, it is found in flowers.

Mycetocharus.—In this genus the head is short and rounded, and the labrum is transverse; the antennæ are shorter and the body is more elongate than in *Cistela*. About ten species are known, most of which inhabit Europe and North America; but one is found in England (*Mycetocharus scapularis*); this is about three-sixteenths of an inch in length; black; the elytra with two orange-coloured spots at the base; the base of the antennæ and the tibiæ and tarsi are yellow.

The larvæ of this insect, together with those of one or two other species of the *Cistelides*, are figured in the first volume of the 'Entomological Society's Transactions,' where an account of their habits will also be found.

The genus *Allecula* (Latreille) may be distinguished from either of the foregoing genera by the species having the penultimate joint of the tarsi bilobed, and the terminal joint of the palpi securiform.

Upwards of thirty species of *Allecula* have been discovered, most of which inhabit South America.

CISTUDO. [CHELONIA.]

CISTUS, a genus of Plants belonging to the natural order *Cistaceæ*. The calyx is composed of 5 nearly equal sepals in a double row; corolla of 5 equal petals, somewhat cuneated, caducous; the stamens numerous; style filiform; stigma capitate; the capsule superior, 5- or 10-celled, loculicidal; the seed ovate, singular; the embryo filiform, spiral. The species are shrubs or undershrubs with opposite leaves and one- or many-flowered peduncles. The flowers are either red or white, large, resembling a rose.

C. Creticus, Cretan Rock-Rose, has spathulate ovate and oblong leaves, somewhat hairy, downy, dull green, somewhat wavy at the edge, and stalked; the petioles furrowed, nearly distinct, the peduncles 1-flowered; sepals with a long taper point and villous; white flowers. It is a native of dry hills in the most southern parts of Europe. It has evergreen leaves which emit a balsamic odour when rubbed, or after damp warm weather in the summer. It yields, with many other species of *Cistus*, a gum-resin called Ladanum [LADANUM, in ARTS AND SC. DIV.], formerly in great repute as a stimulant in medicine, and still used by the Turks as a perfume.

Cretan Rock-Rose (*Cistus Creticus*).

C. laurifolius, the Laurel-Leaved Gum-Cistus or Rock-Rose has stalked ovate-lanceolate 3-nerved leaves, with the upper surface glabrous and the under surface tomentose; the footstalks dilated and connate at the base; the capsule 5-celled. It is a native of the south of France and Spain. It has white flowers with a yellow mark at the base of each petal.

C. ladaniferus, Gum-Cistus, has almost sessile leaves, connate at the base, linear lanceolate, 3-nerved, the upper surface glabrous, the under surface tomentose; the capsule 10-celled. It is a native of the hills of Spain and Portugal. Two varieties are described, one with white petals having a yellow spot at the base, the other with white petals and a blood-coloured spot at the base.

C. Ledon has connate leaves, oblong lanceolate, nerved; upper surface smooth, shining, under surface silky villous; the flowers in corymbose cymes; the peduncles and calyx clothed with silky villi. It is a native of the south of France. All the species of *Cistus* here enumerated are said to yield the Gum Ladanum. Many species which were formerly described under *Cistus* are now referred to *Helianthemum*. [HELIANTHEMUM.] This is the case with the whole of the old British species of *Cistus*. The flowers of both these genera are very beautiful, and are remarkable for lasting only one day, opening with the rising of the sun in the morning and perishing with the setting sun of the evening. All the species of *Cistus* are worthy of cultivation in gardens. They should be kept in the greenhouse in the winter, although during mild seasons and against a south wall they will survive in the open air. They may be propagated by seeds as layers, or by ripened cuttings procured in July or August, which, if planted under a hand-glass, will root readily.

(Don, *Dichlamydeous Plants*; Lindley, *Flora Medica*.)

CITHARI'NUS, a genus of Fishes belonging to the family *Salmonidæ*. The species inhabit the Nile. These fishes are chiefly distinguished from their allies by the depressed muzzle, the upper margin of the mouth being formed of the intermaxillary bones, the maxillaries being very small. The tongue and palate are smooth; the adipose fin is covered with small scales as well as the greater portion of the caudal fin.

CITRON. [CITRUS.]

CITRUS, a genus of Aurantiaceous Plants, one of whose species yields the Orange, another the Lemon, and others the Citron, Shaddock, Lime, and similar fruits. Among the other genera of the natural order to which it belongs, it is known by its stamens being numerous and irregularly combined into several parcels, and by its fruit having a leathery rind which can be easily separated from the pulpy part that lies beneath.

It is a common opinion that the golden apples of the Hesperides were the fruit of some species of this genus; but as the gardens of these fabulous personages were stationed, according to the most approved opinions, either among the mountains of Atlas or to the west of them, there is no probability that the opinion alluded to is correct; for, independently of the historical facts that citrons and lemons at least were obtained from the Persians, it is certain from the researches of Wallich and other Indian botanists that it is among the lower ranges of hills in Nepaul, and most probably in China also, that the wild states of the genus *Citrus* find a home. It is added that the Sweet Orange itself comes from the southern provinces of China and the Malayan Archipelago, but it is by no means clear that the plant in those countries is really wild. It is however beyond all question also of eastern origin.

Eight species are enumerated by Risso, whom we follow in the present article: we regard it, however, as a matter of great doubt how far they are really distinct. The Orange, the Lemon, the Lime, and the Citron were all that could be distinguished amongst the mass of specimens collected for the East India Company in Nepaul; and there is no great difficulty in believing that all the numerous varieties now cultivated in every part of the temperate and tropical zones, both of the Old and New World, have in reality sprung from these four original sources; part of them being natural varieties obtained by long cultivation, and part being hybrids created by accidental circumstances or artificial means.

1. *Citrus Aurantium*, the Sweet Orange (Oranger of the French, Arancio of the Italians). Stem arborescent. Leaves ovate-oblong, acute, a little serrulated, with the stalk more or less winged. Flowers white. Fruit many-celled, roundish, very seldom pointed, golden-yellow or tawny. Cysts in the rind convex. Pulp very sweet. The principal varieties of this species are :—

a. The China Orange, with ovate-oblong leaves; round smooth rather flattened fruit; and a thin golden-yellow rind. This is the Common Orange of the markets, and of the Portuguese.

b. The Pear-Shaped Orange, with elliptical acute leaves, and great top-shaped fruit, with a deep yellow smooth rind; a rare and curious sort not known in the market; it is one of the most capable of resisting cold.

c. The Orange of Nice, with ovate-acute leaves, and large, thick-skinned, rough, dark-yellow, round fruit. This is considered one of the finest of the whole genus, both in regard to beauty, size, productiveness, and quality. It is a good deal cultivated about the town whose name it bears.

d. The Tiny-Fruited Orange, with ovate-oblong acute leaves, tiny globose fruit, and a thin smooth golden-yellow rind. Supposed to have been brought from the Philippines. The fruit is more curious than beautiful or good.

e. The Fingered Orange, with little stiff leaves, and ovate fruit, some one at least of whose lobes is separate from the remainder, and horned; rind pretty thick. This must not be confounded with the Fingered Citron hereafter to be mentioned.

f. The Blood-Red Orange, with ovate-oblong pellucid leaves, and middle-sized round rough reddish-yellow fruit, with a pulp irregularly mottled with crimson. This, which is said to have come from the Philippines, was once looked upon as a great curiosity, and living plants were purchased at a considerable price; it was thought to be produced by grafting an orange upon a pomegranate. Now that it is known to be a variety of indifferent quality, and that its fabulous history is forgotten, it has ceased to attract much notice. A trifling variety of it is the Arancio di Sugo Rosso of the Italians, who call the real blood-red variety Arancio di Malti Sanguigno. Another variety, with small fruit, is the Arancio a Foglia Stretta of Nice.

g. The Ribbed Orange, with oblong-acute leaves, and a flattened ribbed deep-orange fruit. This is one of the most tender of the varieties; its fruit is spongy, and of no value.

h. The Sweet-Skinned Orange, with broad taper pointed leaves, roundish rather ovate heavy fruit, and a deep yellow smooth thick sweet soft rind. This is the Pomme d'Adam, or Forbidden Fruit, of the shops of Paris. Its pulp is subacid and pleasant, and as deep a yellow as the rind, which is soft and melting like the flesh of a cling-stone peach; the acidity of the pulp is agreeably mixed with sweetness, and renders the fruit extremely pleasant. This is very different from the Forbidden Fruit of the London shops; see *C. decumana* further on.

i. The Mandarin Orange, with flattened rough deep-orange fruit, and a thin rind, which separates spontaneously from the pulp. This sort has been raised in China, where its fruit is chiefly consumed in presents to the great officers of state, whence its name. It is now cultivated in Malta, where it arrives at perfection. Its singularity consists in the rind so completely separating from the pulp when quite ripe that the latter may be shaken about in the inside. In quality this yields to no known kind. There are two sub-varieties.

k. The Saint Michael's Orange, with small round pale-yellow seedless fruit, having a thin rind and an extremely sweet pulp. This, when in a state of perfection, is perhaps the most delicious of all the oranges, and it is by far the most productive. Great quantities are imported from the Azores, where it appears to be exclusively cultivated as an object of trade. It is said that 20,000 of these oranges have been packed from a single tree, exclusively of the large quantity which were blown down or rejected as unfit for sale.

Besides these there are numerous other sorts to be found in the gardens of the curious, and in commerce are many kinds about which little is known. Among these may be mentioned the Egg-Oranges of Malta, which are sometimes sent to England as presents; they are not however equal in quality to the China or the Saint Michael's varieties.

2. *C. Bigaradia*, the Bigarade, or Bitter Orange (Bigaradier of the French, Melangolo of the Italians). Branches spiny. Leaves elliptical, acute, with a winged stalk. Flowers very white. Fruit middle-sized, uneven, more or less globose, deep yellow, with an acid and bitter pulp. It differs moreover from the sweet orange in forming a smaller tree, having broader leaves, and larger and sweeter flowers, on which account it is always selected in preference for the purposes of the perfumer. Its fruit is much more uneven. Numerous varieties of it are known, among which are all those cultivated for the sake of their flowers; especially the Horned Bigarade, a variegated variety of it, and the Curled-Leaved Bigarade. The following are a few of the most striking forms of this species:—

a. The Horned Bigarade, with a large pale-yellow ribbed fruit, whose sides project into horns. This variety, which is of the same nature as the Fingered Sweet Orange (var. *e.*), its horned appearance being caused by the separation of the carpels or fruit-lobes, is in great estimation on account of the powerful and delicious perfume of its flowers. It is the Melangolo a Frutto Cornuto of the Italians.

b. The Female Bigarade, with a deep yellow large coarse fruit, containing orange within orange. The circumstance from which this variety derives its name is not at all uncommon in the genus *Citrus*, but it exists here in perhaps the most strongly-marked manner. An orange in its natural state consists of one whorl of carpels, which are consolidated into a round fruit, each of whose lobes is one carpel. But it sometimes happens that two whorls of carpels combine to form the same fruit; in that case the inner whorl is consolidated into a central orange, and the outer whorl grows over it. Or it may happen that three whorls of carpels constitute the fruit; in that case the innermost whorl will combine into an orange in the centre; the second whorl will form a coating over it; and the most exterior whorl will inclose the whole. Finally the carpels may separate wholly, as in the Fingered Citron, or in part, as in the Fingered Orange and Bigarade, and then the fruit consists of a number of lobes more or less distinct. Until the discovery made by Göthe of the real nature of compound fruit, oranges of this kind were looked upon as something wondrous, and many idle speculations existed as to their cause. A figure of this may be found in Risso's 'Histoire Naturelle des Orangers,' t. 38, without however any explanation of the cause of the monstrosity.

c. The Curled-Leaved Bigarade, with very compact blunt small curled leaves, and flowers growing in thick clusters at the ends of the branches. No variety is more generally cultivated than this for the sake of its flowers, which are large, sweet, and produced in extraordinary profusion. The French gardeners call it Le Bouquetier, or Nosegay Plant, and Bigaradier Riche Dépouillé; the Italians Melangolo Ricco. The fruit is coarse, very light, uneven, and with a large conspicuous scar at the point. The plant itself is far more dwarf than the other varieties, and is one of the most robust of its race. It is a common object of cultivation all over the South of Europe.

d. The Purple Bigarade, with leaves, flowers, and fruit stained more or less with a dull purple, especially the young leaves. Hermaphrodite and Bigarade Violette of the French, Melangolo Pavonezzo of the Italians.

e. The Double-Flowered Bigarade, with rather thick leaves, double flowers, round granulated fruit, and a thick rind; the common double orange of the nurseries. It is a great favourite in gardens, because of its multitudes of fragrant double flowers, which do not fall in pieces so quickly as those which are single; it loses its quality of producing double flowers if the soil in which it grows is not kept in a very rich state.

f. The Seville Bigarade or Orange, with round dark fruit, having an uneven rugged extremely bitter rind; commonly brought to the English market, where it is consumed in the manufacture of bitter tinctures, and in the preparation of candied orange-peel. The bitter aromatic principle is a powerful tonic; it gives its flavour to the liqueur called Curaçoa.

g. The Myrtle-Leaved Bigarade, with small very compact ovate sharp-pointed leaves, and small round fruit; generally both in flower and fruit at the same time, if well cultivated. On this account and because of its dwarf habit, it is a very common object in gardens. It is said to be a Chinese production, and that it is employed by the Chinese gardeners as an edging of flower-beds, in the same way as the dwarf box in this country.

h. The Bizarre Bigarade, with curled rather deformed leaves, purplish or white flowers, and fruit of different sorts, some being round and of the common appearance, others half bigarades and half lemons or citrons, the pulp of some being sweet, that of others acid and bitter. A curious lusus naturæ, which was once thought to be the greatest prodigy in all the vegetable kingdom. It is however merely one of those sports, as they are technically called by gardeners, in which, owing to some unknown cause, some one individual assumes the appearance of two or more others in particular parts. Analogous instances are—the grape called the Variegated Chasselas, some of whose fruit is black, some white, and some striped with both colours; the Camellia, which bears red, white, and party-coloured flowers on the same stem; and the Chrysanthemum, some of whose flowers are purple and others yellow. This Bigarade was raised from seed by a gardener at Florence in 1644, and has since been multiplied by grafting, and so has been preserved to the present day. It may be procured from the nurserymen of France and Italy, and it fruits annually in the orangery at Versailles.

3. *C. Bergamia*, the Bergamot Orange. Leaves oblong, flowers small, very sweet. Fruit pear-shaped or flattened, rugged, with a greenish-yellow smooth rind filled with concave receptacles of oil. Pulp subacid, very fragrant. The trees of this species are rather variable in appearance. The fragrance of both flowers and fruit is peculiar. From each of them the perfumer procures an essence of a delicious quality. The rind, deprived of the pulp, first dried, and then moistened with water, is pressed in moulds into fancy boxes for holding lozenges and other sweetmeats, and these boxes retain much of their recent odour. The Mellarosa of the Italians is a variety, with ribbed fruit, having a broad scar at the summit; it is much esteemed on account of the abundance of its flowers.

4. *C. Limetta*, the Lime. Leaves ovate, obovate, and oblong, placed upon a wingless stalk. Flowers small and white. Fruit ovate or roundish, pale-yellow, with a boss at the point; the cysts in the rind concave; pulp subacid. In foliage this resembles the lemon, but its fruit differs in the pulp never having the sharp and powerful acid of the lemon; it is on the contrary flat and slightly bitter: it is principally employed for flavouring punch, sherbet, and similar drinks. The varieties are of no importance; they principally differ in the thickness of their rind and in form. Here is to be arranged the round very uneven fruit called Pomo d'Adamo by the Italians, because they fancy that the depressions upon its surface look as if they still bore the marks of our universal father's teeth.

5. *C. decumana*, the Shaddock. Leaves large, with a winged stalk. Flowers very large and white. Fruit usually very large, roundish, pale yellow, smooth, with flat or convex cysts in the rind. Rind white, spongy, very thick; pulp juicy, sweetish, rather insipid. Shaddocks are among the largest fruits which are known, and are commonly cultivated in both the East and West Indies for the sake of the delicate subacid juicy pulp in which they abound. When they arrive at their greatest size they are called Pompoleons or Pompelmousses; when at the smallest they form the Forbidden Fruit of the English markets. Another small variety, with the shaddocks

growing in clusters, forms a larger tree than any other *Citrus*; the fruit is about as large as the fist; it is what the West Indians call the Grape-Fruit.

6. *C. Lumia*, the Sweet Lemon. Leaves like those of the lemon. Flowers red externally. Fruit with the flesh and rind of a lemon, but with the pulp sweet, and the cysts in the rind both convex and concave. There can be no doubt that this is a mere variety of the next species, from which it only differs in the want of acidity in the pulp. Many sorts are known in orange countries, of which one, the Commander's Pear, resembles very much a large Beurré Pear; their fruit is seldom seen in England.

7. *C. Limonum*, the True Lemon (Citronnier of the French). Leaves ovate-oblong, usually serrulated, pale green, with a winged stalk. Flowers middle-sized, red externally. Fruit oblong, very uneven, now and then almost round, with a pale-yellow fragrant rind, dotted with concave cysts. Pulp juicy, and very acid. Of this species the cultivators take little pains to distinguish the varieties. When young plants are wanted they are generally raised from seeds in the orange countries, and hence the samples of fruit sent to market consist at all times of numerous sorts, differing very much in quality. Some of them have their rind so thick and insipid that they approach the Citron in quality; one, with roundish rugged ribbed fruit, is called Vignette upon the Continent, where it is common; another, with oblong extremely rugged fruit, is one of the Poncires of the French. The most distinct race is that which comprehends the Perettes, or Little Pears; they are very small in the fruit, which is a pale greenish-yellow, and has almost the shape of an egg: their rind is more delicately perfumed than that of common lemons.

8. *C. medica*, the Citron (Cedratier of the French, Cedro, Cedrato, of the Italians). Branches short and stiff. Leaves oblong, toothed. Flowers purple externally. Fruit usually large, warted, and furrowed, with an extremely thick spongy rind, and a subacid pulp. This is an exceedingly variable species, chiefly valued for the fragrance of the rind of the fruit, from which a delicate sweatmeat is prepared. The Citron, supposed to be the Median, Assyrian, or Persian apple of the Greeks, is probably the most beautiful species of the genus. It is described by Risso as having a majestic aspect, shining leaves, and rosy flowers, which are succeeded by fruit whose beauty and size astonish the observer at the same time that their sweet odour gratifies his senses. The trees are constantly in vegetation, the flowers appear even in midwinter, and there is so continual a succession of them, that flowers, young fruit, and ripe fruit, may always be seen together at the same moment. The Poncire Citrons are eight or nine inches long, and are the largest of the race known in Europe.

In China there is an enormous variety, with its lobes all separating into fingers of different shapes and sizes, whence its name of Fingered Citron. The Chinese esteem it very much, both for its rarity and for the grateful odour of its rind. They place the monstrous fruits upon porcelain dishes, and have them in their apartments to fill the air with fragrance. Those who would study this genus in detail will find excellent figures of above 100 varieties in Risso's 'Histoire Naturelle des Orangers.' For the culture, medicinal uses, and commerce of the genus *Citrus*, see ORANGE, in ARTS AND SC. DIV.

CIVET. [VIVERRIDÆ.]

CLA'DIUM (κλάδος, a branch or twig), a genus of Plants belonging to the natural order *Cyperaceæ*. It has 1-2-flowered spikelets, 5 or 6 glumes, the lower ones empty and smaller, bristles absent, the nut with a thick fleshy coat, tipped with the slender base of the style. There is but one European species of this genus, the *C. Mariscus*, Common Sedge. It has lateral and terminal repeatedly compound panicles, the spikelets capitate, the stem roundish, leafy, smooth; the leaves rough on the margins and keel. It is not a common plant in Great Britain, except in Cambridgeshire, where in the bogs and fens of that county it is exceedingly common, hundreds of acres being covered entirely with it. It is used in many districts of Cambridgeshire for the purpose of lighting fires. This plant is the *Schœnus Mariscus* and *Cladium Germanicum* of many botanists. Several species of *Cladium* are natives of Australia. (Babington, *British Bot.*; Burnett, *Outlines*.)

CLA'DIUS, a genus of Hymenopterous Insects of the family *Tenthredinidæ*. It has the following characters:—Antennæ about the same length as the body, ciliated beneath, and nine-jointed; the two basal joints short, the third joint with a protuberance beneath at the base, and a branch thrown out from the upper side at the apex; the fourth and fifth have likewise the last-mentioned process; and in the sixth and seventh it is rudimentary. In the female all these processes are wanting, excepting the one on the underside of the third joint. Wings with one marginal and three sub-marginal cells; tarsi simple.

C. difformis, when the wings are expanded, measures in width about one-third of an inch: it is black, with the tibiæ and tarsi pale yellow. This species may be considered the type of the genus. It inhabits this country, but is not common.

CLADOCO'RA, a Fossil genus of Corals allied to *Lithodendron*, and occurring in the Palæozoic strata.

CLA'DODUS, a genus of Fossil Placoid Fishes, from the Mountain Limestone of Armagh, Bristol, &c. (Agassiz.)

CLADO'NIA, a genus of Plants belonging to the natural order *Lichenes*. It has a thallus somewhat shrubby, branched, rarely simple, leafy, with scales, which are often evanescent; branches cartilaginous, rigid, fistulose, all attenuated and subulate, divided, fertile, generally perforated in the axils. Shields sessile, orbicular, convex, capituliform, not bordered, fixed by the circumference, free beneath in the centre, the sides reflexed, uniform within. The genus *Cladonia* thus defined, with *Scyphophorus* and *Pycnothelia*, are included by Acharius and Delisle in the genus *Cenomyce*. Sir W. Hooker observes of this genus, that "the determination of the species is attended with the greatest difficulty, on account of their variable character; and in the present state of my knowledge I dare not venture upon introducing others than those published in English Botany. Much attention has been given to this genus by Delisle in the 'Botanicum Gallicum,' who, with Acharius, unites this and the two following genera into one, *Cenomyce*, and enumerates fifty-three species, besides many marked varieties, as natives of France; all of which are most probably natives also of Britain. He would render an acceptable service to British Botany who should undertake a monograph of the British *Cladonieæ*." Hooker enumerates only five British species.

C. rangiferina, Rein-Deer Moss, has erect, elongated, roughish, cylindrical, greenish-white, very much branched podetia, the axils perforated, the branches scattered, often intricate divaricated, the alternate ones drooping, apothecia subglobose, brown, on small erect branchlets. This is a frequent plant in Great Britain, on moors, heaths, and mountains. Its botanical characters are very variable, more especially the colour and the length of the ramifications. This may be accounted for by the wide range of latitude in which it is found, extending from the arctic regions, where it is most abundant, to the tropics. This plant is the principal support of the rein-deer in its native countries, and hence its common name. In Lapland there is no plant so abundant as this, especially in the pine forests, where it covers the surface of the soil for many miles together like snow. On the destruction of the forests by fire this plant continues to grow, and then reaches its greatest luxuriance. In such districts the rein-deer are principally pastured in the winter; and whatever may be the depth of snow, these animals are enabled to obtain their food by grubbing with their noses through the snow. It would be quite impossible that the rein-deer should exist in these climates during the winter were it not for this apparently insignificant plant. The Laplanders are also in the habit of collecting this lichen with rakes in the rainy season, when it is flexible, and readily separates from the ground where it has grown; they then lay it up in heaps to serve as fodder for their cows. Dr. Clarke and his companions, during his travels in Lapland, were tempted to eat some of this lichen. "To our surprise," he says, "we found that we might eat of it with as much ease as of the heart of a fine lettuce. It tasted like wheat bran. But after swallowing it there remained in the throat and upon the palate a gentle heat or sense of burning, as if a small quantity of pepper had been mixed with the lichen. We had no doubt that if we could have procured oil and vinegar it would have made a grateful salad. Cooling and juicy as it was to the palate, it nevertheless warmed the stomach when swallowed, and cannot fail of proving a gratifying article of food to man or beast during the dry winter of the frigid zone. Yet neither Laplanders nor Swedes eat of this lichen." This might arise from the fact which Dr. Clarke relates shortly after, namely, "that when Gustavus III. succeeded to the throne an edict was published and sent all over Sweden, recommending the use of this lichen to the peasants in time of dearth, and they were advised to boil it in milk." Such an edict would be likely to have the effect of preventing people from eating it, as it would from that time forth be only looked upon as a last resource. Dillenius however states that when boiled in water it yields no jelly, its substance is very little diminished, and becomes drier than before; and the decoction evaporated yields only a small quantity of an acerb and austere extract. The alimentary secretion of this plant appears to be similar to that of other lichens. It is called Lichenin, or Lichen Starch, and contains the same elements as starch. No nitrogen has been detected. It is however probable that nitrogen will be found to exist in this lichen, as during the winter it supplies the rein-deer with food which must require a nitrogenous compound in order to maintain its muscular power, unless we have recourse to the supposition that starch or lichenin, by union with free nitrogen in the system, can be converted into fibrine or other proteinaceous compounds.

C. vermicularis, Vermicelli Lichen, has its podetia spreading horizontally, pure white, subulate, simple or slightly branched, branches tapering at each end. It has been found not unfrequent on the loftiest mountains of the north of England and Scotland. The shape of its branches give it the appearance of a bundle of small worms or of vermicelli. It is a native of South America, where it is used as a stomachic under the name of *Contrayerba blanca*.

C. sanguinea has a leafy very thick imbricated thallus, scarlet, and frosted with white beneath; above, green and somewhat gelatinous; the lobes crenulated, ascending; podetia nearly solid, cavernous, split into fingered lobes, either wholly or at their apex only; the shields marginal, confluent, scarlet. This pretty form is a native of the Brazils, where it is rubbed down with sugar and water, and is found to be an excellent remedy for aphthæ in children. The remaining described British species are *C. uncialis*, *C. pungens*, *C. furcata*.

(Lindley, *Flora Medica;* Burnett, *Outlines of Botany;* Hooker, *British Flora*, vol. ii.)

CLADYODON, a generic title for some Fossil Reptiles found in the New Red-Sandstone System. [SAURIA.]

CLAKIS. [BERNICLE GOOSE.]

CLANGULA, a genus of Birds belonging to the family *Anatidæ*.

CLARY. [SALVIA.]

CLATHRA'RIA, a genus of Fossil Plants found in the Wealden strata of Sussex by Dr. Mantell. The stem is reticulated on the surface, and has analogies to *Xanthorrhœa* and the *Cycadeæ*. *Clathraria Lyellii* and *Cl. Mantelli* (this latter the fruit) are described by Brongniart ('Hist. des Végét. Foss.').

CLATHRO'PTERIS, a remarkable genus of Fossil Ferns, the foliation of which is marked with quadrangular network of vessels—a rare circumstance in living ferns—such as *Meniscium*. *Clathropteris meniscioides* occurs in the Mesozoic Sandstone of Hör in Scania.

CLAUSILIA, a genus of Palmoniferous *Mollusca*. [HELICIDÆ.]

CLAVAGELLA, a genus of Testaceous Acephalous Animals, established by Lamarck in the fifth volume of the 'Histoire Naturelle des Animaux sans Vertèbres,' published in 1818, and arranged by him under his Tubicolées, between *Aspergillum* and *Fistulana*. He described four species, all fossil, referring at the same time to the 'Annales du Muséum,' where he had figured the first of them under the name of *Fistulana echinata*. Lamarck thus defines the genus:—"A tubular shelly sheath, attenuated and open anteriorly, terminated posteriorly in an ovate subcompressed club beset with tubular spines; the club presenting on one side the one valve fixed in its wall or substance, while the other valve remains free in the tube."

The genus was only known in a fossil state to conchologists, when Mr. George Sowerby observed in the British Museum a recent specimen, which he at first thought might be an *Aspergillum*, inclosed in a mass of stone. On application to Mr. Children, that gentleman allowed Mr. Sowerby to examine it more closely, and on scraping away some of the investing stone the latter found *Clavagella aperta*, the first recorded recent species, and figured and described it in his 'Genera of Recent and Fossil Shells.' The same naturalist, on the return of Mr. Samuel Stutchbury from his voyage to some of the Australian and Polynesian Islands, described and figured (1827) a second species, *Clavagella australis*, three specimens of which were with difficulty obtained by Mr. Stutchbury at North Harbour, Port Jackson, in a siliceous grit like that of the coal-measures, where their presence was betrayed just beneath low-water mark, by their forcible ejection of the water from the aperture of their tubes: the specimen of *Clavagella australis* figured by Mr. Sowerby is also in the British Museum. In 1829 Mr. Henry Stutchbury, in arranging the collection of Mr. Isaac Lyon Goldsmid, suspected the presence of a *Clavagella* in a mass of *Astræopora*, and, on fracturing the specimen, laid open two individuals of another species, *Clavagella elongata*, Broderip. According to Cuvier, and a notice in the 'Annales des Sciences Naturelles' (tome xvii., p. 78), M. Audouin (1829) described a recent species, and M. Rang, in his 'Manuel des Mollusques' (1829), mentions another, apparently *Clavagella rapa*.

Still the animal remained unknown; when, on the return of Mr. Cuming from his first voyage, that zealous collector produced another specimen which fortunately included the soft parts. A fragment of calcareous grit was dredged up by Mr. Cuming from a depth of eleven fathoms, at the island of Muerte, in the Bay of Guayaquil, and in this was the greater portion of the chamber and tube, both valves, and the animal of *Clavagella lata* of Broderip. Mr. Broderip, who has described this and two other recent species in the first volume of the 'Transactions of the Zoological Society' (p. 261), says, that a close examination of the recent species has convinced him that though one valve is always fixed or imbedded in the chamber, and soldered, as it were, to the tube, so as to make one surface with it, the tube is not necessarily continued into a complete testaceous clavate shape. In Mr. Goldsmid's best and largest specimen, the fixed valve was imbedded in the coral, and though continued on to the tube or siphonic sheath, was surrounded by the wall of the coral chamber at its anterior extremity. In the other specimen the fixed valve was also continued on to the tube. In the first-mentioned specimen of *Clavagella elongata*, at the anterior or greater end of the ovate chamber, an insulated or shelly plate had been secreted with tubular perforations; that part of the chamber having afforded (apparently at a former period) the best communication with the ambient fluid: but a calcareous deposit having almost entirely cut off that communication, the animal seemed to have been compelled to secrete a second shelly plate towards the anterior ventral edge of the fixed valve, where the perforation of some other shell (a *Lithodomus* probably) secured the necessary influx of water. Nor is this the only instance of the secretion of a second tubular plate which has fallen under Mr. Broderip's notice. In the last-mentioned or smaller specimen, the perforated shelly plate joins the anterior ventral edge of the fixed valve laterally, that point of the chamber being evidently the most practicable for communicating with the water by means of the tubules: the rest of the anterior edge of the fixed valve is surrounded by the coral wall. In Mr. Cuming's specimen the fixed valve is continued on to the tube. The anterior edge of this valve is surrounded by the naked wall of the chamber, and the greater end of the chamber, or that part of it which is opposite to this anterior edge, being impracticable, from its thickness, as a water communication (with a small exception, which, not improbably, had ceased to be available), the animal had been driven to secrete the perforated shelly plates not far from the throat of the tube on either side, where the chambers of *Petricolæ* or *Lithodomi* opened a passage to the surrounding water.

Professor Owen, from an examination of Mr. Cuming's specimen, has given an account of the anatomy of this mollusk. ('Zool. Trans.,' vol. i.) He found the following to be the relative position of the animal:—The mouth turned towards the closed end of the chamber, which is consequently the anterior part. The heart and rectum near the side where the valves are connected by the ligament, or the dorsal part. The visceral mass projecting towards the opposite or neutral side. The siphon extending into the commencement of the calcareous tube, which leads out of the anal or posterior part of the chamber. The fixed valve, which covers the rough surface of the porous rock or coral, like the tiling of a chamber-floor, and affords a smooth polished surface for the support and attachment of the animal, is the left valve: the right valve remains free, or is connected only to the soft parts and cardinal ligament, in order to assist in the excavating and respiratory actions.

The shelly substance of the fixed valve passes without interruption into that of the tube; a slight ridge circumscribing the entry of the tube into the chamber indicating the line of separation, unless the extent of the valve be limited to that of the internal nacreous deposition. The tube of an oval form, 7 lines by 5 in diameter. The calcareous walls $\frac{1}{8}$th of an inch in thickness at the outlet, and about $\frac{1}{20}$th at the opposite extremity. The free valve unequally triangular, with the angles rounded off, about the thickness of a sixpence, moderately concave towards the soft parts, and striated only in the direction of the layers of increment on the outer surface, as in most of the Pyloridean Bivalves of M. de Blainville. The layers gradually increase towards the dorsal edge for a little more than one half of the valve, beyond which the layers continue of almost equal breadth. "This growth of the valve," adds Mr. Owen, "corresponds to the direction in which the chamber is enlarged, which is principally on the dorsal, dextral, and anterior sides: now this is the mode of enlargement best adapted for the full development of the ovary; so that it would seem that the *Clavagella* continues for a time to work its way into the rock without material increase of size, leaving behind it a calcareous tube, which marks its track; after which it becomes stationary, and limits its operations to enlarging its chamber to the extent necessary for the accomplishment of the great object of its existence."

The mantle enveloping the body is like a shut sac, but perforated for the siphon and foot, the opening for the latter being reduced to a small slit. M. Rüppell observed an analogous orifice in the corresponding part in *Aspergillum*, namely, that which is next the sunken sieve-like extremity of the tube, and by which he supposes the water necessary for respiration to be received when the retreating tide leaves exposed the expanded siphonic extremity. Professor Owen is of opinion that this cannot be its use in those species of *Clavagella* which exist at depths too great to allow of their being ever left with the siphonic aperture out of water; but that it must serve to keep up a communication with the neighbouring cavities of the rock, by means of the calcareous tubules, the formation of which is determined by the proximity of these cavities. When therefore the *Clavagella*, by a sudden contraction of the adductor muscles, has forcibly expelled the branchial currents from the siphon, as was observed by Mr. Stutchbury, the space between the free valve and the walls of the chamber would be simultaneously filled, either by water rushing in through the tubules, or forced out from the branchial cavity through the small anterior orifice of the mantle. To assist this operation there is a proportional development of the muscular system, which is remarkably powerful. The impression of the great or posterior adductor is carried two lines beneath the surface of the chamber posteriorly, but gradually rises to the level of the valve. The impression of the smaller anterior adductor is more faint, and is continued into the sinuous pallial impression, which follows the contour of the anterior margin of the valve at about two lines' distance from it. In the free valve the last two muscular impressions are separate. The outer dermoid layer of the mantle is extremely thin, and, where it does not line the valves, is mottled with minute dark spots, less numerous than those on the skin of Cephalopods, and presenting, under the microscope, a glandular appearance. The muscular layer, after forming the siphon and its retractors, is confined to the anterior part of the mantle, where it swells into a thick convex mass of interlaced and chiefly transverse fibres, and forming, Professor Owen supposes, one of the principal instruments in the work of excavation. No fibres could be detected in other parts of the mantle; nor could any be expected in a mantle which had no lobes to be retracted. The siphon, in the contracted state, formed a slightly-compressed cylindrical tube, half an inch in length, and the same in the long diameter, traversed longitudinally by the branchial and anal canals, separated from each other by a muscular septum, extending to the end of the siphon, beyond which the two tubes do not separately extend outwards, agreeing in this respect with *Gastrochæna* and *Aspergillum*. Muscular walls of the siphon two lines in thickness; the septum separating the branchial and anal canals one line; diameter of each canal about one line; inner extremity both of the anal and respiratory tube provided with a valvular fold: terminations beset with short papillæ. The retractor muscles attach the siphon to the posterior adductor on one side, and to the anterior extremity of the oval mass of muscular fibres above mentioned on the other, leaving an intermediate space on both sides the body, which exposes part of the gills and labial tentacles. The muscular mass which bounds the anterior part of the animal's body is oval, one inch three lines long, eight lines broad, and varying in thickness from two to three lines: it is smooth and convex externally, and hollowed out within to lodge the viscera at the base of the foot, for the passage of which it leaves the small orifice above mentioned. The margins attached to the valves are more or less irregular: that affixed to the loose valve is the broadest, being at the ventral extremity three lines in length.

The gills have the same laminated structure as that observed in other bivalves, they are broad and short, corresponding to the form of the animal; and the laminæ, not thin compressed layers, but broad and projecting but little from the sides of the visceral mass, are arranged in three layers instead of two, on either side of the foot.

The digestive system is accordant with the structure of the same part in the other acephalous mollusks. The mouth, a transverse slit, without masticatory or salivary organs, is bounded by the upper and lower labial processes which are continued in the form of two transversely striated pointed tentacles on either side: these prehensile, sensitive, and probably respiratory organs measure each six lines in length, and about one and a half lines in breadth. The œsophagus, after a course of two lines, dilates into a stomach, the sides of which are perforated by the large hepatic ducts. The intestine, after a course of eight lines, forms a small cæcum about one line in length. The intestine, after making three close turns upon itself in the mass of ova and hepatic follicles at the base of the foot, passes in immediate contact with but not through the heart, and then below the posterior adductor, to opposite the posterior orifice of the anal tube. The exterior of the intestine has an irregular honey-combed appearance, from the close adhesion to it of the capsules of the ova. The liver has the same divided follicular structure and green colour as in the other Bivalves.

The nervous system consists of a large and conspicuous ganglion situated at the posterior part of the base of the foot, just above the orifice of the anal tube. Two nervous cords extend from this ganglion, on either side the foot, to the mouth; other branches radiate in the opposite direction to the siphonic and adductor muscles.

The ovary, of a gray colour, forms a mass at the dorsal aspect of the body above the great adductor muscle, and extending ventral on either side the œsophagus and stomach to the opposite end of the base of the foot. All this mass of intestinal folds, hepatic follicles, and ova was covered by a thin membrane. The little muscular process or foot which passes through the anterior slit of the mantle is but four lines long, and half a line in breadth: its possible use may be to apply a solvent to the rock in which the chamber is excavated.

Mr. Broderip observes that we are left to conjecture the causes which operate to determine the animal in the choice of its abode, if indeed it can be called choice, for most probably *Clavagella* is the creature of circumstances, and if, soon after its exclusion from the parent (when Mr. Broderip supposes it to be furnished with its two

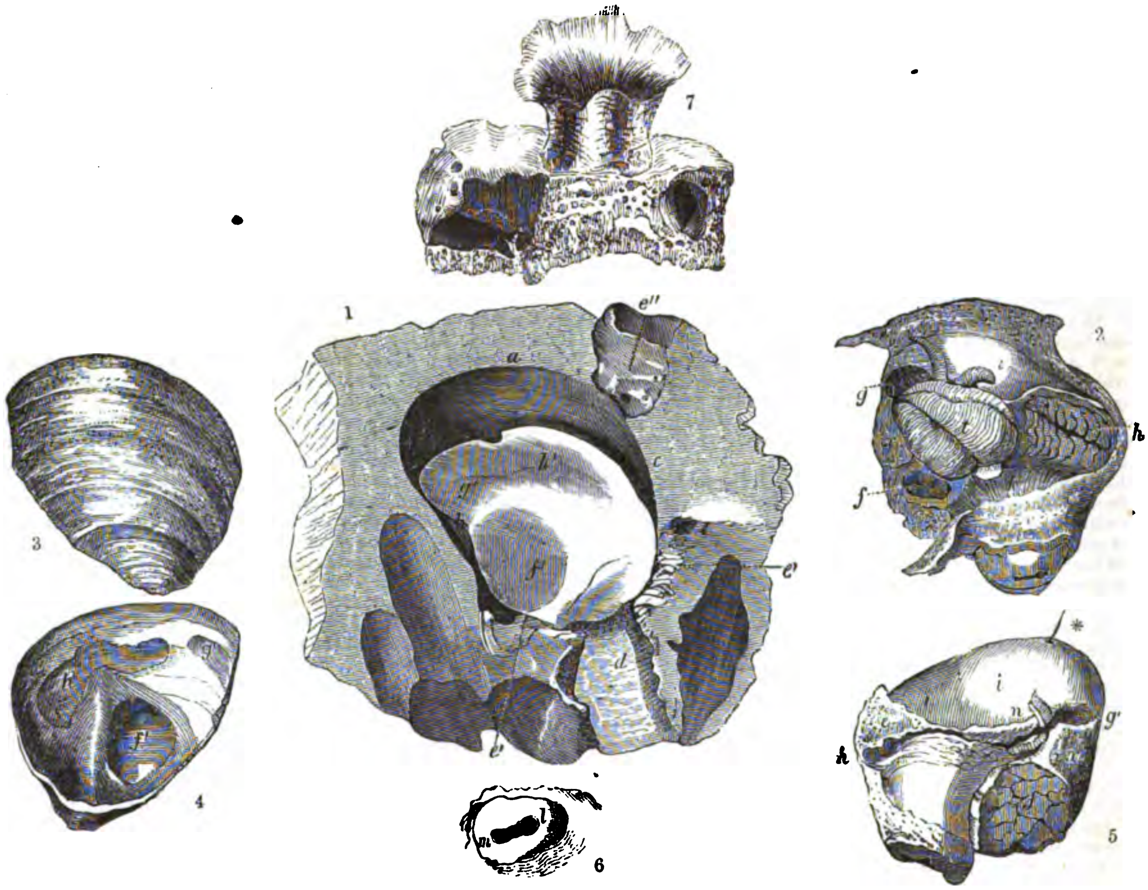


Fig 1, part of calcareous grit rock containing the fixed valve and part of the tube of *Clavagella lata*; fig. 3, external view of the right or free valve; fig. 4, internal view of the same, showing the muscular impressions corresponding with those of the left or fixed valve; fig. 2, soft parts of *C. lata* seen from the right side, the dermal layer of the mantle, *e*, being removed; fig. 5, the same seen from the left side, or that which is in contact with the fixed valve. The extremities of the left labial appendages only are exposed, no part of the gill being protruded. A bristle is placed in the opening of the mantle. *a*, anterior wall of the chamber; *b*, dorsal wall, the letter placed on the hinge of the fixed valve; *c*, ventral wall; *d*, posterior or siphonic outlet; *e*, tubular communications with a neighbouring cavity, here sent off from the posterior part of the mantle; *e′ e′*, calcareous tubes secreted by the above processes and extending into the cavities contiguous to the throat of the tube; *e″*, a cavity communicating with the anterior part of the chamber; *f′*, impression of the posterior adductor muscle; *g′*, impression of the anterior adductor muscle; *h′*, impression of the pallial muscle, or third adductor; *f*, posterior or large adductor (the single adductor of the *Ostraceæ*, &c., corresponds to this, the following are superadded in other families of Bivalves); *g*, the anterior, antero-dorsal, or smaller adductor; *h*, the pallial or antero-ventral adductor; *i*, the convex muscular mass continued over the anterior part of the body, and reducing the opening of the mantle to the small slit *, through which a bristle is placed in fig. 5 (this mass is an inordinate development of what forms the muscular margins of the mantle lobes in other Bivalves); *k*, muscular fibres of the siphon; *l* (fig. 6), the respiratory, or ingestive siphonic canal; *m*, the anal or egestive siphonic canal; *n*, the labial or buccal appendage; *t*, the gills: in fig. 2 the right gill is seen partially protruded between the muscular parts of the mantle; *x*, part of the ovary (figures and description from Owen, to whose lucid memoir and illustrations the reader is referred for the anatomy of the internal parts); fig. 7, anterior termination of the shelly tube of *C. aperta*, Sow., from Mr. Sowerby's 'Genera of Recent and Fossil Shells.'

valves only, and to float free, with, perhaps, some voluntary impulse), it arrives at the vacant hole of some small *Petricola*, *Lithodomus*, or other perforating Testacean which suits it, one valve soon becomes attached to the wall of the hole, and then the animal proceeds to secrete the siphonic sheath or tube, to enlarge the chamber according to its necessities, and to form the shelly perforated tubular plate which is to give admission to the water at the practicable part of the chamber. How the excavation is carried on is also doubtful. The chambers of the individuals of *Clavagella australis*, described by Mr. Broderip, were formed in a siliceous grit, those of *C. elongata* in an *Astræopora*, that of *C. lata* in a calcareous grit, and those of *C. Melitensis* in an argillo-calcareous tufa. "If," says the author last mentioned, "the excavation be the work of a solvent secretion, it must be a solvent of extensive power. The situation of the glands, detected by my friend Mr. Owen, leads me to think that they minister in some way to this operation; and I do not see how the anterior or greater end of the chamber can be operated on by mere mechanical attrition with such parts as must have been contiguous to it. It has been objected that any solvent which would act on a calcareous rock would equally act on the calcareous shell of the animal; but there is perhaps more of point than of strength in this objection. Without laying too much stress on that law of nature by which chemical and vital forces are placed in a state of hostility, and which may or may not be applicable to such a substance as shell, the gland for the secretion of the supposed solvent, as well as the organ for applying it, may be so placed as that the solvent shall only come in contact with the inorganic or dead substance to be acted on without touching the shell. Again, it has been asked, what solvent would act equally on a calcareous and on a siliceous substance? To this it may be answered, first, that it is not pretended that the nature of the supposed solvent is known; secondly, that in siliceous grits, there is more or less calcareous matter by which the mass is held together, and that the solution of the calcareous particles would be followed by the disintegration of the stone. . . . . One observation, arising from the various depths at which the recent species have been found, will not, perhaps, be deemed irrelevant. *C. australis* was so near the surface at low water, that it was detected by its ejection of the fluid; *C. elongata*, from the nature of the coral in which it was chambered, could not have been living far beneath the surface; whereas *C. lata* was dredged up from a depth of 66 feet. Any inferences, therefore, as to the state of submersion of a rock during the life of the fossil species of *Clavagella* which there occur, should be made with caution by the geologist."

The geographical distribution of the genus, though now comparatively rare in cabinets, is probably wide. A sharp investigation of masses of coral and of submerged perforated rocks or stones, particularly in warm climates, is very likely to be rewarded by the discovery of *Clavagellæ*.

With regard to its place amongst the other *Mollusca*, Professor Owen is of opinion that the organisation of *Clavagella*, like that of *Aspergillum* described in the 'Reise von Afrik' of Dr. Rüppell, is modelled on the type of the Acephalous Bivalves; and that it follows most closely, in the variations from that type, the modifications which have been observed in *Gastrochæna*. The lengthened worm-like figure of *Aspergillum* is exchanged in *Clavagella*, observes Professor Owen, for a shorter form with greater lateral development; and instead of the small rudimentary valves, which are enchased, as it were, in the calcareous sheath of *Aspergillum*, we find them here largely developed, and one of them always remaining at liberty, to be applied by a powerful muscular apparatus to those offices which are essential to the forcible expulsion of the fluid in the branchial cavity, and probably to assist in the excavation of its secure abode.

Fossil Clavagellæ.

Mr. Broderip says that no fossil species appear to have been detected below the Supracretaceous group. M. Deshayes, in his tables, gives two living and seven fossil (tertiary) species, and one (*C. aperta*, Sowerby) as found both living and fossil (tertiary). He gives the Mediterranean and Indian Ocean as the habitation of the living animal, and Sicily (Pliocene Period of Lyell) as the locality of the fossil. In his edition of Lamarck he makes the whole number (living and fossil) seven, the seventh and last species being *C. aperta*; but he refers to Rang's 'Manuel' for a second living species. *C. coronata* is found in the London Clay. In Deshayes's edition of Lamarck, the species *C. echinata* is followed by *C. cristata*; and the editor, in a note referred to from the latter, says that these two species should be united, as they only differ in size and age. He also observes that the free valve of *C. cristata*, or of *C. tibialis*, has been placed by Lamarck among the species of *Glycimeris* under the name of *G. margaritacea*. And here we may mention the difficulty of laying down specific characters from the valves, which being, as Mr. Broderip remarks, nearly, perhaps altogether, excluded from the light, colour, at best but a treacherous guide, is absent entirely; while the shape of the chamber and of the valves, together with the comparative roughness or smoothness of their outer surfaces, may depend upon the greater or less degree of hardness of the material in which the chamber is formed.

CLAVELINA. [CLAVELINIDÆ.]

CLAVELINIDÆ, a family of Tunicated *Mollusca*, including the British genera *Clavelina* and *Perophora*. This family may be regarded as uniting together the Compound and Simple Ascidians. Till very recently it was supposed that the animals forming this family belonged to the latter. Milne-Edwards first pointed out that the animals which had been described by Savigny under the genus *Clavelina* were not always, nor even usually, separated from each other; but that they spring, as it were, from a common creeping stem, and multiply by gemmation in the same manner as the Compound Ascidians. Milne-Edwards also pointed out that an animal, described by Mr. Joseph Jackson Lister in the 'Philosophical Transactions' for 1834, was truly an Ascidian. This animal occurs in groups consisting of several individuals, each having its own heart, respiration, and system of nutrition, but fixed on a peduncle that branches from a common creeping stem. The individual animals were connected together by a circulation extending throughout the stem. They are transparent, so that their structure can easily be seen through their membranous covering. Milne-Edwards proposed for these animals the name of Social Ascidians.

Clavelina, Savigny.—The individuals and groups are connected by creeping radiciform prolongations, the animals having elongated erect more or less pedunculated bodies. The branchial and anal orifices without rays; outer tunic smooth and transparent; thorax usually marked with coloured lines.

C. lepadiformis (*Ascidia lepadiformis*, O. F. Müller). Thorax forming a third part of the length of the adult individual, and marked with yellow lines; stomach of a bright orange, placed near the middle of the abdominal portion of the animal; part of the intestines of the same colour. Mr. Alder says this animal is very generally diffused throughout the coasts of Great Britain. He has met with it on the Devonshire, Cornish, and Northumberland coasts, and in Lamlash, Rothsay, and Oban bays in Scotland. Mr. W. Thompson has found it in Ireland.

Milne-Edwards gives the following account of the development of this species:—"If we examine with care the foot of a *C. lepadiformis*, we see that the animal adheres to the soil by more or less numerous radiciform prolongations of the tegumentary tunic; and usually we find also cylindrical filaments, which mingled with these roots and formed externally by the same tissue, creep also on the surface of the soil; but are hollow, and internally furnished with a membranous tube. This tube is continuous with the internal tunic of the Ascidian, and the circulation which is seen in the interior of the abdomen of the latter is equally continued into the appendicular canal. This stalk-like body, which is closed at the extremity, is at first simple, but ramifies as it elongates. When its growth is more advanced, we see developing at the extremities of its branches, or even at different points of its length, tubercles containing in their interior a little organised mass in connection with the internal tube. These tubercles elongate, elevate themselves vertically, and become claviform; the blood which circulates in the stem penetrates the soft and pyriform central mass; but this mass, at first pedunculated and adhering to the inner tunic of the principal canal, soon separates itself, and no longer participates in the circulation of the individual to which it owed its origin. Nevertheless its development continues, and we soon distinguish in it all the principal characteristic traits of the ascidian structure; the branchial sac becomes perfectly outlined without being as yet in communication with the interior; a curved digestive tube is seen beneath the thorax. At length a buccal opening is formed, and the general shape of the young animal approaches more and more nearly that of the adult. Thus there is produced by process of budding a new individual, linked with its parent by a radiciform prolongation of the tegumentary tunic, and which during the first years of its life has a circulation in common with the mother ascidian, but in the end enjoys an independent existence. Still however it may remain in connection with the individual which produced it through the medium of its roots, or it may become completely free by their rupture without any change of consequence in its mode of life." ('Mémoires de l'Institut,' vol. xviii.)

There are several other species of *Clavelina*, and probably many more exist on our own coasts.

Perophora.—The animal discovered by Lister has been thus named by Wiegmann. It is characterised by the individual animals being pedunculated, suborbicular, compressed, attached by their pedicles to creeping tubular processes of the common tunic, through which the blood circulates. Thorax not lineated by granular bands.

P. Listeri is the only species at present known. It is a minute creature, and occurs not unfrequently on the south coasts of England and in the Irish Sea. It lives attached to sea-weeds, and is beautifully transparent. It looks to the naked eye like little specks of jelly dotted with orange and brown, and linked by a silvery winding thread. Mr. Lister's paper describing this animal is entitled, 'On the Structure and Functions of Tubular and Cellular Polypi, and of Ascidiæ.' It is an admirable paper, and was one of the first-fruits of those labours on the improvement of the microscope for which the world is indebted to Mr. Lister.

CLAVICORNES, a name given by Latreille to a sub-section of Coleopterous Insects of the section *Pentamera*.

The insects of this sub-section almost always have the antennæ