BIRDS:

THE ELEMENTS

OF

ORNITHOLOGY.

BY

ST. GEORGE MIVART, F.R.S.

WITH 174 ILLUSTRATIONS, WHEREOF 140 ARE ORIGINAL DRAWINGS.

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TO

MY WIFE,

WHOSE LOVE OF BIRDS FIRST LED ME TO
THE STUDY OF

Ornithology,

I DEDICATE THIS BOOK.

HURSTCOTE,
May 1892.

PREFACE.

THIS small volume is put forward in the hope of supplying a want which its Author has himself felt keenly. It is intended to supply, in a small compass, a general view of the Class of Birds; together with such a knowledge of their structure, activities, geological and geographical relations, and classification as may fit the student to enter upon a serious study of Ornithology.

The Author desires to express his great obligation to Dr. R. Bowdler Sharpe, F.L.S., F.Z.S., who has not only given constant and most valuable aid, but has most kindly read through the whole of the proofs. Thanks are also due to Dr. P. L. Sclater, F.R.S., Secretary to the Zoological Society of London, Mr. Osbert Salvin, F.R.S., Mr. H. Seebohm, F.Z.S., Mr. Howard Saunders, F.L.S., Mr. E. Hargitt, R.I., F.Z.S., and Mr. Scott B. Wilson, F.Z.S., for supplying various points of incidental information.

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CHAPTER I.

Introduction.

ORNITHOLOGY is a most popular branch of Natural History. That it should be so is a necessary result of the exceptional beauty of Birds, which by their vivacious movements force themselves on our notice and lend animation to every landscape. No other creatures, save certain insects, can rival them in brilliancy of colour, and none can charm our ears with such melody or startle them by the utterance of articulate speech. Their intelligence is considerable: some can be taught to perform curious tricks, and others are easily domesticated. Their emotional nature is also attractive; the conjugal affection of not a few birds is remarkable, while the devotion they show to their offspring and the marvellous skill with which many of them prepare a shelter for their brood are known to everyone.

Birds together constitute a group which is ranked as a "Class," and which may be compared and contrasted with the Class of Beasts (or *Mammals*), the Class of Reptiles, and the Class of Fishes, all which Classes agree together in being distinguished as back-boned, or Vertebrate, animals.

The Class of Birds stands out in startling contrast to all the other three Classes just referred to, and is one of the most definite, uniform, and easily defined groups (of its own rank) in the whole Animal Kingdom *.

All Birds have feathers, and no such thing as a feather is possessed by any creature which is not a Bird. This character alone, therefore, suffices to define the whole Class.

The uniformity of their structure is very remarkable. While some beasts, some reptiles, and some fishes have but a pair of limbs, and other reptiles and fishes have none, all Birds have two pairs—a pair of wings and a pair of legs. Most beasts and reptiles have a long tail, while some are without any; but every existing Bird has a tail which, feathers apart, is short †. Some beasts, some reptiles, and some fishes are edentulous, while most have teeth; but no living Bird possesses such structures. Some beasts, some reptiles, and some fishes are eyeless; but every Bird has a pair of eyes.

Birds are eminently aërial creatures, and there are but very few which have no power of flight; while none of the living members of the other Classes can truly fly except Bats; though some ancient reptiles (Pterodactyles) possessed a similar power. Although many birds are more or less aquatic in their habits, none are so completely so as either the Whales and Porpoises amongst beasts, or certain reptiles.

Birds differ much in size, as, *e. g.*, the Ostrich and the Wren; but the differences are not so great as those which exist between different beasts, different reptiles, and different fishes.

No Bird, however cold a climate it may inhabit, ever falls into prolonged winter sleep (hibernates) as do some mammals (*e. g.*, the Dormouse) and a number of reptiles. Many Birds avoid undue cold or heat by a periodical change of place, or "migration," which is fixed and definite. Thus some Birds come to us in winter from the North, and more in summer from the South.

Different kinds of Birds inhabit different regions of the earth's surface, and their distribution is necessarily restricted by the supply of suitable food and other conditions needful for

* All animals taken together are spoken of as the Animal Kingdom in contrast and distinction to the Vegetable Kingdom, which includes all plants.

† In Chapter V. we shall see that this was not always the case.

their existence. Birds have also definite relations to past time—relations which are revealed to us by their fossil remains preserved in different strata of the earth's crust.

The more numerous any set of objects may be, the more necessary it is to arrange them in groups—*i. e.*, to *classify* them. Without this it is impossible for us to study and comprehend such objects. As Birds are very numerous in their kinds, their classification is especially necessary, while the very uniformity of their structure makes that process especially difficult. Nevertheless, the study of their classification is a very interesting one, on account of their structure, their powers, the geographical relations of different kinds of Birds and their relations with the past history of our planet.

Thus the science of Ornithology deals with the structure, functions, external relations, and classification of Birds. But in order that the student may be able to study these subjects profitably, he should possess some preliminary acquaintance with a considerable number of different kinds of Birds. He will again and again meet with the names of different kinds, and of groups of kinds, of Birds; and no advance in Ornithological knowledge can be made by a reader who, when he meets with any such name, is not provided with a corresponding mental image sufficiently distinct to enable him to group his freshly acquired knowledge around it.

Our first task, therefore, shall be to place before the student the names and figures of such a number of Birds of different kinds as may enable him to acquire a certain preliminary grasp of his subject—the subject-matter of his subsequent study. It will be well, however, that the reader, after having perused this introduction, should repair to some Zoological Garden or Museum, and there acquaint himself more fully with the external aspect of the Birds here referred to. Failing this, the next best thing he can do is to carefully examine all the good pictures of Birds he can get access to.

It is always well to advance from the better known to the less known or unknown. We will therefore begin with that Bird which must be most familiar to al our readers—the Common Fowl.

All the various breeds of this animal have been derived from one or more wild species—Jungle-fowls—which have their home in India and the Indian Archipelago, but were introduced into Europe in very ancient times.

One species, named *Gallus bankiva* *, has a very wide range—namely, from the Himalaya down to the Philippine Islands and Timor. Another species is peculiar to Ceylon, and two or three more are found in different parts of the wide region inhabited by *Gallus bankiva*. They all resemble, more or less nearly, the Game-fowl, and have very similar voices and habits.

Hardly less known to most of us than the Fowl is the Pheasant (*Phasianus colchicus*), which also is of Asiatic origin, though close to the frontiers of Europe—namely, the basin of the Caspian, the valleys of the Caucasus and Asia Minor. That singular spot—the island of Corsica—which has so many species of flowering plants absolutely peculiar to it, is also claimed as a natural home of the Pheasant, which, as an introduced resident, ranges all over Europe (even to our Outer Hebrides), except the most northern parts of the Continent and, strange as it may appear, the Iberian peninsula.

In Central and Southern Asia there are some five-and-thirty species of Pheasant, while none are found wild in any other part of the world. Perhaps the most beautiful of all is Lady Amherst's Pheasant (*Thaumalea amherstiæ*), which has its plumage shaped like that of the Gold Pheasant, but is far more delicate and refined in its coloration; while the Chinese Reeves's Pheasant (*Phasianus reevesii*) has by far the longest tail.

The wonderful Argus Pheasant (*Argus giganteus*) would be remarkable also for its length of tail were not this peculiarity overshadowed by its enormous wings, the feathers of which are decorated with a multitude of beautiful eye-like spots. Its wings are rather for parade than use, as the bird can only fly with them for short distances with a heavy flight. It frequents the thickest jungles, and is, therefore, but very rarely seen, even by the natives of the Indo-Malayan region it inhabits.

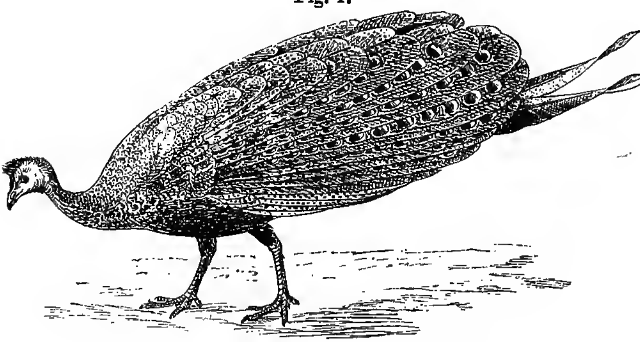
The last-named region and the Himalayas produce the beautiful Peacock Pheasants (e. g., *Polyplectron bicalcaratum*), which have not only the wings, but also the back and tail, covered with lovely eye-like spots. The true Peacocks—of which there

* In Zoology (and therefore in that branch of it with which we are concerned—viz., Ornithology) each kind of creature has a name formed of two words. The first (e. g. *Gallus*) indicates to which smaller group or "genus" the creature belongs. The second word (e. g. *bankiva*) denotes which species it is of such genus. This is like the Christian and surname of a man, only with the surname standing first.

are two species (*Pavo cristatus* and *Pavo javanicus*)—are also exclusively inhabitants of India and its Archipelago, frequenting forests and jungles, especially in hilly and mountainous districts. Large flocks of these Birds, which may be seen in India, constitute one of the most gorgeous natural objects that zoologically rich region affords.

Allied to the Pheasants are certain singular Birds, the Tragopans—called Horned Tragopans because a curious fleshy process, or "horn," is placed on either side of the head behind the eye (fig. 2). It is of different colours in different species, and can be distended and erected, while there is a similarly distensible "wattle" of different colours on the front of the throat.

Fig. 1.



The Argus Pheasant (*Argus giganteus*).

These curious Birds have a more northern range than those last before-mentioned. The Tragopans extend from the Himalayas into Southern China.

Thus all the Birds which most closely resemble the Fowl and the Pheasant—all those which have been hitherto noticed—are inhabitants of Central or Southern Asia, while not one of them is found in Africa.

But a sufficiently well-known domestic Bird—the Guinea-fowl (*Numida meleagris*)—*is* of African origin; and at least ten other species are to be found in the same Continent (including Madagascar, which has two species), but nowhere else in the world. The aspect of these creatures is very different from that of the Asiatic Birds we have hitherto called attention to.

Their peculiar voice, which no one can forget who has once heard it, is said sometimes to produce an almost stunning noise when these flocks (and they live in flocks) assemble in hundreds, as they occasionally are said to do. The Crested species of West Africa (*N. cristata*) is a handsome bird.

America has contributed yet another denizen to our farm-

Fig. 2.

The Horned Tragopan (*Ceriornis satyra*).

yards, which have thus been peopled from no less than three foreign Continents. The discoveries of Columbus and Amerigo Vespucci first made known to us the existence of the Turkey, which was introduced into England towards the close of the reign of Henry VIII., and probably gained its English appellation from its having been brought to England in ships which traded with the Levant. It is strangely different in aspect from the Guinea-fowls and the Pheasants, though the fleshy process above the beak and that on the throat remind us slightly of the Tragopans, or the Fowls with their combs and wattles.

The Turkey of Central America (*Meleagris ocellata*) is one of

Fig. 3.

The Crested Guinea-fowl (*Numida cristata*).

the most gorgeous of all Birds, from the brilliant metallic lustre of its plumage of blue and green and other tints and colours.

The Common Turkey was once widely distributed over the more Southern region of the United States, and, not long ago at the least, was plentiful in the valleys of the Mississippi and Missouri. Franklin recommended the adoption of the Bird as a national symbol of the Republic instead of that hackneyed emblem the Eagle.

South and Central America, though they have no Fowls, Pheasants, Guinea-fowls, or Turkeys, possess between fifty and sixty large species of Birds, known as Curassows, of which the Crested Curassow (*Crax alector*) may stand as a type. They are plain and sombre in colour compared with the brilliant creatures to which we have before referred. They are also more thoroughly arboreal in their habits, being (like so many species which inhabit that widest of forest-regions—Brazil) specially modified

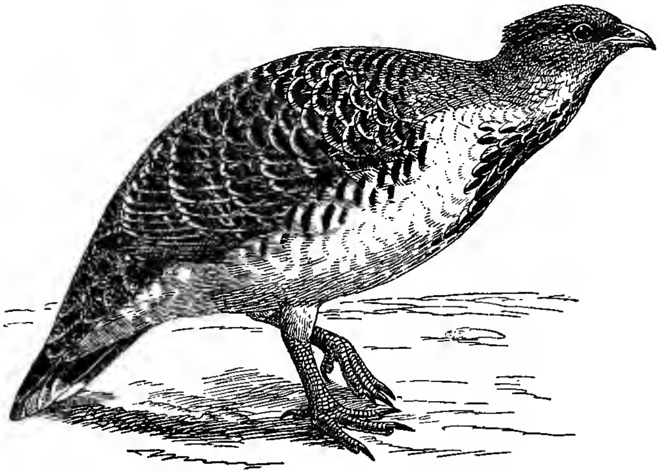
Fig. 4.

The Crested Curassow (*Crax alector*).

to live in trees, high up on which they construct their nests of twigs.

Australia has no birds to show, like those hitherto enumerated, although its curious mound-building Birds, or "Megapodes," go by the misnomer of "Brush-turkeys,"—no doubt on account of the wattled skin of the head and neck which some of them possess. One handsome kind (*Leipoa ocellata*) has its plumage decorated with eye-like markings. These Megapodes are celebrated for the mounds they raise to receive their eggs. The eggs therein deposited are hatched, not, as with other Birds, by the warmth of the body of the parent, but by the heat given out by decomposing matter which they are careful to enclose within their mounds. This absence of parental care in hatching results in the young Birds being forced at once to take care of themselves as soon as hatched. Therewith their development within the egg is so complete that they come forth full-fledged, so that they can fly at once, though it seems that they may actually attain a considerable size before they quit the mound *.

Fig. 5.



The Ocellated Mound-builder (*Leipoa ocellata*).

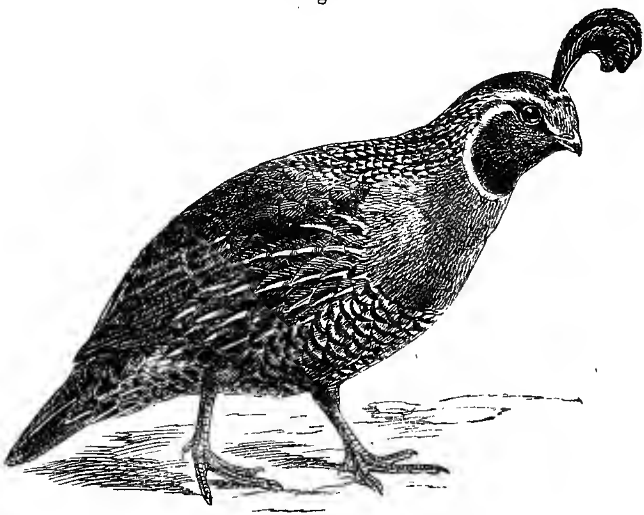
Returning to our own domain, we may note that, relatively small as are the British Islands, they are nevertheless the exclusive home of a much valued Bird—the true Grouse (*Lagopus scoticus*). It is one member of a genus the species of which range through the northern lands of both hemispheres, being one of a number of genera which may be called "circumpolar." Not only is it truly indigenous to the United Kingdom, but it is the one only Bird which is found here and nowhere else in the

* See a note by Mr. Whitehead in 'The Ibis' for 1888, p. 411.

whole world. Its giant cousin, the Capercailzie (*Tetrao urogallus*), ranges from Scandinavia and the Siberian valley of the Yenesay to the Altai Mountains, the Alps, and the Pyrenees.

A great contrast to the arboreal, polygamous, wild Capercailzie, is that familiar denizen of our home-fields—the Partridge (*Perdix cinerea*), which faithfully pairs with its gentle mate for life. For more than a hundred years it has had to sustain an unequal contest with the stronger and more pugnacious red-legged kind (*P. rufa*) of South-western Europe,

Fig. 6.



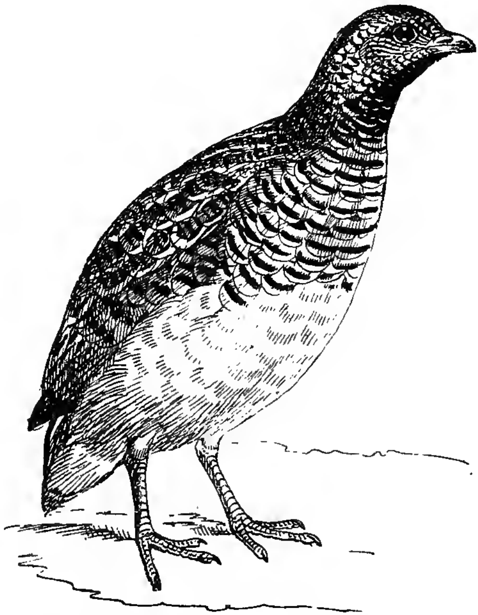
The Californian Quail (*Lophortyx californicus*).

which was introduced in 1770, and has obtained a foothold in the greater part of our Eastern Counties. That miniature Partridge, the Quail (*Coturnix communis*), easily distinguished by its smaller size, very short tail, and pointed wings, is also a ground-bird like the Partridge, though it is well capable of flight, as is proved by the prodigious multitudes which cross the Mediterranean for a winter home in Africa.

Of Quails there are some twenty kinds, ranging through the Old World south of the Arctic regions. Birds nearly allied and often spoken of as Quails also exist in the New World, constituting some four-and-forty species, amongst which is the handsome Californian Quail (*Lophortyx californicus*), with its elegant nodding crest.

There are some very small Game Birds called "Hemipodes" or "Bustard Quails," which are very like Quails, though they

Fig. 7.



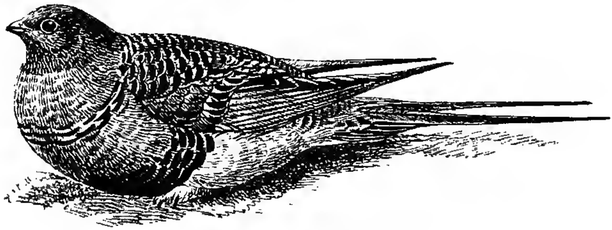
The Black-breasted Hemipode (*Turnix taigoor*).

can easily be distinguished from the latter by their not having any hind toe. They are found from China to Australia, in India, Southern Europe, and in Africa. The Black-breasted Hemipode (*Turnix taigoor*) may serve as a type. The species which inhabits Spain (*T. sylvatica*) has even strayed as far as England.

Certain Birds known as Sand-grouse are so unlike true

Grouse that their English name is misleading. They constitute the two genera termed *Pterocles* and *Syrrhaptes*. The one which is found in Spain (*Pterocles arenarius*) may be considered the type. These Birds are inhabitants of Asia and Africa, but one species, Pallas's Sand-grouse (*Syrrhaptes paradoxus*), sometimes

Fig. 8.



Pallas's Sand-grouse (*Syrrhaptes paradoxus*).

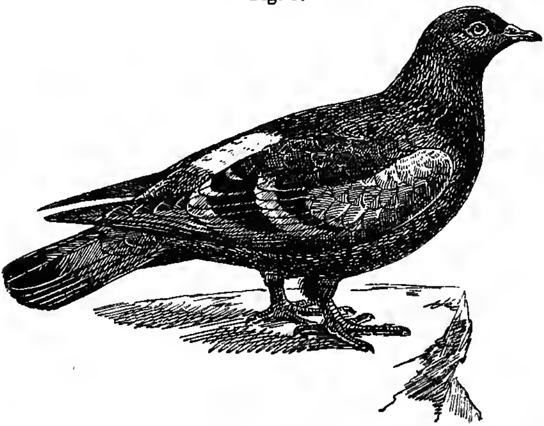
migrates to Europe and into our own country. It first did so in very large numbers in 1863, and it seemed as if it would become a truly British Bird—a very interesting fact as bearing upon the general question of the geographical distribution of species. Nevertheless it has now disappeared.

A certain superficial resemblance, at the least, has been recognized as existing amongst all the Birds which have been as yet herein noticed by us. As the type of this assemblage may be taken that form with which we started, the Fowl; and as the generic name of the Fowl is *Gallus*, this whole assemblage or group of species have been, and still are, very commonly spoken of as *Gallinaceous Birds*.

Only less familiar than the Common Fowl is the Pigeon, which forms the type of another smaller, though still considerable, group of very attractive Birds, the close resemblance of which to one another must strike the most casual observer. They are fruit-eating and grain-eating, monogamous Birds, of which there are about 360 different species. Their geographical head-quarters are in and near New Guinea. About 120 species are found in the Indian Archipelago, while less than a quarter of that number exist either in the continent of India or Australia. Above 40 species are African, while at least 80 exist in either North or South America.

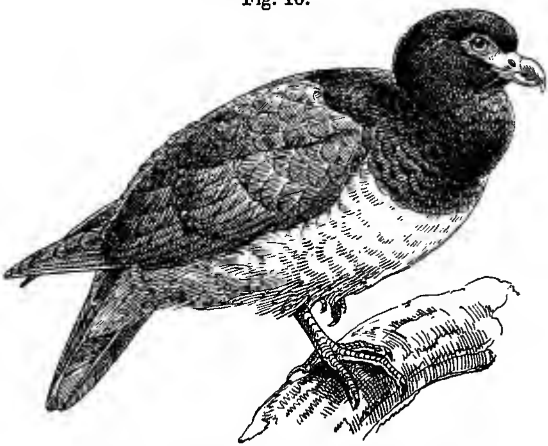
All the domestic varieties seem to have been derived from the Rock-pigeon (*Columba livia*), which is a native of South-eastern Europe.

Fig. 9.



The Rock-pigeon (*Columba livia*).

Fig. 10.

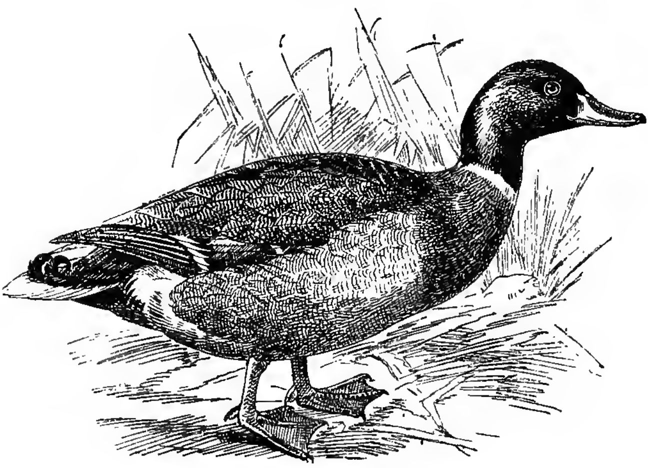


The Tooth-billed Pigeon (*Didunculus strigirostris*).

A very interesting form, called the Tooth-billed Pigeon (*Didunculus strigirostris*), inhabits the Samoan Islands, where it feeds on plantains. It used to be an entirely, or almost entirely, ground-bird, but is said to have taken to flying up into trees to avoid cats and other enemies introduced of late years by man into the region it inhabits. Thus it can fly to a certain extent when it needs to do so; but its main interest consists in the fact that of all existing Birds it is the one which most resembles the extinct Dodo, which could not possibly fly at all.

Not less familiar to us than Fowls and Pigeons are our

Fig. 11.



The Mallard (*Anas boscas*).

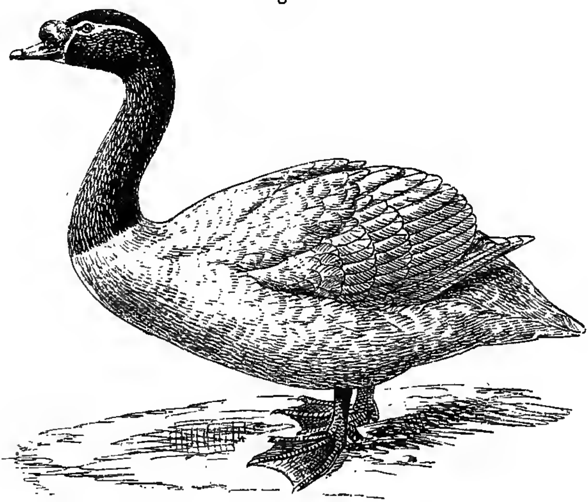
Ducks and Geese. Of these there are very many species, and some are found almost all over the world.

Our Domestic Goose is derived from the Grey Goose (*Anser cinereus*), the natural range of which extends over Europe and Central Asia. There are some fourteen species of the genus *Anser*, and of allied forms there are very many more—some of them being found in one region or another almost all over the world, save that the true Geese eschew the Tropics. In spite of their webbed feet, the Geese generally, like the Domestic

Goose, are Land Birds—at least during their breeding-season, and they breed on the ground.

The Ducks—for which the Wild Duck or Mallard (*Anas boscas*) may be taken as a type—are all so much alike, that the genera into which their numerous species have been grouped present no characters which make it needful for us to deal with them here. They form another cosmopolitan group of broad-billed web-footed Birds.

Fig. 12.



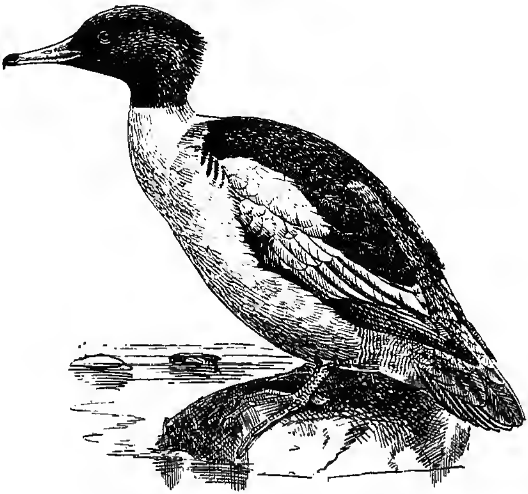
The Black-necked Swan (*Cygnus nigricollis*).

The Harlequin Duck, which rarely visits us from the North, is a handsome Bird. But there are many yet handsomer, and the brilliant and artificially-marked Mandarin Duck is especially noticeable.

Of Swans there are only some eleven species, whereof that "*Rara avis*" of our Latin grammars, the Black Swan, is Australian, while the White Swan with a black neck, from South America, is a remarkably handsome species.

The Mergansers constitute a very small group of Water Birds, markedly different from the before noted web-footed ones, through their narrow bills margined with tooth-like processes. They are noted as great destroyers of fish. Of them, the Goosander (*Mergus merganser*) may be taken as a type—a bird dear to the Scandinavian peasant. Mr. Seebohm tells * us that, as the House-martin has found a better shelter for its nest under the eaves of a roof than in a cliff, so the Goosander immediately avails itself of the wooden boxes which the Fins fasten up in the trees to tempt them. These are made with a trap-door

Fig. 13.



The Goosander (*Mergus merganser*).

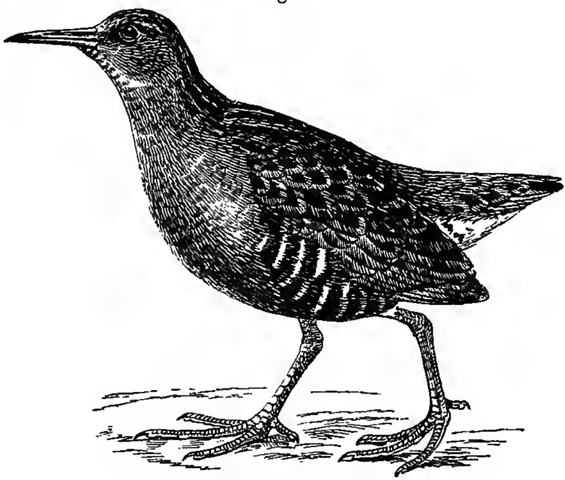
behind "so that the peasant may daily rob the nest, and thus make the too-confiding bird lay a score or more of eggs before the wary man thinks it prudent to cease his depredations, and allow the Goosander to sit upon the nest for fear of spoiling the next year's harvest."

In a half-domesticated state, on the surface or margins of our ponds, by homely farmsteads or in pleasure-grounds, we often find those small familiar Water-Birds known as "Moor-hens"

* British Birds, vol. iii. p. 626.

(*Gallinula chloropus*). We see them sometimes swimming along, with a nodding motion of their heads, or feeding on aquatic insects, larval dragonflies, and others; sometimes hunting for slugs or worms amongst the grass of our meadows, jerking up their tail at every step. Our Moor-hen is the only one found in Europe, but also in Asia, Africa, and America, though not in Australia. There are some fifteen other species of the genus, which is a very cosmopolitan one. The Water-rail (*Rallus aquaticus*) is one of a group of about fifteen species

Fig. 14.

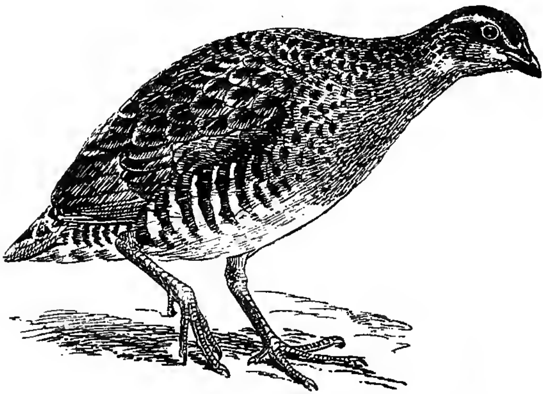


The Water-rail (*Rallus aquaticus*).

found in most parts of the world save Australia and the Arctic regions. It is still common in the fen-countries, and breeds in the Norfolk Broads. By its webless toes it differs from the Ducks and Geese, but that character increases its resemblance to the Land-rail (fig. 15) or Corn-crake (*Crex pratensis*), the harsh voice of which (like a pen drawn across the teeth of a comb) may be heard in our cornfields and dry meadows. The group to which the genera *Crex* and *Gallinula* alike belong (that is, the family of the Rails) comprises some 167 species, some or other of which are found all over the world, save in the

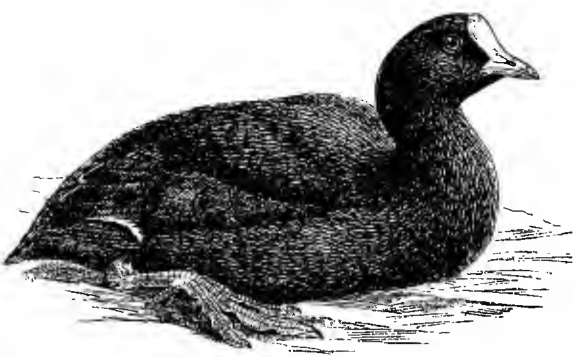
Arctic and Antarctic regions. One of these forms—an aquatic one common in England, and abundant on the Norfolk Broads—

Fig. 15.



The Corn-crake (*Crex pratensis*).

Fig. 16.



The Coot (*Fulica atra*).

is the Coot (*Fulica atra*), which resembles the Moor-hen in its habits, and, like that species, resides with us all the year through.

It differs, however, in having its toes bordered with a scalloped membrane, so that it is a sort of half-web-footed Bird. Another Bird with also half-webbed or "lobed" feet is the South-American one named *Heliornis fulica*. To such Birds as the Coot and its allies we shall have again to refer *.

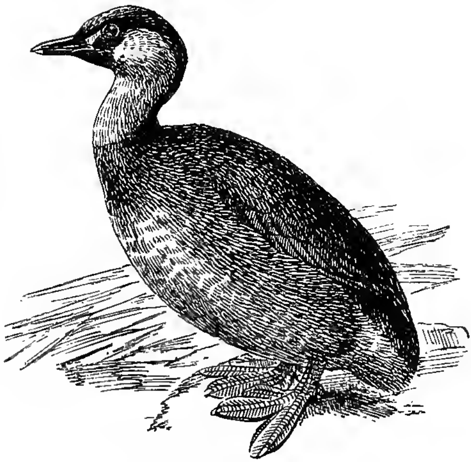
Fig. 17.

The American Fin-foot (*Heliornis fulica*).

Yet another very common inhabitant of our lakes and ponds, which also has its toes festooned with membrane, and notable for its soft plumage, is the Dabchick (fig. 18), or Little Grebe (*Podiceps minor*). But seldom found on land, where it walks badly, and rarely taking the wing, it is a most ready diver, diving with perfect ease when but a week old, and swimming as soon as hatched. It and a few other larger Grebes found in

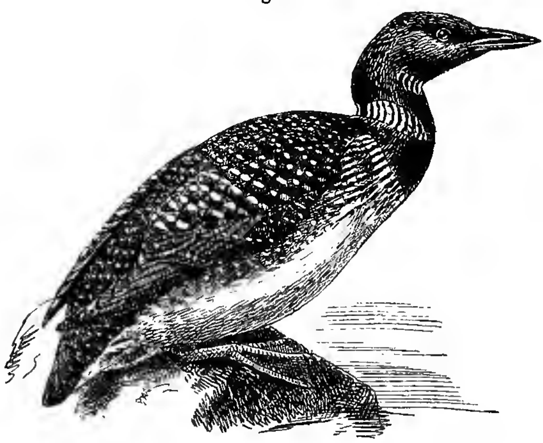
* See below, p. 63.

Fig. 18.



The Little Grebe (*Podiceps minor*).

Fig. 19.

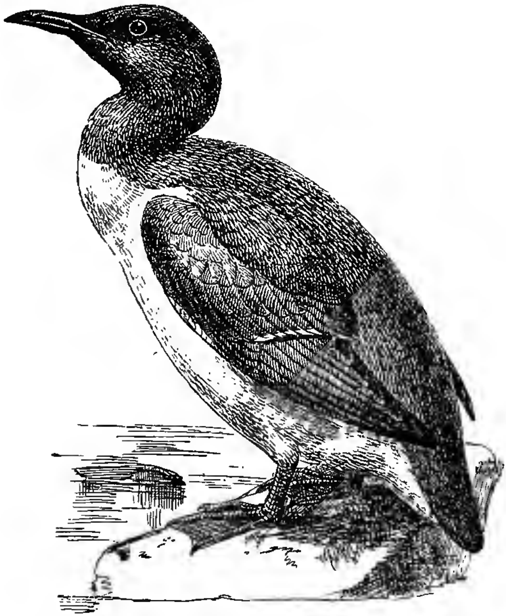


The Great Northern Diver (*Colymbus glacialis*).

the British Isles form part of a family of about thirty species—a group spread over the world, mainly in the temperate regions of both Hemispheres.

Still more aquatic in their habits, and perfect in their diving movements, are the half-dozen or so of Divers, *par excellence*, whereof our Great Northern Diver (*Colymbus glacialis*) may serve as an example. It is a large bird, which breeds in the

Fig. 20.



The Common Guillemot (*Uria troile*).

north of North America, and visits the coasts of England and Scotland in the winter. The Divers live chiefly in the sea, feeding on moderate-sized fishes, which they catch while under water. They all inhabit high latitudes.

Another much commoner but very interesting bird is the Common Guillemot (*Uria troile*). Extremely maritime in its habits, and also a most ready diver, it lives upon the open sea save at the breeding-time, when it seeks some rocky cliff, such as the Bass Rock or Flamborough Head. In such places they assemble in vast numbers, and Guillemots are often seen in thousands at their breeding-places. There each hen bird lays but a single large egg, not deposited in any nest, but simply on some ledge or in some fissure of the rocks. Their most variously coloured eggs are in much request as food, and desperate risks are run in obtaining them from the often precipitous localities where they are laid. Young birds, incapable of flight, are to be found on the sea, though how they get there from their lofty hatching-place has not yet been ascertained.

A small bird—nearly related to the Common Guillemot—called the Sea-dove or Little Auk (*Alle nigricans*), visits us in winter from Spitzbergen. There it breeds in incredible numbers. It is more commonly to be found in the Orkneys and Shetlands than further south in our Islands.

The Razorbill (*Alca torda*) is very like a Guillemot, save for its high, sharp-edged, and hooked bill. It is confined to the North Atlantic Ocean, and such prolongations of that ocean as the British Seas. There it catches fish with great dexterity, pursuing them under water in what may be called aquatic flight, as its wings as well as its webbed feet aid its pursuit. Its principal interest, however, consists in the fact that it is the nearest living representative of the Great Auk or Gare-fowl (*Alca impennis*), which seems to have become extinct about the year 1844. Some 76 skins and 9 skeletons, with 68 eggs and a few bones, preserved in collections, are all the relics we have of this strange Bird. It had absolutely no power of flight, and was as large as a Goose. On land it ran and walked in an upright attitude, but dived and swam under water with extreme celerity and ease. Two hundred and seventy years ago hundreds at a time could be taken at the coast of Newfoundland; but the last one recorded to have been taken in our Islands was at Waterford Harbour in 1834. Its breeding-places ranged from the north of Scotland, the Hebrides and Iceland, to Labrador, Newfoundland, and Nova Scotia, and it was entirely confined to the Northern Hemisphere.

Another strictly aquatic and marine Bird with no powers of flight is now entirely confined to the Southern Hemisphere. This is the King Penguin (*Aptenodytes longirostris*), which may be selected as an example of about a dozen and half of Penguins of different kinds. The King Penguin of the Antarctic Ocean—Kerguelen, the Falkland Islands, &c.—still exists in enormous numbers, passing the greater part of its time in the water, where it swims by means of its wings only, its feet serving but as rudders. On land it stands and walks in an upright position (fig. 22).

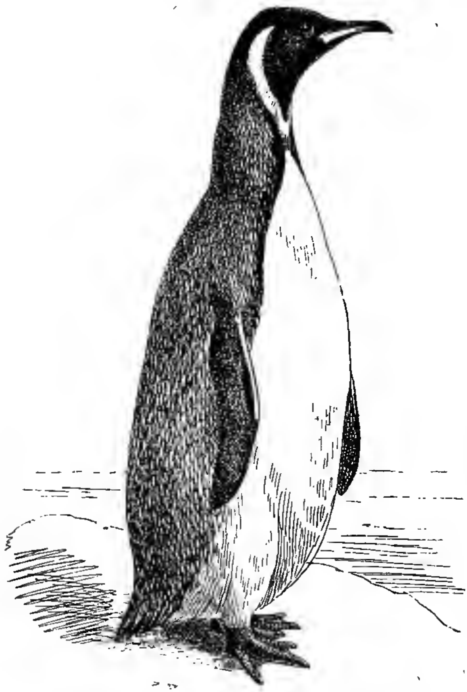
Fig. 21.

The Great Auk (*Alca impennis*).

A curious and much smaller Bird, called the Puffin (*Fratercula arctica*), or Sea-parrot (fig. 23), which inhabits rocky districts of our coasts, may serve as the type of some eight other species which have a circumpolar distribution. They lay but a single egg, which they sometimes deposit in the cleft of a rock, while sometimes they dispute with rabbits the accommodation of their burrows. They are clumsy-looking Birds, which nevertheless have a rapid though not lofty flight.

From the various extremely aquatic Birds which have been here noticed, beginning with the Divers, we may now pass to another set of Birds of different structure, which are not less wonderfully agile in their subaqueous movements in pursuit of prey. Of

Fig. 22.

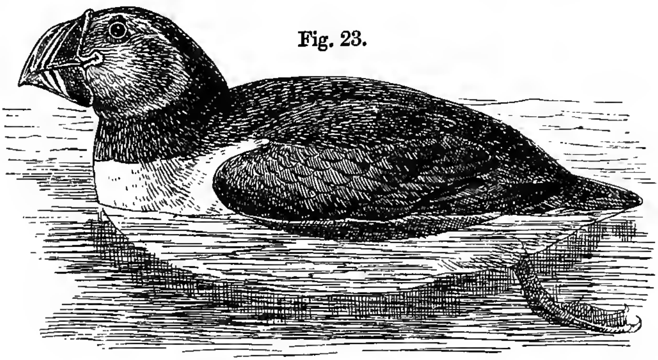


The King Penguin (*Aptenodytes longirostris*).

these, our English species the Cormorant (*Phalacrocorax carbo*) and the Shag (*P. graculus*) may be taken as types, and some thirty or more other kinds are to be found in different parts of the world, save in the Polar regions and amongst the Pacific Islands. Ardent and successful fishers, they, by the help of their wings and very well-webbed feet, outswim the fishes they pursue beneath the surface of the water. But skilful as they are, the more marine of our two forms, the Shag, is apt to be drowned by diving through a hole in the ice and not being able to find again its place of entrance, a task successfully performed by the Cormorant, which is habituated to fresh water. One species of Cormorant has been domesticated by Chinamen, who make use of it to catch fish while secured by a cord and collar.

But the organization of the set of Birds with which we are now occupied finds its highest expression in the Darters. These are,

Fig. 23.



The Puffin (*Fratercula arctica*).

as it were, Cormorants with long necks, very curiously jointed, and with straightened and sharpened bills.

Four species of the genus are distributed over America, South-eastern Asia, Africa, and Australia. These are none of them Sea Birds. They inhabit swamps and rivers, where they pursue fish with extraordinary agility, spearing them through with their sharp beak before seizing them in the mouth, as may often be seen with the American species (*Plotus anhinga*, fig. 24) in our Zoological Gardens. A curious bend or seeming lump in the neck is conspicuous, and indicates the spot where the neck-bones are modified in a most remarkable manner, to facilitate the unerring projection of the bill—like a spear-head—against the body of the fish the bird desires to transfix.

In the Gannet or Booby, also called the Solan Goose (*Sula *bassana*), we meet once more with an Oceanic form. It may serve as the type of a very small group of Marine Birds widely distributed in the Tropics.

The Gannet is a somewhat ungainly Bird, a little smaller than a Goose, and awkward in its movements on the land. Not only is it a perfect swimmer, but it is also remarkable for its wonderful powers of flight, soaring to great heights

Fig. 24.

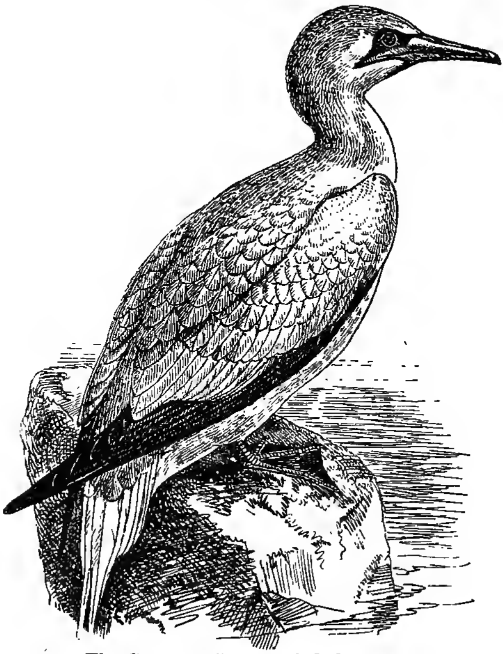
The Darter (*Plotus anhinga*).

and traversing a hundred miles or more of aërial space in one day. Though not possessed of the powers of diving which Darters and Divers enjoy, the Gannet, large and heavy bird though it be, will suddenly descend and plunge directly downwards to catch the fish on which it feeds most greedily. It is very local as to its breeding-places, there being but few such in

Great Britain; amongst them the Bass Rock, Ailsa Craig, and Lundy Island may be mentioned *.

The Gannet, like the Cormorant, has a slightly distensible naked portion of skin at the top of the throat in front, extending to the underside of the bill. This is greatly exaggerated in a Bird which is entirely strange to our own climes, though a common inhabitant of our Zoological Gardens. We refer to

Fig. 25.



The Common Gannet (*Sula bassana*).

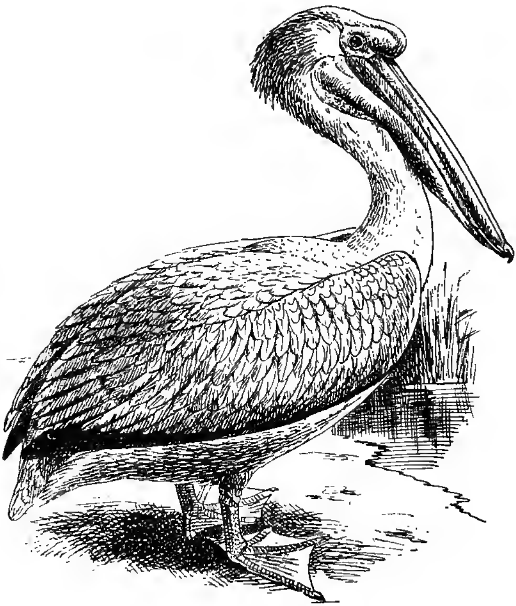
the Pelican (*Pelecanus onocrotalus*), the unwieldy form and awkward gait of which, as well as its long bill with the great bag of skin beneath it and in front of the throat, must have strongly impressed every one who has seen it. Unwieldy as it is, and very web-footed, it is fond of perching on trees.

It inhabits Africa and the Western and Central parts of Asia

* Thousands breed at St. Kilda.

and South-eastern Europe. Other species of Pelicans are also found in North and South America, and there are about ten in all. Pelicans go in large troops, and though, like the Gannet, no divers, they will, like that bird, sometimes dash down vertically into the water from a great height in pursuit of the fish on which they feed, resting a very brief time on the surface of the water to swallow their prey, tossing up their bill and distending the pouch beneath it.

Fig. 26.

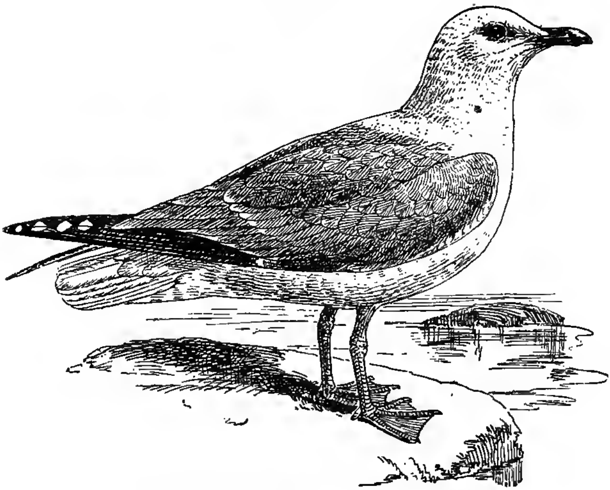


The Common Pelican (*Pelecanus onocrotalus*).

Returning from such exotic creatures as Pelicans and Darters to more familiar forms, when we think of Sea Birds, the Gulls of our coasts come naturally before the mind. The Common Gull (*Larus canus*) may serve as the type of a large group which is spread over the whole world, and consists of at least forty-eight kinds, all remarkably similar in form, general coloration, and mode of life. The common species is very often to be seen on the banks of the Thames, and many of the Gulls, though familiar objects at the sea-side, largely frequent inland waters, feeding on worms, insects, eggs, the nestlings of other Birds, mice, &c., as well as fish. Their flight is graceful, and they may often be seen sailing in circles in the breeze, with hardly a perceptible motion of the wing.

The Terns are yet more graceful in flight, but they walk

Fig. 27.

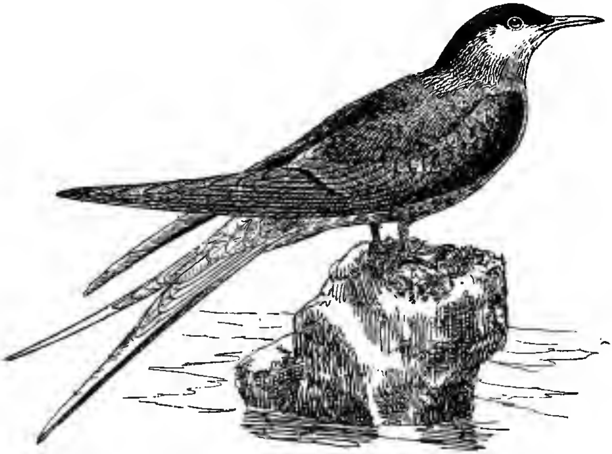


The Common Gull (*Larus canus*).

with less ease, though they swim admirably. Their more slender, less bulky aspect, straighter bills, narrower wings, and long forked tails serve, with few exceptions, to distinguish them from the Gulls. There are, again, some fifty species of this group, some or other of which are to be found nearly all over the globe. Like the Gulls, they are noisy and gregarious, and are found on inland lakes as well as the sea-shore, feeding on insects as well as fish. The Arctic Tern (*Sterna macrura*, fig. 28) may serve for a type, as it is almost as well known as the so-called Common Tern (*S. fluviatilis*). It comes to us in the latter half of April, breeding on islands near the coast.

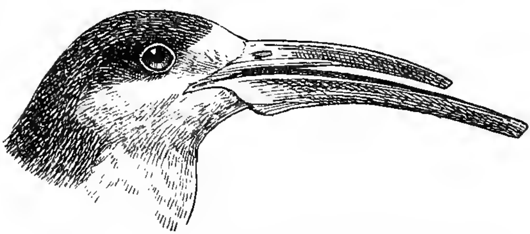
There are also Robber-gulls, called Skuas, and the Great Skua (*Stercorarius catarrhactes*) breeds in Iceland, the Faroes, and the

Fig. 28.



The Arctic Tern (*Sterna macrura*).

Fig. 29.

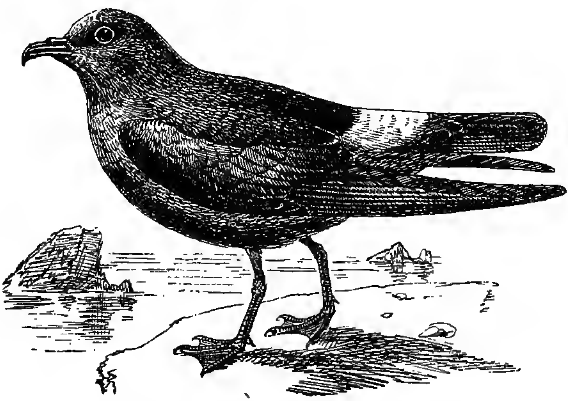


Head of the American Skimmer (*Rhynchops nigra*).

Shetland Islands. There are three curious Birds called Skimmers or Scissor-bills—one in Asia, one in Africa, and one in America. The last of these (*Rhynchops nigra*) has been observed flying backwards and forwards, with its long wings, fishing close to the surface, with the lower half of the beak ploughing the water. It is the very singular shape of the beak which makes it specially noteworthy.

With the Gulls our minds naturally associate that Oceanic Bird with an ill-omened name, the Storm-petrel (*Procellaria pelagica*), which breeds on Lundy Island and on others off our Western coasts. These birds roam over the Atlantic and are known as "Mother Carey's Chickens." They differ greatly from the Gulls and Terns in being silent birds. This Petrel

Fig. 30.

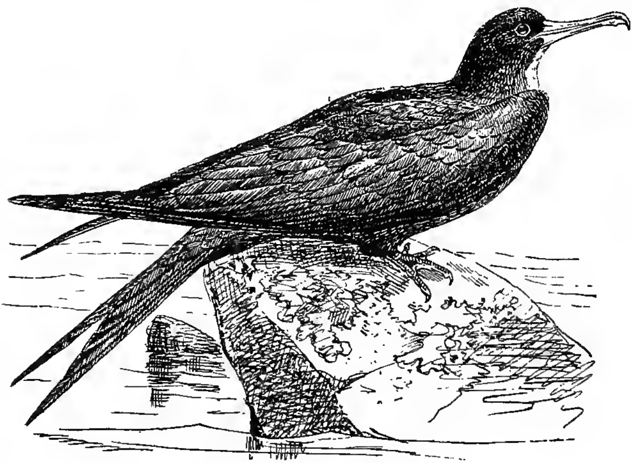


The Storm-petrel (*Procellaria pelagica*).

is a type of a group of more than 100 species distributed throughout the Ocean all over the world, and so pelagic that they only rarely come to land except to breed. They are web-footed birds with hooked bills, long wings, and a short tail, but their most noticeable peculiarity is that their nostrils are prolonged outwards as short tubes. They have wonderful powers of flight and are excellent swimmers, though many of them hardly ever dive. They will often accompany a ship for many days. The various species differ very greatly in size—our type being one of the smallest, not much larger than a Swallow. A rather distinct form called a Diving Petrel (*Pelecanoides urinatrix*) is found in Kerguelen Land. The largest of the group is the Albatross (*Diomedea exulans*), a great wandering species, the largest of all Water Birds. Its home is in the Southern Hemisphere, but it has been taken in Europe. Its enormously long wings and its habit of sailing without flapping them for a long period are well known. There are some ten species of Albatross.

Another wandering oceanic creature is the Frigate-bird

Fig. 31.



The Frigate-bird (*Tachypetes aquila*).

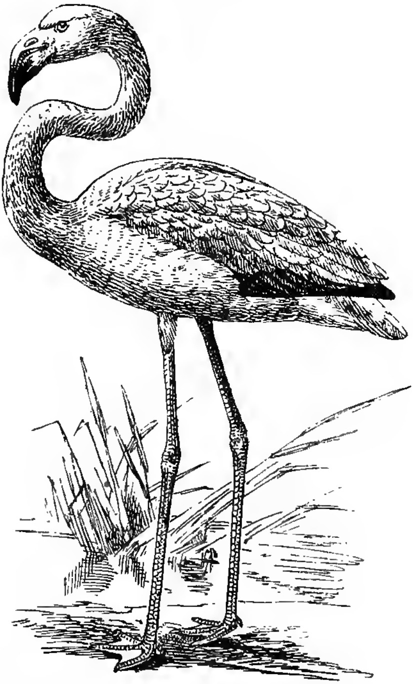
(*Tachypetes aquila*), which has in some respects the aspect of a bird of prey of the Hawk or Eagle kind, with a powerful hooked beak and a long, forked tail. It has, however, marvellously long wings and very small feet, and is believed to have the most powerful flight to be met with in the class of Birds. It soars to great heights. Frigate-birds are great persecutors of others, pursuing Terns and Gannets, forcing them to disgorge a fish they may have captured, and catching it as it falls. They are often called "Men-of-war Birds." They range the ocean in all warm regions, and, like Petrels and Albatrosses, have little to do with the land. They are inhabitants of the Tropics, as also especially are some creatures constituting another very small

Fig. 32.

The Tropic-bird (*Phaëton æthereus*).

Oceanic group, and known emphatically as "Tropic-birds." Of these we may name *Phaëton æthereus* as a type. They are powerful, but not graceful fliers, often accompanying ships in their course, and flying round them at a great height with the velocity and directness of a small steam-engine. Nevertheless, though they depart far from land they do not do so to the extent to which Petrels and the Frigate-bird will go. They are gregarious, and nest together on coasts where rocks

Fig. 33.

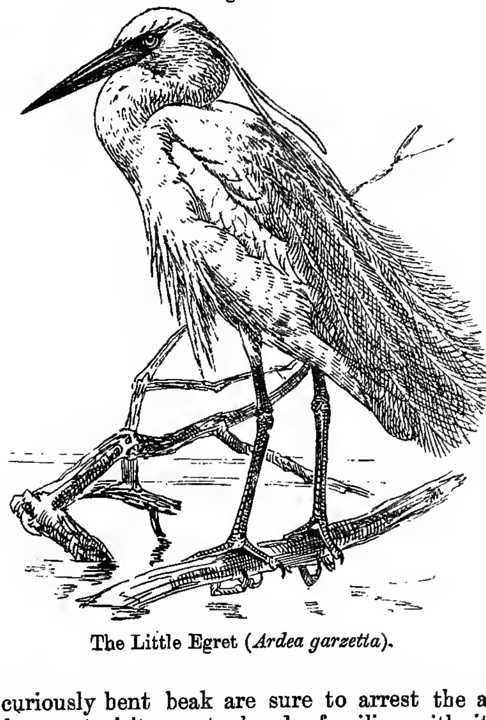


The European Flamingo (*Phœnicopterus antiquorum*).

and bushes are found in proximity. They have much the appearance of Terns, but are shorter and somewhat larger.

We have now noted various Aquatic Birds that are quite strange to England, and which are mostly marine, though some frequent rivers. We will next pass on to consider certain Birds which are found in the warmer parts of both Hemispheres and which are known as Flamingoes. Many individuals of the species known as *Phœnicopterus antiquorum* are often to be seen on the Guadalquivir River between Seville and the sea. This Bird is generally to be found in our Zoological Gardens, where its extremely long neck

Fig. 34.



The Little Egret (*Ardea garzetta*).

and its curiously bent beak are sure to arrest the attention of any observant visitor not already familiar with it. They build their nests of mud, and each nest has the appearance of a small mound, about half a yard high, rising out of the shallow water of some marsh. There are eight different kinds of Flamingoes.

This creature naturally suggests to us a number of other

Wading Birds, the great majority of which are strange to the British Isles. But one handsome long-legged Bird, which wades in ponds and rivers to catch fish with its long sharp beak, is a sufficiently familiar object to many Englishmen. We refer to the Heron (*Ardea cinerea*), which may serve as a type of many

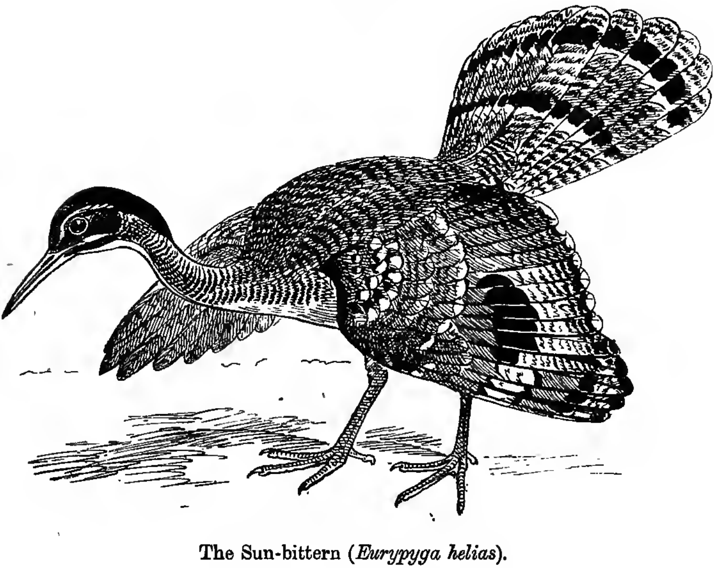
Fig. 35.

The Common Bittern (*Botaurus stellaris*).

closely similar Birds, found all over the world save its coldest regions. The Heron is a very attractive object, as it may be seen fishing in some pond or perched on the branch of a tree overhanging the water, or flying, somewhat slowly, flapping its broad wings, with head brought back, resting on its shoulders, and its long legs trailing behind it. It is a great frequenter of our coasts, at least in our Northern Counties, searching the pools left at low water for crabs, shrimps, or other small marine creatures.

Amongst foreign allied forms may be mentioned the Night-heron, which occasionally visits this country; as also, though very rarely, does the beautiful Little Egret (*Ardea garzetta*) and the great White Egret, which breeds regularly in Southern

Fig. 36.



The Sun-bittern (*Eurypyga helias*).

Russia and the Lower Danube. The Bittern (*Botaurus stellaris*), a shy bird, noted for its peculiar guttural, booming cry, now only a winter visitant to England, is an example of a slightly different form. Of Herons and Bitterns there are altogether about eighty-two different species. The Bird known as the Sun-bittern (*Eurypyga helias*) is very unlike the true Bitterns. It has a very thin neck, and is marked in a peculiar way with transverse stripes of white, brown, and black, so that, once seen, its appearance is not easily forgotten. It inhabits river-banks in South America.

A very odd South-American Bird (*Cancroma cochlearia*) is called the "Boat-bill," on account of its wide and capacious beak. Another Bird, not less singular and with a still larger

Fig. 37.

The Boat-bill (*Cancroma cochlearia*).

beak, comes from Africa, where it inhabits the banks of the Upper Nile, and is even there a rare Bird. It is of large size, and its great bill resembles somewhat the jaws of a Crocodile. It is called the Shoe-bill (*Balæniceps rex*). Another African Bird of very much smaller size (about the size of a Crow), with a much smaller and compressed beak, is remarkable for building an enormous nest, shaped like an oven, which serves for many years. It is so solid that it will bear the weight of a heavy man. Mr. Layard saw one three yards long and one and a half

Fig. 38.

The Shoe-bill (*Balæniceps rex*).

yard broad, and found it decorated with all sorts of bright objects, from bleached bones to brass buttons. It is called the Umbrette or Hammer-head (*Scopus umbretta*). When two or three of them are feeding in a pond together, they will sometimes skip round one another, opening and shutting their wings and playing strange pranks.

Another tropical Bird, which has a very high-shouldered and

Fig. 39.

The Hammer-head (*Scopus umbretta*).

ungainly aspect, has a remarkably long and capacious, though conical bill, very long legs, and a naked neck with a pouch. This is the Adjutant or Marabou (*Leptoptilus dubius*), and it bears beneath its tail those small delicate plumes, which ladies use, known as "Marabou feathers." It ranges from Northern

Hindostan to the Malay Peninsula, and is of great service as a scavenger. It is a faithful attendant on slaughter-houses and the funereal burying-grounds of the natives, and has been

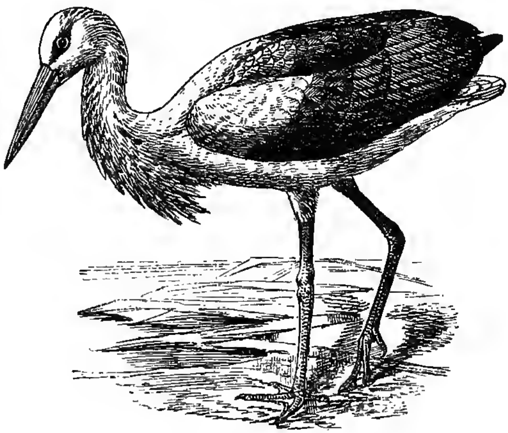
Fig. 40.

The Adjutant (*Leptoptilus dubius*).

observed standing and feeding on a corpse floating down the Ganges. It breeds in cliffs. An allied species is found in Africa. These animals being known as Marabou *Storks*, naturally bring to our mind the thought of the true Stork (*Ciconia* *alba*), which, though very rarely seen in this country, is abundant enough in Holland, where many pairs breed on boxes or other objects which Dutchmen place for them on the tops of their houses. They make themselves as much at home on houses as House-martins do; and sometimes several nests are built upon the same roof, although a nest is a very large structure of 4 or 5 feet in diameter, made of sticks, reeds, and earth, and lined with hair, feathers, wool, rags, or other softer objects.

The Stork may serve as the type of about a dozen and a half

Fig. 41.



The Stork (*Ciconia alba*).

Stork-like Birds which are, for the most part, inhabitants of the Old World, though amongst them is the American Jabiru (*Mycteria americana*) and certain "Wood Storks" (of the genus *Tantalus*), which are often spoken of as "Wood Ibises," though they are in fact very different from the true Ibises, which will be spoken of later.

Another familiar large, long-legged, long-necked Bird, which has an external resemblance to the Stork, is the Crane (*Grus cinerea*). This Bird is said to have bred in English marsh-lands up to the close of the reign of Queen Elizabeth, and was one of the largest of true British Birds; now it is but a rare visitor to our shores. Its nest is never built in a tree, but on a small mound or "hummock" in some swamp. Cranes are

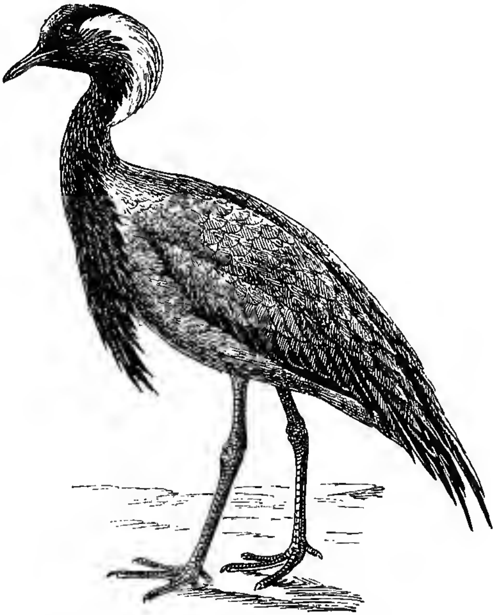
Fig. 42.

The Wood Stork (*Mycteria americana*).

even said never to perch on a tree, and they feed largely on vegetable substances. The Demoiselle Crane (*Grus virgo*, fig. 43) is a very elegant Bird, still more rarely found in our Islands. About seventeen species of the Crane family are known, whereof all but three are inhabitants of the Old World. Amongst these latter is the Demoiselle Crane, just mentioned, and also the Stanley and the Crowned or Balearic Crane, one or more of which kinds are generally to be found exemplified in our Collection at the Regent's Park.

Here may be mentioned the Trumpeters, Cariamas, and Horned Screamers, all of which are South-American forms, and

Fig. 43.



The Demoiselle Crane (*Grus virgo*).

each one of which merits some special attention from the student of Ornithology.

The Trumpeter (*Psophia crepitans*) has a short beak, velvety plumage, and weak powers of flight.

The Cariama, or Seriema (*Cariama cristata*, fig. 45), is a large

Bird, also with a shortish beak, which emits a cry somewhat like the subdued bark of a dog. By some Ornithologists it has been taken to be a sort of long-legged Hawk or Falcon, and it is a bird of prey as far as reptiles are concerned—at least, it has a great reputation as a Serpent-killer, so that by many it is highly valued and carefully protected.

Fig. 44.

The Trumpeter (*Psophia crepitans*).

The Horned Screamer (*Palamedea cornuta*, fig. 46) is a Bird of very singular aspect, since a delicate horn, about 5 or 6 inches long, curves upwards and forwards from about the middle of its head. It has a short beak and large feet, and each of its wings has a long, strong, and sharp spur. It does not scream so loudly as do two allied species (*Chauna*), which have no horn. The voice of one of these is said to be so loud as to be audible when soaring at so great a height as to be hardly visible. The Horned Screamer is said to be a quiet peaceable bird in spite of its spurred wings.

The name of a curious Bird from New Caledonia must not

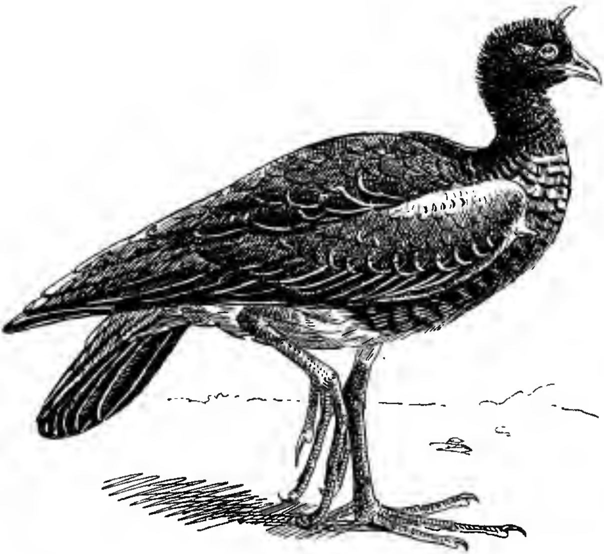
Fig. 45.

The Seriema (*Cariama cristata*).

be passed over unnoticed by the student. This is the Kagu (*Rhinochætus jubatus*, fig. 47), a grey Bird with orange and scarlet feet and bill. Even in captivity it will often perform antics which are quite remarkable. In its native haunts it hunts for snails, worms, and other small creatures by night.

After this short excursion amongst Birds of different distant lands we may return to more familiar forms. First of these may be mentioned a Bird which was common enough in England a hundred years ago, though it is now but a rare visitant. This is the Bustard (*Otis tarda*, fig. 48), a large stout Bird, which may be taken as a type and representative of a group of six-and-twenty species which are entirely confined to the Eastern Hemisphere,

Fig. 46.



The Horned Screamer (*Palamedea cornuta*).

including Australia, though there are none in Madagascar or the Malay Archipelago. Some Bustards seem to have lingered in England till 1845, although they are said to have deserted their accustomed haunts on Salisbury Plain about 1810. They, however, occasionally visit us, and in the winter of 1870–1871 no less than twelve were seen—three on Salisbury Plain once more, and seven in North Middlesex. The Bustard is a vegetable-feeder, and a large and handsome Bird, standing between 3 and 4 feet high, and running and walking well as well as flying rapidly.

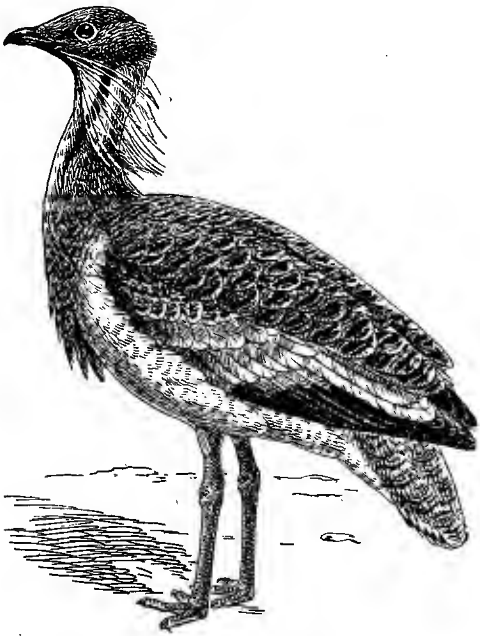
Fig. 47.

The Kagu (*Rhinochætus jubatus*).

A rare visitant to our shores is the Courser (*Cursorius gallicus*, fig. 49), one of a group of ten species which, like the Bustards, love to range over open plains of the Old World.

In the Southern part of the New World, from Mexico southwards, another group of Birds are to be met with, somewhat like the Partridges in general aspect. These are the Tinamous, of which there are some thirty-nine kinds, whereof the species called *Tinamus robustus* (fig. 50) may be taken as a type. They are creatures of singular stupidity, and they are ground-frequenting

Fig. 48.

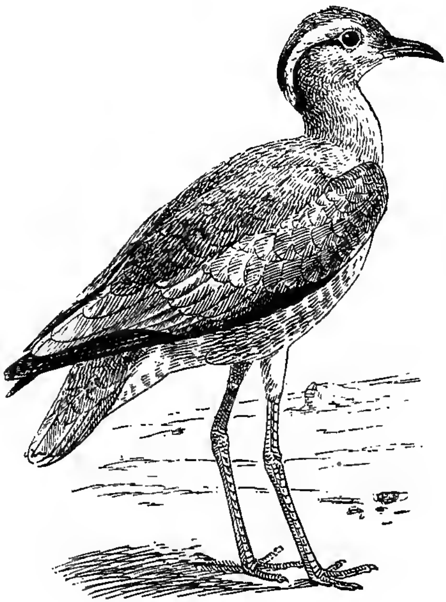


The Bustard (*Otis tarda*).

Birds like those last described. They merit, however, very special attention on account of their very peculiar internal organization, as will be pointed out later on.

A Bird which at once arrests attention from a peculiar *external* character is the Spoonbill (*Platalea leucorodia*), one of a family found in both the Old World and the New, and consisting of five species. As their curious bill would suggest, they wade into the water in search of food. There is one European species, and this bred in England down to about 1670, and even now a few birds seem each year to visit us in spite of their

Fig. 49.

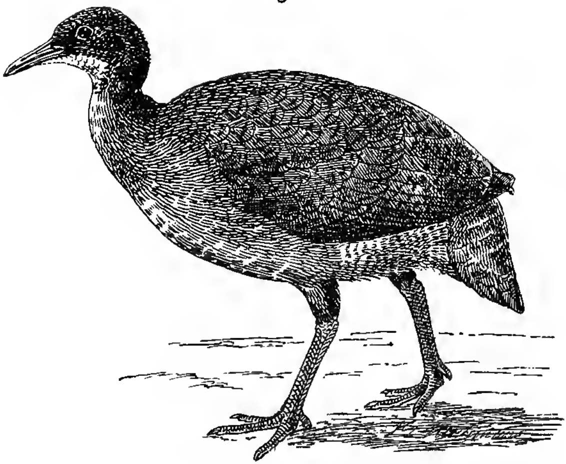


The Courser (*Cursorius gallicus*).

unremitting destruction by the curious, and even by ornithologists not ashamed of saying that thus a specimen of a rare British Bird has been by them "*obtained*"!

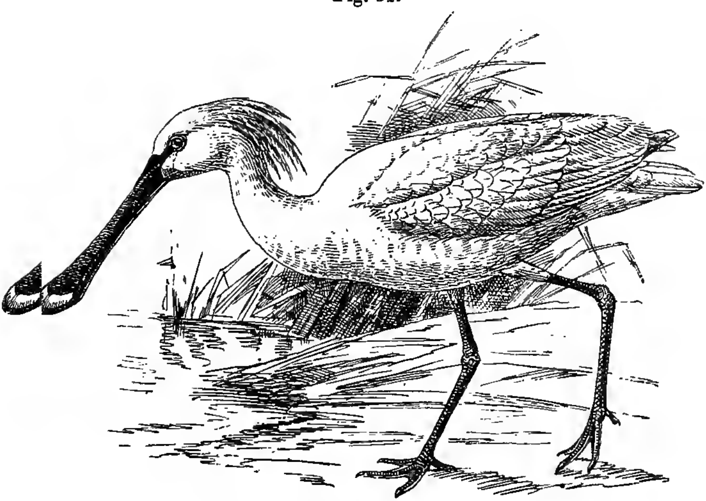
A well-known English Bird, the beak of which is not flattened but elongate and curved, is the Curlew (*Numenius arcuatus*); and it is to be found in winter on almost every part of our

Fig. 50.



The Tinamou (*Tinamus robustus*).

Fig. 51.

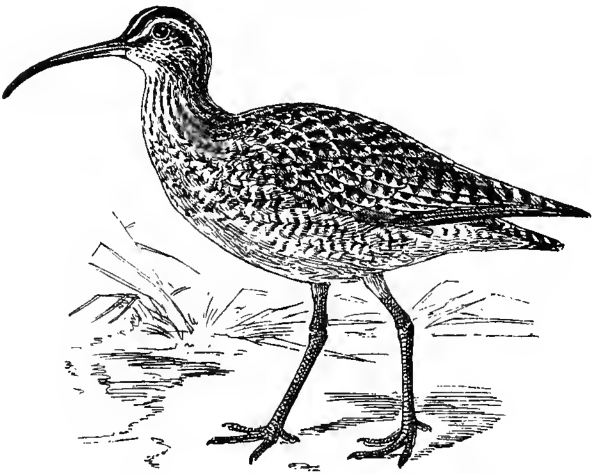


The Spoonbill (*Platalea leucorodia*).

coasts. Curlews run and walk with ease, though they take to flight at the least alarm and fly away very quickly. In summer they migrate inland to heaths and marshes, where their loud screaming cries are very noticeable. The genus to which it belongs is cosmopolitan, though it only breeds in Northern regions. It contains about a dozen species, one of which is the Whimbrel.

The long and curved beak of the Curlew may well recall to

Fig. 52.



The Whimbrel (*Numenius phæopus*).

the reader's recollection the similarly long and curved beak of the Ibis. One species of the genus, the Glossy Ibis (*Ibis falcinellus*), inhabits Africa and Europe as well as America, so it is not wonderful that it is sometimes seen in England. There are about two dozen kinds of these birds, whereof the Sacred Ibis (*Ibis æthiopica*) is the most renowned. Though so familiar an object in ancient Egyptian art, it is now rarely seen on the Nile north of Khartoum. The Scarlet Ibis of South America (*Ibis rubra*) is the most beautiful form.

Those smaller running and wading Birds, the Coursers and Curlews, naturally suggest other forms which resemble them, more or less, in external appearance or in habits; we refer to such smaller forms, still common in England, as the Plovers, Turnstones, Sandpipers, Ruffs, Snipes, and Woodcocks. The last of these, the Woodcock (*Scolopax rusticola*, fig. 54), with its enormously long straight bill, which is a delicate instrument

Fig. 53.

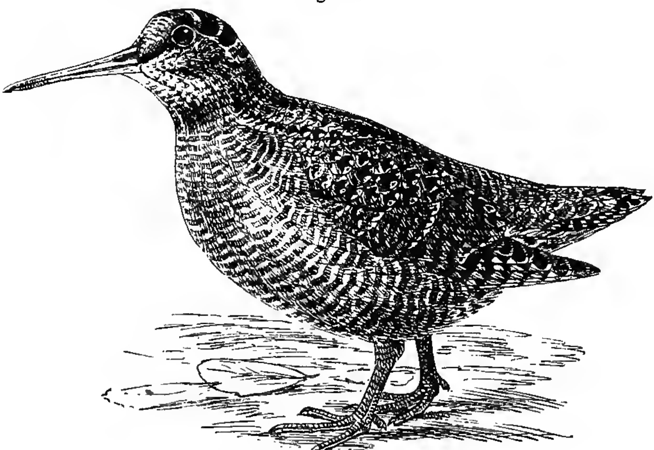
The Sacred Ibis (*Ibis æthiopica*).

of touch, belongs to a small group of four species, and is found in Europe, North Africa, and Central and Northern Asia, occasionally extending to America. Another species is truly American, while one inhabits New Guinea and another Java.

The common English Snipe (*Gallinago media*) may stand for a rather numerous group of Birds which closely resemble it, and are spread over the whole world.

The Little Stint (*Tringa minuta*) is a charming little Bird, whose graceful active movements may be observed in autumn on our Eastern coasts. It flies rapidly, but most characteristic is the way it runs along the wet sand close to the waves as they retreat, and its rapid movements to escape the waves as they return. It is one of a genus of about fifteen species, and amongst them are the English Birds known as the Knot, the Sanderling *, and the Dunlin, as well as different kinds of those Birds which are commonly called "Sandpipers."

Fig. 54.



The Woodcock (*Scolopax rusticola*).

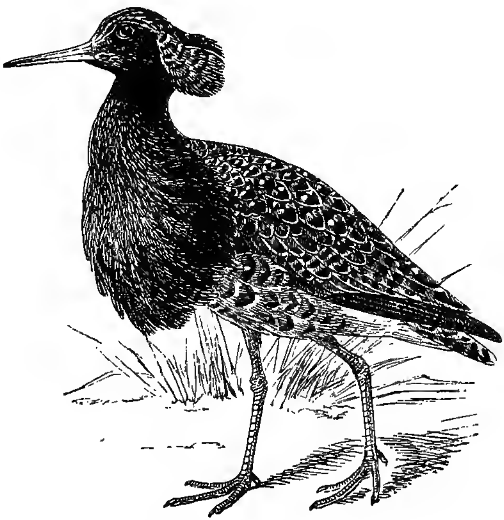
Another group of the Birds commonly called "Sandpipers" (amongst them the Common Sandpiper or "Summer Snipe"), with "Redshanks," "Willets," and "Tatlers," may be represented by our Common Redshank (*Totanus calidris*), so widely spread and generally well known in England. There are seventeen species belonging to this genus, and they are all to be found within the Northern Hemisphere.

* Some consider this to belong to a distinct genus, and name it *Calidris arenaria*.

Very like these birds is the well-known Ruff, which is as noted for its combative habits as for the handsome elongated feathers which, at the breeding-season *, adorn the neck of the cock bird. It is distinguished by the name *Machetes pugnax.*

The Black-tailed Godwit (*Limosa melanura*) represents another group of about four species, all Northern forms.

Fig. 55.



The Ruff (*Machetes pugnax*).

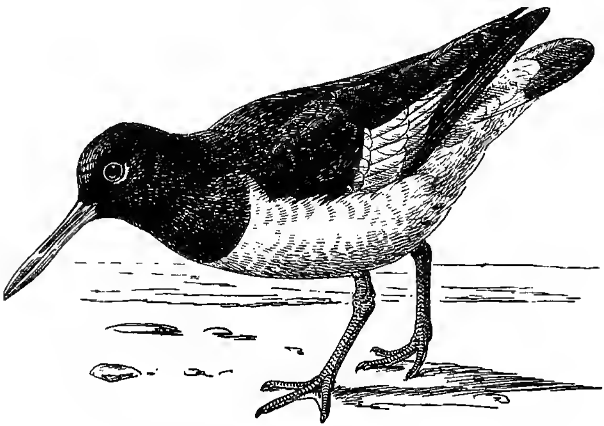
The curious Bird called the Oyster-catcher (*Hæmatopus ostralegus*), well known to most persons at all familiar with the creatures of our shores, is readily recognizable by its black and white plumage and its straight and powerful bill. They breed close to the water, and their nests are sometimes hollowed out on the sand or shingle only just above high-water mark.

* The great differences in the plumage of these Birds, according to sex, age, and season, are very remarkable. They are well exhibited in a case in the Hall of the Natural History Museum.

As might be expected under such circumstances, the Birds are able to swim. There are about seven species of Oyster-catcher, spread over all the great divisions of the earth's surface.

A great contrast to these Birds is presented by the Stilt (*Himantopus melanopterus*), with its very slender beak and exceedingly long legs. It is occasionally seen in England, but there are ten other species of the genus, four of which are found in the Australian region and two in America. The two American species and one Australian one are very often separated off and united with the graceful and singular Avocet

Fig. 56.



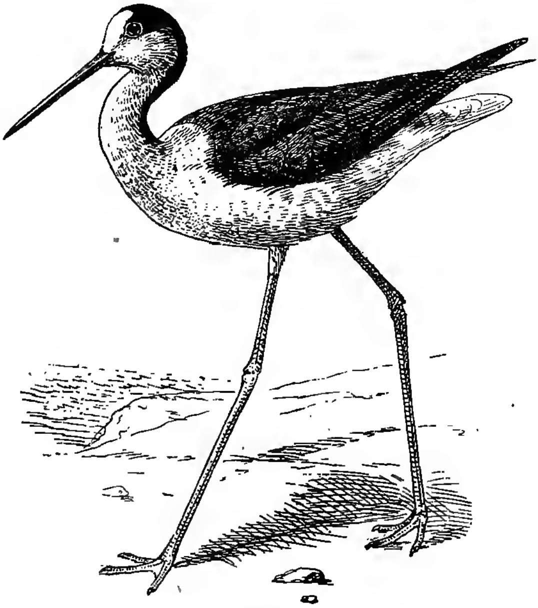
The Oyster-catcher (*Hæmatopus ostralegus*).

(fig. 58) into a separate genus termed *Recurvirostra*. The Avocet used to breed in England in Romney Marsh and the marshes of our Eastern Counties, but drainage has been fatal to it here and in many other places, and it is said only to breed now, in Northern Europe, in the islands off the coasts of Holland and Denmark. The delicate recurved beak of the Avocet when once seen can never be forgotten.

But a still more singular and absolutely peculiar bill is possessed by a New-Zealand Bird (*Anarhynchus frontalis*), or Crooked-billed Plover. Its bill is not curved either upwards or, as so commonly, downwards, but to one side (fig. 59, A).

An elegantly marked Shore Bird—with a plumage of black, white, chestnut, and brown,—which industriously searches for food amongst rocks and stones, and which, from its habits, is

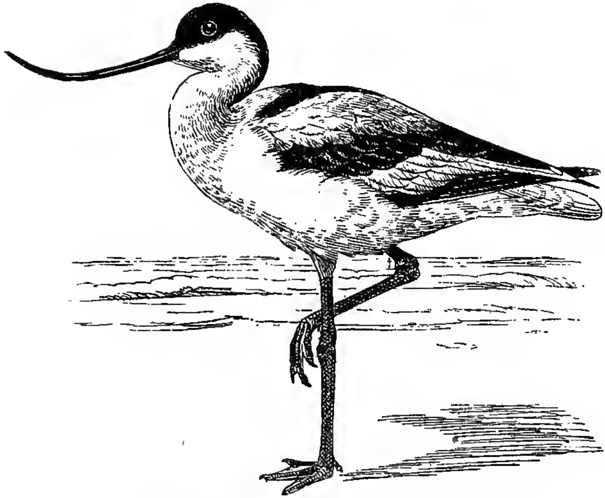
Fig. 57.



The Stilt (*Himantopus melanopterus*).

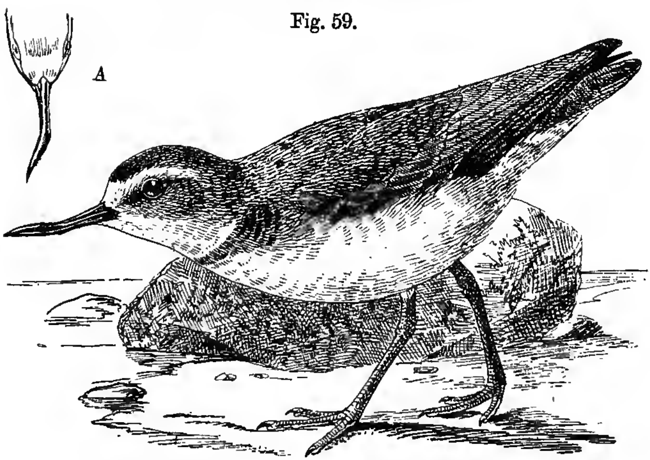
known as the Turnstone (*Strepsilas interpres*), is one of three species which are confined to high Northern regions. They greatly resemble that very familiar Bird the Golden Plover (*Charadrius pluvialis*, fig. 60), which is to be found, during summer, breeding on the high hills and swampy grounds of the North of England and Scotland. There are forty species of the genus—

Fig. 58.



The Avocet (*Recurvirostra avocetta*).

Fig. 59.



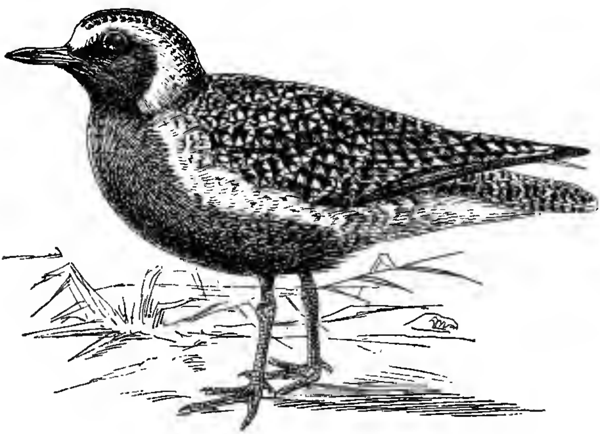
The Crooked-billed Plover (*Anarhynchus frontalis*).

A. Head seen from above, to show the lateral curvature of the bill.

the Dotterel being amongst them—whereof some are Australian, others South-American, others Indian or Ethiopian; the rest being from Northern lands.

Certain other Birds, which are variously named as "Thick-knees" or "Stone-curlews" or "Stone-plovers," are exceedingly like the true Plover. Indeed, one English species is often taken as being *the* Plover "par excellence," namely the species termed *Œdicnemus crepitans* (fig. 61). It is often called "the Great Plover" or "the Norfolk Plover," as well as by its

Fig. 60.



The Golden Plover (*Charadrius pluvialis*).

common, but misleading, name of "Stone-curlew." It is one of about nine species, whereof two are from South America, three from South or Central Africa, and three from India or Australia.

The Peewit or Lapwing (*Vanellus cristatus*), the cry and flight of which almost every one is familiar with, is the type of a group of about thirteen species, while another thirteen constitute the closely allied group *Lobivanellus*.

Here, perhaps, may be mentioned certain Birds called the Sheath-bills (*Chionis alba*), with a short and curious beak, which in manner and appearance somewhat recall the Pigeons to mind.

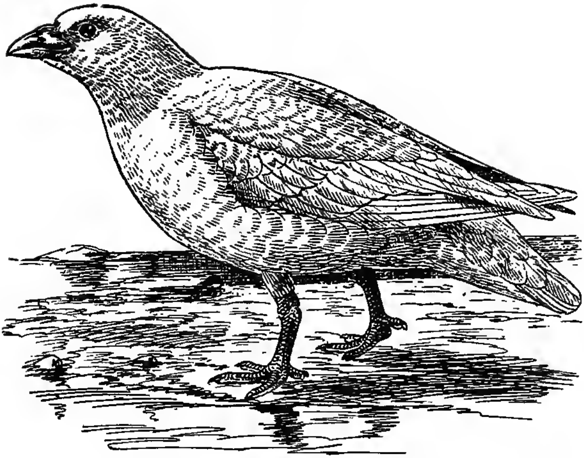
There are but two species, and they live in Kerguelen Island, the Crozettes, and extreme South America, feeding on sea-weed, eggs, and small shell-fish. A Bird called the Pratincole (*Glareola pratincola*) inhabits the temperate and warmer parts of Europe, Africa, and Asia, and occasionally visits England. It frequents the open country (marshes and sandy plains) or the sea-shore, feeding on insects, and giving out a most peculiar rattling

Fig. 61.

The Stone-curlew (*Œdicnemus crepitans*).

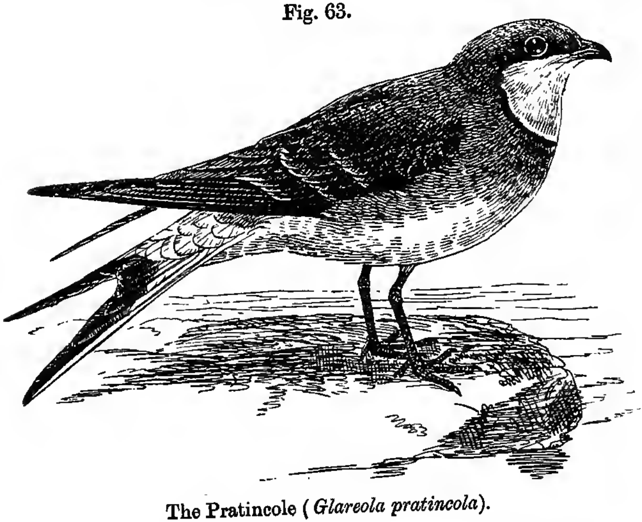
sound. It has long, pointed wings, a forked tail, and short legs, and has been a great puzzle to Naturalists as to where it should be placed in their systems. It flies about a great deal with something of the motion of a Swallow, which perhaps accounts for Linnæus having classed it with that Bird. Unlike the Swallow, however, it runs very well on the ground and even wades into pools. It is the type of a genus which consists

Fig. 62



The Sheath-bill (*Chionis alba*).

Fig. 63.



The Pratincole (*Glareola pratincola*).

altogether of ten species, whereof five are Ethiopian and two Oriental, while one is found in Australia.

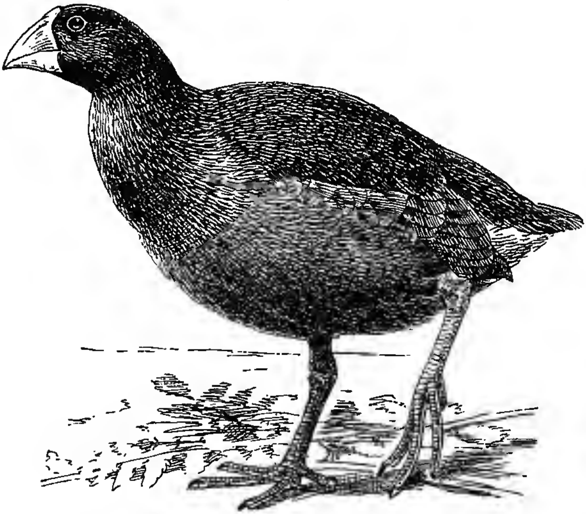
We have now briefly surveyed a great number of Wading Birds, beginning with the Rails and Coots. Their long toes we saw to be noteworthy, but there is yet another group of very similarly formed Water Birds which have their toes still more elongated to facilitate their walking over the large floating leaves of

Fig. 64.

The Brazilian Jacana (*Parra jacana*).

some aquatic plants of the warmer regions. These birds are known as "Jacanas," and the species *Parra jacana* may be taken as an example of ten or a dozen others, some of which are inhabitants of the Old World, while others are American. One form, which is the largest, has a long tail and is classed in a separate genus as the Pheasant-tailed Jacana (*Hydrophasianus* *chirurgus*). These Birds, as just said, have a superficial resemblance to Moor-hens and Coots, some forms of which need further mention here, as was before indicated *. For the Moor-hen of the island of Tristan d'Acunha and that Coot-like Bird the *Notornis* of New Zealand have (like the Penguins) no power of flight and have probably lost it. The Weka Rail of New Zealand (*Ocydromus australis*) is in the same case or nearly so, and is most easily caught. Various species of flightless

Fig. 65.



Mantell's Notornis (*Notornis mantelli*).

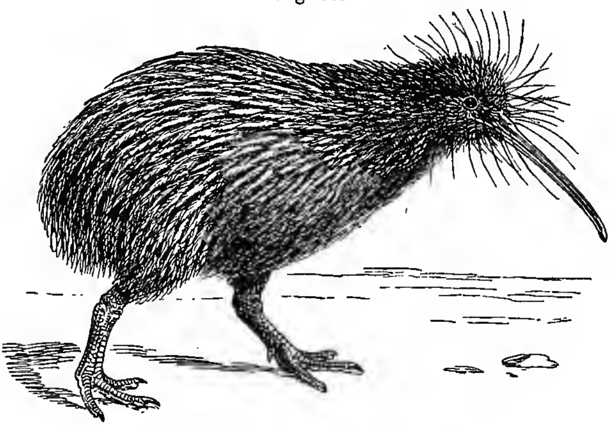
Birds have thus of late become extinct, like the Great Auk before noticed †. Thus Mantell's Notornis (*Notornis mantelli*) has become entirely extinct in the Northern Island of New Zealand, and is nearly extinct altogether.

Numerous species of gigantic Birds called "Moas" (*Dinornis*) have also been found in New Zealand, and were destroyed by the Maories. They were also flightless, and were of huge

* See above, p. 19. † See above, p. 22.

bulk. Yet a Bird of Prey (*Harpagornis*), as large as an Eagle, and with enormous talons, existed there also, and is thought to have been powerful enough to have made the smaller Moas its prey. Three other noteworthy Birds which have become extinct may here also be referred to. The first is the Dodo (*Didus ineptus*), which inhabited Mauritius and became extinct by the end of the seventeenth century. The second is the Solitaire (*Pezophaps solitarius*), which was larger than a Turkey and lived to a somewhat later day than the Dodo, but in the island of Rodriguez. The third extinct kind (*Æpyornis*

Fig. 66.



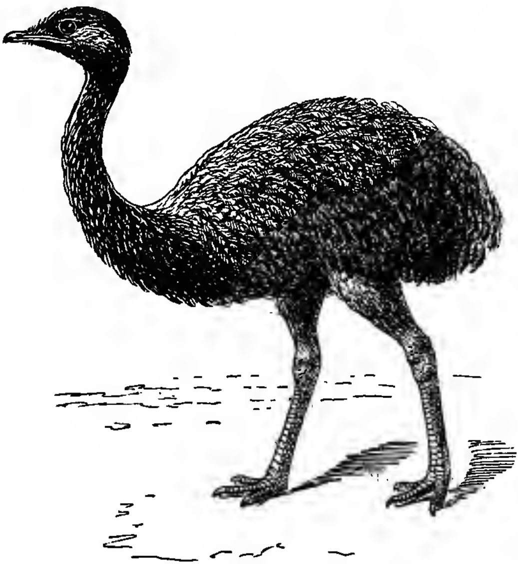
Mantell's Apteryx (*Apteryx mantelli*).

maximus) lived in Madagascar, and may have done so to within the last two centuries. It was a huge creature, and laid so enormous an egg that it may have given rise to the fable of the Roc's egg. Such is the case, because its egg may in early times have been an article of commerce; and the judgment that the size of an egg is a sure index to the proportions of the parent Bird is a very natural judgment, though an erroneous one.

Other Birds, differing much more than these from all existing Birds, became extinct in much more ancient times. Such were the *Hesperornis*, the *Ichthyornis*, and the *Archæopteryx*, which will be further noticed in our Fifth Chapter, as their peculiarities could not be appreciated by the student before becoming acquainted with the leading facts concerning the Anatomy of Birds.

Another feathered inhabitant of New Zealand is rapidly verging towards extinction, namely, the Apteryx (*Apteryx mantelli*). It lays but one egg, and can neither run rapidly

Fig. 67.



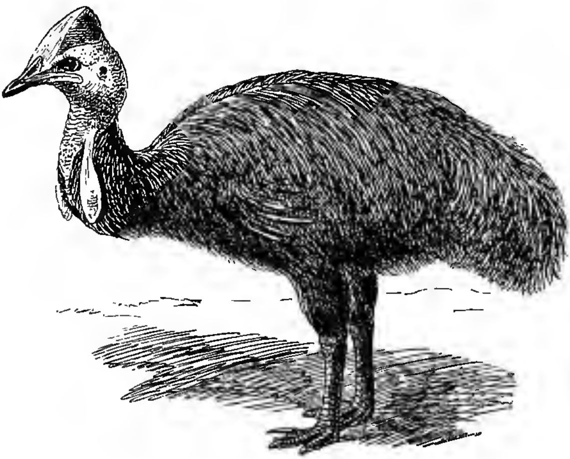
The Rhea (*Rhea americana*).

nor fly in the least. Its single egg is exceedingly large in proportion to the Bird itself, which is about the size of a Hen. There are four species of the genus, which have each a very long, curved bill and only most minute rudiments of wings.

The largest existing Bird is also a Ground-bird, and utterly incapable of flight. This is the Ostrich (*Struthio camelus*), which is exclusively an inhabitant of Africa. It is represented in South America by a smaller Bird, which is called the Rhea or American Ostrich (*Rhea americana*), of which there are really three species. Another large and bulky Bird, quite incapable of flight, is the Cassowary (*Casuarius galeatus*) of the Papuan Islands and North Australia. There are nine species of this genus. Another very similar Bird is the Emeu (*Dromæus novæ-hollandiæ*) of Australia. There are two species of this genus.

Before proceeding further it may be useful to the student to take stock a little of the forms we have referred to, and

Fig. 68.

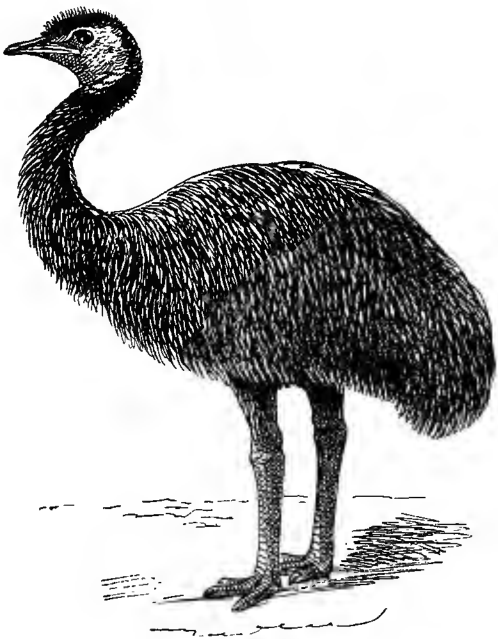


The Cassowary (*Casuarius galeatus*).

endeavour briefly to class them in a merely popular manner, referring to external appearance, or modes of life, only. It is useful for the beginner to be able to think of them in large groups (such as the groups which first suggested themselves to naturalists), even though he will find that such groups have to be largely modified owing to more recent advances in science. It is thus, indeed, that he will be best enabled to appreciate the value of such advances.

Starting with our most familiar Bird, the Fowl, we have noted, in sequence thereto, the Pheasants, Peacocks, Guinea-fowls, Turkeys, Curassows, Brush-turkeys, Grouse, and Partridges. These Birds have been regarded as really alike by earlier and later Ornithologists, and we may find it convenient to refer to them sometimes as Fowl-like or Gallinaceous Birds,

Fig. 69.



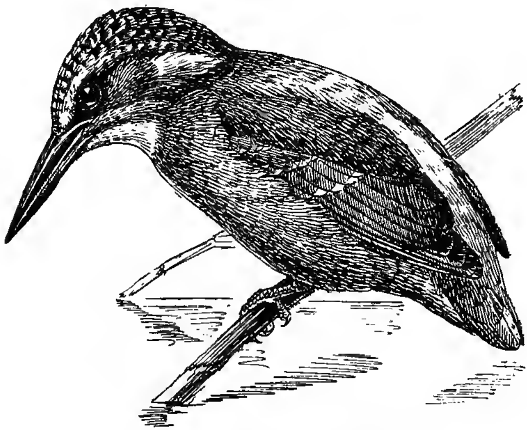
The Emeu (*Dromæus novæ-hollandiæ*).

and, from their habits, as "Scratchers," while Pigeons have been spoken of as "Cooers."

The Duck and Geese led us to Grebes, Divers, Puffins, Guillemots, Auks, Penguins, Cormorants, Gannets, Pelicans, Gulls, Terns, Skimmers, and Petrels, the superficial resemblances between which have caused them, before their anatomy was better known, to be regarded in a lump as "Natatory Birds" or "Swimmers."

The long-legged Flamingo next conducted us to the Herons, Bitterns, Storks, Cranes, and Bustards, and thence to smaller Birds, such as Coursers, Tinamous, Curlews, Snipes, Stints, Godwits, Stilts, Plovers, Peewits, and Rails, most of which are more or less long-legged, and have more or less a wading habit, on which account they have been called "Stalkers," "Waders," or "Grallatorial Birds." We were introduced to this group from the Ducks through the Moor-hens, but we ended

Fig. 70.



The Common Kingfisher (*Alcedo ispida*).

by affirming the greater resemblance between these last-named and the Rails than between them and the Ducks.

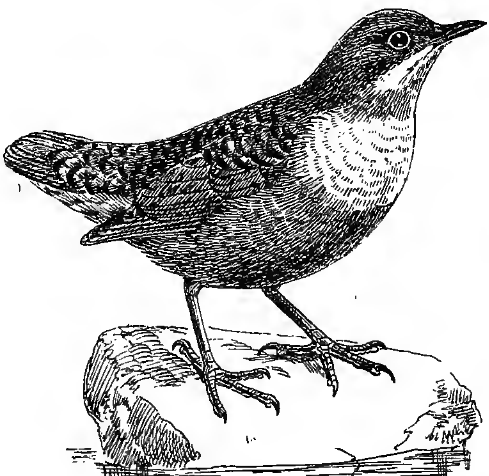
After noting certain species which have become extinct, we enumerated other kinds, which are also eminently "Stalkers" or "Cursorial Birds"—such as the Ostrich, Rhea, Cassowary, and Emeu, all of which we mentioned after referring to the Apteryx.

In days of loose classification these were regarded as forming one group with the Wading Birds above referred to, the whole being spoken of as Cursorial birds, or *Grallæ*.

We must now pass to Birds which are very different from any we have yet considered. As, however, the majority of the forms we have referred to have had to do with water, we may begin our next series of forms with one familiar kind which haunts our streams, namely, the Kingfisher (*Alcedo ispida*).

This well-known blue and red Bird, with its long, straight, and sharply pointed bill, may stand as the representative of at least one hundred and sixty-six species which are exceedingly like it. They are scattered very unequally over the whole

Fig. 71.



The Dipper (*Cinclus aquaticus*).

world, being most poorly represented in America, and most richly in the Indian Archipelago.

The Common Kingfisher loves a quiet spot—some silent pool or some secluded trout-stream with deep banks and well shrouded with foliage. It flies very straight, with its short wings rapidly vibrating, and will dart from the tree on which it has perched, seize a fish and return to beat it dead against a branch, unless it carries it to the hole it has excavated in a bank, wherein is its foul bed of rejected fish-bones. Very different is the comfortable abode—domed-shaped and formed of moss and dry grass—of the Dipper (*Cinclus aquaticus*), which also haunts our mountain streams, even passing much of its time under water searching for the small creatures on which it feeds.

Fig. 72.

The Great Black Woodpecker (*Picus martius*).

In rapid, rocky rivulets it is to be found in England all the year round. It represents a group of about a dozen species of similar habits found in both worlds, mainly in the Northern Hemisphere.

The Dipper, unlike the Kingfisher, does not perch on trees, but a Bird the very existence of which would seem to be absolutely dependent on them is the Woodpecker.

The Great Black Woodpecker (*Picus martius*), a Bird that seems to have been once or twice seen in England, and our Green Woodpecker (*Gecinus viridis*)—the loud cry, or "laugh," of which is so commonly to be heard—are examples of a very large and very distinct family of Birds.

There are about three hundred and fifty different kinds of Woodpeckers, but though so much more numerous in species than the Kingfishers, there are none in Australia any more than in Madagascar or Polynesia—none passing beyond Celebes. As might be expected, they are most abundant in the enormous forest-regions of South America, though, strange to say, a Woodpecker (*Colaptes campestris*) is to be found more to the south, in the plains of La Plata, where there is not a single tree to peck.

The handsomely marked English Bird, which, from its habit of twisting its neck from side to side, is known as the Wryneck (*Jynx torquilla*), and which will hiss like a snake, is one of a small group of four species of the Woodpecker family.

A very numerous and remarkable group of Birds, for the most part great climbers of trees, is formed by the Parrots, whereof the common Grey Parrot (*Psittacus erithacus*), from Africa, may be taken as a type. Amongst Parrots, in the wide sense in which the term is here used, we include Macaws, Cockatoos, Ground-parrots, Grass-parrakeets, Love-birds, &c. They have all a most unmistakable family resemblance, though there are, at the very least, four hundred and ninety-two kinds of them. They are especially tropical Birds, but they are also to be found in the temperate parts of Australia and in New Zealand. Australia, indeed, contains the most varied forms, though South America is the region which has the greatest number of species. Africa is poorly supplied with Parrots in comparison with the other warmer parts of the world. No representative of the group now exists in Europe, although fossil remains indicate that such was not always the case. A Parrakeet (*Conurus carolinensis*) still exists in Florida, and was abundant in the United States, further north, eighty years ago.

One of the most curious species is called the Owl-parrot (*Stringops habroptilus*), on account of its extraordinary and most exceptional resemblance to an Owl. It is found only in New

Zealand, which is also the home of another kind as exceptional in its habits as is the Owl-parrot in its plumage. This second kind is the Kea Parrot (*Nestor notabilis*), which has acquired the bad habit of feeding upon Sheep, which they will kill by puncturing them in the back, and tearing down upon the kidney, the fat of which they greedily devour.

Fig. 73.

The Owl-parrot (*Stringops habroptilus*).

It is generally supposed that we have here an instance of an extraordinary change in habit and instinct, and that the Bird was exclusively a vegetable-feeder till the introduction of sheep into New Zealand. Dr. H. Woodward, F.R.S., has, however, suggested to us, as by no means improbable, that this Bird in former days may have fed upon species of Dinornis, perching on their backs in a situation whence they could not easily be dislodged. If such was the case, it is easy to understand how the woolly back of the sheep might readily have attracted these Parrots. It would have but recalled to their imaginations associated sensations leading to acts which revived this instinct which thus had only become dormant in them.

Fig. 74.

The Kea Parrot (*Nestor notabilis*).

A variety of other groups of remarkable Birds have no representative in Europe, and many of them are exclusively inhabitants of South America, which contains the most extensive forest-region in the world.

Amongst these are the Toucans—very brightly coloured Birds with extraordinarily large, elongated, gently curved beaks, which are as remarkable for their lightness as their size. Of this group—which does not even extend to the West Indies—there are fifty-nine different species. The largest of these, the Toco Toucan (*Rhamphastos toco*), may stand as a type of the whole.

Another group of brilliantly coloured climbing Birds, with stout but very much smaller bills, are called Barbets, on account of the long bristles which project forwards around the beak. The Red-headed Barbet (*Capito erythrocephalus*), which may stand as a type, is, with a few other species, an inhabitant of

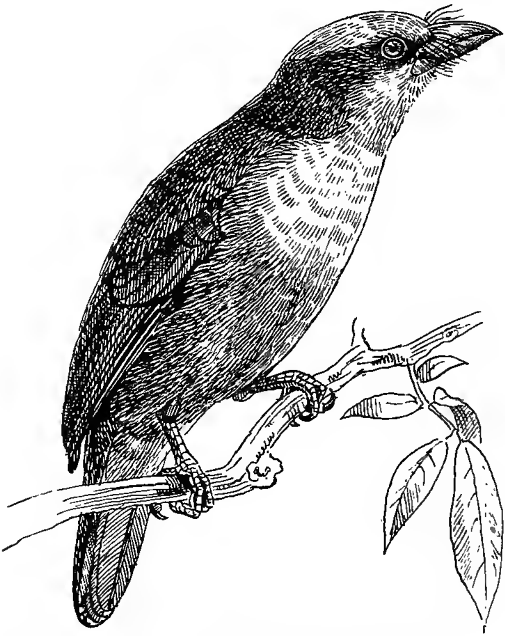
Fig. 75.

The Toco Toucan (*Rhamphastos toco*).

America, although its allies are for the most part Old World forms. Some of these are singularly local, as is known to be the case, for instance, with the Blue-faced Barbet (*Megalæma asiatica*). In a wild state they are said to feed on fruits and berries, but some of them in captivity have been known to kill small birds and swallow them whole. They probably, therefore, do so when wild. There are about one hundred and eight species.

The Puff-birds are in some respects like Barbets externally, though they are also not unlike Kingfishers. They are smaller in size than the Barbets. Forty-three species belong to the group, twenty of them pertaining to the genus *Bucco*, and the species *Bucco tectus* (fig. 77) may serve as a representative of the whole. They feed chiefly on insects, which they take on the wing, darting after them suddenly from a lofty branch, much as a Kingfisher darts after its prey. They are exclusively confined

Fig. 76.



The Red-headed Barbet (*Capito erythrocephalus*).

to South and Central America. The same is the case with the Jacamars, Birds which are sometimes taken for Kingfishers; their mode of feeding is similar to that just noted with regard to the Puff-birds. The Jacamars are usually of a green tint and have a metallic lustre. Their beaks are long and their tails wedge-shaped. The Green Jacamar (*Galbula viridis*) may serve as a type of the group, whereof there are at least twenty different species.

We have just spoken of Birds with large or long beaks, but there is a very noteworthy, though very small, group of Birds whose beaks are so transversely extended that they have obtained the name of Broadbills. The whole group consists but of a

Fig. 77.

The Banded Puff-bird (*Bucco tectus*).

dozen species, arranged in seven genera, and the Javan Broadbill (*Eurylæmus javanicus*) may stand as a type of them. It frequents the banks of rivers and lakes, feeding upon worms, and builds a pendent nest, which overhangs the water. The Broad-bills are described as very stupid Birds, which move about in small parties, and allow themselves to be shot one after the other. Some of them feed on insects in the same mode as

Fig. 78.

The Green Jacamar (*Galbula viridis*).

Fig. 79.

The Javan Broad-bill (*Eurylæmus javanicus*).

do Puff-birds. They give out either a mellow, musical note or a whistling sound.

Beaks still larger, and occasionally much heavier than those of any of the lately mentioned groups, are found in the Hornbills. These Birds are much larger than Toucans,

Fig. 80.

The Red-necked Hornbill (*Buceros ruficollis*).

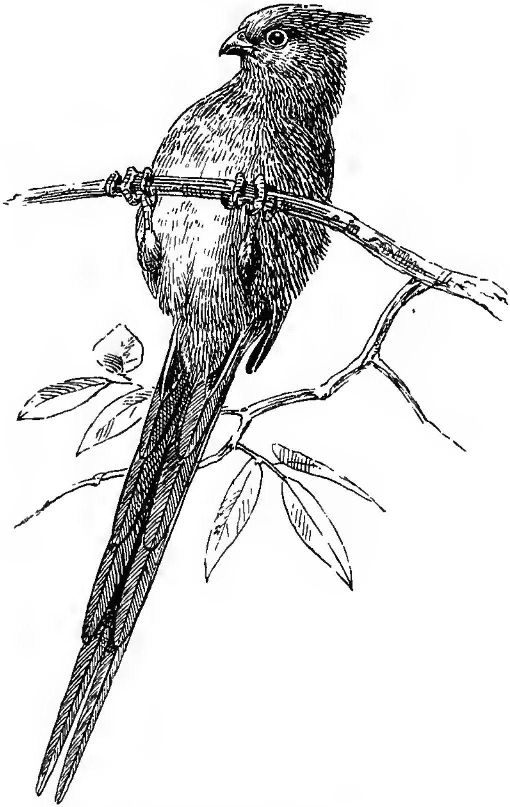
and they are as entirely confined to the warm parts of the Old World, as the latter are to those of the New. Hornbills are found in Ethiopic Africa and the warmer parts of Asia, down to New Guinea, where the Red-necked Hornbill (*Buceros ruficollis*) is to be met with. These Birds have a very curious habit. The Hen makes her nest within a hollow tree, and there her mate shuts her up, closing the aperture of the nest with mud and other substances, so that only a small opening is left. Through this aperture she and her young progeny are fed by the zealous devotion of the male Bird. There are about sixty-eight kinds of Hornbills.

Fig. 81.

The Violet Plantain-eater (*Musophaga violacea*).

There are certain other rather large Birds which may by their aspect recall to the spectator's mind the Curassows or other Gallinaceous Birds. These are the Turacous or Plantain-eaters, of which the Violet Plantain-eater (*Musophaga violacea*) may serve as an example. This very handsome Bird comes from Western Africa, and the whole group, consisting as it does of about twenty-five species, is entirely confined to that

Fig. 82.



The White-backed Coly (*Colius capensis*).

Continent, where they feed on fruit, frequenting the loftiest trees. On the head is an elegant crest of feathers, which they can elevate or depress. Almost all of them have a beautiful red colour on the wing, which can be washed away with soap and water. This colour is due to the presence of a pigment which has been termed "Turacine," which has been shown to contain copper.

Fig. 83.

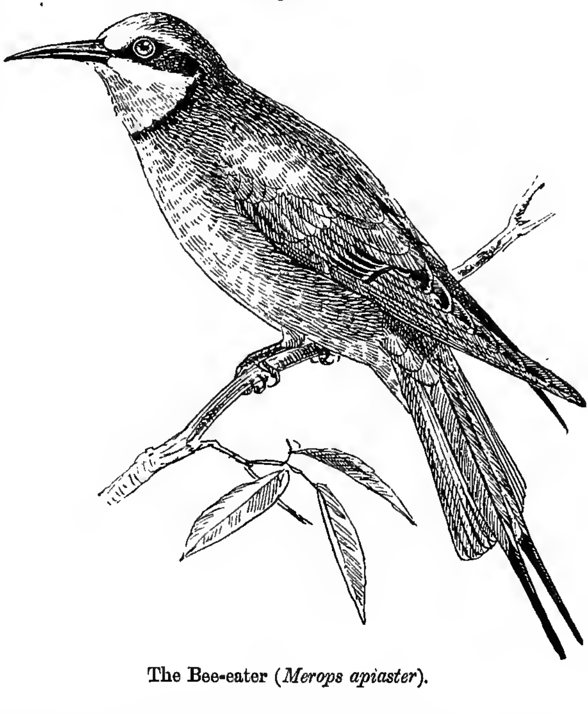
The Green Tody (*Todus viridis*).

About eight species of fruit-eating Birds are known as Colies, and they are also exclusively inhabitants of Africa. Here we again meet with a crested head, but their long tail amply serves to distinguish them from the Plantain-eaters. The White-backed Coly (*Colius capensis*) is not uncommon in

Cape Colony, where it is known as the Mouse-bird, and is said always to sleep hanging head downwards. They are short-beaked Birds, often to be seen in Zoological Gardens, for they can be kept with considerable facility.

Another small group of Birds, still more restricted geographically, are the Todies, of which there are but nine species,

Fig. 84.



The Bee-eater (*Merops apiaster*).

all confined to the West Indies. With their short tails and straight, rather long bill, they have somewhat the aspect of Kingfishers. The Green Tody (*Todus viridis*) may stand as a representative of this small group.

Birds named—from their habits—Bee-eaters are found throughout the warm and temperate regions of the Old World. They are beautiful creatures, from which the common species (*Merops apiaster*)—a Bird which is occasionally found in this country—may be selected as a type. Altogether there are thirty-five species more or less closely allied to it. They excavate, with their long bill, a cavity in some sandy bank,

Fig. 85.

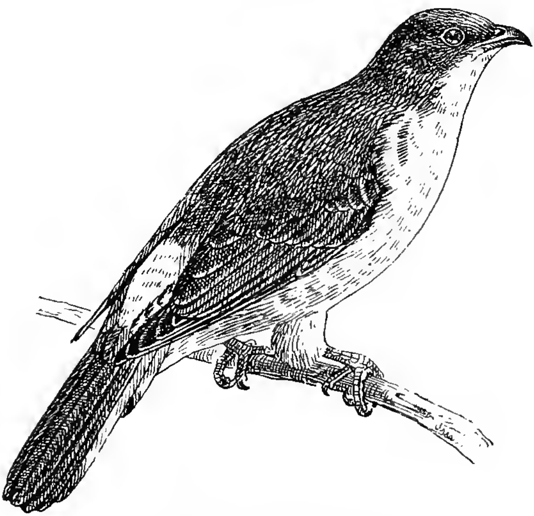
The Motmot (*Momotus momotus*).

preferentially the bank of some river, and therein make their nest. They like the open country rather than the shade of woods, and they are conspicuous from their bright coloration.

Birds which much resemble the Bee-eaters, but which are entirely confined to Central and South America, are the Motmots, of which the Motmot *par excellence* (*Momotus momotus*) may serve as the representative. There are nineteen species in this group, arranged in seven genera. These Birds go about alone or in pairs, often sitting motionless on a branch till they dart off to snatch some insect. They appear to have a singular habit of cutting away with their toothed bill, in a regular symmetrical manner, certain parts of the feathers of the tail.

Another very small group, numbering about eleven species, consists of Birds which are called Honey-guides or Indicators, the majority of which come from Africa—about a

Fig. 86.

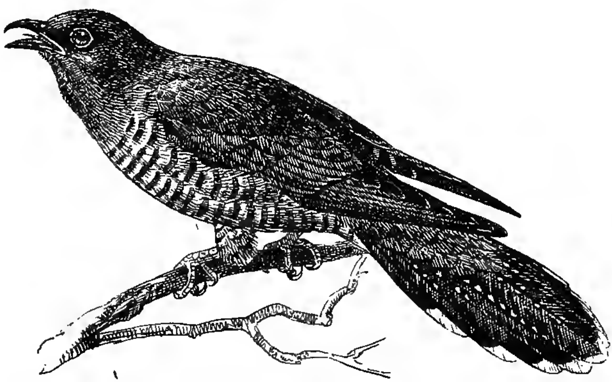


The Honey-guide (*Indicator major*).

couple of species coming from India and the Malay Archipelago. The species named *Indicator major* (which inhabits South and West Africa) may be taken as a type. It is firmly believed in Africa that these Birds will guide people to bees' nests, and feed upon what honey may be left when the nests have been successfully taken. They should, however, rather be called Bee-guides than Honey-guides, since their object is to be able to feed on the Bee-grubs, not on the honey, and they will guide to nests which contain no honey. The Indicators are plain Birds, and have a very bad habit, since they will lay their eggs in other Birds' nests.

In this they resemble the Cuckoo (*Cuculus canorus*), a Bird with which almost all Englishmen must be familiar—at least as regards its monotonous song. It is a type and representative of a wonderfully distinct group of Birds, which includes about one hundred and sixty-five species, although to the uninstructed eye they may not seem nearly so distinctly

Fig. 87.



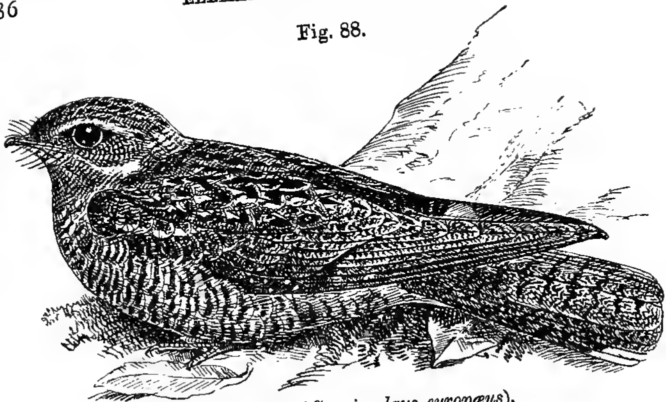
The Cuckoo (*Cuculus canorus*).

marked a group as those which contain the Parrots, Woodpeckers, or Kingfishers. Ornithologists associate with them the group of Plantain-eaters, before noticed *, making a group of one hundred and ninety-one species, at the least. Cuckoos are very widely diffused, and extend into both the Old and New Worlds, including Australia and the West Indies. They seem to be absent from the coldest regions alone.

In summer evenings, in the South of England, a curious noise, like the sound of a small rattle, is very commonly to be heard.

* See *ante*, p. 79.

Fig. 88.



The Nightjar (*Caprimulgus europæus*).

Fig. 89.

The Hoopoe (*Upupa epops*).

This is the voice of the Nightjar or Goatsucker (*Caprimulgus europæus*). The Bird itself will often suddenly appear, rising almost from under the spectator's feet, flying away with a curious, jerking, irregular motion, something like the flight of certain Moths. It is a very handsome Bird, having its feathers marked with many delicate, dark bars. It lives exclusively on insects, especially Moths and Beetles, which its wide-gaping

Fig. 90.

Jackson's Wood-hoopoe (*Irrisor jacksoni*).

mouth is admirably adapted to catch. It is a type of a well-marked group of about eighty species, arranged in at least five genera.

No greater contrast could well exist between two Birds of not very dissimilar size than exists between the Nightjar and the Hoopoe (*Upupa epops*). The latter has now become very rare in England, because, unlike the Nightjar, it is no sooner seen than it is "obtained" by some zealous collector. It is a striking and elegant Bird, with a long, slender, slightly curved bill, and a large spotted crest of feathers which can be raised or depressed. It passes much of its time on open ground searching for insects. The male feeds the female when sitting on her rough nest in a hole in some tree, thus reminding us of the Hornbill, although the hen Hoopoe is not enclosed, and probably

Fig. 91.

The Long-tailed Trogon (*Trogon macrurus*).

leaves her nest occasionally. It is the type of a very small group of some fourteen species, of which only five belong to the genus *Upupa*, and the whole fourteen members of the group are confined to the Old World, excluding Australia and the Indian Archipelago.

Included in this group are the Wood-hoopoes (*Irrisor*), which are peculiar to Africa, where they inhabit the forests. Of these, Jackson's Wood-hoopoe (*Irrisor jacksoni*) may serve as our type (fig. 90).

There is a very gorgeous group of Birds, with glowing brilliant metallic hues, which are known as Trogons. Of these there are a

Fig. 92.

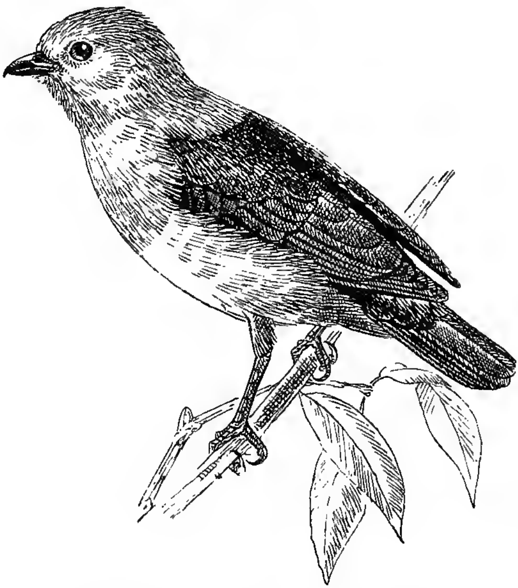
The Lyre-bird (*Menura superba*).

little less than fifty kinds, thirty-three of which are inhabitants of Tropical America, and the long-tailed Trogon (*Trogon macrurus*) may stand as a type of these very handsome creatures.

Still more beautiful and much more varied than the Trogons are the renowned Birds of Paradise, of which the largest known form, *Paradisea apoda*, may be taken as the representative.

Of these wonderfully ornamented Birds, there are fully forty-four species; but they are nevertheless exceedingly restricted in range, none being found in any part of the world but the Moluccas and New Guinea, savo one or two in Australia.

Fig. 93.

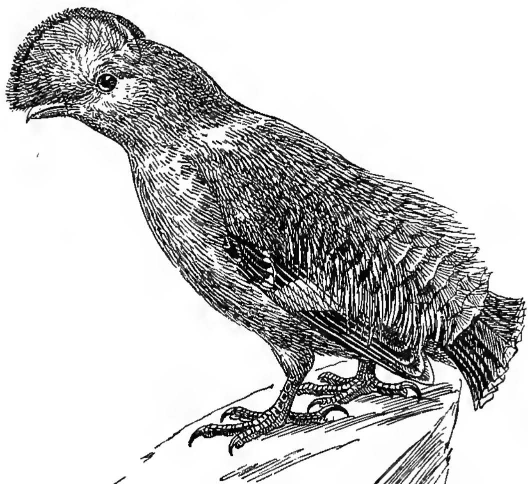


The Yellow-throated Manakin (*Pipra aureola*).

There is a Bird the curious tail of which reminds us a little of Birds of Paradise, in spite of its dull colour. This is the Lyre-bird (*Menura superba*), so-called from the peculiar disposition and form of its tail-feathers (fig. 92). It and two allied species are peculiar to Australia.

A group of small birds of brilliant plumage, and entirely confined to South America, are the Manakins, of which the Yellow-throated Manakin (*Pipra aureola*) may stand as an example. This little bird from Guiana is red with a black back, tail, and wings, and a yellow throat. There are about fifty-nine species of the group to which it belongs. They are all small shy birds which are dwellers in woods.

Fig. 94.



The Cock-of-the-Rock (*Rupicola crocea*).

A curious and very handsome Bird of an orange-red colour is called the Cock-of-the-Rock (*Rupicola crocea*), the antics of which have been so well described by Mr. Darwin. It comes from Cayenne.

The Umbrella-bird (*Cephalopterus ornatus*, fig. 95), so-called from its peculiar crest, and the Bell-bird (*Chasmorhynchus nudicollis*, fig. 96), which derives its name from its wonderful note, are likewise South-American Birds, as is also the Blue Chatterer

(*Cotinga cœrulea*) of Cayenne. This last is a type of a group of some hundred and ten species to which the Cock-of-the-Rock and the Umbrella- and Bell-birds also belong—a group known as the *Cotingidæ.*

Yet another exclusively South-American Bird is, as we shall hereafter see, of extraordinary interest, owing to its exceptional structure, and the divergence of opinion which has existed, and

Fig. 95.

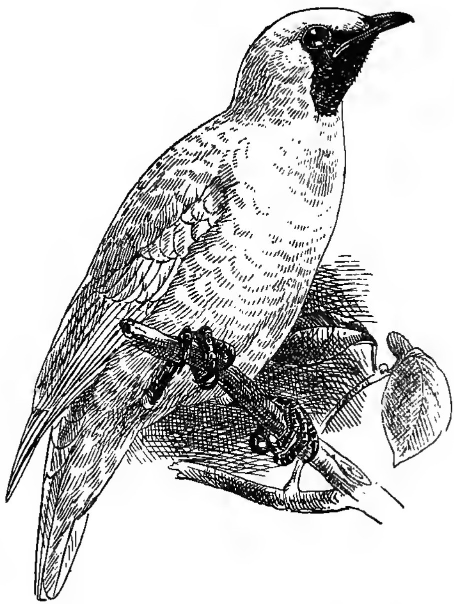
The Umbrella-bird (*Cephalopterus ornatus*).

exists, as to its true affinities. This is the Hoatzin (*Opisthocomus cristatus*, fig. 97), which inhabits Guiana and the immense Valley of the Amazon. When hatched, it has two well-developed fingers, each with a claw, and is said to creep about on all fours like a Quadruped.

The curious and rapidly disappearing Huia-bird of New Zealand (*Heteralocha acutirostris*) is very remarkable because the two sexes have very differently shaped beaks. The male's is short, straight, and conical; the female's is long, slender, and very much curved (fig. 98).

The Bower-birds, so noted for the playing-places, or

Fig. 96.



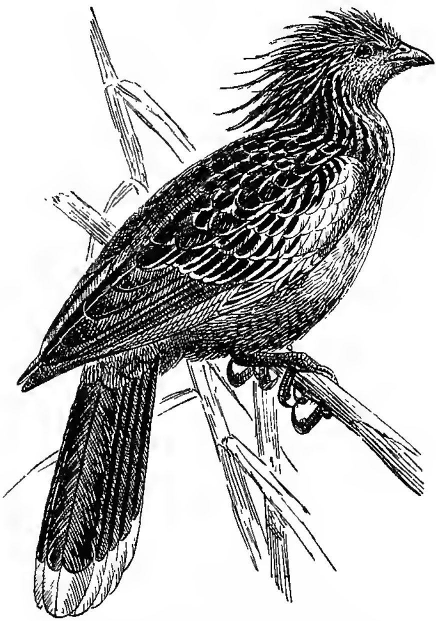
The Bell-bird (*Chasmorhynchus nudicollis*).

"bowers," which they construct, and which do not serve as nests, are a small group of sixteen species absolutely peculiar to Australia and New Guinea. Of these, the Satin Bower-bird (*Ptilonorhynchus violaceus*, fig. 99) will afford a good example.

We may now return to consider certain Birds which are represented in our own region of the world. The Common Roller

(*Coracias garrula*, fig. 100), which tumbles in the air somewhat like a Tumbler-pigeon, is a very handsome bird which is common in the South of Europe, and occasionally visits England. It is the type of a group of bright-coloured Birds which extend southwards to Australia, the Malayan region, and Madagascar, but

Fig. 97.

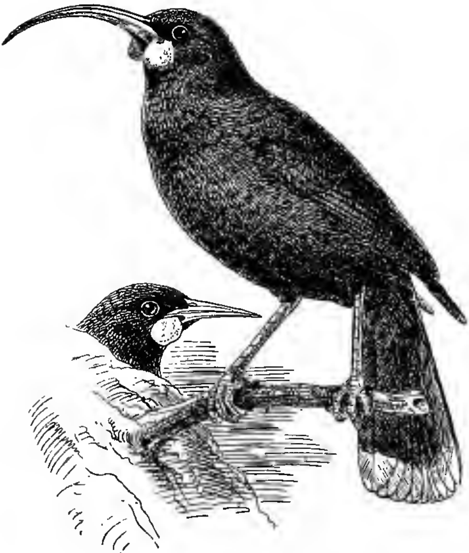


The Hoatzin (*Opisthocomus cristatus*).

are absent from the New World. There are twenty-four species in the family. An allied form from Madagascar, called the Cyrombo (*Leptosoma discolor*), has a similar tumbling habit and a peculiar condition of the nostrils.

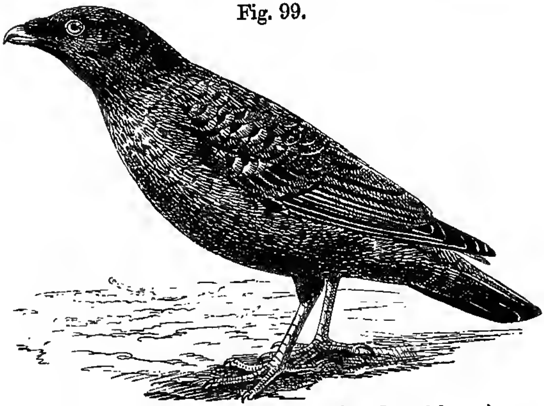
That very familiar Bird the House-martin (*Chelidon urbica*)

Fig. 98.



The Huia-bird (*Heteralocha acutirostris*).

Fig. 99.

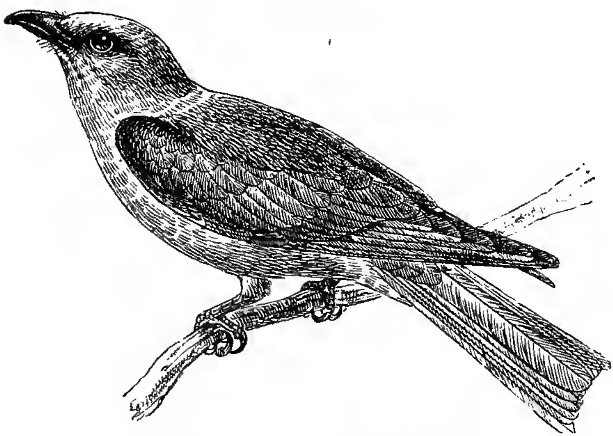


The Satin Bower-bird (*Ptilonorhynchus violaceus*).

represents a group of Swallows and Martins which is spread over the whole world, and contains about eighty-two species. Of these the Common Swallow (*Hirundo rustica*) may answer as our example.

Swifts greatly resemble Swallows in general appearance and in their mode of flight, though this is much more powerful. Nevertheless, as we shall see, they are really very distinct from them. They number about eighty-six different kinds, which range through the warm and temperate regions of the

Fig. 100.



The Common Roller (*Coracias garrula*).

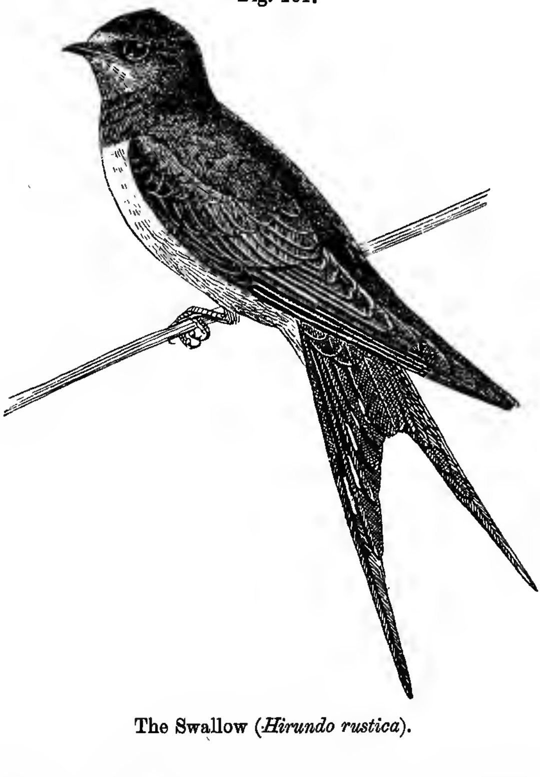
globe. The Common Swift (*Cypselus apus*) stays with us little more than three months, quitting our shores for the South about the middle of August.

Extremely contrasted with the Swift is that charming little, bush-loving Bird the Wren (*Anorthura troglodytes*, fig. 102), the lively shrill note of which may be heard all the year round. It is an example of a numerous group of small, similar Birds numbering some hundred and thirty-four species, the great majority of which are exclusively American. The Golden-crested Wren

(*Regulus cristatus*) is a yet more attractive example of a very small group of but six species.

There is a very lovely group of little blue and black Australian Birds which have a somewhat similar aspect to Wrens. Their fifteen species constitute the genus *Malurus*.

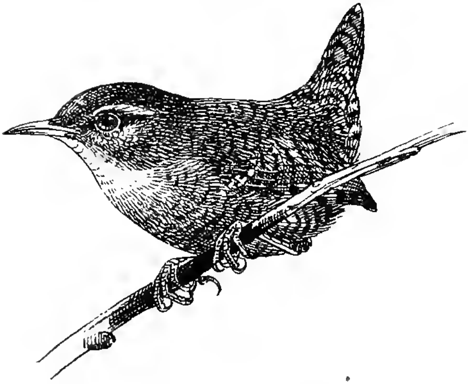
Fig. 101.



The Swallow (*Hirundo rustica*).

With its small tail and shortish bill, the Wren may remind the reader of another lover of trees which resides with us all the year round. This is the Nuthatch (*Sitta cæsia*), which is so noticeable for its habit of running up and down the trunks of

Fig. 102.



The Wren (*Anorthura troglodytes*).

Fig. 103.

The Nuthatch (*Sitta cæsia*).

trees, to which it clings with its strong feet. This Bird may serve as an example of a group of about twenty-eight species which are found scattered over the Northern Hemisphere south of the Arctic regions.

Its peculiar movements recall to mind another nearly allied English Bird, the Common Creeper (*Certhia familiaris*), which is found all over England, and has received its name from its

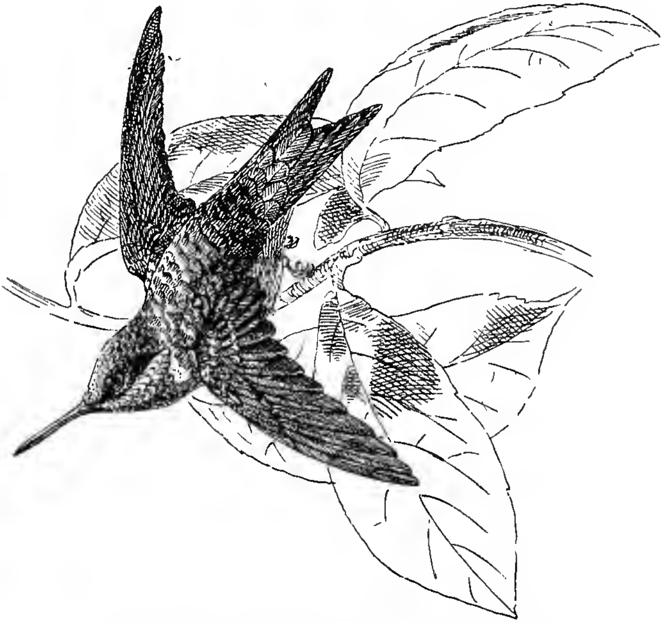
Fig. 104.

The Warty-faced Honey-sucker (*Meliphaga phrygia*).

creeping motion over tree-trunks, which has been compared to the movement of a mouse. It has a much longer, more slender, and curved bill, and is a type of a group, containing about sixteen species, which is nearly allied to the Nuthatches. Except one Mexican species they are all Old-World forms and several pertain to Australia.

Another set of Australian Birds are the Honey-suckers or Honey-eaters, which, with their long, slender, and curved bills, form a very characteristic zoological feature of that region. More than one hundred and forty different species belong to the group, whereof the curious, black and yellow, warty-faced Honey-sucker (*Meliphaga phrygia*) may be taken as a type. They are not absolutely confined to Australia, but extend into

Fig. 105.



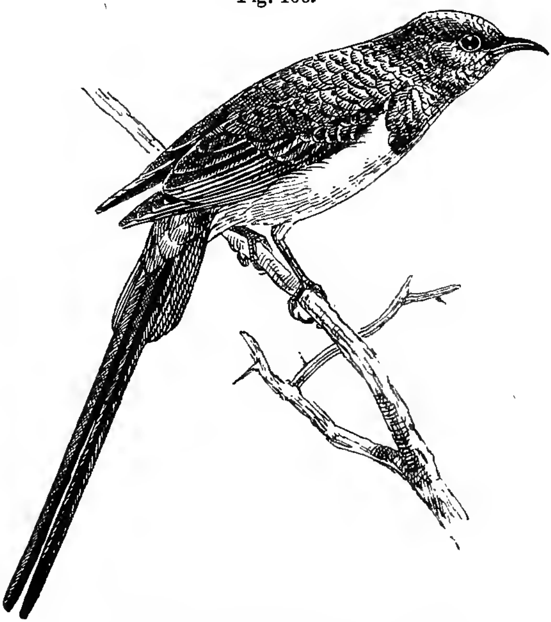
The Ruby-throated Humming-bird (*Trochilus colubris*).

the islands of the Pacific, while the largest member of the group, known as "the Parson Bird," has its home in New Zealand.

Long and slender bills are also characteristic of those most beautifully coloured of all Birds—the Humming-birds, from amongst which we may select the Ruby-throated one (*Trochilus colubris*) as our example. There are, at the least, four hundred and seventy-six species of these Birds. They are all exclusively confined to America, but different species are so distributed that the whole group may be said to range over that continent from Alaska to Patagonia.

Only second to the Humming-birds in beauty are the Sun-birds, which are as exclusively confined to the Old World as the Humming-birds are to the New. They are mainly African

Fig. 106.

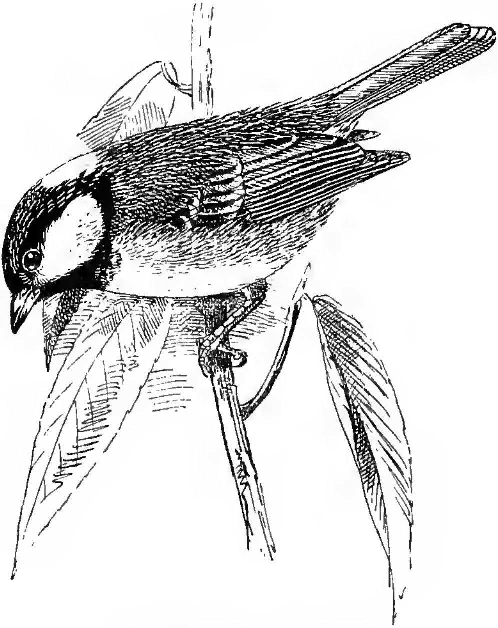


The Metallic Sun-bird (*Nectarinia metallica*).

forms, but they also range through India to Australia. The Metallic Sun-bird (*Nectarinia metallica*) may be taken as a type of the group, which embraces a hundred and five different species, arranged in nine genera. They have long and slender bills like the Humming-birds.

Of those charming familiar little Birds known to us as Tits, one of the most charming is the Blue Tit (*Parus cœruleus*), which shows itself even in our towns. We take the Coal Tit (*Parus britannicus*) as our example of this group of Birds, of which there are seventy-seven species, the greater number, and the brighter kinds, being confined to the Old World. With few exceptions, they do not extend beyond the Northern Hemisphere.

Fig. 107.



Coal Titmouse (*Parus britannicus*).

A very numerous group of small, brilliant Birds, confined to America, and mainly to Tropical America, are known as Tanagers, and there seem to be no less than three hundred and seventy-four species of them. Their plumage is very often more or less extensively or markedly red, but may be of various other bright tints, and *Tanagra episcopus*, which may stand as our type, is of a pale blue colour marked with white spots.

Fig. 108.

The Golden Oriole (*Oriolus galbula*).

Fig. 109.

The Chaffinch (*Fringilla cælebs*).

A beautiful black and yellow Bird, which is occasionally to be seen, during the spring, in the South or East of England, is known as the Golden Oriole (*Oriolus galbula*). It is common

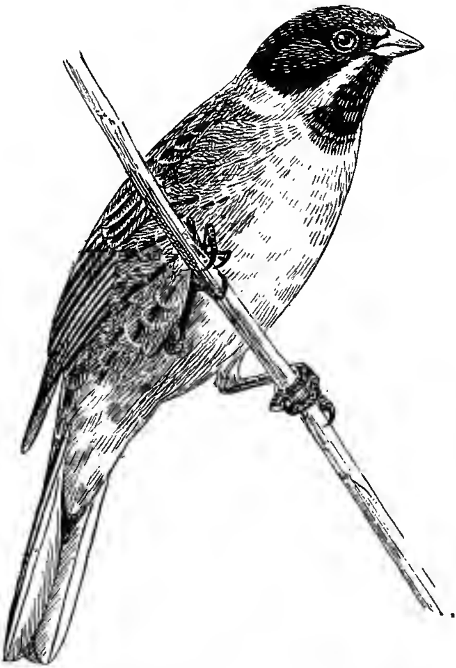
Fig. 110.

The Crossbill (*Loxia curvirostra*).

enough in Europe during summer, but in the winter it retreats to South Africa. In spite of its conspicuous coloration it is not easily seen, because it loves to conceal itself amongst dense foliage. It feeds mainly on insects and caterpillars, but also on fruit, and has a beautiful flute-like note. It is the type of a group containing at least about thirty-seven species. They are all Old-World Birds, mainly inhabitants of Asia and Australia, though a few are African, as is the one which sometimes reaches our shores.

That handsome familiar little Bird the Chaffinch (*Fringilla*

Fig. 111.

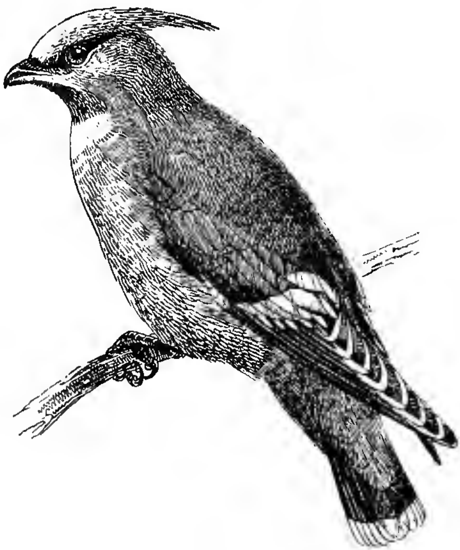


The Reed Bunting (*Emberiza schœniclus*).

cœlebs) is a type of a very large group of Birds called *Finches*, to which the House Sparrow (*Passer domesticus*) also belongs, as likewise does the curious Crossbill (*Loxia curvirostra*), the Virginia Nightingale (*Cardinalis virginianus*), and the luscious Ortolan or Green-headed Bunting (*Emberiza hortulana*), and the marsh-loving Reed Bunting (*Emberiza schœniclus*), but not the true Nightingale. Of this large family-group of stout-billed Birds there are more than five hundred different species, some or other of which are found all over the globe, except in Australia.

The Bohemian Waxwing (*Ampelis garrulus*), an occasional visitor in England, is an example of a small group of nine species of Northern forms. It is one of the most beautiful

Fig. 112.



The Bohemian Waxwing (*Ampelis garrulus*).

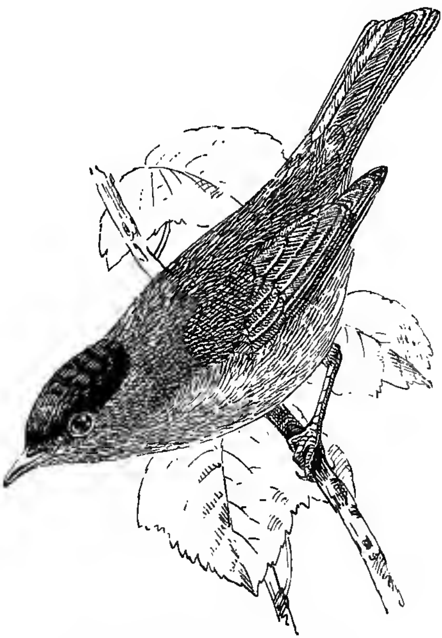
Birds ever to be found in our country, and its name is derived from curious appendages, like small pieces of sealing-wax, which are attached to certain feathers of its wing.

The Blackcap (*Sylvia atricapilla*), which is the best-known of our Warblers, and one of the earlier arrivals of the spring (the song of which is considered as hardly inferior in quality to that of the Nightingale), is the type of a group within which the

Sedge Warblers and the Wood Wren are also contained. It embraces about two hundred and ninety species. They are all dull-coloured Birds inhabiting the Old World, having their headquarters in the countries surrounding the Mediterranean Sea.

But there are a number of other Birds, also called Warblers,

Fig. 113.

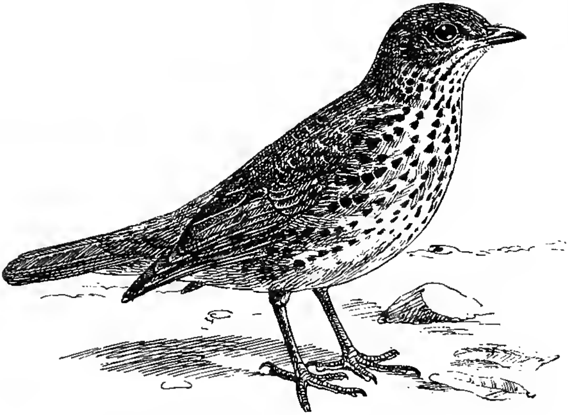


The Blackcap (*Sylvia atricapilla*).

but distinguished as "American Warblers" (*Mniotiltidæ*), of which there are some hundred and thirty-seven kinds.

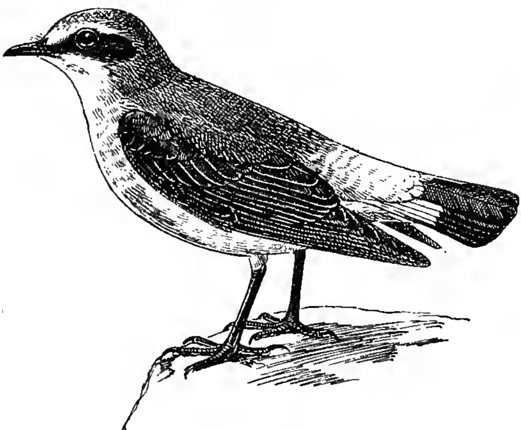
The songster whose note is the most familiar to the inhabitants of these islands is, perhaps, the Thrush (*Turdus musicus*), and it is the type of a large cosmopolitan family of Birds numbering fully three hundred and forty-four species. Amongst

Fig. 114.



The Thrush (*Turdus musicus*).

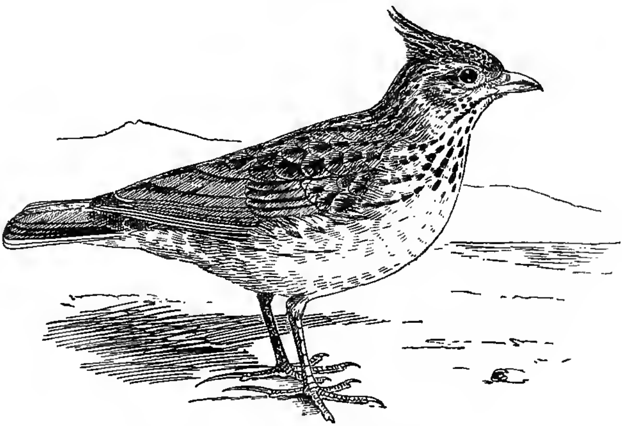
Fig. 115.



The Wheatear (*Saxicola œnanthe*).

these are the not less familiar Blackbird, the Fieldfare, the Wheatear (*Saxicola œnanthe*), our Robin (*Erithacus rubecula*), and, most distinguished of all, the ever-welcome Nightingale (*Erithacus luscinia*). Not less welcome, because most melodious, even in the month of March, is the song of the Sky-lark (*Alauda arvensis*). It is one of a group of about seventy species which, with two exceptions, are all confined to the Eastern Hemisphere. One of the most familiar on the continent of Europe is the Crested Lark (*Galerita cristata*).

Fig. 116.

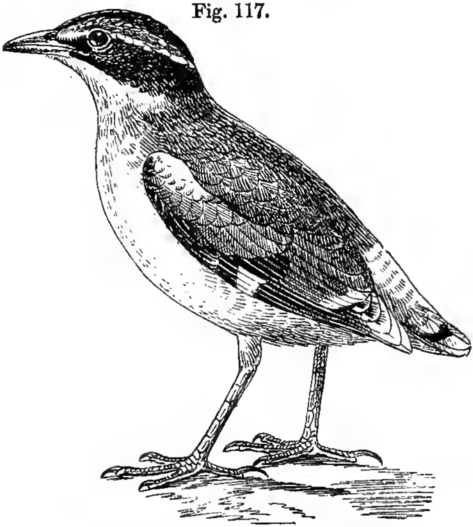


The Crested Lark (*Galerita cristata*).

The renowned American Mocking-bird (*Mimus polyglottus*) is the type of another family, numbering forty-seven species.

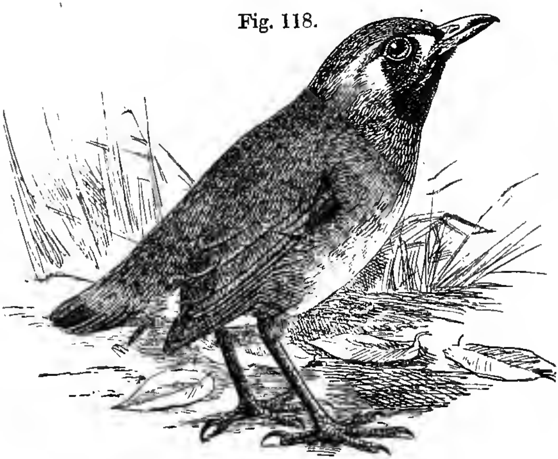
Certain Birds called "Ant-thrushes" may, on account of this denomination, be here referred to, though they cannot be considered to resemble Thrushes at all. They are more properly called Pittas, and the Bengal Pitta (*Pitta bengalensis*) may be considered as a representative of about fifty species. All of them are confined to the Old World, the Malay Archipelago being their headquarters, whence they extend, in different directions, to Australia, Africa, and Northern China. They are

Fig. 117.



The Bengal Pitta (*Pitta bengalensis*).

Fig. 118.

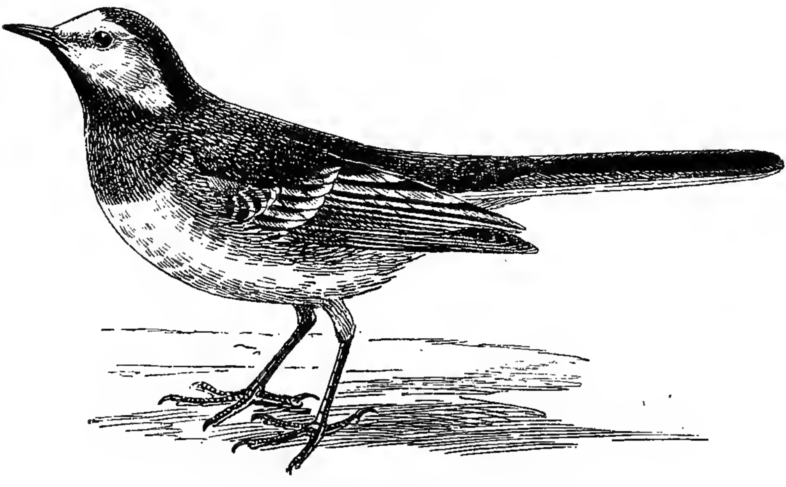


The Brazilian Ant-thrush (*Formicarius crissalis*).

noisy Birds, dwelling in forests, and remarkable for their brilliant coloration. They feed on insects, snails, slugs, and other small creatures.

Certain birds are known as American Ant-thrushes, and they have much the habit of Butcher-birds. They rarely descend to the ground, and are very noisy. The Brazilian Ant-thrush (*Formicarius crissalis*) may stand as a type of the group, which contains some two hundred and fifty-four species.

Fig. 119.

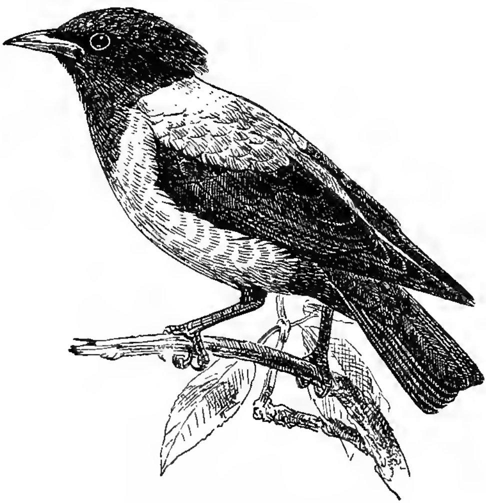


The Barred Wagtail (*Motacilla lugubris*).

The Wagtail, or Dishwasher (*Motacilla lugubris*), is a type of an almost exclusively Old-World group of Birds—Wagtails or Pipits—consisting of about sixty-four species, one section of which is very like our Wagtail, while another resembles our Meadow Pipit (*Anthus pratensis*), which is to be seen on commons and waste grounds all the year round.

The Common Starling (*Sturnus vulgaris*), with which almost all our readers must be familiar, is a convenient example of another group of Birds containing about thirty-five species, which are exclusively Old-World in distribution. One of them is the Rose-coloured Starling or Pastor (*Pastor roseus*), which has been often shot in England, though it can only be regarded as one of the accidental visitors to our shores, whereof it is one of the handsomest. Starlings may often be seen perched on the backs of sheep or oxen, which they benefit by extracting from them ticks and other parasitic pests. Another species of

Fig. 120.

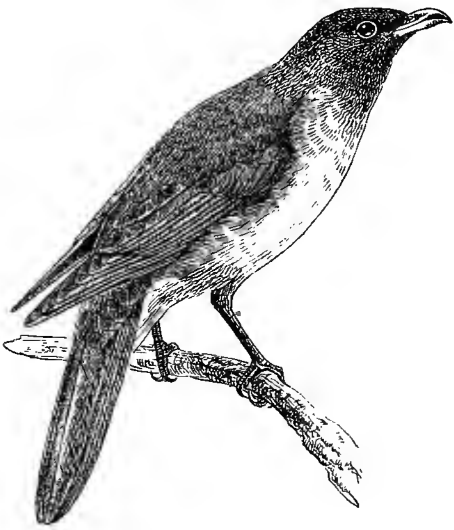


The Pastor (*Pastor roseus*).

Bird, however, called the Beef-eater or Oxpecker (*Buphaga erythrorhycha*), found in South Africa, similarly perches on the backs of cattle for parasites, especially the grubs, or larvæ, of a fly (*Œstrus*). In extracting these, however, it is apt to produce bad sores. There are two species of this genus.

A Bird is often to be seen in our Zoological Gardens which is pretty sure to attract attention by the eye or the ear, or by both. It attracts the eye by its conspicuous bright yellow wattles which project from its head, which, with the body, is of a fine velvety black. It attracts the ear not only by its very loud note, but frequently by the sentences it articulates, for it can be easily taught to speak. This is the Grackle or Myna of India (*Eulabes religiosa*, fig. 122). There are at least five species of the genus, and it is the type of a family-group of Birds of about ninety-three different kinds, all of which are

Fig. 121.

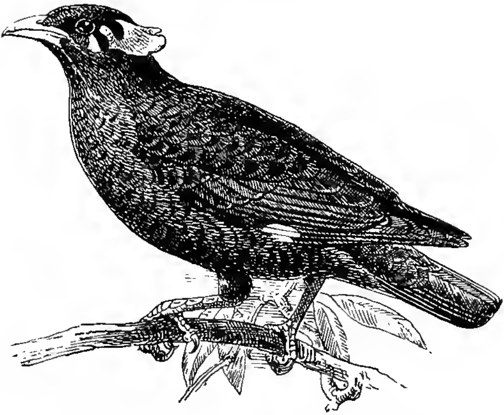


The Red-billed Oxpecker (*Buphaga erythrorhyncha*).

inhabitants of the Old World. The Grackles are mainly dwellers in hill-forests, dwelling in the highest trees, living on fruit, and never descending to the ground.

This noisy bird may recall to mind our noisy and bright, though very differently coloured, Jay (*Garrulus glandarius*); it is the type of a large group of Birds—the family of Crows—numbering about a hundred and sixty-four species, some or other of which are to be found in most parts of the world. Amongst

Fig. 122.



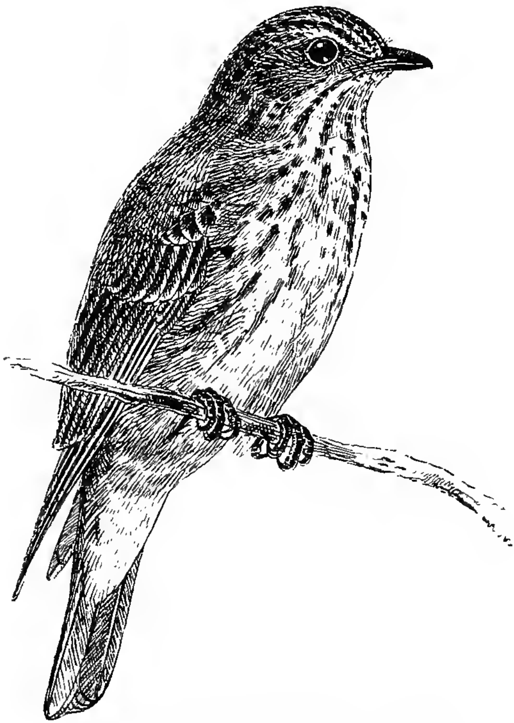
The Southern Grackle (*Eulabes religiosa*).

Fig. 123.

The Magpie (*Pica pica*).

them may be enumerated the Magpie (*Pica pica*), the beautiful blue Magpie from the East (*Urocissa erythrorhyncha*), the Common Rook (*Trypanocorax frugilegus*), the Jackdaw, the Chough (*Graculus graculus*), and many more. This Corvine

Fig. 124.



The Spotted Flycatcher (*Muscicapa griseola*).

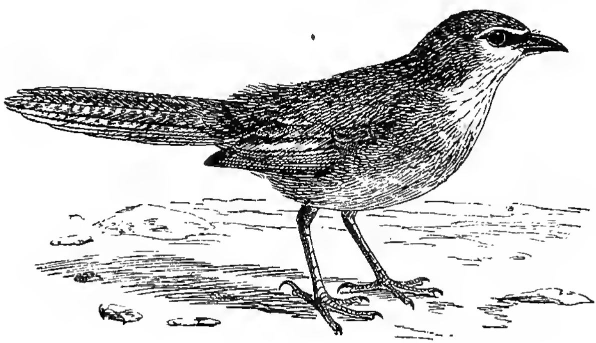
group of Birds is mainly an Old-World one, although it is cosmopolitan in distribution, save that it is absent in New Zealand. Two species of Crow are found in Australia.

Certain Birds called Weaver-birds, whereof the Common

Weaver-bird of India (*Ploceus baya*) may be taken as a type, form a large family-group of two hundred and eighty-eight species. These birds are distributed over Africa and India, extending into the Malay Peninsula. They are not very unlike Finches, but are of especial interest on account of the wonderful nests some of them construct, as will be noticed later on *.

There is a large group of Birds called Flycatchers, which, although they are confined to the Old World, yet number more than four hundred and five species. Of these we may

Fig. 125.



The Red-capped Babbler (*Timelia pileata*).

select the Spotted Flycatcher (*Muscicapa griseola*) as an example. It is one of the most regular of our summer visitants though late in its arrival. All these Birds have similar habits, catching insects on the wing, and then returning to the perch from which they took wing to catch them.

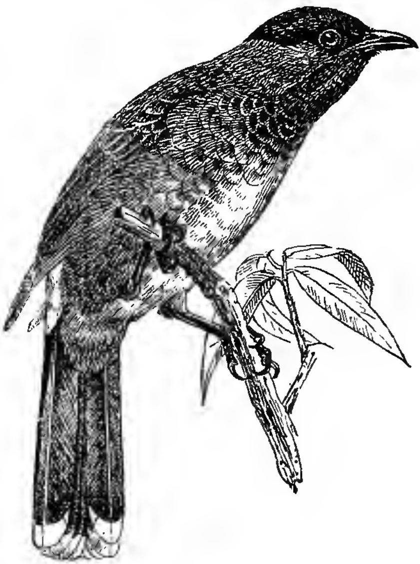
There is also a very large group of Birds called Babblers, or Babbling Thrushes, of not less than three hundred and seventy species, more or less, whereof the Red-capped Babbler (*Timelia pileata*) may be taken as a type. It inhabits grassy plains, but the group to which it belongs consists mostly of bush-birds, that

* See below, p. 232.

feed on insects, and go in small flocks, which are constantly in motion, chattering and piping as they go. They are found in Africa, India, and Australia.

A much less extensive group is that of the Bulbuls, and the Madras Bulbul (*Pycnonotus hæmorrhous*) may serve as an example of them. They are Old-World Birds, and are very destructive to fruit. There are about one hundred and eighty species

Fig. 126.



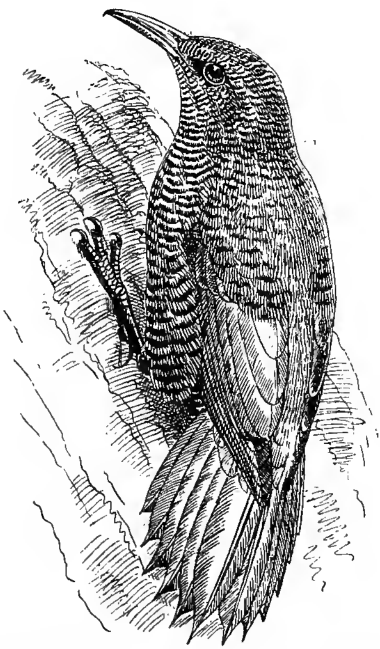
The Madras Bulbul (*Pycnonotus hæmorrhous*).

in this family-group, and they are peculiar to the Indian and African regions.

The Barred Woodhewer (*Dendrocolaptes radiolatus*) may be taken as the type of a large family-group of exclusively Tropical American Birds, numbering some two hundred and seventy-two species. They are climbing birds, and many of them have much the appearance of Creepers. A very handsome species is Bridges's Woodhewer (*Drymornis bridgesi*).

The Oven-bird (*Furnarius albogularis*, fig. 129), which is said to burrow in the ground, is another example of a special section of the group.

Fig. 127.



The Barred Woodhewer (*Dendrocolaptes radiolatus*).

There is a pugnacious, irritable set of Birds exclusively confined to the New World, and mainly to South America. The King Tyrant-bird (*Tyrannus carolinensis*) may be taken as a type of the whole four hundred and fourteen kinds which compose the group. They are remarkable for a flattened bill, and for the strong bristles about the gape. The Tyrant-bird is a voracious

Fig. 128.

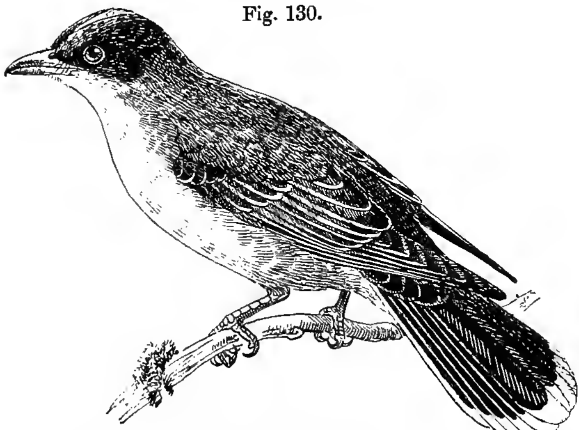
Bridges's Woodhewer (*Drymornis bridgesi*).

eater of insects, but as Bees are amongst those destroyed by it, it is not a popular bird in North America. Birds which are really aggressive and destructive are the Shrikes. Amongst them may be noted the Great Grey Shrike, which is but an

Fig. 129.

The White-throated Oven-bird (*Furnarius albogularis*).

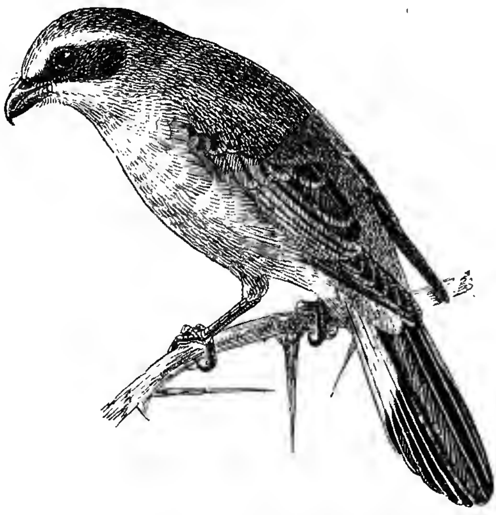
Fig. 130.



The King Tyrant-bird (*Tyrannus carolinensis*).

occasional visitant to this country. It feeds on mice, small birds, frogs, lizards, and various insects. The commonest species of the genus is the Red-backed Shrike or Butcher-bird (*Lanius collurio*), and may serve as our type of the whole group. The name of Butcher-bird has been no doubt occasioned from the curious habit it has of impaling its prey upon sharp thorns or fixing them into clefts. Fragments of its victims, pieces of skin, with bleached bones of birds or mice, or the dry hard cases

Fig. 131.



The Red-backed Shrike (*Lanius collurio*).

of beetles may be seen suspended all about in the vicinity of its nest, so that the bush supporting them may be compared to a small butcher's shop. This habit is supposed to be due to the feet of the Bird not being strong enough to hold its food satisfactorily while tearing it with its sharp and toothed bill; so that it is convenient for it to have its prey securely fixed by such an artifice. It may also be that the food is more welcome after having become tender by keeping. There are about 266 species.

Some forty birds known as Drongo Shrikes are fly-catching ones which associate in flocks. They are Old-World forms, mostly with long, forked tails, whereof the Black Drongo Shrike (*Buchanga atra*) may stand as an example.

The toothed and powerful beak of the typical Shrikes would seem by itself enough to show that such creatures were Birds of

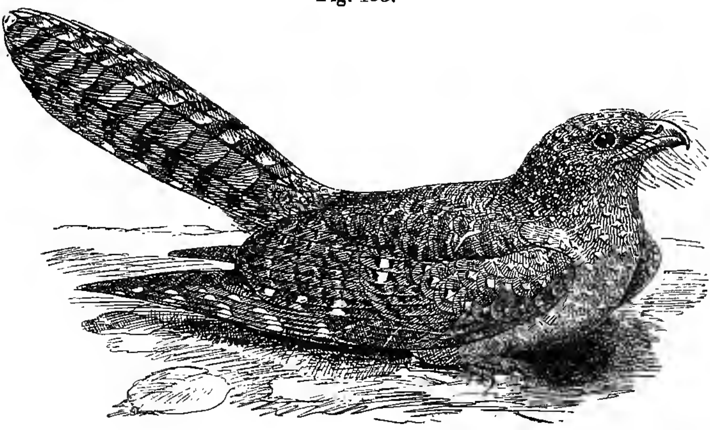
Fig. 132.

The Drongo Shrike (*Buchanga atra*).

Prey, and we may shortly proceed to notice forms which all agree to be Birds of Prey *par excellence*. Before doing so, however, we may note a very curious form—a bird with such a hooked and Hawk-like bill that we might be disposed to include it in the predaceous set. The creature referred to is the Oil-bird (*Steatornis caripensis*) of the island of Trinidad. But this Bird, with so formidable a bill, is said to feed on the fruits of palms and by no means on other Birds or Beasts which need to be torn to pieces. It is a nocturnal Bird, dwelling in the deepest recesses of caves, wherein it makes a nest (shaped like a cheese) of the soil of guano found by it within the cave, in which the rejected seeds of palms enter as constituents. The young are very fat, and are sometimes eaten by persons who manage not to be disgusted with the odour which is peculiar to them.

Passing on now to true Birds of Prey, we may first refer to the Sparrow-hawk (*Accipiter nisus*) as an example. It is still

Fig. 133.



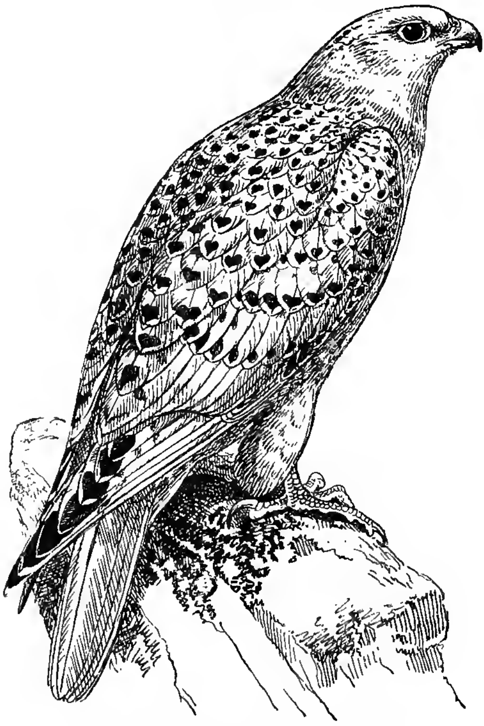
The Oil-bird (*Steatornis caripensis*).

more or less common in most of our counties. There are two-and-twenty other members of this genus, which is united with nine other genera to form an Accipitrine group of eighty-two species, amongst which is our Goshawk (*Astur palumbarius*) and the Marsh Harrier (*Circus æruginosus*).

The Kite (*Milvus regalis*) was, a hundred years ago, a very common English Bird, but now it is only an occasional visitant. Its deeply forked tail and habit, when on the wing, of sailing in circles without apparent effort serve to distinguish it easily.

The Peregrine Falcon (*Falco peregrinus*) is an example of a more powerful group of Birds of Prey than that last mentioned. There are five-and-twenty species of the genus *Falco*. The Peregrine Falcon is the Falcon of Falconry, but our Hobby and our Merlin both belong to the same genus, as well as that rare

Fig. 134.

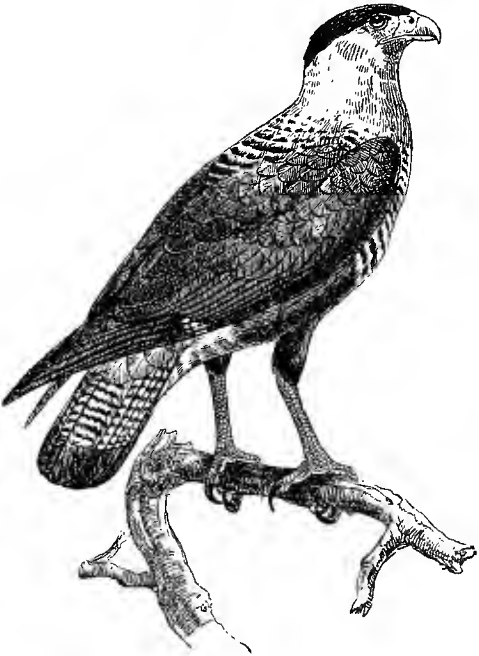


The Greenland Falcon (*Falco candicans*).

visitant to our shores, the Greenland Falcon (*Falco candicans*). The Kestrel (*Falco tinnunculus*) is a still more familiar Bird than the Sparrow-hawk, from its habit of poising itself in the air, and remaining apparently in one place whilst rapidly moving its wings. There are eleven genera of Falcons, and at least seventy-eight species, and the group is a cosmopolitan one.

Our Buzzard (*Buteo vulgaris*), a bulky, short, and now very scarce Bird, belongs to a group of fifty-one species which is

Fig. 135.



The Common Caracara (*Polyborus tharus*).

cosmopolitan, save that it is absent from Australia, Polynesia, and the Malay Archipelago.

Besides the foregoing, a small group of but ten species, with curiously half-webbed feet, are peculiar to South America and are called Caracaras. The Common Caracara (*Polyborus tharus*) may serve as an example. They pair for life, and each couple has its own permanent nesting-place. They vigorously chase Lapwings and Tinamous, and are very bold when several combine together. They sometimes attack and kill young Rheas, in spite of the efforts of the parent bird. In the absence of better food, however, they will feed on carrion.

Fig. 136.

The Osprey (*Pandion haliaëtus*).

The Golden Eagle (*Aquila chrysaëtos*), still to be found in Scotland, is one of some ninety-seven species of Eagles which are scattered over the whole world.

The Fishing-hawk or Osprey (*Pandion haliaëtus*), which we may certainly still reckon as a British Bird, is the only species of its genus. It is generally distributed over the world, though absent from the temperate parts of South America.

The Caracaras have just been spoken of as feeding much on

Fig. 137.

The Black Vulture (*Vultur monachus*).

carrion; but the most renowned feeders upon it are the Vultures, which are valuable scavengers in hot countries; whereof the Black Vulture (*Vultur monachus*) is a type. It is to be found on both sides of the Mediterranean, and extends to India and China.

It is recorded that an Egyptian Vulture (*Neophron percnopterus*) was shot in Somersetshire in the year 1825. When found it was busy eating the carcass of a sheep, and was so gorged that it could not, or would not, fly far at a time.

Fig. 138.

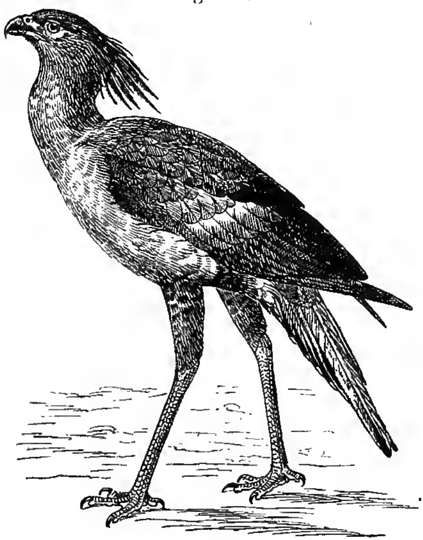
The King Vulture (*Cathartes papa*).

There are fully sixteen species of Vultures, forming a group which is peculiar to the Old World, where they range over its warmer regions, save the Malay islands, Ceylon, Madagascar, and Australia.

In the New World there are nine other kinds of Vultures forming a distinct group. Of these the Condor (*Sarcorhamphus* *gryphus*) may still serve as a type, though it may ere long become extinct. The handsome King Vulture (*Cathartes papa*) also belongs to this group.

A very curious and exceptional predaceous creature is the Secretary-bird (*Gypogeranus serpentarius*) of Africa, which has long legs like those of a Crane. It is a renowned Serpent-eater. The name of "Secretary" has been applied to it on

Fig. 139.



The Secretary-bird (*Gypogeranus serpentarius*).

account of a peculiar growth of feathers hanging from the back of the head in such a way as to recall the appearance of pens placed behind a man's ear.

Owls, unlike Vultures, are found in the coldest as well as in the warmest climes, and in the remotest Oceanic islands. There are a hundred and fifty-one species of Owls, whereof the Barn Owl (*Strix flammea*) may serve as a type. It is the form best known to most of us, though it is really a tropical form, inhabiting, as it does, the warmest parts of both hemispheres and only ascending some distance northward in the mild climate of Western Europe. The hooting cry of the Wood or Tawny Owl (*Syrnium aluco*) is familiar, no doubt, to most of our readers who dwell near any well-wooded parts of the country. The Great Horned Eagle-owl

Fig. 140.

The Eagle-owl (*Bubo ignavus*).

(*Bubo ignavus*), which has often been taken in this country, and the smallest of British Owls (*Scops giu*), must not be passed by without any reference, as they are good examples of the most numerous section of the entire group of Owls.

Before proceeding to consider the structure of Birds, it may be well first to cast a backward glance over the route we have come, and to once more take stock of the principal forms to which the reader's attention has been called, as being so many specimens of different groups of Birds.

Our object, as before said, has been to afford some help to the investigation and memory of the beginner in his attempt to obtain a mental grasp of the whole Class of Birds. For this purpose we have spoken of great groups arranged in a rough and ready, or popular, manner, as "Scratchers" or "Gallinaceous Birds," as "Cooers," as "Swimmers or Natatory Birds," as "Waders or Grallatorial Birds," and as "Runners or Cursorial Birds."

Amongst the many forms to which we have referred since speaking of the Emeu*—the last of our Cursorial Birds mentioned—are a certain number which have feet specially modified so as effectually to help them in climbing—two toes being turned one way, the two others being turned the opposite way. Amongst the Birds the feet of which are thus modified, are the Woodpeckers, Wrynecks, Jacamars, Cuckoos, Barbets, Toucans, Touracous, Plantain-eaters, Parrots, and Trogons—the last named being specially exceptional in the arrangement of their toes. All these Birds, thus specially fitted for climbing, have been distinguished as "Climbers" or "Scansorial Birds."

The Birds last noted by us—the Hawks, Falcons, Buzzards, Kites, Eagles, Ospreys, Vultures, and Owls—are all Birds of Prey or Rapine, and they are hence spoken of as "Raptorial Birds." Those most like the Hawk, the generic name of which we saw was "*Accipiter*," are also distinguished by the epithet "Accipitrine."

Almost all the rest of the Birds we have herein referred to (*i. e.* all since the Cursorial Birds, which are neither Scansorial nor Raptorial) are, however different in size, form, or appearance, frequently called Perching Birds, Perchers, or *Insessores*. From the name of their commonest species, the Sparrow, "*Passer*," they have also been called *Passerine* Birds or "*Passeres*;" and most of them are still commonly so denominated. They constitute the great majority of the whole class of Birds. On account of their prodigious numbers it was long ago felt necessary to divide their members amongst subordinate but large

* See *ante*, p. 67.

groups, and this was done by Cuvier, who mainly rested his divisions on the form of the beak. Thus, as the Shrikes have a marked notch or "tooth" on either side of the bill, he placed them in a group called toothed-billed or *Dentirostral* Birds—associating with them the Flycatchers, Tanagers, Waxwings, Thrushes, Orioles, Warblers, Manakins, Lyre-birds, the Water Ouzel, Wren, Wagtails, Pipits, and Mynas.

The Swallows, Swifts, and Goatsuckers, on account of their wide gape, were also associated together as wide-mouthed or *Fissirostral* Birds.

The vague name of cone-shaped beak was bestowed on the Larks, Tits, Buntings, Sparrows, and other Finches (including the very exceptional Crossbill), Colies, Oxpeckers, Starlings, Pastors, Crows, Magpies, Jays, Rollers, Birds of Paradise, and Woodpeckers. These were all spoken of as "*Conirostral* Birds."

The remaining Passerine Birds, all of which have long, and most of them slender bills, were taken together in a group designated as "*Tenuirostral* Birds." Such were the Humming-birds, Sun-birds, Creepers, Bee-eaters, Honey-eaters, Hoopoes, Motmots, Todies, Nuthatches, and Kingfishers.

Thus there were recognized in popular Ornithology:—(1) Raptorial Birds; (2) Tenuirostral *, Conirostral, and Dentirostral Passerine Birds; (3) Scansorial Birds; (4) Cursorial Birds; (5) Gallinaceous Birds; (6) Grallatorial Birds; and (7) Natatorial Birds; and these constituted the primary groups into which Birds were divided by Cuvier. These divisions have, for the most part, become obsolete; but it is none the less desirable that the beginner should not be altogether ignorant of them.

We have now enumerated the more leading forms of Birds, and the student who has acquired some slight knowledge of each of the groups whereof a named type has been here put before him, will be able to set forth on a serious study of the whole class of Birds. He must not suppose, however, that all the more important forms have been as yet indicated. To set out a complete list is impossible in an introductory chapter, except at the cost of making it so burthensome as to defeat the very object for which it has been written. Nevertheless, we believe the forms herein brought forward and distinguished are sufficient in number for our purpose, so that it will be enough hereafter, when intro-

* See below, p. 144.

ducing to notice any new bird, to refer to the resemblances in appearance or to the affinity which it may possess with some or other of the species and groups to which the student's attention has been called.

We may now pass on to the next subject we have to consider, the Organization of Birds. Before, however, entering upon the question what part any organ or organism can play, it is necessary to have some notion of what such organ or organism in itself really is. A study of "Structure," or "Morphology," should always precede a study of what any structures, or the whole organism they compose, can do. This latter inquiry constitutes the study of "functions," or "Physiology."

CHAPTER II.

THE EXTERNAL STRUCTURE OF BIRDS.

THE body of every Bird consists of a compact central part, or trunk; a very moveable neck, bearing a rounded head with a more or less prolonged beak; a pair of wings; a pair of legs, and a short solid tail. It is always clothed with feathers and the wings and tail almost always support long ones. The legs end in from two to four toes terminated by claws. There are always a pair of eyes plainly visible, but the equally constant pair of ears generally give no external indications of their presence.

The leading facts of the internal structure of a Bird are, like those of our own internal structure, matters of common knowledge. Thus it is almost superfluous to say that immediately beneath the skin of a Bird is the "flesh" of its body, which more or less amply wraps round its bones—the bones of the head, neck, trunk, tail, and limbs. Within the trunk is a cavity wherein lie a variety of parts known as the heart, lungs, kidneys, crop, stomach, intestine, liver, &c.

Inside the skull, and its continuation posteriorly, the back-bone, is a mass of white substance—the brain and spinal marrow. Delicate threads of similar substance (nerves) and tubes of various sizes (vessels) traverse the body in all directions.

Each considerable and more or less distinct part is called an "organ"—as *e.g.* the heart is an organ of circulation. Each connected set of organs is called a system—as the heart and the vessels called "arteries" and "veins" form the "circulating system," and the brain, spinal cord, and nerves form the "nervous system." The flesh is composed of muscle, and all the muscles taken together constitute the "muscular system," and we shall presently have to notice the "alimentary," "respiratory," "urinary," and "generative" systems, as well as organs "of investment and support," which consist of the external skeleton—the skin with its appendages—and the internal skeleton, or the skeleton commonly so called.

We will first notice the organs of investment and support, beginning with the external skeleton—the skin and its appendages.

The skin of a Bird, like our own, consists of two layers :—an external layer called the *epidermis* or *ecteron*, and a deep fibrous layer, supplied with nerves and blood-vessels, called the *dermis* or *enderon*. The feathers, the horny scaly outer skin of the feet and legs, and the outer covering of the beak are all epidermal structures—that is appendages or modifications of the epidermis.

Before describing any of these, we will first note some of the general conditions which modify and determine the leading characteristics of bird-structure.

The whole organization of Birds is specially modified to subserve flight. It is this which mainly governs the general shape of the body, the arrangement of the organs of movement—the muscles—and the position and packing of the internal organs or viscera, which are so placed as to be most conveniently carried near the centre of the body's gravity, so helping to maintain that in a suitable position. Flight determines the structure and form of the most internal organs, the bones, as well as of those wonderfully delicate and beautiful structures which clothe the body externally. At the same time all Birds have more or less to walk, and very many have to swim; and hence arise various structural conditions which, however, with rare exceptions, are never so modified as to impede flight.

The fore limbs are absolutely and entirely given up to flight, not even taking on any other function in birds which cannot fly. Those of the Ostrich only assist its running by their flapping, while those of the Penguin act as organs of aquatic flight beneath the surface of the water.

Since, then, some members must be applied to ordinary locomotion, all birds require to have a pair of legs exclusively or mainly devoted to that function. But as much delicate work (as *e. g.* in nest-building) has often to be done, which a foot even when used like a hand, as by a Parrot, could never do, there is nothing but the head to do it. Hence arises the need of a more or less elongated and very moveable neck, to enable that delicate grasping organ, the beak, to perform all needed manipulations.

So complete is the packing of parts towards the centre of the body, that even the hard structures which serve to grind the food are not in the form of teeth in the mouth, but of stones swallowed down and held in the modified stomach * or "gizzard." The voice-organ, also, instead of being at the top of the throat (as in man and beasts) is at the bottom of it, and many of the muscles are largely reduced to strings or "tendons" for a great part of their extent.

But very powerful muscles are needed to work the wings, and this again demands a vigorous circulation with very pure blood and a body lightened as much as possible. These conditions are admirably fulfilled in most birds by a provision for the entrance of air into their very bones. This diminishes the specific gravity of the body, while it helps to purify the blood and so facilitate the action of the muscles, and therefore flight. A Bird may be said to breathe not only with its lungs, but with its whole frame. Hence the lightness of Aquatic Birds on the water, swimming most easily with a boat-shaped body and oar-like feet; some also, such as the Swans, being provided with sails, in the shape of their raised and slightly expanded wings.

For flight nothing could be better than the shape of the body of most birds, which is in the form of two cones united by their bases, with a small rounded head and pointed beak in front, poised on a neck which, by its protrusion or retraction, can, at will, change the position of the centre of gravity.

The rapidity of flight may be very great; a Falcon which belonged to Henry IV. of France flew from Fontainbleau to Malta (1350 miles) in one day. The race-horse "Eclipse" went a mile a minute for a short time; but a Hawk at full speed has been calculated to fly at the rate of 150 miles in one hour, and an Eider-duck at 90. The distances also which birds traverse are prodigious. Our Swifts and Swallows fly to the Gold Coast of Africa, and our Cuckoos to the Cape of Good Hope.

All this wonderful work, facilitated by the arrangement above noted, is directly effected exclusively by means of certain feathers of larger size than those which clothe the body, never by expanded skin as in the Bat.

All Birds, as before said, have this characteristic external

* See below, p. 208.

investment. It is beautifully adapted to harmonize with the rest of their organization, being extremely light, warm, and non-conducting. It thus serves most effectively to maintain that high temperature which distinguishes their class.

Beasts are provided with hairs, but feathers are much more complicated and elaborate organs. They are, in fact, the most complicated of all the appendages of the skin which any animals possess.

Whatever may be their modifications of size, colour, or texture, they are all formed on one common plan. Each feather consists of a firm central axis, the base of which is the "quill," and the part above this the "*rachis*" or "*scapus*" or "shaft," to which the *web*, *vexillum* or *pogonium*, is attached on either side. The "webs" of both sides of the "rachis," taken together, constitute the *vane*. The quill is implanted in the skin and has two apertures, one at either end. Into the lower—the *umbilicus inferior*—the soft vascular "*pulp*" of the feather penetrates. The other aperture is called the *umbilicus superior*. The "vane" consists, as before said, of the flattened expanded parts on both sides of the central axis, and each lateral portion of it (the fore or outer web, fig. 141, F, or the hind or inner web, H.V.) is made up of a number of elongated closely arranged laminæ called "*barbs*;" while from the margins of each barb much smaller processes project, called "*barbules*" or "*radii*," and the sides of the barbules may also be furnished with still smaller processes or "*barbulets*," or *barbicels*, or *hamuli*, or *hooklets*. Not unfrequently a second shaft, called an "*aftershaft*," H.R., springs from the summit of the quill, and this is generally a miniature representation of the normal "shaft" with its "vane." The large feathers of the wing and tail never have an aftershaft. They present a striking combination of the two generally opposite characters—strength and lightness—in a very high degree, as the barbules interlock and keep the whole structure remarkably firm and coherent. This kind of feather is called *pennaceous*. Certain feathers in which these parts are separate, and which also have long barbules, are very much looser in structure, and are called "*plumes*," and their structure is termed *plumulaceous*—such as those of the Ostrich.

Most Birds are provided with more or less "*down*." Down consists of very soft feathers, which may or may not have an aftershaft, and may have no rachis at all, the soft barbs radiating directly from the summit of the quill. *Filo-plumes*, or *thread-feathers*, much resemble hairs, as they are long and very narrow, with a rudimentary vane. Some of these are bristly and called *setaceous*; and many Birds have a row of bristles or *vibrissæ* bordering the opening of the mouth or *gape*, and these are particularly long in the Goatsuckers *.

Fig. 141.

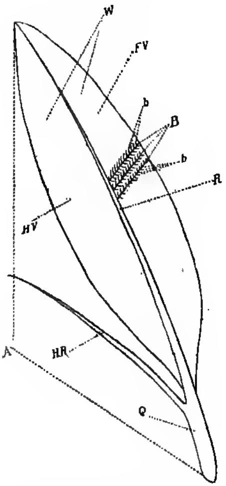


Fig. 142.

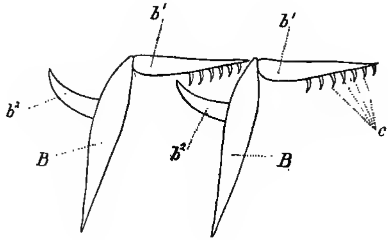


Fig. 141. Diagram of a Feather (with only three of its barbs indicated).

A. Axis. Q. Quill. R. Rachis, or shaft, or scapus. W. Vane, vexillum, or pogonium. F. Front half of vane or outer web. H.V. Hinder half of vane or inner web. B. Three barbs or rami. *b*. Barbules or radii. H.R. Hyporachis or aftershaft.

Fig. 142. Diagram (*after Nitzsch*) of parts of Web.

B B. Two barbs in vertical section. *b' b'*. Anterior barbules. $b^2\,b^2$. Posterior barbules. *c*. Barbicels, or barbulets, or hamuli, or hooklets.

Certain down-feathers are called *pulviplumes* because the ends of their barbs habitually break up into a fine powder called *powder-down*, such as may be remarked on Parrots.

The ordinary feathers which clothe the body and hide the down are called *contour feathers*. Their basal barbs are commonly soft.

* See *ante*, pp. 86, 87.

Feathers may be considered as very complex hairs of a conical form, which split up according to a definite pattern. Each is at first a little, soft, vascular process or papilla, curiously grooved. On one side is a central vertical groove, broadest at the base, and vanishing towards the apex of the papilla. Other less deep grooves, closely set, go out, nearly at right angles, from either side of this vertical groove. They extend almost all round the papilla, only vanishing towards the middle of the opposite side to that which bears the vertical groove. Grooves smaller still and much shorter are given off again nearly at right angles from the grooves encircling the papilla, and sometimes others again from these. A horny secretion is deposited on the papilla, and is, of course, thickest where the grooves are deepest, and thinnest where there are no grooves at all—*i. e.*, on the interspaces of the grooves. With the progress of growth, this whole horny investment splits up along the interspaces, where the deposit is thinnest. The part which was the main vertical groove is thickest of all, and becomes the shaft of the feather, the parts in the secondary grooves become the "barbs," those on the still smaller ones the "barbules," and those in the occasionally present yet smaller ones, the "barbulets." Sometimes a papilla will have a vertical groove on either side, and then the feather will have two shafts (one an aftershaft)—as in the Cassowary. The vane is the part of the case of the papilla which thus splits. The quill is that part of the case which does not split at all. At the upper end of the quill there must be a small perforation which marks just that spot where the feather ceases to open and flatten itself, and begins to remain curled round and continuous, as it all was at first. The space where it thus begins to remain curled round is the *umbilicus superior* before mentioned. The papilla persists as the "pulp" which ascends through the *umbilicus inferior*.

Feathers are developed with great rapidity, sometimes attaining a length of two feet or more in a few days. They are also almost all renewed every year, and in many species twice a year. When we think of the serious effects of teething in mankind we cannot but be struck with the great vital energy of birds, and with the critical character of their process of moulting (*ecdysis*), which is, indeed, not unfrequently a fatal one.

The annual moult commonly begins just after the close of the breeding-season, and it takes place in all Birds, from the Wren to the Ostrich. Such a process is obviously a necessary one as regards the most important feathers—those of flight. A structure which, however strong it may be, is so delicately formed as is a feather, must be liable to accidents and must sooner or later wear out. But if the feathers needful for flight were not renewed, then such accidents and wearing out would cause birds to be unable to fly, and therefore, for the most part, unable to fulfil the conditions necessary for life—that is to say, to obtain their food and escape their enemies. On this account in almost all birds the flying-feathers, or quill-feathers of the wing, are shed gradually and in pairs, so that the moulting birds can retain both their equilibrium and their power of flight.

The numerous family of Ducks forms an exception to this rule, for most of them shed their quill-feathers almost simultaneously, and so, for a time, are unable to fly. But then, from their mode of life, they have other resources for concealment and escape, and they can obtain their food in or near water. Aquatic herbage, which is commonly luxuriant, also affords them a ready and effective shelter.

Most male Ducks not only change their feathers, but also their colours. This necessitates for them another and second moult, in order to put on their gayer plumes for the next breeding-season.

Very rarely, indeed, birds moult in the spring only, as is the case with the Swallows.

A great number of birds undergo a double moult, but species which are close allies may differ in this respect, as the Garden Warbler (*Sylvia salicaria*) differs, as it is said, from the Blackcap (*Sylvia atricapilla*) by moulting twice instead of once.

But there may be yet more changes. Thus the Ptarmigan (*Lagopus mutus*) moults after the breeding-season (as usual), both sexes assuming a grey colour. They then moult again, to become white in winter, and then moult a third time in the spring, to assume their breeding costume once more. The quill-feathers of the wing and tail are not, however, so often changed by them.

The second moult of Birds is, indeed, often but a very partial one, and sometimes a certain change of plumage may be effected by an alteration in the colour of the feathers themselves—such as is sometimes produced by the shedding of the barbulets or barbicels.

Besides the annual moult of adult Birds, the young may undergo several changes in order to attain the fully developed plumage of their species and sex. Some Birds, *e. g.*, the Black Redstart (*Ruticilla tithys*) and the Rosy Bullfinch (*Pyrrhula rosacea*), however, rear a progeny before attaining it *.

The young of most Birds do not shed the quill-feathers in their first year, and in many even an otherwise complete moult does not seem to take place during that period.

When the plumage of the sexes differs, the young resembles the mother, save when the latter is more conspicuously coloured than her mate, in which case they resemble the male parent.

When the adults of both sexes are alike, the young is different from either. The young of both the black and the white Swan are of a dusky colour, while the black-necked Swan has white young.

It has been supposed that when adult birds assume at the breeding-season a plumage which differs from their winter dress, the young are intermediate in colour. The Linnet alone, however, suffices to disprove this dictum.

Feathers do not by any means grow—save in rare cases—all over the body of Birds, but only along certain definite tracts, the forms and arrangements of which are very characteristic of different kinds. Such an arrangement in a Bird is called its *pterylosis*, and the special description of these conditions is called "*pterylography*" †. This does not apply to down.

While considering the form and structure of different parts and appendages of the external skeleton, it will be well also to note the conditions presented by the body as a whole and its various parts and members. In other words, we must study the external topography of Birds—their head, neck, body, tail, wings, and legs.

The Head and Neck.

The Head.—This is always more or less rounded and pyramidal, and almost always covered with feathers. It terminates in front in the beak or *bill*, consisting of an upper jaw, or *maxilla*, and of a lower jaw, or *mandible* ‡, each of which is provided with a more or less horny investment, and is naked or bears but a few feathers. The crown of the head is the *vertex*, behind this is the *occiput*.

* I am indebted to Mr. Seebohm, F.L.S., for a knowledge of these two examples.

† See below, p. 164.

‡ The maxilla and mandible are very often called the upper and lower mandibles.

The *eyes* are generally placed at the side of the head towards its middle, but may be placed further back, as in the Woodcock; or anteriorly situated, looking forwards, as in the Owls. Each eye has an upper and a lower eyelid, and there is also a third eyelid (a rudiment of which exists at the inner angle of our eye) which sweeps obliquely over the eyeball within the other eyelids. If the eye of an Owl or Hawk be watched, this will be seen as a pearly-white film rapidly appearing and disappearing as it covers and uncovers the eye. It is called the *nictitating* membrane.

The *ear* almost always opens a little below and behind the eye, but may do so below it, as in the Woodcock. It is hidden, and only indicated by a difference of texture in the feathers (*auriculars*) which cover them. Occasionally this opening is provided with a flap, which can close it, as in some Owls.

The *nose* is always made up of a pair of nostrils, though these may open above like one tube, as in the Petrels. The nostrils open externally on the bill in different situations in different birds,—as may be more conveniently indicated in describing the bill. Internally they open into the back of the mouth, sometimes by one aperture, but generally by two.

The part of the side of the head between the eye and the base of the upper mandible is termed the "*lore*;" and the cheek is behind and below it in a line with the lower mandible. At the lower margin of the cheek is a narrow, linear space known as the *malar region.*

The "*chin*" or *mentúm* is the part (feathered or bare) on the underside of the lower mandible behind the point of junction of its two lateral halves or *rami.* This is also called the *interramal* space. Below the chin is the *gular* region or throat, followed by the *jugulum* or lower throat, to which succeeds the *prepectus* or fore-neck.

Some Birds—as, *e. g.*, Turkeys and Vultures—have naked heads. That is, they have only filoplumes instead of ordinary feathers on their heads. Such Birds often possess (as also do various others) some other kind of warty or fleshy outgrowth called "*lobes*" or "*wattles,*" "*combs,*" "*caruncles,*" or "*horns,*" such as those of the Tragopans *, as the case may be. The gular region may be naked as in the Pelican's pouch, or the lores as in Grebes, or the *circumorbital* region, or part round the eyes, as in the Herons. The ordinary feathered

* See p. 6.

covering of the front part of the head may be replaced by a horny plate or "shield," as in the Coot and Moor-hen.

On the other hand, some or other of the head-feathers may be exaggerated in size, forming *crests*, which may be single and median as in the Cockatoo, or double and lateral, as in the so-called "horns" of Eared Owls (structures which have nothing whatever to do with the ears) and in the Crested Grebe.

Very rarely feathers of the mentum may be elongated, as in the Bearded Vulture. More often those of the gular and malar regions with the auriculars may form "ruffs."

The *Bill* is perhaps the most important part of a Bird's external organization for the purposes of classification. It is also a most important organ in the economy of the Bird's life, for it not only serves for taking food, but, as already said, subserves the purpose of a hand or fingers, and in some cases is an organ of feeling, as in the Snipes and Woodcocks. The bill serves for picking up, carrying, cutting, tearing, or crushing, according to circumstances, and it is almost always more or less conical, generally ending in a sharp point.

Different definite technical terms are used by Ornithologists to denote its form. A bill is said to be of *medium* length if it is about as long as the head. If less than that length, it is *short*, and it is *long* if it much exceeds it. A bill which is short is said to be *acute* if pointed at the tip. If there is a hook-like process at the tip, the bill is called *hamulate* or *uncinate*. It is *dentate* when toothed as in a Falcon, and when there are a number of small tooth-like processes along the margins of the bill, it is said to be *serrate*. If the bill, as in the Duck, bears a nail-like process at the end of the maxilla, it is termed *unguiculate*. When the bill is extremely long and slender as well as pointed, it is sometimes compared with a needle and so called *acicular*, or, if less slender, to an awl, *subulate*. If only slightly elongated it is *acuminate*; and the term *attenuate* is supposed to denote a condition intermediate between "acuminate" and "subulate." A bill which is flattened is said to be *depressed*, and if widened at the end is called *spatulate* (as that of the Shoveller Duck and, still more, that of the Spoonbill). A bill rather high and narrow is called *compressed*. A bill of the most ordinary shape, like that of a Sparrow, is called *conirostral*. A beak which is short with a wide gape, like that of the Swift, is termed *fissirostral*. The quite opposite condition of bill (*e.g.*, that found in the Humming-bird) may be called "*tenuirostral*."* If there is a notch or tooth-like process at the side, then such a bill is said to be *dentirostral*. A bill which is bent up towards the end, as in the Avocet, is termed *recurved*, while the opposite condition is *decurved*, as in the Curlew. In one genus of crook-billed Plovers of New Zealand (*Anarhynchus*), the bill is, as before said †, bent laterally.

Before noting the terminology used to denote the parts and condition of either mandible, a few words may be said as to the *covering of the bill*, which will especially relate to the maxilla. In the immense majority of instances the bill is entirely hard and horny, and the investment of either jaw is in one piece. In some Birds, however, as in the Petrels ‡, it may be in several pieces, and these may be moulted like the feathers, so that they form part of the summer dress, and constitute a secondary sexual character, as is the case in the Puffins §. Such bills are said to be *deciduous* or *caducous*.

The bills of Birds are often marked with ridges proceeding in this or that direction, and such are called *carinate* or *striate*, if the ridges are pretty straight. A bill, on the contrary, is said to be *rugose* or *corrugated* if the prominences form rather irregular wrinkles than ridges. If the bill is marked with linear depressions instead of ridges, it is termed "*sulcate*," each groove being a *sulcus* or *furrow*. If the depressions are not elongated, but are little rounded ones or pits, the bill is called *punctate*.

Instead of being all hard as horn, a bill may be of rather leathery texture, as in the Ducks, or invested with a sort of skin and very sensitive towards the tip, as in the Woodcock. The bill may be hard towards the tip, but notably softer at the base, as in that in most Pigeons and Plovers. In Parrots and Hawks the base of the bill is clothed by a peculiar wax-like investment called a *cere*, and this sometimes bears feathers. Sometimes the bill bears very large, soft, fleshy processes, and then it is said to be *carunculate*. If the processes are smaller, like warts, the bill is termed *papillose*, the warts being named *papillæ*.

Not only is the lower jaw moveable, but the upper one is so in a slight degree, though this is hardly noticeable, save in Parrots,

* See *ante*, p. 100. † See *ante*, p. 58.
‡ See *ante*, p. 31. § See *ante*, p. 25.

where its mobility is very marked. These differences depend on conditions of the skeleton, to be noticed later on.

The two mandibles are almost always of about equal length, meeting together at the point and not overlapping. In the great majority of birds the lower mandible fits into the upper one. This normal condition is termed *paragnathous*. When the mandibles cross each other towards their apices, as in the Crossbill*, they are termed *metagnathous*. This is an extremely rare condition, but it is by no means unusual to find the upper mandible longer than the lower one, and curving over the tip of the latter, as in Parrots and Hawks. This condition is termed *epignathous*. Rarest of all is the form denominated *hypognathous*, in which the lower mandible is longer than the upper, in the Skimmer (*Rhynchops*) †.

The two mandibles join each other so as to form by their junction a line, which may or may not be straight, and which extends from the tip of the bill back to the point where the two jaws laterally unite, which is the *angle of the mouth*. This line is formed in part (anteriorly) by the junction of the upper and lower portions of the horny bill, and in part (posteriorly) by the junction of the two jaws when their opening extends backwards beyond the hinder end of one or both portions (upper and lower) of the horny bill, and these two junctions require distinguishing by two different names. The former one is the *tomia* ‡, the latter one is the *rictus*, while the whole margin of the tomia and rictus, taken together, is the *gape* or *commissural* line, or line of *commissure*. The angle of the mouth may be further distinguished as the *point of commissure*. The line of commissure, or gape, may be *straight*, *curved*, or *angulate*.

It will be "straight" when the tomia and the rictus together form one straight line. It will be "curved," or *sinuate*, when they together form one curved line. Finally, it will be "*angulate*" when both the tomia and the rictus are nearly straight but do not lie in one line, and, therefore, form an angle at their point of junction.

The *maxilla* or *upper mandible* has two definite lines most evident to the observer when the bill is viewed in profile. One of these lines coincides with the uppermost margin of the bill

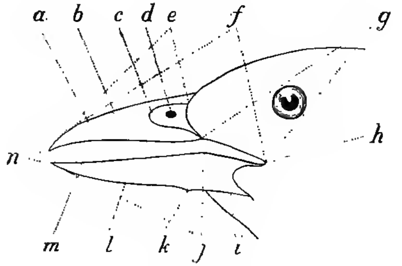
* See p. 104.

† See above, p. 30.

‡ This distinction was proposed by Elliott Coues in the second edition of his 'Key to North American Birds,' p. 105.

and is called the *culmen*. The lower line coincides with its lowest margin, that which encloses the under mandible. This lower line is the *maxillary tomium*. The culmen may be in the form of a sharp elevated ridge like a knife, when it is said to be "*cultrate*," the mandible which bears it being "*keeled*"; the apex of the upper mandible may be *hamulate* or *unguiculate*. The maxillary tomium may bear tooth-like processes or be notched like a saw, when it is said to be *serrate*. If it has a

Fig. 143.



PARTS OF A BILL.

a, Side of maxilla or upper mandible; *b*, culmen; *c*, nasal fossa; *d*, nostril; *e*, tomia or inferior margin of upper mandible; *f*, gape, or whole commissural line; *g*, rictus; *h*, commissural point or angle of the mouth; *i*, ramus of under jaw; *j*, tomia of under mandible; *k*, angle of gonys: the hindermost point of junction of the two rami which form the lower mandible is the "gonys proper," but the term is extended to apply to the whole line of union of the rami from the gonys proper to the tip of the under mandible corresponding to the culmen or median ridge and upper outline of the upper mandible; *l*, *m*, side of under mandible; *n*, tips of mandibles.

single notch or tooth-like process (as in the Hawk) it is called *dentate*. If it forms a sharp edge like that of a knife it is (like a sharp culmen) termed *cultrate*, and if it is at the same time much curved it is *falcate*, or "like a sickle." An upper mandible provided with a series of transverse plates or ridges within it (like that of the Duck) is called *lamellate*.

The *nostrils* are almost always conspicuous one on either side of the upper mandible. As a rule they each open at the bottom of a depression, which when rounded is termed the *nasal fossa*; if it is long and narrow it is called the *nasal sulcus* or *groove*. They are usually *lateral* in position, but are called *culminal* if they open on the culmen. When high, but not quite so high, they are *superior*, and they are *inferior* when nearer the maxillary tomium than the culmen, and they may be quite near the former—as in the Puffin. They are also usually *basal* or *subbasal* (*i. e.* situated near the base of the bill), but sometimes they are median, as in the Goose. In the Apteryx they are *terminal* or at the end of the bill—a quite exceptional position. When the cere is feathered, they may be thus completely hidden, and they may be also hidden by the extension forwards of the frontal feathers of the head in pointed forward extensions (called *anticæ*) on either side of the culmen—as in the Grouse. They may be also covered by setaceous feathers which project forwards over them, and therefore project in the contrary direction to that of the head-feathers generally, or are what is termed *antrorse* in direction. Very rarely, as in the Pelican, the nostrils do not open externally at all, or are *impervious*. It may be that they can both be seen through at the same time, or this may be impossible owing to the existence of a median septum between them. The terms *perforate* and *imperforate* are used to denote one or other of these conditions. The shape of the openings may vary from *round* to *linear*, and they are sometimes termed *oblong*, *ovate*, *oval*, or *elliptic*, as may be deemed the most fit. They are sometimes club-shaped or *clavate*. They may sometimes have a raised rim round them much prolonged—as in the Petrels, and such are called *tubular*. Sometimes there is special development called a *nasal scale*, which may overarch the opening as in the Fowl, or may form a partial floor as in the Wryneck. The part of the bill between the nostrils is called the *mesorhinum*.

The *lower mandible* is generally the smaller of the two, being slightly surpassed by the upper at the tip and also laterally. It is generally also less deep than the other. Its cutting-edge is called the *mandibular tomium*, which bites against, and generally a little within, the maxillary tomium of the upper mandible. Each half of the lower mandible is called a *ramus*, and the two *rami* unite at the tip and for a greater or less distance, thence backwards and downwards as the case may be. This line of junction forms part of the lower margin of the lower mandible, and corresponds with the culmen of the upper mandible. It is called the *gonys*, and this term is especially applied to the posterior point of this line of junction. The gonys line usually forms from a half to three fourths of the inferior outline of the bill, but it may form the whole or even more than the whole, extending backwards in a process—as in the Puffin. On the other hand, it is exceedingly short in many other water-birds, *e.g.* the Duck and especially in the Pelican. The longer may be the gonys, the shorter will be the extent of the space existing between the rami behind it, which is called the *inter-ramal space.* A hook or claw may exist at the tip of the lower mandible.

The *Neck* is always a part of much importance in a bird, not only, as in ourselves, on account of the important organs which pass through it within, but because it has to move like an arm to subserve the hand-like action of the beak. It is, therefore, always very moveable and never very short, while it is sometimes, as in the Swan and Flamingo, extremely long. The neck is always long when the legs are long, as otherwise the beak could not reach the ground; but it may, as we see in the Swan, be very long in proportion to the legs, and this is evident also in the Darter. The Darter and the Heron spear the fish on which they feed, and so the head has to be thrown forward with the greatest rapidity, and at the same time with the greatest accuracy of direction. This is facilitated by the fact that the neck of a bird forms (plainly or hardly perceptibly) a sigmoid curve (the superior concavity and inferior convexity being directed forwards), so conditioned by the shape of the bones and the adjustments of the muscles, that it can be instantly straightened but not bent in contrary curves. The feathers which clothe the neck are named from the regions of it from which they grow. Thus those behind the neck are *nuchal* or *cervical*, according as they belong to the upper part of the back of the neck or to its lower part—the *nape* or *nucha*. Similarly, the feathers on the lowest part of the front of the neck are those of the *prepectus*. Above these are the *jugular*, then follow the *gular*, while all of them together are sometimes called *guttural*.

The feathers of the neck are rarely elongated except as a "nuchal crest." But there may be long jugular feathers as in the Heron, and the elongated neck-feathers of the Ruff are very remarkable. The neck may be bald here and there, or altogether so, as in the Vultures.

Fig. 144.

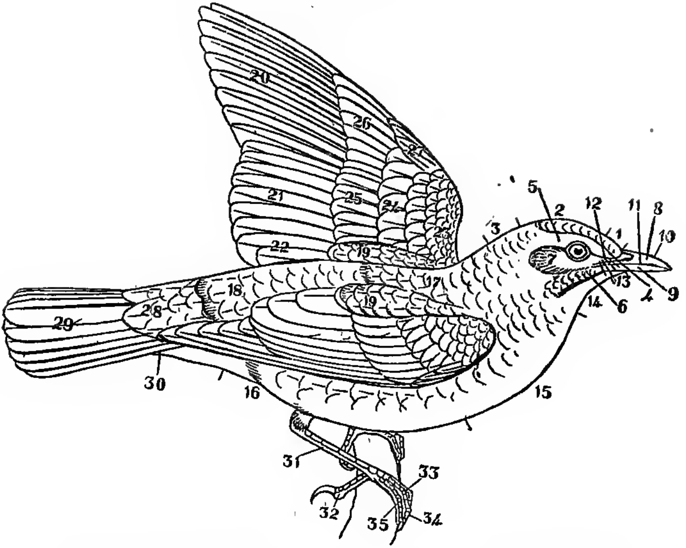


Diagram of a Bird, to illustrate the terminology of the plumage and limbs (*after Oates*).

1. Forehead. 2. Crown or vertex. 3. Nape. Between this and 2 is the hind-head, or occiput. 4. Lore (space in front of the eye). 5. Supercilium. (The space around the eye is the "orbital" or "circumocular region" and is subdivided into supra-orbital, infra-orbital, ante-orbital, and post-orbital). 6. Cheek or gena; its lower margin is the malar region. 7. Auriculars or ear-coverts. 8. Upper mandible or maxilla. 9. Lower, or true, mandible. 10. Culmen, or upper profile of maxilla. 11. Rictus, or commissural line of junction (or gape) of the two mandibles. The extreme posterior end of the gape is the corner or angle of the mouth, or commissural point. The space between this and the base of the horny bill is the rictus. 12. Rictal bristles or vibrissæ. 13. Chin or mentum. 14. The throat—divisible into "upper throat" (gula) and "lower throat" (jugulum), which extends down to 15, where begins the prepectus, or fore-neck, after which comes the breast or pectus—that is the part which covers the breast-bone or sternum. 16. Abdomen. (The breast and abdomen together are called "gastræum.") 17. Back—the upper part of which is the interscapular region. 18. Rump or uropygium. 19. Scapulars. 20. Primaries (the outermost 9 or 10 quills of the wing springing from the pinion or bones of the hand). 21. Secondaries (wing-quills springing from the lower arm-bones—radius and ulna). 22. Tertiaries (springing from the upper arm-bone or humerus).—The primaries, secondaries, and tertiaries together constitute the "remiges." 23. Lesser wing-coverts. 24. Median wing-coverts. 25. Greater wing-coverts. 26. Primary wing-coverts. 27. Winglet or bastard wing or alula (feathers springing from the thumb). 28. Upper tail-coverts. 29. Tail-feathers or rectrices. 30. Under tail-coverts. 31. Tarsus. 32. Hind toe or first toe or hallux. 33. Inner or second toe. 34. Middle or third toe. 35. Outer or fourth toe.

The Body and Tail.

The *Body* of a bird forms, roughly speaking, an egg-shaped mass. This may be somewhat laterally pressed in, or it may be flattened from above downwards, these conditions being termed (as in the analogous conditions of the bill) *compressed* or *depressed* respectively. As in ourselves and in beasts, the body has its *dorsal* and its *ventral* region. The former is sometimes called the *notæum* and the latter the *gastræum*. The feathers of the belly are generally softer than those of the back. The surface of the back taken together with the dorsal, or upper, surface of the wings is also sometimes spoken of as the *mantle*. The feathers which grow on the shoulders are named *scapulars* or *scapularies*, and, of course, the space between them is the *interscapular* region. The part immediately behind this is sometimes distinguished as the *lower back* or *tergum*, and behind this comes the *rump* or *uropygium*.

The ventral region would seem hardly to need description, such simple terms as *pectoral*, *abdominal*, and *lateral* apparently explaining themselves. Yet confusion has arisen, so that it is necessary to point out that the breast, or pectoral region, is the part over the sternum, behind which is the abdomen, and in front of which is the prepectus. The term "*crissum*" is one which is variously, and therefore rather misleadingly, applied to a region it may be desired to distinguish, and which is in near proximity to the vent. It is best applied to feathers just behind the vent, that is to the more anteriorly situated of those feathers which we shall soon describe—amongst those of the tail—as "under tail-coverts."

Tail.—The tail of a bird, in the ordinary acceptation of the term, means the collection of more or less strong, more or less elongated feathers which are implanted into the skin of the hinder end of the body. But evidently this "tail" has no relation to what we mean by a "tail," when we speak of the tail of a beast. Moreover, as we shall soon see, elongated conspicuous feathers, commonly called the tail of certain birds, do not correspond with the tail-feathers which other birds possess. The tail of a beast, for example of a Cat, consists of a firm bony basis surrounded with flesh and sinew and invested by the skin. Such a tail always exists in birds, but it is a very different structure from what is ordinarily called "a bird's tail."

Most aquatic beasts, and other backboned animals which swim, have an elongated powerful tail which is their main aid in swimming; but no bird whatever swims by its tail. Very many climbing animals are assisted by a tail which is "prehensile" or can grasp. Some birds (such as Woodpeckers) are aided in climbing by their very stiff tail-feathers. But no bird has a tail which can grasp. No existing bird has a long tail in the sense that a Cat has one. That part of a bird which answers to the tail of a beast is a short fleshy, more or less heart-shaped structure, which in the chicken is often called the "parson's nose." Into it the long true tail-feathers are implanted, and it also commonly bears on its upper surface, at its root, a peculiar body known as the *oil-gland*, sometimes called the *uropygial gland* or the *elæodochon.* The structure of the bony basis of this true tail must, of course, be reserved for description along with that of the rest of the endoskeleton. Here we are alone occupied with its exterior and its epidermal appendages. In the first place the oil-gland is composed of numerous contorted tubes, which gather themselves together and unite more and more till they open by one or several pores on the surface generally, on a little papilla. These tubes secrete within them a greasy fluid, which exudes and can be pressed out from the pore or pores. This gland is specially developed in aquatic birds, which carefully anoint their feathers with its secretion, the presence of which causes water so proverbially to "run off a duck's back." The gland is often surrounded with a circlet of feathers, the presence or absence of which serves as a distinctive character of various species, and is by some anatomists considered important enough to define the great orders.

The true feather-tail is formed by those generally well-developed feathers which are inserted into the fleshy tail. These feathers are called *rectrices* or *steerers*, and are, as a rule, thoroughly firm and pennaceous, though generally the web of the outer side of each feather is narrower than the other. The rectrices are even in number, and there are generally twelve of them. This number may, however, be diminished to eight or raised to twenty or four-and-twenty, while the Penguins may have two-and-thirty or even more. When the rectrices are expanded it will be found that the central pair are inserted highest up (most dorsally), one being higher in origin than the other. The insertion will be found to follow on alternately—the next to the median pair on one side being inserted above the next to the median pair of the other side, and so on. These feathers may be of very different shapes in different species of birds. When very narrow they are said to be *linear*, and when very long and slender they are called *filamentous*. Each is termed *lanceolate* when tapering to the tip from a broader base. When the feather becomes gradually very pointed it is called *acute*; but if it is suddenly narrowed towards the point it is termed *acuminate*. The tail of the Woodpecker shows such rectrices. A feather enlarged at the end (more or less like the beak of a Spoonbill) is called *spatulate*. A *mucronate* or *spinose* rectrix is one in which the rachis projects at its end beyond the vanes. This condition is also sometimes spoken of as *spinose*. A *truncate* rectrix is one seeming to be cut straight off transversely at its end, while if its terminal border is concave, it is said to be *incised*.

A very fine and curiously developed tail is that of the Lyre-bird, most of the tail-feathers of which creature have their barbs widely separated, so that the webs are quite loose. The true tail-feathers may be very short, as in the Tinamou; or quite rudimentary or downy, as in the Grebe.

To estimate the shape of the tail-feathers, they should be nearly closed. Then the posterior margin of the whole group of rectrices may or may not appear concave, when the tail is more or less *forked*. If this forking is only minute, the tail is said to be *emarginate*. If truly forked it is *furcate*; it may be more, i.e. *deeply forked*, or it may even be extremely forked, which has been called *forficate*.

There may be a median projection with lateral concavities at the tail's hind margin. Then it is said to be a tail *doubly emarginate* or *doubly forked*. In the same way a tail which, instead of having an evenly *rounded* margin, has a median notch with a convex but rounded margin to the tail on either side of the notch, is said to be *doubly rounded*. If the tail ends with a simple, straight, transverse margin it is *truncate*, *even*, or *square*. There may be a pair of very long projecting feathers, which are then said to be *far-exserted* or "produced." If the rectrices shorten gradually and successively from within outwards, the tail is said to be *graduated*. If they thus shorten less and less, they form a *cuneate* or wedge-shaped tail, and this may become *acutely cuneate* or *acute*.

The tail-feathers may fold up so as to form a whole, convex above or, on the contrary, a convex below, so as to somewhat simulate the shape of a boat.

These true tail-feathers, or *rectrices*, have their bases covered and protected both above and below by feathers, which take their origin in the trunk, and thence project backwards over the quills and bases of the rectrices. They are generally small and softish feathers (especially those beneath the tail), which tend to complete the conical form of the hinder end of the body. They are called *tectrices*, *i. e.* covering feathers or *coverts*, and those above and below the *rectrices* are respectively distinguished as the upper and lower tail-coverts. They are always present, but may be very short. The upper ones generally extend less backwards than do the under tail-coverts. They may, however, take on a very great development, as, *e.g.*, in the Peacock, the gorgeous so-called tail of which is not even a true feather-tail, but is formed only of elongated upper tail-coverts (*tectrices superiores*), which when expanded are held up and supported by the true (though in appearance insignificant) rectrices beneath them.

We have now completed our survey of the skin and its appendages—the exoskeleton—of the axial part of the body—the head, trunk, and tail.

It remains to consider the same system of parts as developed on the two pairs of limbs which constitute the *appendicular* portion of the bird's bodily frame, being appendages attached to its *axial* portion.

The Limbs.

We will first consider the anterior pair of limbs called *pectoral*, from their situation beside the chest. These "pectoral appendages" are, of course, the wings.

The Wings.—All birds possess wings, though in some they are very small. Such is the case in the Emeu and the Cassowary, but above all in the Apteryx. When we speak of the wing of a Bird, we have mainly the feathers of the wing present to our imagination. This is reasonable, for the feathers are not only the most conspicuous objects, but the direct agents in effecting flight. Nevertheless, the solid structure in which they are implanted is of course no less necessary, it forms the basis and solid part of the wing. This solid structure is really the arm of the bird, and its distinct component parts correspond with and answer to our own. There is a part which answers to our upper arm and—in all existing birds—a part which answers to our fore-arm, these being united by a joint like our elbow. These portions of the arm are further held together by a very elastic and extensible fold of skin, which is of course widest opposite the elbow-joint. Another fold extends from the trunk to the upper arm; each of these folds is sometimes called a *patagium*. Thirdly, there is a part which answers to our hand, and which is termed the *pinion*. Within this "hand"—or *manus*—there are, as we shall see when we study the skeleton, parts which represent, more or less imperfectly, our first and second (index and middle) fingers, but they are all enclosed in one solid structure invested by skin, so that no finger can be externally recognized as free and separate like our own. There is, however, a short and small thumb—or *pollex*—which shows itself externally as a separate part. Thus the thumb and fingers (or *digits*) of the hand are enclosed as ours are when we have put on a pair of boxing-gloves. The thumb is a separate and distinct part of the pinion, but the other digits are enclosed, together with what answers to the middle part of our hand, in one continuous pad.

The relative proportions of the three solid parts of the wing differ in different birds. Thus the upper arm is relatively, as well as absolutely, very long in the Albatross; while in the Humming-birds it is relatively, as well as absolutely, very short. The fore-arm is longer than usual in the Apteryx, while in the Humming-birds and Swifts the pinion is relatively very much elongated.

The feathers which clothe the wing belong to three divisions, two of which correspond to those of the two divisions of the tail-feathers.

There are, first, the effective feathers of flight, which are called *remiges* or *rowers*; and there are, secondly, the covering feathers or *tectrices*, which invest the bases of the effective feathers of the wing, as the covering feathers of the tail invest the bases of the effective feathers of that part—the "rectrices." The third division consists of a small group of feathers which are implanted on the thumb.

Thumb-feathers.—The feathers of the pollex are a small group which constitute what is called the *Alula* ("little wing") or the *Ala spuria* (bastard wing). This little group of feathers is placed on the front and outer side of the pinion, and lies on the dorsum of the wing along its front or outer border.

Remiges.—These feathers are implanted into bones of the pinion and the arm, and belong to distinct categories accordingly. They mainly determine the size and shape of the wing, in conjunction with the development of the solid parts which support them. They are very little developed in the Cassowary and Emeu, and are still more rudimentary in the Apteryx. In the Penguins, however, they are peculiarly reduced, being no more in them than so many short scale-like feathers closely investing the arm, and forming a "flipper." In the Ostrich they are large, but, as every one knows, soft and loose, *i. e.* plumaceous in composition.

The remiges are very often so formed as to make the wing a structure strongly convex above and concave below—a condition which determines the noise made by Partridges when they rise. They may, however, form a nearly flat surface, though they are generally more or less concave underneath. The Divers afford an example of short wings with fully developed feathers, while the wings are at their maximum of relative length in the Frigate-bird.

As might be expected from their use, the remiges are the stiffest and strongest of all feathers, being most thoroughly "pennaceous" and coherent in their elements and the rachis always bears a web on either side. Of these the anterior or outer web is the narrower and stiffer, and the posterior or inner web the broader and softer. They vary in number (apart from the very exceptional forms such as the Apteryx or the Penguin) from sixteen to more than fifty, as may be seen in Humming-birds and Albatrosses respectively.

The feathers are so placed that the softer inner vane of each of the remiges underlies the stiffer external or anterior vane of that next to it. It is now ascertained that, in flight, a certain rotation of the long axis of each large quill-feather takes place, so that the air can pass between the feathers as the wing is raised. In the down-stroke they become closely applied, and the stiffer vane of each feather then helps to keep from yielding to the pressure of the air the broader soft vane of the feather external to it. They generally taper gradually and regularly to an obtuse point (*i. e.* are *lanceolate*). Sometimes either or both webs are abruptly narrowed, or *emarginate*, or they may be in appearance abruptly cut short (*truncate*), often obliquely so, or with a curved edge (*sinuate*).

Primaries.—This term is applied to denote those remiges which are inserted into the pinion (not, of course, into the pollex), and the length of the wing is often defined by the length from the base (or *proximal* end) of the pinion to the apex (or *distal* end) of the longest feather it bears. These feathers are the stiffest and strongest of all, and there are almost always nine or ten of them. If the first, or outermost, is very short, it is often called a *bastard* or *spurious primary*, as, *e. g.*, in the Thrush. The tip of the longest primary constitutes the point of the wing.

Secondaries.—The feathers thus named are those which spring from the arm. They vary greatly in number and in size. They may be extremely short, as in the Swift, or extremely long, as in the Argus Pheasant. There may be only six of them, or their number may exceed forty. It is very often easy to distinguish the secondaries from the primaries by their being less stiff and by a slight difference in their inclination.

Such feathers as may arise from the upper-arm bone used to be called *Tertiaries* or *Tertials.* But now all the remiges which are not primaries are termed "secondaries," the inner ones being distinguished as *innermost secondaries.* These latter are generally few in number and inconspicuous, but may be elongated and conspicuous, as in the Lark or the Woodcock. They are often useful in defining some genera of birds, as they frequently differ in colour from the other secondaries, and sometimes partake of the tints of the greater coverts.

Scapulars (fig. 144, 19) are sometimes confounded with innermost secondaries, but the latter belong to the series of "remiges," while the former pertain to the series of feathers implanted in what is called the humeral pteryla *.

Wing-coverts.—The coverts—*tectrices*—or covering feathers of the wing, differ from "tail-coverts" in that they strengthen the quills. They are, however, like tail-coverts in that they are divided into an upper series (*superiores*) and an under one (*inferiores*), and, as has been said, they cover over and protect and strengthen the quills and base of the "remiges."

Tectrices superiores.—These are the more important, and they are much more complex than those of the tail, as might be expected from the greater complexity of the parts they cover.

* See below, p. 165, fig. 147, 2.

They are divisible into two sets, namely (A) those which spring from the pinion and cover the primary remiges, and (B) those which cover the secondary remiges.

(A) The *upper primary coverts* spring from the pinion and overlie the primaries. By these it can often be determined how many primaries a Bird has. There is a series of large size, and a second series mostly few in number and scarcely visible, being covered almost always by the bastard wing.

(B) The coverts of the second category, or the *upper secondary coverts*, mostly spring from the fore-arm, and are divided into three distinct categories or transverse rows:—

(1) The *greater upper secondary coverts* (tectrices majores) or "greater coverts." This category includes the largest and most important set of feathers of all the "upper secondary coverts." They form the transverse row which extends farthest down over the secondaries, and afford valuable characters for classification.

(2) The *median upper secondary coverts* (tectrices mediæ), or *middle coverts*, are a transverse row of smaller feathers which cover over the bases of the greater coverts. Their apices are often otherwise directed than those of the latter.

(3) The *least upper secondary coverts* (tectrices minores), or *lesser coverts*, are all the feathers, forming various transverse small rows, which cover over the bases of the middle coverts and the upper surface of the wing—fore-arm and fold of skin, or patagium, attached to it—thence to its anterior margin.

The *humeral coverts* are a short series of feathers arising from the skin over the humerus, very well seen in the Duck. These coverts are very often absent, and when present they may have much of the appearance of innermost secondaries, as in the Duck, where they are very long and conspicuous. It may also, in some cases, be difficult to distinguish them from "scapulars," but they take origin from the skin over the upper-arm bone, more or less external to the humeral pteryla where it gives origin to the scapulars. These two categories of feathers—scapulars and humeral coverts, can both be seen very clearly and distinctly in the Duck.

The *under wing-coverts* (tectrices inferiores) are divisible into primary and secondary ones like the *upper wing-coverts*, but they are less important for purposes of classification.

Some of these feathers may, however, be distinguished as *axillary feathers*, because they are nearest to the arm-pit. They lie close to the body at the inner margin of the under surface of the wing, and are generally longer and firmer than the rest of the under wing-coverts. They correspond below with the humeral coverts above, and may be well seen in the Duck, the Snipe, and the Plover.

Claws.—In some birds a claw exists at the end of the thumb; in others one at the end of the thumb and one towards the apex of the pinion or there only. Besides these claws, claw-like structures termed *spurs* may be borne, one on the side of the pinion; and in one bird, the Screamer (*Palamedea*), there are two of them. Such a structure is called a *calcar*.

The Legs.—We must now pass to the hind, or posterior, pair of limbs—the legs—which are called *pelvic* limbs, or appendages, because they are attached, as we shall shortly see, to a portion of the skeleton called the "pelvis."

As has been said, all birds have a pair of legs, and these organs have a general, essential resemblance to our own lower limbs, having three distinct parts:—(1) the part corresponding to our thigh, (2) the part answering to our leg and called the *crus*, and (3) parts which correspond with our foot, the straight upper part of which is called in Ornithology the *tarsus*.

There is a knee-joint between the thigh and the leg which is like our own joint in its direction and essential particulars.

There is also a joint between the *crus* and the *tarsus* which roughly answers to our own ankle-joint, but (as we shall see when we study the bones) does not entirely or accurately correspond therewith.

The foot—*pes*—(using that term as the equivalent to our foot) includes the straight and sometimes greatly elongated segment of the limb called the "tarsus," and also the toes, or digits, which diverge from the lower end of that segment, though the toes alone are commonly called the "foot."

The foot, using that term in its wide sense, is of course always a conspicuous part of the limb, while more or less of the leg and all the thigh are concealed by the plumage, or even enclosed within the general envelope of the skin of the trunk. Thus the knee is never externally apparent, and this circumstance, together with the conspicuous ankle and long upper part of the foot, give rise to popular misapprehensions about the nature of the lower limbs of birds.

The thigh is always very thick. The next segment, or true leg, is called in Ornithology, as before said, the *crus*. It is also thick at its upper part, but tapers downwards, becoming much contracted towards the ankle-joint.

The pelvic limbs vary much in structure, in harmony with the very different uses to which they may be put in creatures which differ so much in modes of life as do a Hawk, a Swift, a Heron, and a Penguin.

The entire length of the whole limb varies greatly, being relatively very short in the Swift and Frigate-bird, and relatively extremely long in the Stork, the Flamingo, and the Stilt. When the limbs are very elongated, it is the leg and upper part of the foot which are mainly lengthened. The thigh is always relatively short. The toes may be exceptionally long relatively, as in the Water-hen, Screamer, and Jacana.

Though in descriptive Ornithology the upper, single, and straight part of the foot above the toes is always, as before said, called the *tarsus*, the inexactitude of this term will be evident when the internal skeleton of the leg and foot is understood. It is always more or less slender and cylindrical, and never thick like the upper part of the crus. It may be somewhat *compressed*, or laterally pressed in. Rarely, as in the Penguin, it may be much flattened from behind forwards—*i. e.*, decidedly widest in the transverse diameter.

The most variable part of the leg is, as might be expected, the foot, and especially the number, shape, and disposition of the digits or toes.

Birds always walk on their toes, or are what is called *digitigrade*, with the exception of the Penguin, which applies its tarsus also to the ground, and is thus the only *plantigrade* kind of Bird.

The *number of the digits* varies from four, which are present in the immense majority of birds, to two—a number present only in the Ostrich.

The *first toe* may also be called the *hallux* and compared with the great toe in ourselves. It has almost always two joints, not including that at its base.

The *second toe* may also be called the *index*, and compared with that which is next to our great toe. It has always, with two exceptions *, three joints.

The *third toe* may also be called the *medius* and compared

* The genera *Ceyx* and *Alcyone*.

with our middle toe. It has almost always four joints, but may have but three *.

The *fourth toe* is comparable with the fourth toe of our foot—a digit which, as analogous to the fourth digit of the hand, may, at need, be distinguished as the *annulus*. It has nearly always five joints, but may have four † or only three ‡.

Our own little toe has no representative in the Class of Birds.

When there are but three digits, it is the hallux which disappears, and when, as in the Ostrich, another is absent, it is the second one. This rule is universal save in the genera *Ceyx* and *Alcyone*, where the second digit is defective or hidden under the skin, and the Babbler (*Cholornis*), where the fourth is defective.

Disposition of the Digits.—Ordinarily birds have three toes turned forwards and one, the *hallux*, turned backwards. Very rarely, as in the Swift, all four are turned forwards, when the hallux is the innermost of the four. Very often two toes are turned forwards and two backwards, constituting what is termed a *zygodactyle* or yoke-toed foot. In this case it is generally the first and fourth digits which are turned backwards. In the Trogons, however, the first and second toes are turned backwards and the third and fourth forwards.

When there are only three toes they all turn forwards, save in the genus *Picoides*, where the fourth is turned backwards. Sometimes a digit is what is called "reversible" or "versatile"—that is, it can be turned either way, as is the case with the fourth toe in most Owls.

The *hallux* may vary much in its relation to the other toes. In the first place, it may or may not be on the same level with them—the 2nd, 3rd, and 4th toes always being placed side by side at the bottom of the so-called "tarsus." If it is on the same level with them, it is said to be *incumbent*. If it is attached to the hinder side of the tarsus above the level of the attachment of the other digits, it is termed *elevated*, as in the Fowl and the Duck. It is generally longer than one or two of the other toes, and may be the longest digit of all. It is never so long when elevated as when incumbent. It may barely reach the ground, or it may, as in the Petrels, exist in a rudimentary condition.

* As in the Swift. † As in the Goatsucker.
‡ As in the Swift.

Length of Digits.—Of the three external digits the median one is almost always the longest; the toes on either side of this are generally of equal length, but if unequal, then, save in rare instances, the outer of the two is the longer.

The *connection between the digits* may be confined to the immediate proximity of their origin, when they are separate and distinct, as in the Thrush. The third and fourth toes may cohere for almost their whole length, being invested by skin as if they were but one toe. This condition is termed *syndactyle* or *anisodactyle* or *syngenesious.* Examples of this structure are to be found in Kingfishers and Hornbills. The two outer digits may be exceptionally connected in some Fowls and Pigeons *. The digits are often much connected together by folds of skin, or are *palmate.* Such Birds are said to be *web-footed*, as in the Duck. The webs ordinarily connect together only the 2nd, 3rd, and 4th toes, but they may, in addition, connect the first toe with the second—as in the Pelican and Cormorant. Such a foot is called *totipalmate.* If the webs are short, only reaching about halfway down the toes or less, the foot is *semipalmate.* The webs may have their margins sharply concave or cut in; such are said to be *incised.* The incision may extend to the roots of the toes, so that each digit is fringed with membrane, which forms festoons on either side of it. A foot of this kind is said to be *lobate*, and we find such in the Coot and Grebe.

The skin of the pelvic limb is always more or less invested with feathers, but also almost always partly bare. The skin of the bare portion is peculiarly conditioned and needs separate description; but the plumage had better first be noticed.

The feathers of the pelvic limb are very different from those of the pectoral one. Only by very rare exception, and as a sort of monstrosity, are long pennaceous feathers developed, comparable with the remiges of the wing. The thigh is always feathered as part of the body-plumage. The feathers of the crus are almost always inconspicuous, but they may be conspicuous from their length, as in the Hawks and some Cuckoos.

The crus is always feathered at its upper part, and may be feathered its whole length, as in the Diver.

The tarsus is generally naked, but it may be closely invested

* In some of those which have abnormally developed feathers, technically called "boots." See below, p. 162.

by small feathers for its whole length, as in the Barn Owl, some Eagles, and the Grouse, or it may be only partly feathered. The toes are normally feathered also in some Owls and in the Ptarmigan.

Abnormally, feathers grow on the feet which resemble the long feathers of the wing. Such feathers may be found on the feet of Trumpeter Pigeons and Bantam Fowls, and structures of this kind are called "boots." These extra feathers are attached to the outer side of the foot, just as the primaries of the wing are to the outer side of the pinion. These foot-feathers have been known to exceed the wing-feathers in length, which they resemble not only in size but in structure.

The *skin of the bare portion of the limb* is almost always horny, but may be somewhat leathery, as, *e. g.*, in the Duck and most aquatic birds. The epidermal covering is more or less divided into scale-like segments. If these are very small they are said to be *reticulate*; if they form largish quadrate segments the part so invested is *scutellate*; but the tarsus may be invested by a continuous horny plate in front—or along what is called the *acrotarsium*—when it is said to be *booted* or *greaved*. When the reticulations are in the form of little prominences which roughen the legs, such a covering is *granular*; and if a scutellate part is so formed as to make the leg rough, it is called *scarious*. Its prominences may be so sharp as to be termed *serrations*. The wrinkled surface of the web of palmated feet is spoken of as *cancellated*.

Different naked parts of the limb may be differently invested.

The whole naked epidermal investment is named the *podotheca*. If this is divided into many subdivisions, it is said to be *schizothecal*. The lateral and the hinder surface of the tarsus, or the *planta*, may be invested with scales or scutellate—a condition termed *scutelliplantar*—or it may be covered with reticulations. But each lateral surface may be clothed with only one continuous plate, which meets its fellow at the middle of the back of the tarsus, the junction of the two forming a prominent ridge; such a condition is denominated *laminiplantar*, and the coexistence of this condition with a continuous horny plate in front of the tarsus forms a podotheca, the very opposite to that termed "schizothecal." By contrast, therefore, it is distinguished as *holothecal*—a "holothecal podotheca." A tarsus may, however, be laminiplantar and yet scutellate in front, or it may be scutellate in front and reticulate laterally and behind, or it may be entirely reticulate. Rarely the tarsus may be "greaved" (continuously sheathed) in front and yet scutelliplantar.

The upper surface, or dorsum, of all the toes—called the *acropodium*—is almost always scutellate. Their under surface is in general minutely marked, but may develop small wart-like structures—"*pads*" or *tylari*—as may be seen in Hawks.

Claws.—Every digit of a bird's foot is provided at its end with a horny claw, more or less curved and pointed at its extremity,

Fig. 145.

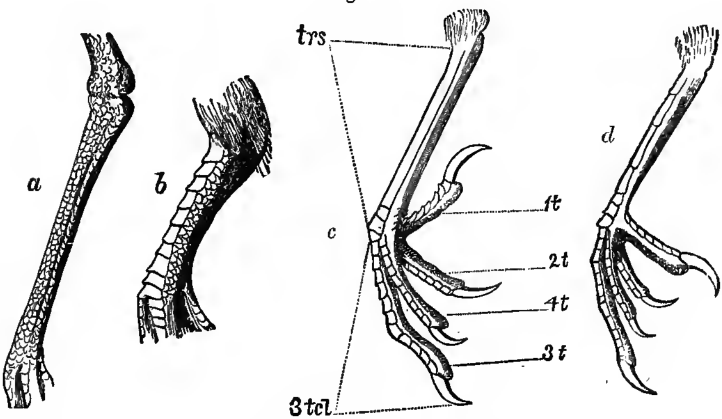


DIAGRAM OF EPIDERMAL COVERING OF TARSUS AND DIGITS.

a. Reticulate form (Plover). *b.* Scutellate and reticulate form (Pigeon). *c.* Booted or greaved laminiplantar form (Robin). *d.* Scutellate laminiplantar tarsus (Cat-bird—*Mimus carolinensis*). 1 *t*–4 *t.* Digits. *trs.* Tarsus. 3 *tcl.* 3rd digit from tarsus to end of claw. (*After Coues.*)

except that the hallux, when in a rudimentary condition, may be clawless. Claws vary as to length and strength. They are exceptionally long and all straight in the Jacanas, especially that of the hallux. They are at their maximum of strength, as well as much curved and acutely pointed, in the Hawk and other birds of prey. They are but little pointed in such birds as the Fowl and the Pigeon, but most obtuse of all in the Grebe.

Claws are always more or less concave beneath transversely as well as in the direction of their length. They may be grooved —*sulcate*; or ridged—*carinate*. The inner edge of the middle claw may be dilated and its margin very strongly toothed. It is then said to be *pectinated*, and such a "comb" is well seen in the Goatsucker's foot.

Spurs or *calcars* exist, as everyone knows, on the back of the tarsus of the Cock; and two spurs may exist on each foot, as in the double-spurred Peacock (*Polyplectron bicalcaratum*), or even more, as in *Ithaginis*. They are sexual characters—only found in the males.

Thus very different *types of feet* are to be found amongst birds, according to their habits. The "Scratchers," as, *e. g.*, the Fowl, have the foot rather thick, the claws short, and the hallux elevated—the "rasorial" type. The "Climbers," as, *e. g.*, the Woodpecker, have the foot zygodactyle and the claws well developed and curved—the "scansorial" type. In the "raptorial" type, *e. g.* the Hawk, we find a powerful foot, with long, curved, sharp, and powerful claws. In the "grallatorial" and the "cursorial" types we find a foot with a minimum power of grasping, and a reduced or elevated hallux and an elongated tarsus. In the most opposite type—that of the "perchers" —the "insessorial" type—there is a long, well-developed hallux, and the other digits are cleft to their bases; while, on the contrary, in the "natatorial" type—the Swimmers—we find the feet webbed more or less completely or else lobate.

PTERYLOSIS.

As before said * the feathers of birds do not usually grow all over the body, but along certain definite *tracts*, each of which is termed a *pteryla*. These are separated by spaces wherein feathers are not implanted, or *apteria*.

A few birds, however, have feathers implanted all over the body. Amongst these are the Toucan, the Penguin, and the Ostrich. The definite "pterylæ" which have been defined are the following:—

The *dorsal* or *spinal* pteryla, which extends from the nape of the neck to the tail. Its shape varies greatly in different

* See *ante*, p. 141.

Fig. 146.

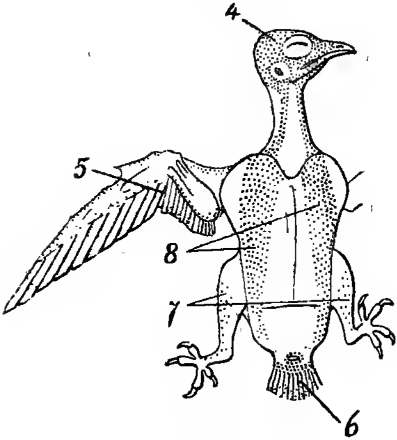
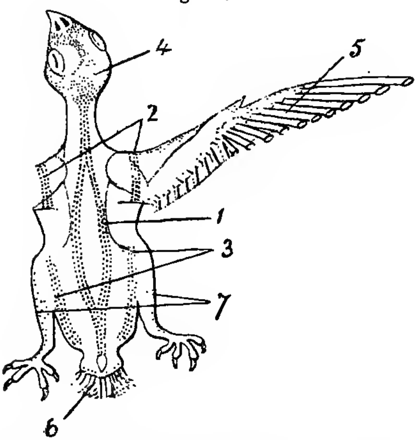


Fig. 147.



PTERYLÆ OF DORSAL AND VENTRAL SURFACES OF THE SWIFT, *Cypselus apus*. (*After Nitzsch.*)

Fig. 146. Ventral aspect. Fig. 147. Dorsal aspect.

1. Dorsal or spinal pteryla. 2. Humeral pteryla. 3. Femoral pteryla. 4. Cranial pteryla. 5. Alar pteryla. 6. Caudal pteryla. 7. Crural pteryla. 8. Ventral pteryla.

kinds of birds, sending out branches, bifurcating or suffering interruption, as the case may be. Fig. 147 (1).

The *ventral* pteryla extends from the throat to the root of the tail, and may vary in disposition, as already stated, with respect to the dorsal pteryla. Fig. 146 (8).

The *cranial* pteryla, or tract of the head, more or less extensively invests the head and becomes continuous with the dorsal pteryla. (4).

The *caudal* pteryla, or tail-tract, comprises both the dorsal and ventral surface of the tail, wherein the rectrices and upper and lower coverts are inserted. (6).

The *humeral* pterylæ, or shoulder-tracts, are constant but small. One crosses obliquely backwards and inwards over the shoulder from the upper part of the upper arm. Fig. 147 (2).

The *alar* pterylæ, or wing-tracts, run each along the solid part of one of the wings from the upper arm to the end of the pinion. (5).

The *femoral* pterylæ, or thigh-tracts, form two oblique bands, one outside either side. They are very variable. Fig. 147 (3).

The *crural* pterylæ, or leg-tracts, cover those portions of the pelvic limb below the knee which have feathers inserted into them. (7).

Downy feathers generally clothe the body (partially or entirely) independently of the pterylæ, and beneath the other feathers distinguished as *contour feathers*. But down may be absent altogether, as in the Woodpeckers.

CHAPTER III.

The Internal Skeleton.

HAVING now completed our brief survey of the skin and its appendages—the external or *exo-skeleton* of Birds—we must now turn to that which is ordinarily alone called the skeleton—namely, the internal or *endo-skeleton.*

This mainly consists of bone, though, in part also, of cartilage and membrane. The bony substance, or *osseous tissue* *, of birds is very dense and strong and yet very light. Their bones are whiter than those of other animals, and are more or less generally permeated with air. In the Penguins; however, none of the bones contain air, while in the Ostrich many of the bones which in other birds contain air are filled with marrow. With one or two other exceptions, the bones of the upper arm and of the thigh always contain air. All the bones, except those of the toes, may contain air—or be *pneumatic* (as it is called)—as in the Pelican and Gannet; and even the bones of the toes are pneumatic in the Hornbill, and all its bones are so save the jugal †.

There are several reasons why it is desirable that the student should pay very particular attention to the study of the internal skeleton.

In the first place, a knowledge of that system of parts which supports and sustains all the others—the bony framework or skeleton—is most useful, because many of its characters are made use of in Ornithological classification and the defining of groups. It is, besides, the part least perishable, and our only guide to the nature and affinities of birds which can now

* Every different kind of substance of which the living body is composed (*e. g.* bone, gristle, muscle, fat, &c.) is called a "tissue."

† For the "jugal" see below, p. 180.

be known to us by their fossil remains alone. The skeleton also bears a close relation to the general external form, and its structure is a guide to the actions and therefore to the modes of life of the living organism of which it once formed the basis and support.

Various parts of the skeleton are capable of being moved one upon the other, and to facilitate these motions the contiguous surfaces of such moveable bones are so shaped as to form what are known as "joints."

The skeleton consists of the *back-bone*, or *spine*, which supports, at its anterior end, the *skull*. From either side of part of the back-bone, the *ribs* proceed outwards, and are attached at their other ends to a *breast-bone* or *sternum*. All this constitutes the *axial* part of the endo-skeleton. The back-bone constitutes the *spinal* part of the axial skeleton, while the skull forms its *cranial* portion. The rest of these parts—the breast-bone and ribs—together make up the *thoracic* * part of the skeletal axis. Two pairs of bony *girdles* are attached to the axial skeleton, and each such girdle supports the bones of one of the two pairs of limbs.

The anterior, or *pectoral*, limb-girdle is attached to the front of the sternum, and to it the wing-bones are affixed.

The posterior, or *pelvic*, limb-girdle is much more solidly connected with the more posterior part of the back-bone than is the pectoral girdle with the breast. It forms the sockets into which the upper ends of the thigh-bones fit.

These two bony limb-girdles, with the bones of the wings and of the lower limbs, together constitute the *appendicular* portion of the endo-skeleton.

The axial skeleton.—As we began by considering the exo-skeleton of the head, trunk, and tail before that of the limbs, so we will here begin by first studying the bony framework, or endo-skeleton, of the head, trunk, and tail.

It will, however, be more convenient to defer considering the skeleton of the head, till we have made acquaintance with the bony parts of the trunk and tail—*i. e.*, with the "spinal" and "thoracic" parts of the skeleton.

* So called because it answers to the parts which form the skeleton of our chest or "thorax."

THE BACK-BONE, RIBS, AND BREAST-BONE.

From the hinder side of the head to the end of the tail there runs that bony structure already spoken of as the "back-bone" or, as it is also often called, the *spinal column*. It is made up of a chain of bones placed one behind the other, each being a more or less cylindrical ring, much thicker on one side—the ventral side—than elsewhere. Each of these bones is called a *vertebra*, for which reason the term *vertebral column* is also applied to the whole spine.

The "vertebræ" being thus serially conjoined, the juxtaposed

Fig. 148.

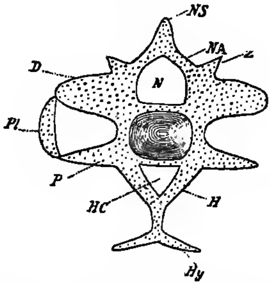


DIAGRAM OF A VERTEBRA, seen in front.

The shaded central part in the middle is the centrum of the vertebra.

D. Diapophysis or superior transverse process. *H*. Hæmal arch. *HC*. Hæmal canal enclosed by hæmal arch. *Hy*. Diverging ends of hypapophyses. *N*. Neural canal enclosed by neural arch. *NA*. Neural arch. *NS*. Neural spine. *P*. Parapophysis or inferior transverse process. *Pl*. Pleurapophysis, represented as present on one side only. *Z*. Zygapophysis.

rings form a long canal called the *vertebral* or *neural canal*, because it contains and protects the spinal cord or spinal marrow, the most important part, with the brain, of the nervous or "neural" system. The thickened or ventral part of each vertebra is named the *centrum*, and the rest of the ring the *neural arch*, for it is an arch springing by piers from either side of the centrum.

Various bony prominences projecting from the vertebra are termed *processes.* From the middle of the dorsal side of the neural arch there generally arises a prominence called the *neural spine* or *neurapophysis*, though it is sometimes simply called the *spinous process.* Prominences which jut out laterally from the side of the neural arch or centrum are called *transverse processes.* There may be two of them on either side. In such case the superior one is called the *diapophysis* or *tubercular* transverse process, and the inferior one the *parapophysis* or *capitular* transverse process. The distal ends of these two processes may be connected on either side by an osseous bridge, which may be prolonged into a process—the *pleurapophysis.* Two processes may arise, one from either side of the ventral surface of the centrum, and meeting together below form an arch beneath it comparable with the "neural arch" above. Such an inferior arch is termed a *hæmal arch*, and serves to protect and transmit blood-vessels.

A median process may depend from the middle surface of the centrum or the ventral end of the hæmal arch. Such a part is named a *hypapophysis*, and it may bifurcate laterally, as in the Penguins.

Two other processes generally project forwards and two backwards from the neural arch of each vertebra. These four are termed *zygapophyses* or *articular processes.* They are so termed because they serve to articulate adjacent vertebræ together. Each articular surface of the anterior pair of zygapophyses, or *prezygapophyses*, looks more or less dorsally, or *dorsad*, and receives upon it the articular surface of one of the pair of posterior zygapophyses, or *postzygapophyses*, the articular surfaces of which look more or less ventrally, or *ventrad.*

Adjacent vertebræ are also articulated by the adjacent surfaces of their centra. Parts which thus articulate have interposed between a membranous bag, or *synovial membrane*; so called because it contains *synovia*, or joint-oil—an arrangement which facilitates movement and diminishes friction. Adjacent vertebræ may completely unite with each other or with other parts of the skeleton. Such parts are then said to be *anchylosed* together.

The vertebræ are divisible into four categories:—(1) Those of the neck, or *cervical* vertebræ; (2) those of the trunk, or *dorsal* vertebræ; (3) those intermediate between these and the tail, or *sacral* vertebræ; and (4) those of the tail, or *caudal* vertebræ.

The *cervical vertebræ* vary in number from eight or nine, as in the Sparrow, to twenty-three, as in the Swans—sometimes, it is said, even twenty-four. The usual number is thirteen, or one more or less. An ordinary cervical vertebra has only a very short neural spine. Each centrum is shaped somewhat like an hour-glass. Anteriorly it is concave from side to side, and convex from above downwards; posteriorly the reverse. Thus either end is saddle-shaped, but the saddles being differently disposed, each saddle-shaped surface of a vertebra fits admirably into that of the vertebra it adjoins both in front and behind. Vertebræ the centra of which articulate together in this manner are spoken of as *heterocœlous.* The transverse processes of either side are connected by a bony bridge (the pleurapophysis), whence a styliform process projects backwards. Thus the series of these arches on either side forms a lateral canal which shelters blood-vessels, and is called the *vertebrarterial canal.* The bony-bridge, with its styliform process which thus encloses it, is at first a separate bone, and is called a *cervical rib.* Those of the more posteriorly situated cervical vertebræ are the more prolonged, and the last is a very long rib-like bone. It always, however, ends freely, and does not join the breast-bone. The first two vertebræ differ from all the others and from each other.

The first of these, the *atlas*, is a short ring of bone. The anterior surface of the ventral portion of the ring presents a cup into which the hindermost portion of the base of the skull is received. Above this there is a lateral prominence on either side jutting inwards, and the apices of these prominences are connected by a strong membranous cord, or *ligament*, which separates off the lower part of its cavity from the larger cavity above it for the spinal cord. This ligament may become ossified, and then the vertebra forms two superimposed rings, greatly differing in size.

The second vertebra is called the *axis* vertebra, and bears a strong peg-like process on the front of its centrum. This is called the *odontoid* process, and it is received into the small ring of the atlas just described as bounded above by a ligament. Round it, as on an axis, the atlas turns—bearing the head with it —a circumstance which gives its name to the vertebra, which is also known, from the process it bears, as the *Os odontoideum.*

The cervical vertebræ are the most moveable, and are so formed as to produce by their junction that sigmoid flexure of the neck before described *.

The *dorsal vertebræ* are very much less moveable, and generally some of them are anchylosed together. They are usually about seven or eight in number, but there may be only five or as many as eleven. They are very different in shape from the cervicals. They consist of the first vertebra which bears a jointed rib directly articulating with the breast-bone, together with all the vertebræ behind it to which ribs belong in whatever way such ribs may terminate at either end. When we consider the dorsal vertebræ with the ribs attached to them, we see at once the rib-like nature of the cervical ribs—the hindmost of which is very much prolonged, though it does not attain the breast-bone. Each such vertebra is, generally, shorter than a cervical vertebra, they are also broader as seen dorsally, but their centra are much narrower from side to side than those of the cervical vertebræ, being compressed so as to form a median ventral ridge. Above, they bear high, broad, and thin neural spines in the form of squarish plates, which very often become anchylosed together.

There is a broad upper transverse process—" diapophysis "—to which part of the rib (called the "tubercle") is attached, and there is below it an articular surface for the proximal end of the rib (called the " head "), which surface may be taken to represent the lower transverse process—" parapophysis "—of the cervical vertebræ. The centra articulate together by saddle-shaped surfaces in all existing birds save the Penguins, in which, from the third dorsal backwards, each centrum exhibits behind a hemispherical cup, into which is received a hemispherical ball belonging to the anterior surface of the centrum of the vertebra next behind it. Such vertebræ are termed " hollow-behind " or *opisthocœlous*.

There are often median inferior processes or hypapophyses, and these may bifurcate distally, as in the Penguin and Diver.

The *sacral vertebræ* of birds are very numerous. They constitute what is called the *sacrum*, and it is a very extensive structure. A "sacrum" is that part of a vertebral column where the vertebræ are anchylosed together in order to form a firm point of support, or fulcrum, for the hinder or pelvic limbs.

* See *ante*, p. 148.

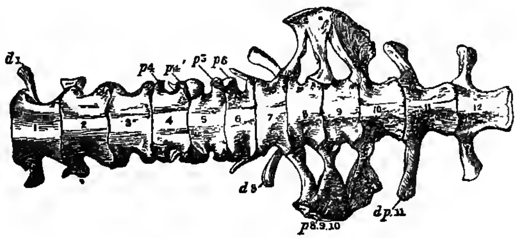
It does this by affording attachment to a bony girdle—called the "pelvis"—from which the lower limbs are suspended.

The *sacrum* of a bird, being so extensive, includes more vertebræ than does the pelvis of any beast or reptile, and we may distinguish three parts in it:—

(1) A part made up of vertebræ which may be taken to represent vertebræ of the trunk, which have been absorbed by it. The vertebræ which form this part may be called *lumbo-sacral* *.

(2) A part which may be taken to be especially sacral, or the "sacrum" *par excellence.* Its vertebræ are the *true sacral* ones. (Fig. 149, 8, 9, & 10.)

Fig. 149.



VENTRAL ASPECT OF SACRUM OF YOUNG OSTRICH.

1–12, Centra; d–d^8, diapophyses of corresponding vertebræ; p^4–p^{10}, parapophyses of corresponding vertebræ; *dp,* conjoined dia- and parapophyses of the vertebra marked 11.

(3) A part made up of vertebræ which may be taken to represent vertebræ of the tail, which have been absorbed into the sacrum. The vertebræ of this region are termed *uro-sacral.*

The number of vertebræ thus anchylosed together varies from a dozen or eleven to thirteen, which is about the average, up to twenty.

The whole sacrum is an elongated structure somewhat spindle-shaped, and is compressed between those bones of the pelvis

* So called because these vertebræ seem to answer to those vertebræ of man and other mammals which are termed "lumbar," and are the vertebræ which come between their dorsal vertebræ and their sacrum.

each of which is called an ilium—one of them abutting against its whole length on either side.

Looked at on the ventral surface, there is a continuous median bone—made up of the centra of the anchylosed vertebræ—which is narrowest towards the anterior and more posterior parts of the sacrum, and is somewhat broad and flattened towards its middle from before backwards. Transverse processes project outwards conspicuously both in front of and behind this median part, on either side of which no such prominences are conspicuous, so that a depression or hollow appears between that median part and the ilia beside it. This hollow receives and shelters a portion of the kidney.

The most anterior *lumbo-sacral* vertebræ show well developed diapophysial (higher) transverse processes, which become gradually augmented, from before backwards, by parapophysial (lower) transverse processes joined with them, and all these abut against the ilium. There may be from two to five or more of these vertebræ. (Fig. 149, 1–7.)

The true *sacral* vertebræ are those without conspicuous parapophysial transverse processes, though they may be represented by very short blunt processes, whereof one projects from the front and another from the hinder part of the side of each centrum.

The "diapophyses" are in the form of lateral plates which pass outwards, one from either side of the neural arch, to anchylose with the ilium against which they abut. There may be from two to five of these vertebræ.

The *uro-caudal* vertebræ are plainly distinguishable by their conspicuous slender lateral processes, which are directed outwards, backwards, and upwards, and the first three or four of them are for a time united by suture * with their centra, so as to seem more or less distinct in nature. They recall to mind the pleurapophysial processes of the cervical vertebræ, which are, for a time, distinct and separate bones. As the latter are termed cervical ribs, these sacral annexed lateral parts may be called *sacral ribs*. Besides these, the uro-caudals give out plate-like diapophysial processes. The whole series of lateral processes, whereof those just described are the most anterior,

* A suture is a line indicating the junction of two bones by a more or less extended apposition of their edges instead of by any other kind of joint.

become shorter as we proceed backwards, and ultimately grow more like those of the hindmost lumbo-sacral vertebræ. There may be from five to eleven uro-caudals, as in the Ostrich.

Caudal Vertebræ.—These are all the vertebræ posterior to the sacrum. They are sometimes called *coccygeal,* because they answer to that terminal part of the spinal column in man which is called the coccyx. Almost all existing birds have more or fewer—three to ten—of the terminal caudal vertebræ anchylosed together into a solid mass called the "ploughshare bone," or *pygostyle**. In the Penguin this part is shaped somewhat like a man's wooden leg, and is useful for sustaining the body in the upright position the Bird assumes when on land. Sometimes it expands below into a broad disc—as in the Woodpecker. It supports the fleshy tail with its rectrices and oil-gland. In front of the pygostyle are the free caudal vertebræ, which are mostly about eight in number. They have spinous and transverse processes and, at least the hinder ones, develop a hypapophysis which may bifurcate. In the Rhea all the caudal vertebræ are distinct, but they are exceptionally imperfect in their formation, none having transverse processes, and only the first five, or sometimes only three, have complete neural arches, which become smaller and smaller from the first caudal vertebra, backwards.

The *thoracic* part of the axial skeleton consists, as before said, of the ribs and breast-bone.

The Ribs.—Having already noted what are called cervical and sacral ribs, it remains but to consider those which are related to the dorsal vertebræ.

Ribs belong to two categories :—(1) Those which are dorsally placed and are articulated (save by the rarest exception) with the vertebral column, on which account they are called *vertebral ribs.* (2) Those which are ventrally placed, and are articulate below with the breast-bone or "sternum," on which account they are called *sternal ribs.* Each vertebral rib articulates at its lower end with the upper end of a corresponding sternal rib, except the two or three hindmost, which may end freely, neither being connected with a sternal rib nor joining the sternum.

Vertebral ribs.—Of these there are commonly about half a dozen on either side, though there may be nine, as in the Diver.

* See below, p. 195, fig. 157, *py*.

The first one joins the sternum by the intervention of its corresponding sternal rib. All such ribs are called *true ribs.* Vertebral ribs which do not reach the sternum are termed *false* or *floating* ribs. Ordinarily the last sternal rib joins the sternal rib in front of it instead of the sternum. Very rarely, as in the Diver, the last rib floats at either end, being connected with the vertebral column by membrane only.

There are usually five "true" ribs, though there may, as in the Rhea, be but three. Ribs are usually elongated narrow structures, having considerable spaces between them, though in the Apteryx they are exceedingly broad.

Each vertebral rib joins its sternal rib at a marked angle open forwards, and a synovial membrane is interposed between the ends of each conjoined vertebral and sternal rib. This facilitates motion, and enables the angle just referred to to be made more or less acute, according as the breast-bone (to which the sternal ribs are fixed at their lower ends) is drawn up towards the back-bone, or the reverse. These movements are most important to a bird, as it empties its lungs by drawing up the breast-bone, and so contracting the body-cavity in which they lie—and fills them by depressing it, and so causing air to rush in and fill the vacuum which thus tends to be formed. To the hinder margin of all the vertebral ribs except the last or the last two or three, a bony process is almost always annexed, called the *uncinate* process, which projects upwards and backwards. These processes may be anchylosed to or moveably articulated with the rib, or they may be absent, as in the Horned Screamer, *Palamedea cornuta* (fig. 46), and in its allies the Chaja Screamers (*Chauna*).

Each vertebral rib ends superiorly by dividing into two branches, the upper branch of which is called the "tubercle" of the rib, or *tuberculum*, and articulates with a diapophysis. The lower branch is called the "head and neck" of the rib or *capitulum*, and articulates with a parapophysis or parapophysial surface. It is the fact of these articulations which has caused the diapophysis and the parapophysis to be respectively called the "tubercular" and "capitular" transverse processes as before stated*. The vertebral ribs increase in length from before backwards.

The *sternal ribs* are shorter than the vertebral ones. They

* See *ante*, p. 170.

may expand more or less from above downwards at their ends, becoming compressed from before backwards, where they join the sternum, as is well seen in the Ostrich, where each such elongated articular surface presents two superimposed articular cavities for its junction with the breast-bone. The sternal ribs increase in length from before backwards.

The Sternum.—This is a very variously modified and characteristic part of a bird's skeleton, the several forms it assumes helping to define different groups of birds. Its great size and the prominent median ridge or "keel" (which must be known to everyone who has carved a fowl) stand in close relation to flight, since the principal use of its great size is, as we shall see later, to provide sufficient space for the insertion of the muscles which both raise and depress the wing. In some instances, as in the Swan, the keel is much expanded and hollow and the windpipe makes a coil within it. The sternum of a bird answers to much more than our breast-bone, but might be represented in us by an imaginary extension of our sternum into a great sheet of bone passing downwards beneath part of the muscles of the abdomen or belly. It is a large continuous bony structure more or less convex ventrally both transversely and from behind forwards.

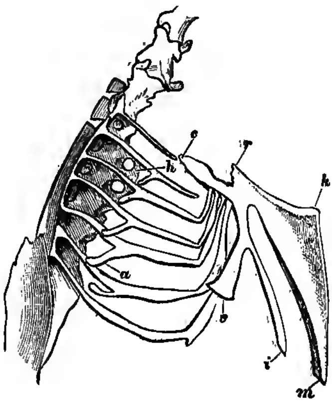
The Bird's sternum consists, in fact, of:—(1) An anterior part, into the sides of which are set the sternal ribs while its front margin affords a firm implantation to two bones—called "coracoids"—which mainly serve to support, as two fulcra, the anterior or thoracic limbs; and (2) a posterior portion which may be variously formed as follows:—It may be very short and broad, as in the Apteryx. Its posterior margin may be entire and obtuse, as in the Emeu; or entire and acutely prolonged, as in the Cassowary; or entire except that it has a short median notch, as in the Rhea; or with a short median prominence and two lateral ones, as in the Ostrich; or with a very long median one with two lateral notches on either side of it, as in the Common Fowl; or its posterior margin may be transversely continuous, while a little in front of it there may be two vacuities side by side, or five in a transverse series. Each such vacuity is called a *fenestra* or a *fontanelle.*

A sternum which has neither notches nor fenestræ is called *entire*, and, as just said, it may be *single-notched* or *double-notched*, or it may be *unifenestrate* or *bifenestrate.*

In the overwhelming majority of birds there is a keel, whence they are called *Carinate* birds. A keel is wanting, or more or less rudimentary only, in the Ostrich, Rhea, Emeu, Cassowary, and Apteryx, in a single kind of Parrot, a peculiar Rail-like bird (*Notornis*), and in the singular *Opisthocomus* *, amongst existing birds.

The lateral part of the sternum which receives the ribs, generally extends forwards on either side into a more or less marked prolongation called the *costal process*. From the middle

Fig. 150.



SIDE VIEW OF THORAX OF FOWL.

k, Keel of sternum; *m*, middle xiphoid process; *i*, internal lateral xiphoid process; *e*, external lateral xiphoid process; *r*, rostrum or manubrium; *c*, costal process; *h*, hypapophysis from middle of vertebral centrum; *a*, appendage from ribs, or uncinate process.

of the anterior margin of the sternum—which is almost always convex—a single process called the *rostrum* or *manubrium* may project forwards and may bifurcate.

On either side, between this and one of the costal processes, is the *coracoid groove*. Sometimes (as in the Hoopoe) the median anterior part of the sternum is perforated to receive processes from the bases of the coracoids. Very rarely, *e. g.* in

* See *ante*, p. 94.

the Apteryx, the anterior margin of the sternum is strongly concave. It is slightly so in the Rhea.

The median process extending posteriorly is called the *middle xiphoid* process, and if there is a single backwardly projecting process on either side of it that is called the *lateral xiphoid* process. If, instead of one, there are two such processes on either side of the "middle xiphoid" process, then the more external process of each such lateral pair is termed the *external lateral xiphoid process*, and the other the *internal lateral xiphoid process.*

Other names have been imposed on parts of the sternum. Thus the median part which supports the keel has been called the *lophosteon*; the anterior lateral piece which receives the ribs has been named the *pleurosteon*; and the part on either side which forms the single or double lateral xiphoid process has been distinguished by the term *metosteon.*

The hinder end of the keel and the part bearing it may remain more or less cartilaginous, as we see in the Fowl.

The Skull and its Appendages.

The *Cranial Skeleton* is made up of three parts, separable by mere removal of the soft tissues. These are (1) the skull with the upper jaw, (2) the lower jaw, and (3) the bones of the tongue or the *os hyoides.*

The *Skull* consists mainly of a rounded bony box, the *cranium* proper, containing the brain, with a hole behind through which the brain and the spinal marrow become continuous. The skull also affords protection to the organs of sight and hearing. The latter organs are enclosed within the substance of the lower, hinder part of the skull-wall, near a conspicuous external opening which leads towards them. The organs of sight are sheltered and partially enclosed behind and above, by the bony framework of the antero-lateral and anterior parts of the brain-case, the roof of which—or *frontal* part of the skull—projects forwards and also outwards over the bony orbits, or large lateral concavities for the reception of the eyeballs. From the front of the base of the brain-case a long tapering and pointed process, the *rostrum*, extends forwards. A thin vertical plate of bone ascends from this rostrum to the roof of the orbits, between which it may, or may not, form a complete, vertical, antero-posteriorly extending partition or *septum.*

To the cranium thus understood, the bony framework of the *face* is anteriorly annexed. It consists at its most anterior end of a solid cone of bone called the *premaxilla*—the apical portion of the upper bony jaw—which is attached to the skull behind by six long, more or less slender bars; but not all these are parts of the *premaxilla*. One of these is median and superior; one is median and inferior; two are external and lateral (one on each side of the skull), and two are inferior and intermediate—one on each side of the median inferior bar. These six bars form the framework of the face.

Attached to the side of the cranium, just behind the orbit and in front of the external opening of the bony ear, is a very irregularly shaped moveable bone called the *os quadratum*.

The *conical apex* of bone—which really consists of two bones (*premaxillæ*) anchylosed and united in one—extends backwards in three diverging branches: one superior and two lateral. The superior branch constitutes the *median* and *superior* bar of the six bars just enumerated as making up the framework of the face.

Each of the two lateral branches of the premaxilla forms a common base whence one of the two external and lateral bars and one of the two inferior and intermediate bars, above mentioned, both take origin and thence project backwards.

Each *external and lateral bar* of the face is an extremely slender one, which passes backwards, from the lateral branch of the premaxilla of its own side, to abut against the *os quadratum*. This very slender bar is made up of three pieces, whereof the more anterior is called the *maxilla,* the median one the *jugal*, and the posterior the *quadrato-jugal.* This external and lateral bar is sometimes called the *zygoma.*

Each *inferior and intermediate bar* of the face is an elongated but less narrow piece of bone—called the *palatine*—which passes backwards and inwards from the lateral branch of the premaxilla of its own side, to abut—almost always—against the side of the root of the "rostrum." From the sides of the rostrum, just behind its normal junction with the palatines and from the palatines themselves, two other elongated bones called *pterygoids* extend outwards and backwards to articulate with the quadrate bones. They may, as in the Ostrich, proceed outwards, not from the side of the rostrum, but from a more posteriorly situated part of the base of the skull. Thus each quadrate bone is embraced between the end of a pterygoid bone (which articulates with the inner aspect of the quadrate) and the end of a quadrato-jugal bone (which articulates with the outer aspect of the quadrate).

The *median and inferior bar* of bone is the most irregular in form and altogether the most inconstant of the six. It is formed of a bone, called the *vomer*, generally single, but which may be double (two side by side), extending from beneath the anterior part of the rostrum, forwards towards the middle part of the premaxilla, with which it is often connected by soft tissue only.

The two organs of smell are situated one on either side within the facial part of the skull, being sheltered and more or less protected by the bony framework of the bill. A scale-like bone, called the *nasal*, roofs over the hinder part of each nasal cavity, and forms the hinder margin of the nasal aperture. This bone consists of a posterior body and two forwardly extending and diverging limbs, the angle between which may be more or less acute or may be rounded. When it is rounded, and a line, joining the most backward point of the margin of the nasal of one side with that of the other, passes in front of the hindmost end of the median backwardly extending branch of the premaxilla, such a nasal is called *holorhinal*. If the angle is acute, and the same transverse line does not pass in front of the hinder end of the median branch of the premaxilla, then such a nasal is called *schizorhinal*. Extending outwards on either side of the median, ascending branch or process of the premaxilla, external to each nasal, another bone called the *lachrymal* is placed at the front margin of the orbit. Within it is a bone, bounding the orbit in front, called the *lateral ethmoid*. The anterior part of the interorbital septum is called the *median* ethmoid. At the hinder margin of the orbit there is a more or less prominent process called the *postfrontal*.

Returning to consider the cranium proper, or brain-case, it may be noted that the hole mentioned as permitting the junction of the brain and spinal marrow is called the *foramen magnum*. It is also called the *occipital foramen*, because the most posterior region of the skull is called the "occipital" region. Immediately beneath the foramen magnum is a spheroidal prominence which fits into the depression on the front of the atlas vertebra already described. This prominence is called the *occipital condyle*. The bones which enclose the internal ear are called *periotic*, but they are not separate from the parts of the cranium which adjoin them *. The median part of the skull above the occipital foramen is called the *supra-occipital*, and the parts on either side of that foramen are termed the *ex-occipitals*.

The hinder part of the roof of the cranium, just in front of the supra-occipital, is formed by two bones (not to be distinguished by any line of separation) side by side, called *parietals*, and in front of these is a pair of *frontals*, similarly anchylosed together and to the parietals.

The middle of the hindmost part of the floor of the skull is termed the *basi-occipital*, and immediately in front of this is the *basisphenoid*, in front of which, again, the "rostrum" (before described) projects forwards, and is, therefore, called the *sphenoidal rostrum*. Behind this, and beneath the basi-occipital, are two medianly conjoined plates of bone called the *basi-temporals*.

The periotic bones—or "periotic capsule"—enclose the organ of hearing. An aperture on the external surface of the skull, which is opposite to this capsule, is the opening of the ear, and is called the *meatus auditorius externus*. The nerve of hearing, "auditory nerve," passes from the brain to the ear through a foramen on the inner wall of the periotic capsule, which foramen is called the *meatus auditorius internus*.

The lateral surface of the cranium above the periotic capsule is called the *squamosal*, and it may develop a forwardly projecting process. In front of the periotic bone, the side-wall of the cranium is formed by a bone called the *alisphenoid*.

In front of the alisphenoids and at the hinder part of the inter-orbital septum is a small Y-shaped bone. The median lower and single part of this is called the *presphenoid*, and its lateral upward branches the *orbito-sphenoids*.

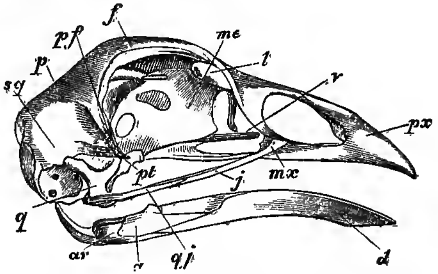
A pair of nerves called "optic" go from the brain to the eye-balls, and pass out at an opening rather low down, in the middle of the front of the cranial box. This opening is divided into two by the hinder end of the inter-orbital septum, and each such division is called an *optic foramen*. The nerves of smell pass forwards under the roof of the orbits, through a foramen in front of each orbit between the median and lateral ethmoids. This aperture is the *olfactory foramen*. A third important

* Their distinctness and the essential distinctness of different parts of the roof and other portions of the skull is known from their separate condition in the skulls of very young birds and of other animals.

foramen, called the *foramen ovale*, is pierced in the alisphenoid. It transmits the third branch of the fifth pair of nerves.

Beneath the sphenoid behind its rostrum is the opening of a passage called the *eustachian tube* or *canal*—which bifurcates as it passes backwards to the bony cavity of each ear; but the two tubes may open separately on the under surface of the skull. Further back on either side is the opening of another canal, which transmits an important blood-vessel called the carotid * artery. These parts are bounded below by the bony plates

Fig. 151.



SIDE VIEW OF FOWL'S SKULL.

a, Surangular bone of mandible; *ar*, articular bone; *d*, dentary; *f*, frontal; *j*, jugal; *l*, lachrymal; *me*, median ethmoid; *mx*, maxillary bone; *p*, parietal; *pf*, post-frontal process; *pt*, pterygoid bone; *px*, premaxilla; *q*, quadrate bone; *qj*, quadrato-jugal; *sq*, squamosal; *v*, vomer.

called "basi-temporals." The nerve which moves the tongue, the ninth or "hypoglossal nerve," passes out through the basi-occipital, and the nerve called "vagus" makes its exit from the skull more externally and a little anteriorly to the former. A little more anterior still, is that hinder opening of a canal for the carotid artery just mentioned.

Part of the interorbital septum and more or less of the median partition between the nostrils may remain gristly or cartilaginous. In the very young condition the skull is entirely formed of membrane and cartilage, and when the bones begin to form they are numerous and distinct, but they mostly soon

* See below, p. 217.

anchylose, or ossify, together, as will be further mentioned under the head of "Development."

The conditions above described being those common to the Class, a few of the more important variations in the form of the bones of the skull may now be noted.

The *lachrymal* is sometimes indistinguishable from the adjacent prefrontal. It may be greatly elongated and even unite with the postorbital process, thus forming, with the help of the other bones, a complete ring round the margin of the orbit.

A bony bar may even extend between and unite the postfrontal and squamosal processes, as in some Parrots.

The *nasal* bones, in other instances, may be completely anchylosed with the lachrymals, as in *Opisthocomus*.

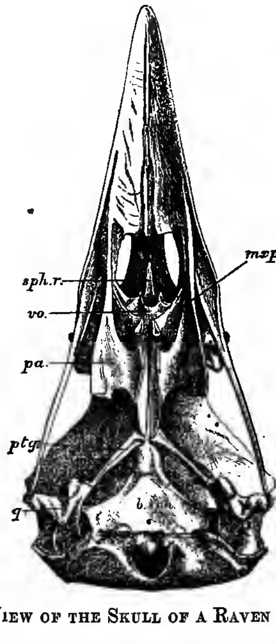
The *vomer* is generally single, but may be double (side by side), as in the Woodpecker. It may be more or less obsolete, as in the Pigeon and Duck; or large and broad, as in the Tinamou; and it may be deeply cleft behind and abruptly truncated in front.

The *maxilla* may vary much as to size, and generally sends inwards a process, or plate, of bone called the *maxillo-palatine* process (fig. 152, *mxp*), and this may be of a spongy nature. It may unite with its fellow of the opposite side, or may be not only distinct from that, but from the vomer also. Each *palatine* unites with the premaxilla, either by bony union, suture, or by a flexible joint—as in Parrots. In passing to this junction it traverses the ventral side of the just mentioned process of the maxilla. Instead of directly articulating with the rostrum posteriorly, it may be separated from it by the vomer, or, as in the Ostrich, pass back directly to the pterygoid, hardly even approximating to the rostrum.

The *pterygoid* may, as in the Ostrich, pass outwards and backwards to the quadrate, not from the palatine and the rostrum, but from the palatine and a process of the basisphenoid behind the rostrum. The processes with which the pterygoids articulate, whether such processes proceed from the basisphenoid or from the rostrum, are known as *basipterygoid processes*.

These varying conditions of the bones of the skull need separate description when the characters of separate groups of birds come to be noticed. It may be well, however, here to note certain terms which have been applied to some leading modifications of the parts of the facial skeleton of Birds. Thus a skull in which the palatine and maxillo-palatine processes remain quite separate from the vomer (which tapers anteriorly), so that there is an antero-posterior cleft in the skull on either side of it, is called a *Schizognathous* or "cleft" skull. Such a condition may

Fig. 152.



VENTRAL VIEW OF THE SKULL OF A RAVEN (*after Oates*).

vo, Vomer; *mxp*, maxillo-palatine process; *pa*, palatine; *ptg*, pterygoid; *q*, quadrate; *b.sph*, basi-sphenoid; *sph.r*, sphenoidal rostrum.

Behind the basi-sphenoid is the large occipital foramen or *foramen magnum*, at the middle of the front margin of which is a rounded prominence, the *occipital condyle*. The foramen magnum is bounded on each side by a lateral occipital bone, or *exoccipital*.

be seen in the Fowl. A skull in which, on the contrary, the maxillo-palatine processes form a continuous transverse ossification is called a *Desmognathous* skull, and the Duck's will serve as an example. A skull wherein the maxillo-palatines remain separate from each other and from a vomer which does not taper, but is broad and truncated anteriorly, is distinguished as an *Ægithognathous* skull, and such a one exists in the Sparrow and the Raven (fig. 152). A *Dromæognathous* skull is one wherein the palatines and pterygoids do not join the rostrum, but are separated from it by the vomer, or each pterygoid articulates with a lateral outgrowth from the basi-sphenoid.

The bones of the face are more or less moveable, as will be explained shortly.

The *lower jaw* is formed of two lateral branches or *rami*, which anchylose together anteriorly where they meet at what is called the *symphysis*. The hinder end of each ramus is expanded and presents above a concave *articular* surface for junction with the quadrate bone. Often a process projects backwards beyond, this is called the *angle* or *posterior angular process* or *posterior articular process*. This may be upturned at the end, i. e. *recurved*, or it may be abruptly terminated or, as it is called, be *truncated*. Another process generally projects inwards from the articular surface. This is called the *internal angular process*. Another process may project upwards in front of the articular surface, and such a structure is termed a *coronoid process*.

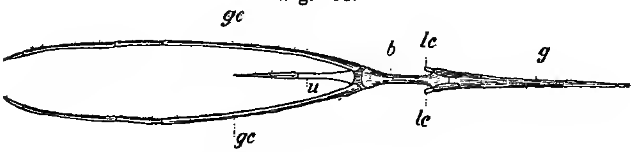
Each half of the mandible is made up of five bones.

In front is the *dentary*, next comes the *angular* with the *surangular* above it outside the articular process, which is formed by the *articular*, while on the inner side of the ramus towards its middle is a small bone termed the *splenial*. There is often a vacuity or fontanelle towards the middle of either ramus between the dentary and the angular and above the splenial.

The Movements of the Jaws.—The lower jaw of the bird moves substantially as does our own, but the upper jaw is to a greater or less degree moveable also. The delicate bony bars which connect its solid apex with the cranium are to a certain extent elastic, and that apex tends to be elevated by the mere action of opening the beak. For when the beak is opened and the lower jaw lowered, pressure is thereby exerted on the quadrate bone, which is almost always more or less moveable. Consequently when it is pushed forwards by the depression of the lower jaw, it simultaneously pushes forwards on each side the quadrato-jugal bar, or "zygoma" (which unites posteriorly with the quadrate externally), and also the pterygoid (which unites with the quadrate on its inner side), and, through that bone, the palatine is also pushed forward. These simultaneous forward thrusts, bend the apex of the upper jaw slightly upwards, flexing the skull where the nasals and lateral ethmoids join the frontals. But this movement of the upper jaw is very much more extensive in the Parrots, where a regular joint extends across the skull just in front of the frontals, and facilitates that extreme mobility of the upper part of the bill, which is so evident when a Parrot eats.

The Os hyoides or *Hyoid.*—This curiously shaped bone consists normally of a central portion formed of two ossicles—one in front of the other—and of two pairs of slender and more or less elongated branches—called "horns" or *cornua.* The front part of the hyoid lies between and below the rami of the lower

Fig. 153.



OS HYOIDES OF A CRANE.

b, Basi-hyal; *g*, glosso-hyal; *gc*, *gc*, greater cornua or thyro-hyals; *lc*, *lc*, lesser cornua or cerato-hyals; *u*, urohyal.

jaw, with its cornua extending backwards and more or less upwards behind the head. It is entirely disconnected with the rest of the cranial skeleton save by soft structures, except that sometimes (as in Woodpeckers) the apices of the cornua are applied to one side of the skull beneath the orbit or within the nasal opening.

The posterior of the two median bones is called the *basihyal* and is generally short and thick, but is sometimes slender; the anterior one is the *glosso-hyal*, and lies within the tongue. A bony process which often projects, tipped with cartilage, backwards from the basihyal is called the *uro-hyal*, and may be a distinct bone.

To either side of the front part of the basi-hyal a styliform bone is generally articulated, and may be short or more or less elongated. This and its fellow of the opposite side constitute the "lesser horns," *lesser cornua*, or *cornicula*, or *cerato-hyals.* A much longer, and segmented, pair are attached, one on either side, to the hinder part of the basi-hyal, and these are called the "greater horns," *greater cornua*, or *thyro-hyals*. It is these which are so prolonged and so singularly fixed in the Woodpeckers, where they serve as a spriug to help the darting forwards of a spear-like tongue borne at the end of a long and slender basi-hyal.

The Limbs.

The Appendicular Skeleton.—This, as before said *, consists of two limb-girdles, each supporting a pair of limbs—one thoracic, the skeleton of the shoulder or *shoulder-girdle*, the other pelvic, the skeleton of the hip.

The *thoracic limb-girdle*—which is also called the *scapular arch*—is firmly attached, as before said, to the ventral portion of the thoracic part of the axial skeleton, namely, to the anterior end of the sternum, where it is fixed into the grooves there situate. It has no other connectiou with the axial skeleton. The girdle consists of three parts or elements on either side, and the bone of the upper arm—the proximal bony segment of the limbs—is articulated to two of these three elements at the point where they meet. These three elements are termed respectively the *coracoid*, the *clavicle*, and the *scapula*.

The girdle is actually completed below by the junction of the two lateral portions of the clavicle.

The Coracoid.—This is a bone which is not only invariably present, but is the strongest and most important one of the thoracic limb-girdle. It is that bone which at one end is fitted into the groove of the sternum, while at the other it is the main support of the bones of the wing. Its size is directly related to the use of the wing, and is immense in the Penguin, which has to exert so much force with its wings, and which employs the motions of flight in the denser medium of water, as this bird may be said to fly submerged. It is a straight, stout bone, more or less expanded below for its implantation in the sternum, and bifurcating at its upper end into two processes which unite with the other elements of the "scapular arch." One of these, that which joins the scapula, presents at

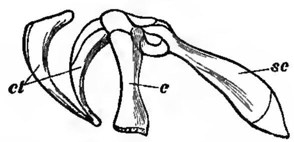
* See *ante*, p. 168.

its upper end a small concave surface, called the *glenoid*, into which fits the upper end of the bone of the upper arm or root of the wing. The other division is called the clavicular process, because it articulates with the clavicle.

The coracoid is not represented by any distinct bone in ourselves, but only by a curved process jutting out from our blade-bone. This has been compared to a crow's beak, whence it was named "coracoid" process, and this has led to the name bestowed on that bone of the bird which corresponds with this process in ourselves.

The *scapula* or *blade-bone* is another constant element of the limb-girdle, which has received from it the denomination of "scapular" arch. It answers to our "blade-bone," but is very different in shape, being a long, narrow, curved bone flattened

Fig. 154.



SHOULDER-GIRDLE OF A BIRD (*after Parker*).

c, Coracoid (its lower end abuts against the sternum—here removed); *cl*, the clavicles (merrythought); *sc*, the scapula—the rounded glenoid surface, for the head of the humerus, is indicated in the scapula close to the junction of the latter with the coracoid.

from without inwards, like a small bony sabre passing backwards over the ribs but quite detached from them. It is, however, rather broad in the Penguins. At its lower end the scapula may be said to bifurcate; part of it forms a concave *glenoid* surface which unites with that so named in the coracoid, to form the "glenoid cavity" for the reception of the upper arm-bones. The other bifurcation forms a process called the *acromial* process, which gives attachment to the clavicle.

The scapula may anchylose with the coracoid, as in the Ostrich. In that and a few other Birds the long axis of the scapula may be nearly in a line with that of the coracoid, but in almost all other existing species they make an acute, right, or only a very slightly obtuse angle.

The *clavicle* of each side usually anchyloses below with its fellow of the opposite side to form a single more or less V-shaped bone called the *furculum* or "merrythought." It is the least constant of all the elements of the shoulder skeleton. It may be entirely absent, as in the Apteryx and some Parrots; or it may be medially divided, as in the Emeu and some Parrots and Owls.

The furculum may anchylose with the manubrium of the sternum below and with the coracoid element above, as in *Opisthocomus*, and in some birds it anchyloses to the keel of the sternum and also at the shoulder.

Usually each half is expanded where it joins the coracoid and scapula, and such expansion is called the *epicleidium*. Each half may be also expanded (as in the Fowl), where the two meet together in the middle line, and this latter expansion is termed the *hypocleidium*.

The clavicles, or two halves of the furculum, are generally curved in two directions—convex outwards and convex forwards. They serve to keep the shoulders apart—keeping the coracoids apart during the downstroke of the wings—and their strength and firmness are in direct relation with the powers of flight or equivalent action in water. Thus they are very large in the Penguin and immensely powerful.

Where the clavicle, coracoid, and scapula meet together they leave between them a foramen which, as we shall see, has an important relation to the muscles of flight *.

A very small bone or ossicle, called the *scapula accessoria* or *humero-scapulare*, is generally present at the outer side of the shoulder-joint.

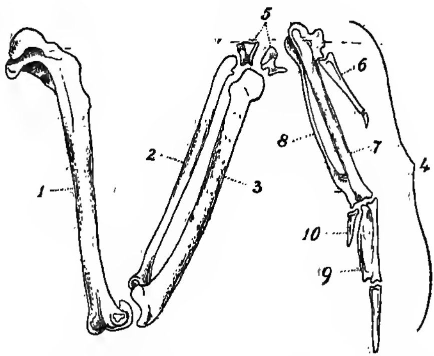
The *skeleton of the wing* consists of a single bone, called the "humerus," in the upper arm; of two bones, named respectively the "radius" and the "ulna," in the lower arm, and of the bones of the pinion. These last-named bones answer to the bones of our wrist, the middle part of our hand, and some of those of our thumb and fingers.

The *humerus*, or bone of the upper arm, is always a more or less elongated and cylindrical bone, expanded at either end, but especially at its upper, or proximal, end. This "upper end" or *head* is transversely oblong, with a strongly marked ridge or crest on its anterior, or ventral, surface. It articulates with the glenoid surface of the shoulder-girdle. An orifice, which admits

* See below, p. 203.

air into the interior of the humerus, is situated on the hinder surface of its head; and even in birds in which this bone is not pneumatic—as *e. g.* the Ostrich and the Penguin—we find a deep depression in the place where this orifice in other birds is to be found. At the lower, or distal, end of the cylindrical part, or *shaft*, of the humerus are two prominent articular surfaces, or *condyles*, with a median depression. In birds which do not fly —the Ostrich, and especially the Apteryx—it is greatly reduced

Fig. 155.



Bones of the Right Wing of a Duck, seen from above.

1. Humerus. 2. Radius. 3. Ulna. 4 indicates all the bones of the manus. 5. Carpal ossicles—that opposite the end of the radius is the radiale, or scapho-lunar bone; that opposite the end of the ulna is the ulnare or cuneiform bone. 6. Pollex, consisting of two phalanges. 7 & 8 indicate the large bones of the hand, made up of 7, the metacarpal of the index digit, and 8, the metacarpal of the third digit. 9. Basal phalanx of index digit. 10. Single phalanx of third digit.

in size and the characters above stated are very feebly marked. In the Penguin the humerus is in the form of a flattened plate, or *lamina*, of bone.

The *radius* and *ulna* are two elongated cylindrical bones placed side by side in the fore-arm. They meet together at either end, but diverge more or less from one another medianly. Each bone has an articular concavity or cup at its proximal end, into which one of the convex condyles of the humerus is received. The ulna is placed on the external or posterior aspect of the fore-arm, and often shows tubercles which correspond with the points of attachment of the secondary "remiges." It is somewhat longer than the radius, and its proximal end bears posteriorly a more or less enlarged prominence termed the *olecranon*. The two bones articulate at their distal ends with that part of the skeleton of the pinion which corresponds with our wrist. In the Penguin the bones of the fore-arm are considerably flattened.

The *skeleton of the pinion* consists of three parts:—(1) the part called "carpus," which corresponds with our wrist-bones; (2) the part called "metacarpus," which corresponds with the bones in the middle, or fleshy, part of our hand; and (3) the "phalanges," or bones which correspond with those of our thumb and fingers.

The *carpus* in adult birds never consists of more than two bones, which are small, short, more or less rounded or polygonal ossicles. In the very young bird there may be one or two other small bones which with growth anchylose with the bones of the middle hand, *i. e.* with the "metacarpus." Of the two permanently distinct carpal bones one lies at the distal end of the radius, on which account it is often called the *radiale*, while it is also named the *scapholunar bone*. The other carpal bone lies at the distal end of the ulna, and is called the *ulnare* or *cuneiform bone*. The carpal bones answer to the bones of our wrist.

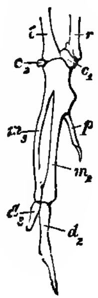
The *metacarpus* is composed, in adult birds, of a singe bone of complex shape and nature. It bears a more or less rounded articular surface at its proximal end, which is somewhat expanded; for the greater part of its extent, however, it consists of a long, stout, cylindrical bone, generally separated by an interspace from a more slender and curved, similarly elongated, bony bar situated externally to the other. This slender external bar answers to that bone of the fleshy part of our hand—or "metacarpal" bone—which supports our middle finger. The stouter bar answers to that bone of the fleshy part of our hand which supports our fore finger or index digit, and it is therefore the "metacarpal of the index."

On the inner side of the base of this metacarpal is a small prominence truncated distally. This answers to the bone of the fleshy part of our hand which supports our thumb or pollex, and it is therefore the metacarpal of the pollex. In no existing adult bird are the metacarpals separate.

Digits and Phalanges.—Except in one or two birds with defective wings, such as the Apteryx and Cassowary (which have each but one digit in the hand), the pinion always includes some bones (*phalanges*) belonging to the three digits which correspond with the three metacarpals already mentioned.

The pollex consists of two small phalanges which support the "alula" *. The index is much larger than either of the other digits, and also consists of two phalanges which are relatively large, and occasionally there is a third phalanx. The

Fig. 156.



RIGHT HAND OF OSTRICH.

c_1, Radiale, or radial carpal ossicle; c_2, ulnare, or ulnar carpal ossicle; d_2, proximal phalanx of the index digit which has three phalanges; d_3, phalanx of third digit; *l*, ulna; m_2 and m_3, metacarpals of second and third digits anchylosed together with that of the pollex; *p*, proximal phalanx of pollex; *r*, radius.

third digit consists of but a single phalanx, except in the Ostrich, where there may be a second phalanx, and a small cartilage representing such a part has been found in a very young Duck. This third digit is applied to the outer †, or ulnar, side of the index digit.

It is the pollex or the index, or both (as in the Ostrich), which alone, in existing birds, ever bears a claw. As we have

* See *ante*, p. 154.

† The wing being supposed to be completely extended.

already pointed out *, claws do sometimes exist on the pinions of birds.

The *articulations of the wing-bones* are so arranged that the arm cannot be twisted as we twist our own arm in turning the palm of the hand upwards and downwards.

The elbow-joint, or that between the upper and lower arm, only permits hinge-like movements in one plane, for folding and unfolding the wing, and the same is the case with that joint by which the skeleton of the pinion is joined with that of the lower arm. The individual digits being all bound together, save the short pollex, in one common skin or integument have hardly any power of separate movement. The hinge-like movements of folding and unfolding are, however, extensive, the hand, or pinion, being capable of moving so as to be folded back close against the outer (ulnar) side of the fore-arm.

The *pelvic limb-girdle*, which is also called the *pelvic arch*, or skeleton of the hips, contrasts strongly with the "thoracic limb-girdle" †. In the first place it hardly ever, in Birds, merits the name of a "girdle," for, with the exception of the Ostrich and the Rhea, its sides do not unite ventrally, *i. e.* distally. The name has been bestowed on it because in other classes of animals—in almost all Mammals and Reptiles—it does truly form a girdle. Moreover, the pelvic so-called "girdle" contrasts with the thoracic one because, instead of being firmly knit with the axial skeleton ventrally and sitting quite loose from it dorsally, it is firmly knit with the axial skeleton dorsally and is quite loose from it ventrally.

It agrees with the thoracic girdle, however, in that it consists of three parts or elements on either side and in that the proximal bony segment of the limb—the bone of the thigh—is articulated to these three elements at the point where they meet, and form a cup called the *acetabulum* or *cotyloid cavity*, into which the head of the thigh-bone fits. The three lateral elements of each lateral half of the pelvis anchylose together into a single bone, which in us is the hauuch-bone or *os innominatum*. In Birds the acetabulum does not form a complete bony cup, the bottom of it being composed of membrane only.

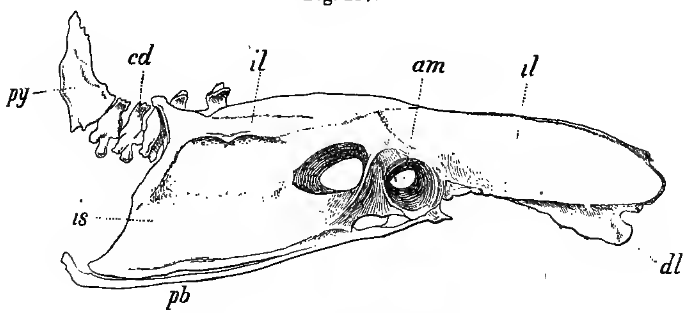
The three elements which thus make up each lateral half of the pelvis are termed respectively the *ilium*, the *ischium*, and the *pubis*.

* See *ante*, p. 158. † See *ante*, p. 188.

The *ilium* may be considered as answering to the scapula of the thoracic girdle, in spite of the extreme difference of its shape from that of the blade-bone of the shoulder *. It is of enormous size compared to that of Mammals, being greatly extended both in front of and behind the acetabulum. It is the bone which anchyloses on either side with the many vertebræ which go to form the "sacrum" as already described †.

The ilium of one side of the body may so anchylose with that of the other side and with the sacrum that the dorsal hinder part of the skeleton of a bird's trunk presents an expanded bony shield like that presented by the sternum on the ventral anterior part of the trunk skeleton. Moreover, the appearance

Fig. 157.



PELVIS OF A FOWL (*after Parker*).

il, *il*, Ilium; *is*, ischium; *pb*, pubes; *dl*, dorso-lumbar vertebræ; *cd*, caudal vertebræ, at the distal end of which is (*py*) the pygostyle ‡; *am*, acetabulum.

of a median ridge is more or less produced by lateral depressions, though there is never anything really like the keel of the sternum, and for a very good reason, as we shall see when the muscular structure of a bird comes to be described.

The ilium forms the upper margin of the acetabulum, and at the hinder part of that margin develops a strongly marked, somewhat flattened process bearing an articular surface. This is called the *antitrochanteric process*.

* See *ante*, p. 189.

† See *ante*, p. 173.

‡ See *ante*, p. 175.

The *ischium* is the bone which forms the hinder margin of the acetabulum, and is very much smaller than the ilium. It is generally in the shape of a thin elongated plate of bone more or less expanded dorso-ventrally towards the hinder end, where it generally anchyloses with the distal portion of the postacetabular part of the ilium, thus enclosing a vacant space between it and the ilium—the *ilio-ischiatic foramen.* In some Birds—as the Ostrich, Cassowary, Tinamou, Apteryx, and a few others—the ischium does not anchylose distally with the ilium, so that there is a deep notch, instead of a foramen, between these bones, as is the case in ourselves.

In the Rhea alone the ischia anchylose together beneath the caudal vertebræ, forming an *ischiatic symphysis.* The ischium develops from its inferior margin a small *ventral process,* which is situated a little behind the acetabulum. This process may anchylose with the pubis.

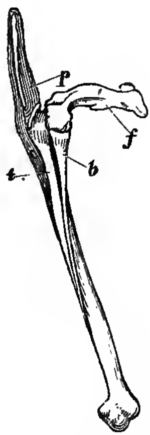
The *pubis* is a long narrow bone which forms the antero-inferior part of the acetabulum, and thence runs backwards near the inferior margin of the ischium, which it may or may not exceed in extent. The distal end may be more or less expanded, but in the Ostrich alone does it unite with its fellow of the opposite side to form a *pubic symphysis.* It may anchylose extensively with the ischium, or a long notch—the *obturator notch*—may be left between them. It may anchylose with the ischium towards the distal end only, so converting the notch into an *obturator foramen*; or it may anchylose with the ischium both towards its distal end and also with the "ventral process" of the ischium, remaining elsewhere separate, and so forming two *obturator foramina.* Often a more or less marked process projects forwards from the pubis from beneath the acetabulum. This is called sometimes the *ilio-pectineal process,* and sometimes the *prepubis.*

In a general way we may consider the ischium to repeat in the lower limb the coracoid of the thoracic girdle, and the pubis to represent the clavicle; but this parallelism is not exact.

The *skeleton of the leg* consists of a single bone, called the "femur," in the thigh; of two bones named respectively the "tibia" and the "fibula" in the leg or "crus"; of one or two bones in that part called in Ornithology the "tarsus"; and of the bones of the foot. These latter answer to the bones of our toes only; those of the middle part of our foot answering to the greater part of the skeleton of the bird's so-called "tarsus."

The *femur*, or boue of the thigh, is more or less cylindrical and expanded at either end. It is short and thick compared with the tibia. Its upper end, or *head*, is rounded and is obliquely directed inwards, its long axis being almost at right angles with that of the shaft. It bears a deep pit into which a strong ligament, the *ligamentum teres*, is inserted and helps to bind it to

Fig. 158.



LEG-BONES OF THE DIVER (*Colymbus*).

f, Femur; *t*, tibia; *p*, cnemial process (only found thus developed in the Diver and its allies); *b*, fibula.

the acetabulum. An upwardly projecting prominence from the summit of the shaft is called the *trochanter*, and it plays against the "antitrochanteric process" of the pelvis. On the back of the femur, below its middle, there may be (as sometimes in Swans and Ducks) a prominence into which the femoro-caudal muscle is inserted. This may be called the *inferior trochanter*.

The distal end of the femur bears two prominences, or *con-*

dyles, side by side. On the outer side of the outer condyle is a depression into which fits the upper end of the "fibula."

The *tibia* and *fibula* are two elongated bones extending downwards side by side, but of very unequal size.

The *fibula* is a quite delicate needle-like bone which below is imperfect, pointed, and often anchylosed with the tibia, but

Fig. 159.

RIGHT FOOT OF EMEU.

a, The proximal tarsal element, which is supposed to answer to that tarsal, or ankle, bone which is called "Astragalus" in man and beasts; d_2–d_4, second, third, and fourth digits; *m*, metatarsals anchylosed together into a tarso-metatarsal bone, except at their distal ends; *t*, tibia; t_2, the distal tarsal element exceptionally distinct in this bird.

which somewhat expands and ends freely above, where it fits into the notch just mentioned as being situated on the outer side of the outer condyle of the femur. In some Penguins, however, and sometimes at least in *Pandion*, the fibula is as long as the tibia.

The *tibia* is generally the longest bone of the leg, and is somewhat triangular in section at its upper part. At the anterior aspect of its upper end is an irregularly shaped prominence called the *cnemial process*. The lower, or distal, part of the tibia ends in two *condyles* or antero-posteriorly directed prominences with a median depression forming a pulley-like articular surface or *trochlea*, which is directed somewhat forwards as well as downwards. On the front of the lowest part of the tibia, just above the condyles, is a deep depression over which a band of bone (a bony bridge) generally passes.

In front of the junction of the tibia with the femur there is usually a small bone, the *patella*, answering to our knee-pan. There may be two such bones, while sometimes there is no patella at all.

The tibia answers to our shin-bone and more. It does so because the distal end of the bone, which is distinct in the young, answers to a portion of our ankle.

The main, often the only, element of the skeleton of the next segment of the lower limb is termed the *tarso-metatarsus*. As already said *, it answers to the skeleton of the middle part of our foot which is called the "metatarsus." It consists of metatarsal bones more or less completely fused into one, and something more, since it also includes what answers to a portion of our ankle-bones. Now in human anatomy the skeleton of the whole of the ankle is called the "tarsus," and thus the skeleton of the "crus" of birds answers to our leg-bones together with the proximal part of our tarsus; while the skeleton of the so-called "tarsus" of birds answers to the distal part of our tarsus together with the bones of the middle part of our foot. It is thus clear that the joint by which the so-called "tarsus" of birds articulates with their "crus" does not answer to our ankle-joint. It answers indeed to no conspicuously moveable joint which we possess. It answers to the interval between the proximal and the distal parts of our ankle or tarsus. The joint between the "crus" and "tarsus" of birds is thus only *analogous* to our ankle-joint and is not *homologous* therewith, *i. e.* does not bear corresponding structural relations with surrounding parts.

The *tarso-metatarsal bone* is of complex nature over and above the fact that it contains elements of the ankle anchylosed with

* See *ante*, p. 197.

it. We saw * that the metacarpus of Birds answers to three of the bones of the fleshy part of our hand, each of which three bones is in us called a "metacarpal." In the same way the tarso-metatarsal bone of Birds answers to three (only in the Ostrich to no more than two) of the bones of the fleshy part of our foot, each of which three bones is in us called a *metatarsal.* Evidence of this complexity is afforded at the distal end of the bone †, which exhibits three convex articular surfaces for articulation with the bones of the second, third, and fourth toes (or digits) respectively. This essential complexity is clearly shown in the extremely short tarso-metatarsal bone of the Penguin, by large apertures left between its middle and its inner and outer metatarsal elements. Similar but much smaller apertures are to be detected in other birds. The three metatarsals do not lie in the same plane, the median one inclining more backwardly at its proximal end, and more forwards at its distal termination, than do the other two metatarsals.

At the upper end of the tarso-metatarsal bone there is generally a backwardly projecting *calcaneal* process—or *hypotarsus,*—which may be marked by vertical grooves or perforated by small canals ‡ for tendons. It may be more or less cartilaginous or a separate ossicle.

When there is a hallux it is supported by a small separate metatarsal of its own, which is applied to the back of the lower part of the much longer tarso-metatarsal bone. This metatarsal, which answers to that of our great toe, ends freely above in a styliform process. Below it develops an articular surface for the proximal bone of the first digit of the foot—the hallux.

Very rarely the first metatarsal is long, and still more rarely it anchyloses with the tarso-metatarsal bone.

The bones of the toes, or *digits* of the foot, are—like those of the digits of the pinion §—called *phalanges.* Their number has been already indicated || when we pointed out the number of joints in the toes, with which number that of the phalanges corresponds.

We have already noted ¶ the occasional existence of "spurs."

* See *ante*, p. 192.

† This is comparable with the "cannon-bone" of an ox, which is not essentially a single bone, but consists of two metatarsals anchylosed together.

‡ See below, p. 206.

§ See *ante*, p. 193.

|| See *ante*, p. 159.

¶ See *ante*, p. 164.

Bony supports for them may exist anchylosed to the inner side of the tarso-metatarsal bone.

The *articulations of the leg-bones* are so formed that they mainly move with a hinge-like joint one on the other. This is especially the case with the joint between the tibia and the tarso-metatarsal bone. The articulation of the femur with the pelvis is more free, though not so free as that of the humerus with the thoracic girdle. The knee is capable of a slight rotation, especially in aquatic birds, and in them again we find such a disposition of the joints between the metatarsal condyle and the proximal phalanges as determines the spreading out or approximation of the fingers by their mere flexion and extension. Many birds, especially the long-legged waders, can sleep securely on one leg owing to an arrangement of the bones which does not allow them to be flexed without an effort. A rounded prominence on the front of the proximal part of the tarso-metatarsal bone passes up, and locks into a depression on the front of the distal end of the tibia when the leg is straightened, and firmly maintains the leg in this position. A slight voluntary effort, however, serves to unlock this junction, and allows the prominence to pass into the fossa between the condyles when the leg is bent, which forms a sort of socket for it, though a sharp prominence at the lower end of that "socket" prevents the process passing into it without such effort. This is well seen in the Stork. The connection of the head of the fibula with the side of the outer condyle of the femur also serves to maintain the limb in firmness and stability; although the knee-joint is almost constantly more or less flexed during sleep, the weight of the body keeping it so.

CHAPTER IV.

The other Systems of Organs, and the Development and Migration of Birds.

The Muscular System.

THE flesh which invests the skeleton consists of a multitude of most delicate threads called "muscular fibres," which are variously aggregated in masses to form "*muscles.*" These are the organs of movement. They are generally attached at one or both ends to different bones, sometimes by the muscular fibres themselves, often by the intervention of a very strong and dense band of fibrous membrane called a *tendon*—the muscular fibres being implanted into the tendon, and the tendon into the bone the muscle acts on. Muscles act by contracting; that is, the fibres which compose it—and therefore the whole muscle they compose—temporarily change their shape, becoming shorter and stouter, and so causing those bones to approximate, to which the ends of the muscle are directly or indirectly attached. They act on the bones by making use of the latter as *levers* or *fulcra.*

The muscles of birds are very compact and red, especially those which are the most exercised. They are packed where they can best be carried with respect to the centre of gravity. They are thus very voluminous on the breast, while many muscles have very long tendons, so that they can act on parts remote from the centre of gravity, while their heavy fleshy substance is placed in proximity to it. This is especially the case with the muscles of the limbs.

Muscles are called *flexors* or *extensors* or *rotators* or *tensors* or *elevators* or *depressors* or *abductors* or *adductors,* according to the sort of motion their contraction results in.

Only those muscles will be here noted a knowledge of which may be useful to the Ornithologist for purposes of classification.

As flight is the most essential and important action for a Bird, so the muscles of flight are the most voluminous—those muscles, that is, which raise and depress the wing.

In ourselves the muscles which draw back and raise the arm are situated on the dorsal surface, while those which move it forwards are on the breast. In Birds, however, as almost everyone must have noticed, there is very little flesh on the back, and, iudeed, both these sets of muscles are on the breast, which is the most convenient arrangement with respect to the centre of gravity, though it necessitates a very special modification. They are called pectoral muscles. It is said that these muscles in the Swift weigh more than all the other muscles of its body taken together.

The largest muscle of a Bird is that on the surface of the breast, which is called the *great pectoral.* It takes origin from the sides of the keel and some other parts of the steruum, and is inserted into the inner side of the crest* on the anterior surface of the head of the humerus, and by its action depresses the wing.

Beneath this great muscle there is another, called the *second pectoral*—or *supracoracoideus*—which has an extensive origin from the sternum, and is a powerful muscle devoted to antagonizing the action of the great pectoral—that is, it raises the wing. For this purpose there is the special modification (to which we before referred) to compensate for the ventral situation of the muscle itself. The fibres of the *second pectoral* are inserted into a tendon which passes through the interspace left at the junction of the coracoid, scapula, and clavicle †, the bony margin of which serves it as a pulley. Passing round the coracoid it is inserted into the upper end of the crest of the humerus, and is thus enabled to act as an *elevator* of it and therefore of the whole wing. This muscle is particularly strong in the Penguin and other diving birds.

There is a *third pectoral*, a small muscle, which arises from the sternum and often from the coracoid, and thence passes directly to the humerus, which it depresses. There is sometimes also a *fourth pectoral*, which is similar to the third one.

The skin of birds contains many very small muscles which act upon the individual feathers. Most important are those which act on the remiges of the wing, and by rotating them allow the air to pass between them each time the wing is elevated in flight.

* See *ante*, p. 190. † See *ante*, p. 190.

The other muscles of the wing correspond in a more or less general way with the muscles of our own arm reduced; but their tendons are long and slender, and the arrangements of the skeleton, as already stated *, are such that, though there are muscles answering to those which rotate the hand in us, in Birds they cannot rotate it. They can do nothing but open and shut the wing. There is, however, a muscle called the *tensor patagii* which has an elastic tendon, and acts on the fold of skin on the front of the wing between the shoulder and the wrist †. It takes origin by muscle from the former, while its tendon is inserted into the latter. It may be distinguished, as the *tensor patagii longus*, from a *tensor patagii brevis* which arises in common with the former but is inserted into membrane within the bend of the elbow. The arrangement, however, of these tensor muscles—which sometimes receive the common name of *propatagialis*—differs in various ways in various birds. There is also another tensor—sometimes called *metapatagialis*—which acts on the fold of skin between the trunk and the inner surface of the upper arm, and there is sometimes also a muscle, called *dermo-tensor patagii*, which arises from the inside of the skin of the front of the neck, and passing thence over the shoulder is inserted, by a delicate tendon, in common with that of the *tensor patagii longus*.

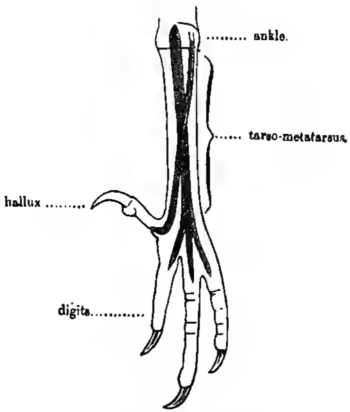
Amongst the muscles of the leg available for classification must be mentioned one called the *ambiens*, which exists in some birds and not in others. When fully developed it arises from the pelvis in the vicinity of the acetabulum, and ends in a tendon which passes over the outer side of the knee and ends by joining one of the flexor muscles which bend and contract the toes. When a bird is at roost and the knee bent by the weight of the body, such bending of the knee stretches the long tendon, and this (by the connection of the tendon with the flexor muscles) *ipso facto* causes the toes to contract, and so, without any effort, a firm grasp is maintained. Birds with an ambiens are termed *homologonatous*, those without it, *anomalogonatous*. A muscle called the *biceps cruris* varies as to the conditions it presents. Ordinarily it arises from the greater part of the dorsal margin of the post-acetabular part of the ilium. Its fibres end in a round tendon, which is inserted into about the middle of the fibula.

* See *ante*, p. 194. † See *ante*, p. 154.

The *semitendinosus* is a flat ribbon-like muscle which arises from the transverse processes of the anterior caudal vertebræ, and is inserted by a flat tendon into the inner side of the upper part of the tibia. An *accessory* muscle may join it, after arising from the femur, to end upon the surface of the back of the crus.

The *semimembranosus* is another ribbon-like muscle which runs parallel to but beneath the semitendinosus. It arises from the outer side of the ischium and is inserted, with the tendon of the semitendinosus, into the inner side of the head of the tibia by a flat tendon.

Fig. 160.



FLEXOR TENDONS OF A PASSERINE BIRD.

The tendon of the *flexor longus hallucis* crosses superficially to that of the *flexor profundus digitorum*, and then goes to the hallux. The last-named muscle exclusively supplies the other three digits.

The *femoro-caudal* is a long muscle which springs from the transverse processes of the hinder caudal vertebræ and is inserted onto the posterior surface of the femur—into its inferior trochanter when there is such a process.

A muscle *accessory* to this may arise from behind the acetabulum to join iu part the tendon of the femoro-caudal and in part to be itself inserted into the femur.

The muscles which go to the toes become tendinous when they pass down beside the tarso-metatarsal bone, and some of their tendons may pass through small bony canals before mentioned * as existing in the calcaneal process. There are two special muscles which arise from the hinder surface of the tibia and fibula and serve to bend the toes; each muscle ending in one or more tendons, which are implanted one into each digit. One of these muscles is the *flexor profundus digitorum*, which generally sends its tendons to the three front toes. The other muscle is the *flexor longus hallucis*. It usually ends by sending a single tendon to the hallux. The tendons of these muscles, as they are situated on the under, or plantar, surface of the foot, are spoken of as the plantar tendons (fig. 160).

The *diaphragm* is a sheet of membrane and muscle which covers the ventral surface of the lungs, and is most complete in the Ostrich and Apteryx. Even in those birds, however, it is not continuous, and the apex of the heart passes backwards through it.

The Alimentary System.

Birds eat more, in comparison with their bulk, than do animals of any other class of vertebrates. They feed on animal substances in the majority of species, and most of all on insects. The system of organs devoted to this function is the alimentary canal, with the various parts annexed to it. The *alimentary canal* itself consists of the mouth, gullet, crop, stomach, gizzard, intestine, cloaca, and vent. The parts annexed to it, and which assist it in performing its great function of digestion, are the salivary glands, the pancreas, and the liver. Other parts forming no part of the alimentary system may nevertheless communicate with the cavity of the alimentary canal. Such are: the nostrils, the ears, the lungs, the kidneys, and the generative glands.

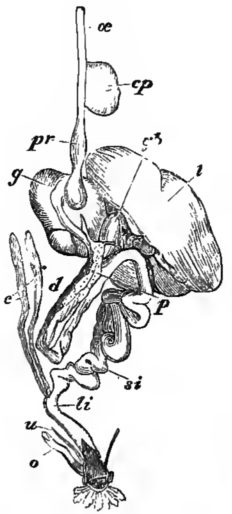
The *mouth* is bounded and enclosed by the bill, which we have already described, and with the shape of which it corresponds. Into the roof of the mouth the nostrils open by a slit which is generally single, and the ears open into it more posteriorly, the usually single opening being that common to the two eustachian tubes †. At the lower part of the mouth is

* See *ante*, p. 200. † See *ante*, p. 183.

the tongue, supported by its "os hyoides" *, and behind the tongue is an opening, called the *glottis*, which leads into the windpipe and so into the lungs.

Into the base and sides of the mouth open the spittle-glands or *salivary glands*, which are usually small and simple, but may, as in the Woodpecker, be considerably developed.

Fig. 161.



VISCERA OF THE FOWL.

æ, Œsophagus; *cp*, crop; *pc*, proventriculus; *g*, gizzard; *l*, liver; *gb*, gall-bladder; *p*, pancreas; *d*, loop of the duodenal part of the intestine enclosing the pancreas; *si*, small intestine; *li*, large intestine; *c*, cæca; *o*, oviduct; *u*, ureter.—The cloaca is cut open, and some feathers are represented as attached to its margin.

The *tongue* may be of large size, and soft as in the Parrot; it may be a horny spine, as in the Woodpecker. It may form two delicate tubes, side by side, as in the Humming-bird; it

* See *ante*, p. 187.

may be feathery, as in the Toucans and Honey-eaters; or it may be a mere rudiment at the bottom of the mouth, as in the Kingfisher and Pelican. Very rarely, as in the Bustard, a large pouch may open beneath the front of the tongue and be capable of much distension with air.

The *gullet*, or *œsophagus*, is sometimes very capacious. It may also have a special dilatation in front, called a *crop* or *ingluvies*, wherein food can be temporarily retained, and sometimes macerated, before reaching the stomach. Sometimes, as in the Pigeon, there may be a double crop, and it may furnish a milky secretion at the breeding-season. Birds of prey throw up the indigestible parts of their food as "castings." Other birds throw up part of their food to feed their young. The Hornbill will throw up the lining of its stomach.

At the lower end of the gullet is the *digestive stomach* or *proventriculus*, which answers to that part of our own stomach which is called the "cardia." It is richly supplied with glands.

The next segment of the alimentary canal is the *gizzard*, which answers to that part of our stomach which is called the "*pylorus*." It generally has very thick fleshy walls, with only a small internal cavity provided with a horny lining. It is into this cavity that birds swallow down stones, which when brought to bear on food by contractions of the gizzard's very muscular walls, act as teeth and grind the grains or other hard substances fed upon. In birds that feed on food which needs no grinding, the gizzard's walls are much thinner.

The *intestine* is much shorter relatively than in us. In the Toucan it is hardly twice as long as the bird's body and bill. It generally consists, as in ourselves, of two parts: an anterior *small* intestine, which is continued into a shorter part called the *large* intestine. The foldings of the intestine vary in arrangement, especially those of the small intestine, and these arrangements distinguish certain groups of birds. There is but little difference of capacity between the so-called "small" and "large" intestine. The anterior part of the small intestine is called the *duodenum*, and this part is disposed in a pretty constant fold called the "duodenal fold." The hinder part of the large intestine is called the *rectum*. The transition between the small and the large intestine is usually marked by a pair of hollow offshoots or diverticula, called the *cæca*. These may be very small or very large or of moderate size. Instead of a pair of cæca there may be a single cæcum or there may be nothing of the kind whatever.

The rectum opens posteriorly into the terminal chamber of the alimentary canal, which is called the *cloaca*. The latter is a capacious rounded space, into which the urinary and generative ducts also open, the whole communicating with the exterior by a single aperture, the vent.

A glandular structure, called the *bursa Fabricii*, also opens upon the wall of the cloaca into its cavity.

A gland, called the *pancreas*, which supplements by its secretion the action of the saliva, lies embraced by the duodenal fold of the intestine. Two or three ducts from it enter the intestine near its commencement. A little further down, the ducts of the *liver* convey its secretion, the bile, into the intestine. It is divided into two main lobes, and may or may not be provided with a gall-bladder.

A small round or oval body, called the *spleen*, lies not far from the stomach.

The Urinary and Generative Systems.

The urinary system consists of two *kidneys*, the ducts of which—the *ureters*—pass backwards and open into the cloaca, behind where the alimentary canal opens into it. The kidneys are soft in texture, and sometimes—as in the Grebe and Coot—are more or less blended together at their hinder ends. They are dark-coloured and firmly fixed upon the ventral surface of the dorsum of the trunk, especially within those cavities of the sacrum before described *. At the anterior end of either kidney is a small yellowish body named the *supra-renal capsule*.

The *testes*, or essential male organs, are a pair of oblong or more elongated bodies placed on the ventral side of the anterior part of the kidneys. Each consists of a mass of most minute and highly convoluted tubes. The testes vary much in size according to the season of the year, enlarging greatly at the breeding-season. Their secretion is conveyed outwards by two long, more or less convoluted tubes—the *vasa deferentia*—which pass back beside the ureters and open, each on a papilla, in the cloaca, one on each side of the openings of

* See *ante*, p. 174.

the ureters. In Water Birds, such as the Drake, there is a special intromittent organ, spirally arranged, which can be protruded from the cloaca or retracted within it, as the finger of a glove may be everted and the reverse.

In a few Birds, such as the Ostrich, a more solid organ of the kind, grooved beneath, is attached to the front wall of the cloaca.

The *ovary*, or essential female organ, is generally single; its companion aborting. It is usually the right ovary which atrophies. This female organ has somewhat the appearance of a small bunch of grapes, the grape-like structures being the more or less developed eggs. The duct—*oviduct*—which conveys the eggs outwards is widely open at its upper or anterior end. The more posterior part of its interior is lined with long delicate processes, or close-set *villi*, which secrete the material of the egg-shell. Posteriorly the oviduct opens into the cloaca.

The eggs or *ova* will be further noticed when we come to speak of the development of Birds.

The Respiratory System.

This system is wonderfully developed in Birds which, as they are specially modified to move in the air external to them, are also specially modified to receive air extensively within them, as has been already stated *.

Birds breathe by the alternate approximation and separation of the sternum and the back. Their separation tends to produce a vacuum, and causes air to rush into the body, while their approximation expels it by contracting the space into which it has been received. This movement is greatly facilitated by the joints which exist at the junction of the vertebral and sternal ribs †.

Although this action is called "breathing," respiration or breathing really consists in the purification of the blood by the elimination of carbonic-acid gas and the absorption of oxygen.

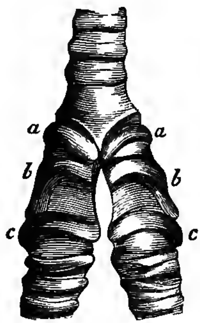
Air is introduced into the body through the "glottis," which is the external aperture of the *windpipe* or *trachea*. The uppermost part of the trachea is slightly dilated, and contains parts which correspond with those which exist in a dilatation

* See *ante*, p. 167. † See *ante*, p. 176.

of the uppermost part of our own trachea, which is called the *larynx*. In us this is the organ of voice, but it is not so in Birds.

The windpipe of Birds is kept in the form of an open tube by a numerous series of generally complete bony rings in its substance. It is very long and often convoluted, sometimes making a coil within the sternum, and sometimes possessing subcutaneous dilatations, as in the Emeu, where some of the

Fig. 162.



SYRINX OF RAVEN.

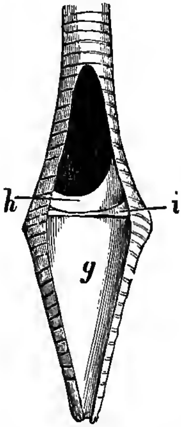
Lowest part of trachea and roots of the two bronchi.

a, Front half-ring of bronchus; *b*, second (more moveable than the first); *c*, third half-ring—connected with the second by ligament and membrane.

rings are incomplete in front. In the Penguin the trachea has a longitudinal septum. At its lower end the trachea bifurcates and its two branches, which lead into the lungs, are called *bronchi*.

The organ of voice in Birds is called the *syrinx* or *lower larynx*, because it is placed much lower down than our own organ of voice. Indeed, such a structure as the "syrinx" is absolutely peculiar to the Class of Birds. Its general condition is as follows. It is formed by the coalescence and modification in shape of the lower rings of the trachea and the upper rings of the bronchi, the latter being incomplete internally, so that the sides of the bronchi which look towards each other are at their upper part merely membranous, forming what is called the *membrana tympaniformis* (figs. 163 & 164, *g*). The coalesced rings of the lower part of the trachea form a chamber called the *tympanum of the trachea*. Internally, the syrinx is generally divided by a bar of bone, the *os transversale* or *pessulus*, from the upper margin of which a delicate membrane ascends into the cavity of the tympanum of the trachea, ending in a free concave margin, whence

Fig. 163.



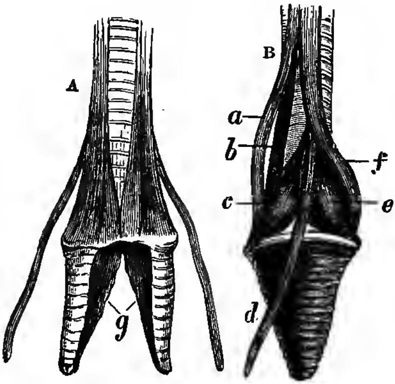
SIDE VIEW OF CAVITY OF LARYNX OF RAVEN.

The outer part of the lower end of the trachea and of the bronchus next the spectator being cut away to show the interior.

i, Os transversale, pessulus, or bony bar traversing the lower end of the trachea from before backwards, and having an opening into one of the bronchi on either side of it; *h*, membrana semilunaris ascending from the os transversale, and terminating within the trachea by a free concave margin; *g*, membranous inner wall of the bronchus or membrana tympaniformis connecting the inner extremities of the bronchial half-rings.

it is termed the *membrana semilunaris*. This highly elastic membrane, together with two other elastic folds of membrane, which project inwards from the outer side of the commencement of each bronchus, are the special agents of song. They sound as does an oboe or any other reed instrument. Their action is modified by special muscles which act on adjacent parts. These are called *extrinsic* muscles if they pass between the respiratory tube and parts external to it. They are called *intrinsic* muscles if they only pass from one part of the respiratory tube (trachea and bronchi) to another. Generally there are two pairs of "extrinsic" muscles, passing from the clavicles, or the sternum,

Fig. 164.



MUSCLES OF SYRINX OF RAVEN.

A. Front view of syrinx. B. Side view.

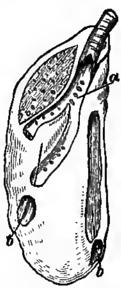
a & *f*, Inferior bifurcations of the lateral tracheal muscle (*tracheo-lateralis*) going to the third bronchial half-ring; *b*, shorter muscle (*broncho-trachealis brevis*) inserted into posterior end of second bronchial half-ring; *c*, posterior common laryngeal muscle—*bronchialis posticus*, going from last tracheal ring to hinder end of second bronchial half-ring; *e*, anterior ditto—*bronchialis anticus*, from last tracheal ring to fore ends of first and second bronchial half-rings; *d*, relaxor of tympaniform membrane (*sterno-trachealis*) going from the side of the trachea to the sternum; *g*, membranous inner walls of the bronchi.

to the trachea. In addition to these there is commonly one pair or there may be five or six pairs of "intrinsic" muscles, passing down from the trachea to the bronchial rings. These additional muscles are present in Singing-birds; but also in many Birds which do not sing, as, *e. g.*, the Crow and Raven.

There may be no "membrana semilunaris," and only three pairs of additional muscles, in birds highly gifted as to their power of emitting special sounds. A syrinx may be formed by the trachea only (without the intervention of the bronchi), as in *Thamnophilus*, where the lower part of the trachea has delicate walls, and is flattened dorso-ventrally into six or seven delicate segments of rings, the rings being interrupted laterally.

A syrinx may be formed in each bronchus (without the intervention of the trachea), as in *Steatornis*, where more than ten rings in each bronchus may be counted before reaching the syrinx, and where a pair of muscles pass from each bronchus to the trachea.

Fig. 165.



Right Lung of a Goose (*after Owen*).

a, Bronchus; *b*, *b*, openings into air-sacs. (In the two bronchi which are cut open are seen the apertures of their primary branches.)

The intrinsic muscles of the voice-organ may be inserted into the ends of the bronchial semi-rings, or in what is called an *Acromyoidal* manner, or into their middle parts, a mode which is distinguished as *Mesomyoidal*. A condition in which the trachea alone forms the vocal organ is spoken of as "*Tracheophonal*." An arrangement in which the lower end of the trachea is not modified to form a vocal organ is called *Oligomyoidal*.

Parrots have no *os transversale* or septum dividing the lower end of the trachea, and they have only three pairs of intrinsic muscles. They speak with the aid of their tongue and beak alone. The syrinx may be altogether absent, as in the American Vultures and in the Ostrich and its allies.

The *lungs* are two oval flattened organs fixed in and imbedded between the ribs from the second dorsal vertebra to the kidneys. Their texture is loose and spongy. The two bronchi penetrate their anterior surface, and divide into four or six branches terminating by side openings on the surface, which openings communicate with air-sacs, which are usually nine in number.

Fig. 166.

Diagram of a Lobule of the Lung of a Bird: greatly magnified (*after Thomas Williams*).

Normally one of these is situated between the clavicles, and gives out a process on either side which, passing into the *axilla* or "arm-pit," enters the humerus *. Two others penetrate the abdomen, and often enter the sacral vertebræ and each femur; four permeate the more anterior region of the trunk, and two go to the neck. The latter often send branches into the bodies of the cervical vertebræ. These air-sacs do not supply air to the cranial bones. These are supplied from the nose and the cavity of the outer part of the ear.

* John Hunter tied the windpipe of a fowl and then divided the humerus, and he found that it breathed through the aperture in that bone.

The bronchi lose their rings after entering the lungs, and give off secondary branches at right angles (fig. 166), and these again tertiary ones in a similar way, ultimately ending, in the lobules of the lungs, in very minute air-sacs, which make up the bulk of the substance of these organs.

The Circulatory System.

The *heart* of a Bird consists, like our own, of four cavities—two *auricles* and two *ventricles*. The blood is collected from all parts of the body by the veins, which gradually unite together and end in three large vessels—two called the *superior venæ cavæ* and the other the *inferior vena cava*—which pour the venous blood they contain into the right auricle, whence it passes into the right ventricle, a valvular flap formed of muscle—the *right auriculo-ventricular valve*—preventing its regurgitation. From the right ventricle a vessel goes forth called the *pulmonary artery*, which bifurcates and then subdivides in either lung, conveying the blood into it. Thence it is collected and brought back, by converging vessels called the *pulmonary veins*, to the left auricle, whence it passes into the left ventricle, another valvular structure—the *left auriculo-ventricular* valve—preventing its regurgitation. From the left ventricle it is sent forth by a single great artery called the *aorta*, which ramifies, sending blood all over the body, its branches ultimately ending in most minute vessels called *capillaries*, which lead to the commencement of the veins of the body. Thus all the vessels proceeding from the heart are called "*arteries*," whilst those advancing towards it are termed "*veins*," and a complete circulation goes on as above indicated. There is, however, another subordinate circulation which takes place in what is called the *portal system*, or system of vessels ramifying in the substance of the liver. The vessels which thus convey blood to the liver and therein ramify are called *portal veins*, while those which collect the blood from the liver and carry it on towards the heart and into the inferior vena cava are termed *hepatic veins*. The blood collected by the portal veins comes from the stomach, intestines, and also from a caudal vein. The heart of a bird is more pointed than that of Mammals, and its apex lies between the lobes of the liver.

The *aorta* as it proceeds from the heart arches over the right bronchus, but before doing so gives off two large arteries, each of which is called an *innominate artery*. Each of these gives off an artery named the *subclavian* (for the wing), and then ascends a short way and divides into the carotid and vertebral arteries. The vertebral arteries traverse more or less of the canal formed by the transverse processes and pleurapophyses of the cervical vertebræ *. The carotids may ascend side by side to the base of the skull or may meet and blend into a single trunk which bifurcates again before entering the cranium. Very often, however, there is but a left carotid, which bifurcates at its summit. These various conditions characterize different groups of birds. The aorta then passes backwards beneath the spine, and supplies all parts of the body, sending two large arteries to each of the pelvic limbs.

On reaching the base of the skull the carotids enter it, passing above the basi-temporals and through the sphenoid into the cranial cavity.

The blood of Birds is hotter than that of any other animals, and is of a deep red colour. It is also more richly supplied than is that of Mammals with those minute bodies called *red corpuscles*, which it always contains. They are elliptical, flattened, and nucleated, and average $\frac{1}{2100}$ of an inch in long diameter.

The Nervous System and Organs of Sense.

As the internal skeleton is divisible into an axial and an appendicular portion, so the nervous system is divisible into a *central* and a *peripheral* division.

The central part of the nervous system is made up of the brain and spinal cord, while all the nerves which thence proceed constitute its peripheral portion.

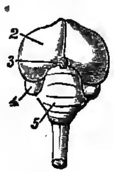
Very little need be here said about either, as such structures have been hitherto but little used in the definition and classification of Birds.

Their *brain* affords a good example of the law that this organ requires to be of a certain absolute size independently of that of the whole body; for the brain of extremely small Birds is relatively very large.

* See *ante*, p. 171.

This organ consists of a main part called the *cerebrum*, formed of two lateral rounded masses placed side by side called the *cerebral hemispheres*, and which are medianly united to a certain extent. Immediately behind them is a single, transversely marked body

Fig. 167.



DORSAL ASPECT OF BRAIN OF A PIGEON.

2, One of the cerebral hemispheres; 3, pineal gland; 4, one of the optic lobes; 5, cerebellum.

called the *cerebellum*, which if cut through shows a peculiarly ramified disposition of a darker and a lighter substance, termed the *arbor vitæ*. On each side of the hinder part of the cerebrum is a rounded body, and these two are called the *optic*

Fig. 168.

LEFT-SIDE VIEW OF BRAIN OF PIGEON.

1, Olfactory lobe; 2, left cerebral hemisphere; 3, pineal gland; 4, one of the optic lobes; 5, cerebellum; 6, pituitary body; 8, optic nerve.

lobes, which lie rather beneath the front part of the cerebellum. The common base of the brain continues backwards in the median line, and is called the *medulla oblongata*, which is directly continuous with the spinal cord. From the front end of each cerebral hemisphere a process proceeds forwards. These are the *olfactory lobes.* Between the cerebral hemispheres and the cerebellum, on the dorsal aspect of the brain, is a small process called the *pineal gland.* A median inferior prominence is called the *pituitary body.* Within, the brain is hollow, but the hollow space is variously disposed in different regions, and its walls are of very different thicknesses in different parts. Those parts of the cavity which extend into the hemispheres are called the *lateral ventricles,* and they open posteriorly by an aperture termed the *foramen of Munro* into a median cavity called the *third ventricle.* This is continued backwards into another beneath the cerebellum, which is the *fourth ventricle.*

The spinal cord shows two enlargements where it gives off nerves for the wings and legs respectively. The posterior of these enlargements also contains a cavity or *ventricle* termed the *sinus rhomboidalis.*

Some of the nerves given off from the brain go to the organs of sense, while others go to muscles and viscera. The points of exit from the skull of some of the nerves have been already indicated *.

The Nose.—This consists of two nostrils, which open externally in the way before described † and which pass back to open internally on the roof of the mouth, generally by a single aperture there. The olfactory lobe (often called olfactory nerve) above mentioned supplies the nerves which give the power of smell, and they ramify on the membrane which lines the nasal cavities.

The Organ of Taste.—The tongue, which has been already described ‡, is a part which in other animals serves for gustation, but probably has little or no power of taste in very many Birds. That sense is probably ministered to by the lining of the beak, which is doubtless also a most important instrument for ministering to the *sense of touch.*

The Ear.—There is hardly any external ear, save sometimes a circle of feathers—as in the Bustard, Ostrich, and Owl. In the last-named bird the external opening is wide, and is protected by a flap of skin with a few folds, thus distantly resembling the human ear. The external opening leads into a very shallow cavity bounded by the quadrate, squamosal, and exoccipital bones.

* See *ante,* p. 183. † See *ante,* p. 146. ‡ See *ante,* p. 207.

It is closed by the *drum of the ear*, *tympanum*, or *tympanic membrane*, which is invested by the general skin, and is therefore not itself to be seen. Within this membrane is a bony chamber named the *tympanic cavity*. In some Birds a bony tube, called the *siphonium*, passes from the tympanic cavity to the lower jaw, and conveys air to the articular bone.

In the front part of the tympanic cavity is an opening which is the hinder orifice of the eustachian tube, while in the inner wall of the tympanic cavity are two apertures close together. The upper and anterior of these is called the *fenestra ovalis*, while the other is the *fenestra rotunda*. A delicate little bone shaped like a doctor's stethoscope traverses the tympanic cavity. Its expanded end is applied to the fenestra ovalis, while its opposite extremity, from which various delicate processes may diverge, is attached to the tympanic membrane. It is called the *columella*.

The two fenestræ open into another still more internal cavity, within which is the true ear or *organ of hearing*. This most internal cavity lies within the substance of the periotic bones of the side-wall of the skull *, and is the "internal ear"—the tympanic cavity being the "middle ear," and the parts external to the tympanic membrane the "external ear." This innermost cavity has a very complex shape and is therefore called a *bony labyrinth*. Its form is determined by the membranous parts it encloses, which constitute the *membranous labyrinth*.

The membranous labyrinth consists of three semicircular canals (anterior, posterior, and external) which open into a common central cavity or *vestibule*, from which an elongated membranous bag, the *cochlea*, proceeds in the opposite direction. This membranous labyrinth is filled with a fluid called the *endolymph*, and floats in another fluid, filling the bony labyrinth containing it, called the *perilymph*. The fenestra ovalis is set in the wall of the bony cavity containing the vestibule. The fenestra ovalis is set in that which encloses the cochlea.

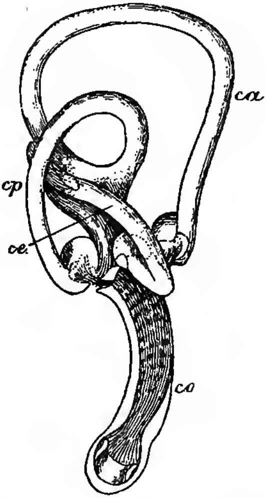
The nerve of hearing penetrates the periotic capsule and supplies the walls of the cochlea and semicircular canals.

The Eye.—This organ in Birds is formed in essentially the same way as our own. It consists of an eyeball enclosed by a strong *sclerotic membrane*, which is transparent in front, forming

* See *ante*, p. 182, and *below*, p. 227.

the *cornea.* Within this are two unequally-sized chambers separated by a vertical curtain, the *iris,* with a central aperture, and by a dense transparent body enclosed in a very delicate membrane or *capsule.* This dense, transparent body is the *crystalline lens,* which fills the aperture—the pupil—left in the middle of the iris. Around the lens are small processes termed *ciliary processes.* Round the iris is a fibrous band called the *ciliary ligament,* while

Fig. 169.



SIDE VIEW OF MEMBRANOUS LABYRINTH OF PIGEON: greatly enlarged.

ca, cp, and *ce,* anterior, posterior, and external semicircular canals; *co,* cochlea.

on the outer surface of the choroid is a similar band of contractile fibres—the *ciliary muscle.* The chamber in front of the lens is filled with the *aqueous humour,* while the *vitreous humour* fills that behind it. Lining this posterior chamber is the essential organ of sight, the expanded optic nerve or *retina.* External to this is a dark, highly vascular membrane termed the *choroid.*

Directly enclosing the vitreous humour is the *hyaloid membrane*, which splits around the *capsule* enclosing the lens, leaving a space termed the *canal of Petit*. The optic nerve passes from the brain to the eyeball through the optic foramen, as already* mentioned. This eyeball is moved in its socket by straight and oblique muscles implanted into the outer surface of the

Fig. 170.

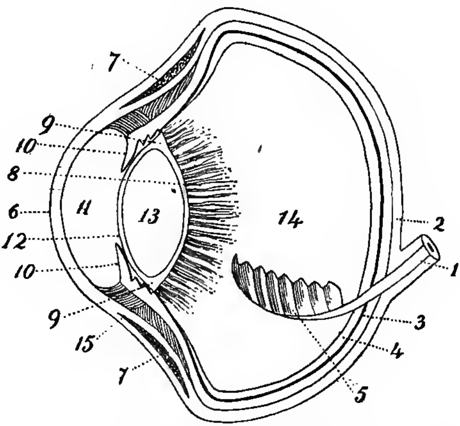


DIAGRAM OF A VERTICAL ANTERO-POSTERIOR SECTION OF THE EYE OF A BIRD (enlarged).

1. Optic nerve. 2. Sclerotic. 3. Choroid. 4. Retina. 5. Marsupium. 6. Cornea. 7, 7. Bony plates enclosed in sclerotic. 8. Corrugations of choroid forming the ciliary processes. 9. Canal of Petit—formed by a bifurcation of a most delicate membrane, the hyaloid membrane, which immediately surrounds the vitreous humour, and which bifurcates anteriorly and goes to the capsule of the lens. 10. Iris. 11. Anterior chsmber of the eye containing the aqueous humour. 12. Capsule of the lens. 13. Lens. 14. Posterior chamber of the eye containing the vitreous humour. 15. Ciliary muscle.

sclerotic, and it is protected in front by an upper and lower eyelid and also by a third eyelid or *nictitating membrane* †.

Both Mammals and Reptiles number amongst the species which compose their class, forms which are naturally blind, but

* See *ante*, p. 182. † See *ante*, p. 142.

all Birds are provided with large and efficient eyes. Their eyeballs are generally longer from within outwards than those of other vertebrate animals, and their crystalline lens is but little convex. The whole eye is shortest and the lens least flat in aquatic Birds and longest in the Owls.

The sclerotic of birds is not only dense but contains bony plates which overlap each other and by their contraction protrude the aqueous humour—which is very abundant—and so render the cornea more convex. An organ called the *marsupium* or *pecten* is a vascular membrane which projects into the vitreous humour along a line extending from near the entrance of the optic nerve to the lens. It seems that this organ can be distended and then must help to push the lens forwards. These various telescopic arrangements facilitate rapid changes from very long to very short sight. They are most needful for such active creatures as Birds. A Hawk will suddenly descend a quarter of a mile and probably can keep a creature it intends to prey on in focus all the time of its descent. The Bird's eye is indeed the most perfect of all.

The nictitating membrane is drawn out over the eye by a muscle which arises from the lower part of the inner side of the sclerotic, and thence its tendon winds round the optic nerve and passes over the eyeball to be inserted into the third eyelid. By its contraction it would compress the optic nerve and so impair sight, but that it passes through a tendinous sheath of a *quadrate muscle* which comes from the back of the sclerotic. When, then, the winding muscle acts, the quadrate muscle acts at the same time, and draws the tendon away from the optic nerve.

The lower eyelid is more moveable than in Man and Mammals, having its own depressor muscle, and contains a small cartilage.

Two glands secrete fluid to lubricate the eyeball. One of these, the *Harderian gland*, lies at the inner angle of the eye. The other, the lachrymal gland, lies, as with us, at its outer angle.

The Development of Birds.

It would be quite beside the purpose of this work to describe in detail the very complicated process by which the germ of a Bird transforms itself gradually into the structure of the adult. Our object, we believe, will be completely attained by a brief statement of a few fundamental facts and a short account of certain structures the temporary distinctness of which enables us to understand the nature of parts which ultimately show no trace of their earlier divided condition.

The ovary has been compared to a small bunch of grapes, but these grapes vary greatly as to size. They are, of course, the immature eggs or ova. The smallest consist of but a microscopic spheroid of the substance called *protoplasm* * enclosed in a delicate membrane, the *zona pellucida*, and containing within its substance a denser particle called the *nucleus* or *germinal vesicle*, within which again is a minute distinguishable particle, the *nucleolus* or *germinal spot*.

Gradually one ovum after another increases till its protoplasm, the *yelk*, becomes of large size. It is enclosed within a membranous envelope, the *ovisac*, which ruptures and allows the ovum, when ripe, to escape into the upper, open end of the oviduct. As it descends this tube it becomes coated with an albuminous secretion, the *white*, and further down that tube it receives its calcareous investment, or *shell*, and very often layers of pigment according to the colours which may characterize the eggs of this or that kind of bird.

But a very small portion of the yelk is actually transformed directly into the developing embryo—namely, a small patch on the surface familiarly known as the *tread*. The rest of the yelk serves but to nourish the embryo.

From this small superficial patch of protoplasm all the varied tissues and all the complex parts which constitute the adult Bird are, by degrees, derived. The primitive cell of which the embryo, at the very first, consists, divides and subdivides itself again and again till three layers of cells are gradually but rapidly formed. The most superficial of these is called the *epiblast*, the deepest the *hypoblast*, while between them is the *mesoblast*.

Soon a slight longitudinal furrow is formed, called the *primitive streak*; but much more important is another longitudinal groove (more anteriorly situated with respect to the embryo, as subsequent development shows), the *medullary groove*, wherein is laid the foundation of the brain and spinal cord; while beneath

* A term proposed by Mohl to denote the soft interior of cells. It is a soft, viscid, transparent, colourless substance, easily decomposable. It is resolvable into oxygen, hydrogen, nitrogen, and carbon, and with traces of some other chemical elements.

the latter the first rudiment of the back-bone is formed. Then, after certain other elevations and depressions and various foldings, blood is formed, vessels arise, a heart shows itself and beats, and a primitive circulation is established. Limbs also grow forth, and jaws, and sense-organs form themselves, and so, little by little, what was at first a minute spheroidal particle of protoplasm, more and more approximates to the form of a Bird.

But the body is only built up in a very roundabout way. Its earlier structural arrangements are very different from those of adult life. The brain is at first more like that of a fish than of a Bird. The heart begins as a simple tube, which subsequently becomes bent on itself and subdivided into chambers. The blood-vessels which go to and from it are at first very different from what they ultimately become.

The arteries which proceed from it form at first a series of arches passing up on either side of the neck to unite dorsally and there give rise to the commencement of the aorta.

Certain clefts, termed *visceral clefts*, also exist for a time on either side of the throat, while the series of solid parts left between them are named *visceral arches*, along the inside of which proceed the arteries just mentioned as arching up on either side of the throat. These conditions are very fish-like.

The skeleton is at first represented only by stretches of membrane, afterwards by these and by cartilages, and only finally by bones. Instead of the series of vertebræ which later make up the back-bone, there is at first only a continuous gelatinous rod, called the *notochord* or *chorda dorsalis*. The bones are at first much more numerous than those which are found distinct later in life, especially in the cranium. Finally, before hatching, a covering of feathers may be formed which is very different from that of the adult, and is sooner or later cast off.

At a very early stage of this process a membrane grows up around the embryo, and the upgrowths meeting together above it, unite and enclose it. This membrane is called the *amnion*, and it is filled with fluid—the amniotic fluid—wherein the embryo lies as in a water-bed.

Another membrane grows forth from the ventral surface of the embryo's body, and spreads out on all sides of it immediately within the egg-shell. This is called the *allantois*, and is the bird's breathing-organ while developing within the egg. The egg-shell is porous, and allows air to pass through, while blood-vessels from the body ramify over the allantois and there receive that purification and oxygenation wherein the process of respiration, as before said, consists.

When ripe for leaving the shell, the young Bird pecks at and cracks it, being often aided, as in the chick, by a small hard prominence on the beak, which subsequently disappears.

It may be useful here to note a few points as to the development of the arteries and the skeleton.

Five pairs of arteries arch up on each side of the neck in the embryo, to form by their junction the aorta. The changes they undergo have been described as follows:—

The first and second pairs soon disappear.

The third pair gives rise to the carotid arteries.

The right arch of the fourth pair persists as the arch and trunk of the aorta, and the left arch, as the left subclavian artery.

The two arches of the fifth pair become the pulmonary arteries.

Since, however, there are such great differences in the adult condition of these vessels, it is hardly to be expected that there should not also be divergences in the modes of their development.

As to the skeleton, its primitive axis, the notochord, becomes invested with cartilage which subsequently segments, and then points of ossification begin to form the vertebral centra, and gradually the whole vertebræ are sketched out.

In a later but still young condition of the skeleton, the little ossicles which are attached to the transverse processes of the cervical vertebræ are all distinct, and show their essential nature as small ribs each with its tubercular and capitular process.

The sacrum also reveals its essential composition by the distinctness of its component parts, as may be well seen in the Ostrich (fig. 149).

The caudal vertebræ later on anchylose together to form the "pygostyle" *.

The sternum is not at first a single osseous structure, but is made up typically of five parts. One of these forms the keel. Another on each side in front is the bone with which the sternal ribs articulate; while the hinder lateral parts of the sternum are formed by yet another on each side behind.

* See *ante*, p. 175.

The skull, in its earlier condition of cartilage and membrane only, is thus conditioned :—

There is a median mass of cartilage which invests the anterior end of the notochord and forms the base of the cranial cavity. The sides of this investing mass extend upwards and meet above, the internal ears being enclosed in these uprising lateral cartilages. From the front of the median investing mass, cartilage extends forwards in the direction of the middle of the upper mandible, and from this a median and two lateral extensions of cartilage mount upwards in the position where we subsequently find the median and lateral ethmoid bones. There is also an extension upwards from the investing mass on either side, in the place where we subsequently find the alisphenoid. From the investing mass, four bars of cartilage (on each side) pass forwards or downwards. The first of these lays the foundation of the pterygoid and palatine ; the second becomes a lateral half of the lower mandible. The third and fourth go to construct the hyoid—the thyro-hyals being ossifications in the fourth descending lateral bar of each side.

The roof of the cranium is completed by membrane only.

In this membranous and cartilaginous cranium various distinct points of ossification arise and lay the foundation of what at first are separate cranial bones. As these bones grow, they soon meet together, and their lines of junction are the "sutures" of the skull. These still remain pretty distinct in a Chicken till it is nearly two months old.

Only in the young, even of Mammals, can we clearly perceive the distinctness of the three bones which together form the continuously anchylosed "periotic capsule," the names of which are: "prootic," "epiotic," and "opisthotic."

The *prootic* is the most anteriorly situated of the three, and shelters that one of the three semicircular canals * of the labyrinth which is called the "anterior semicircular canal." It also forms the upper margin of the "fenestra ovalis" and the whole of the foramen through which the auditory nerve passes to the ear—namely, the "meatus auditorius internus."

The *opisthotic* is the most inferiorly situated. It forms the lower margin of the "fenestra ovalis," and entirely surrounds the "fenestra rotunda."

* See *ante* p. 221.

The *epiotic* is superior and posterior, and shelters the posterior semicircular canal.

The two latter bones anchylose with the occipitals next to them behind, before they anchylose with the "prootic."

The earlier condition of the limb-bones of birds serves to reveal their essential composition. Then we find the four carpal * bones and all the three metacarpal bones distinct.

Similarly in the leg we find the two tarsal elements distinct which in adult life respectively anchylose with the distal end of the tibia † and the proximal end of the tarso-metatarsal, and the last-named bone plainly shows how it is made up not only of a tarsal element, but of three metatarsals also.

The wonderful egg-laying capacity of the domestic Fowl is notorious both for its duration and the number laid in a nest. Wild Birds of the Fowl and Pheasant kind will also lay a considerable number of eggs. Many small Birds lay and sit on eight or ten eggs, and many Birds lay only five or six. Pigeons lay but two, and the same is the case with Humming-birds, while the Petrel and the Penguin lay but one.

The *size of the egg* is not strictly related to the size of the individual which lays it. Thus the Apteryx, though only about as large as a moderately sized Fowl, lays a very large egg. The Guillemot and the Raven are Birds of about the same size, but the egg of one is ten times the size of that of the other, that of the Guillemot being as big as that of an Eagle.

The *shapes of eggs* also differ considerably. Thus those of the Owls are nearly round, while those of the Heron and Sand-grouse are elongated with both ends nearly equal in size. Everyone knows, on the other hand, that the Plover's egg is pear-shaped, and some of the Guillemots lay eggs which attenuate very rapidly towards the smaller end. In the Grebes the eggs are pointed at both ends, although very wide in the middle.

The grain of the shell is different in different species. It is

* Probably answering to the *magnum* and *unciform* bones of man and beasts, as well as the scapho-lunar and cuneiform bones. There is also sometimes a fifth carpal ossicle, which afterwards anchyloses with the metacarpus, as also do the representatives of the *magnum* and *unciforme*. It has been termed the *pentosteon*.

† This proximal element consists at first of two distinct parts, which, as they lie beneath the ends of the two leg-bones, may be distinguished as the *tibiale* and the *fibulare* respectively.

sometimes so fine that the surface of the egg is quite glossy. Those of the Tinamous look like glazed porcelain. Some other Birds, however, as the Grebes and the Pelicans, lay eggs covered with a chalky film, often thick and with calcareous protuberances. The eggs of the Stork are more or less granulated or pitted on the surface; and those of the Ostrich of South Africa much more so, though, strange to say, the eggs of those of North Africa have a smooth unpunctured surface*. Ducks lay eggs with a greasy exterior.

Eggs have commonly a special ground-colour, the intensity of which seems to increase with the strength and vigour of the individual. Upon this a variety of markings may be superimposed as small speckles, or round spots, or irregular blotches or spiral streaks. The colour is not invariably the same in all the eggs laid by a bird in one season. Thus the Tree-sparrow seems always to have one egg different from that of the rest laid in the same nest. The Guillemot is quite exceptional for the extraordinary amount of variation in the colour and marking of its eggs. There is a great variety of coloration in the class. Professor Newton affirms that hardly a shade known to the colorist is not exhibited by one or more, and some of these tints have their beauty enhanced by their harmonious blending, or by the pleasing contrast of the pigments which form markings, often most irregular and often regular in shape.

For the most part coloured eggs are laid in open nests, and white eggs in covered nests; but white eggs are sometimes laid in open ones, as by Ducks. On the other hand, some spotted and coloured eggs are laid in covered nests—as by the Jackdaw, the Magpie, and the Grass-warbler.

The changes of development in the egg can only go on at a certain temperature, to maintain which birds sit on their eggs, or, as it is called, *incubate*. The period of incubation varies, and is much related to the size of the birds. The egg of the Ostrich requires to be incubated for from fifty to sixty days, while that of the Wren needs but ten days. Mostly it is the Hen which sits, the male often bringing her food; often, however, the two sexes takes turns in incubating. In some birds the male is said to incubate, as in the Cassowary and Emeu, the Australian Frogmouth (*Eurostopodus albogularis*), and the Ostrich.

With the Cuckoo, however, both sexes avoid the labour

* See 'The Ibis,' 1860, p. 74.

altogether, by laying in the nests of other Birds, a practice facilitated by the small size of their eggs.

One brood annually is the rule with Birds, though many hatch two or even three broods in the year.

Parent birds sometimes assist their unhatched brood to break the shell when they hear the cry of the young one within it.

The only Birds which neither incubate their eggs themselves nor provide them with foster mothers, are the mound-building birds of the Australian region, such as *Megapodius*. They raise, as before said *, large heaps of vegetable substances—refuse of all kind—and earth, and therein deposit their eggs, which are hatched by the heat produced through such an accumulation of decaying and slightly fermenting matter. Their eggs are large, and the young developed in them are so fully formed when hatched, that they can not only force their way to the surface of the mound, but having reached it can fly away at once for short distances.

Some species lay their eggs in the loose hot sand of the beach (above high water-mark), where the rays of the sun suffice to hatch them.

Birds differ much as to the state of development in which they are hatched. Many are born nearly naked and helpless, and require good shelter till they acquire feathers, as is the case, *e. g.*, in the Canary and the Sparrow. Others, like the Heron, are born nearly naked, and acquire a downy covering before they acquire feathers. Others again, like the Hawks, are born helpless but covered with down; while yet others, like the Chicken, are hatched covered with down, and can run about at once. Birds of the latter kind are said to be *precocious*. The most precocious of all are the Mound-builders above mentioned.

Young birds are assiduously fed by their parents, and the crops of Pigeons secrete a nutritious fluid which the young partake of, extending their heads down the gullet of one or other parent for the purpose.

The relations of the colours of the plumage of the young and the adults of both sexes, and the process of moulting, have been already noted †.

Nidification.—As country boys know, the shapes of, and the materials used in making, the nests of Birds are different in different species. Some make carefully made covered nests,

* See *ante*, p. 9. † *See ante*, p. 140.

some carefully formed open ones, some very rough open ones, and some make none at all. Thus the Guillemots are content to lay their single egg, without shelter or protection, on the naked surface of a ledge of rock, where its conical shape, however, affords it a certain help in retaining its place.

The Penguin is said to carry its one egg about with it in a sort of pouch of the skin of the belly; reminding us of the Kangaroo amongst beasts.

The Goatsucker and the Stone-curlew lay their eggs on the ground without any previous arrangement for their protection, though they are efficiently protected by careful selection as to their surroundings. Many Gulls and Plovers lay their eggs in a shallow pit. Pigeons only make a nest of a few sticks loosely put together. Grebes collect vegetable refuse and pile it on some growing water-weed and lay on it. The mounds built and supplied with refuse by the *Megapodius* have been already described. The Magpie makes a domed nest which bristles with thorns. Some birds make use of burrows, as does the Burrowing-owl (*Speotyto cunicularia*) and the Sand-martin; while our Kingfisher generally makes a so-called nest with fish-bones ejected from its stomach, thus differing widely from the Sand-martin, which makes a "feather bed" in the bottom of the burrow it breeds in. The Woodpecker makes use of a hole in a tree-trunk, which it perforates. Many small Birds seem to moisten and glue together the twigs and straws of their nest with their saliva, but the adhesive nests of the House-martin are known to all. Some Swifts, however, secrete a saliva which rapidly hardens, and so construct a sort of isinglass nest, which is the material whereof "birds'-nest soup" is made.

The Chaffinch and Goldfinch make admirable open nests, but the Wren makes a domed one. Some domed and covered nests have a pendent, cylindrical tube, which has to be traversed to reach the nest's interior.

The Indian Tailor-bird (*Orthotomus longicauda*) selects a broad leaf, and sews the edges together with thread-like fibre. The hollow interior it lines with fine grass and vegetable down.

The female Hornbill retires into the hollow of a tree, the opening of which is closed in by her mate with a partition of mud, which drying, forms a solid wall, through an aperture left in which he assiduously feeds her and her young.

As a rule, only those birds in which the female is dull coloured make open nests. Certain Birds in which both the sexes are bright (as the Kingfisher), or both dull (as the Swift), build in holes or covered nests; while others, in which the female is the duller, make covered nests, as especially in the gsnus *Malurus*.

The Savannah Cuckoo (*Crotophaga ani*) is said to be a social nest-builder, several Birds using a nest in common. The Weaver-birds of Africa, however, practice the most curious, social nidification. They form nests associated together in large masses, which are pendent, with a stocking-like entrance-funnel, by which they better avoid the attack of snakes. The Birds construct together the general cover which is common to and protects all their nests. Then, underneath this cover and suspended from it, they separately form their individual nests placed closely side by side. New nests are annually constructed beneath, and suspended from, the older ones, till the whole mass becomes too heavy for their support and gives way. Then the labour is recommenced in another locality.

As everyone knows, the Cuckoo builds no nest, but places its egg in the nests of other Birds. The same is the case with the Cow-bird of the New World (*Molothrus pecoris*), and the Argentine Cow-bird (*Molothrus bonariensis*) is singularly irregular in its modes of laying. But some other birds occasionally do the same, from stupidity or otherwise, Pheasants' and Partridges' eggs being often laid in the same nest.

Generally each species adheres to one mode of nidification, but sometimes this will vary. The Heron will breed in trees or in open fens, according to circumstances, and the Falcon and Golden Eagle will show an analogous versatility from rocky cliff to plain. The Water-hen will often build in trees in districts liable to sudden floods.

The male very often sings zealously while his mate is sitting, his song stopping short when the eggs are hatched, though it will be renewed should the young be destroyed very quickly, the female then laying again, perhaps in a new nest. Some Birds, however, as the Robin and the Wren, will sing their song all the year round, save at moulting-time and in severe weather. Skylarks and Thrushes also sing after their moult, but their notes have not the force and melody of the spring, and, indeed, the sounds uttered by Birds are specially related to the breeding-season, whether those sounds be whistles, screams, hoots, bleatings, drumming, or booming sounds, or whatever they may be. Akin to these vocal utterances are also the curious antics and contortions of body which many Birds affect at the time of courtship, as notably do the Capercalzie, the Grouse, the Blackcock, and the Cock of the Rock. It is then the Peacock is seen in all its pride, and it is probably for courtship that the Bower-bird makes its singular structure of twigs set on end in two rows, with shells, bright feathers, or other conspicuous objects, disposed at the mouth of its curious avenue.

The Migration of Birds.

Everyone knows that various Birds which are with us in the summer (such as the Swallow and the Cuckoo) leave us before the near approach of the winter season, returning to us with the warmth of spring, to breed and hatch their young. This annual movement is "migration," and is a far more general practice than is ordinarily supposed, if, indeed, it may not be said to be to some degree universal.

Many Birds which are not commonly thought to migrate at all, as the Robin and the Song-Thrush, yet do so to a greater or less degree in some localities, though in others this may not be readily perceptible. Such species are called "*partial migrants*." Birds have exceptional powers of changing their dwelling-place with ease, and mutations of temperature with diminished supplies of food seem to determine a movement to warmer climes. Many birds are for us *winter visitants*, that is, breed in the North and visit us in the winter; while others breed with us, as does the Nightingale, and are winter visitants (that is, pass our winter months) in more southern climes. Some Birds not only breed to the north of us, but are not content with the conditions found in England during the winter, but pass beyond us to southern latitudes. Such Birds as never make any prolonged stay, though passing us each way on very prolonged annual journeys, are distinguished as "*Birds of passage*." Sometimes Birds collect in large flocks before leaving, as do the Swallows; but most species slip away almost unobserved. The same species does not, however, behave, in this respect, invariably in the same way.

Migration takes place in part at night, and various anecdotes have been told of the multitude of passing Birds, giving abundant evidence of their passage to the ear, though darkness may make them imperceptible to the eye.

The extreme punctuality of Birds in their migrations is often very remarkable. This is especially the case with Water Birds. Whatever may be the weather, the Puffin has been noted as arriving on the very day it was, from previous experience, anticipated.

The motive of the return northwards is more mysterious than the impulse which drives Birds south. The latter may be explicable by growing scarcity of food. The former can as yet be only regarded as the result of an instinctive longing to return to a wonted haunt. The accuracy and perseverance of this return has often been observed, but never better than by Professor Newton. He tells * us : "A pair of Stone-Curlews (*Œdicnemus crepitans*)—a very migratory species, affecting almost exclusively the most open country—were in the habit of breeding for many years on the same spot though its character had undergone a complete change. It had been part of an extensive and barren rabbit-warren, and was become the centre of a large and flourishing plantation."

It appears that migrating birds often pass along the coasts of countries which lie in their line of march. Thus it is said † that some skirt the west coast of Norway as they pass from Siberia to us. River-courses are also preferentially followed. Others leave Northern Russia, skirt the Gulf of Finland to Holland, then pass by the Valleys of the Rhine, and along the coasts of France and Spain, to Africa.

The way in which migration is accomplished remains still unexplained. It has been said to be due to past "experience" of landmarks, but how can that guide birds in their first year that do not migrate in companies? How can it account for the great distances of sea which are so often successfully traversed?

There are some Birds which migrate irregularly, as do the Crossbills, Nutcrackers, and Waxwings. Sometimes birds from distant regions make their appearance in strange localities, as do, *e.g.*, American birds in Norfolk and Suffolk. Sometimes, also, a migration takes place comparable with the invasion of Europe by the Huns. Such an example we have in Pallas's Sand-grouse, which before 1863 was only known as an inhabitant of the plains of Tartary, but which has now come to establish itself in Europe and once at least actually bred in England.

* Ency. Brit., Article "Birds," p. 766.

† See Palmén's 'Om Fylarnes flyttingsvägar' (Helsingfors, 1874).

CHAPTER V.

THE GEOLOGICAL AND GEOGRAPHICAL RELATIONS OF BIRDS.

THE relations which different kinds of Birds and their whole class bear to past time is revealed to us by fossil remains preserved in the earth's crust, and by relics found in caves and fissures on its surface. "Fossils" may be either: (1) bones which retain the greater part of their own mineral matter and some of their animal matter also; (2) *Substitutes* or *pseudomorphs*, which are relics the original substance of which has been transformed, particle by particle, into mineral matter—ferruginous, calcareous, or siliceous; (3) *Moulds*, that is, a deposit which exhibits impressions—such, *e. g.*, as footprints—made upon it; or (4) *Casts*, which may be casts of moulds or casts of hollow structures, such, *e. g.*, as a cast of the cavity of the skull.

The crust of the earth is made up in the first place, superficially, of accumulations of sands, clays, and gravels, which form what are called *recent deposits*, and are not counted as constituting any part of what are spoken of as *geological strata*, which are classified in three great groups, belonging respectively to three great epochs. The deepest and most ancient group comprises the strata called *Primary* or *Palæozoic.* The second or middle group of strata is called *Secondary* or *Mesozoic.* The uppermost and least ancient group consists of strata called *Tertiary* or *Cainozoic*, upon the uppermost surface of which the "recent deposits" (which are but their modern continuation) lie.

Each of these three great groups is made up of a certain number of subordinate groups of strata, or "formations." Thus the "Palæozoic" rocks are made up of the *Laurentian, Cambrian, Silurian, Devonian, Old Red Sandstone, Carboniferous,* and *Permian* formations. The "Mesozoic" rocks are made up of the *Triassic*, *Jurassic*, and *Cretaceous* formations. To the "Triassic" formation belongs the stratum known as the *New Red Sandstone*. The "Jurassic" formation includes the *Lias*, the *Oolite*, and *Solenhofen Slates* of Bavaria. The "Cretaceous" formation comprises the *Wealden*, the *Lower* and *Upper Greensand*, the *Gault*, and the *Chalk*. The "Cainozoic or Tertiary" rocks are composed of three "formations"—the *Eocene*, the *Miocene*, and the *Pliocene*. The oldest or "Eocene" formation underlies both Paris and London, and exists as very important deposits in North America. The "Miocene" formation is widely distributed in Europe and the North-American continent, but is very slightly represented in Britain. To it, however, belong the rocks which form the Giant's Causeway and the islands of Staffa and Mull with others. The Pliocene formation is extensively distributed in Europe, Asia, and the United States. In England it is represented by the Norfolk and Suffolk "Crag." The later Pliocene rocks—which are often called *Quaternary* strata—include the deposits found in the ancient caves of Europe, and those thrown down during what is known as the *Glacial epoch*. That a period of intense cold prevailed in geologically recent times, over Northern and Central Europe and the greater part of North America, is shown by the evidences of prodigious glaciers, which have scooped out valleys, and grooved and scored the surface of hill and dale in those regions. Blocks of stones, called "boulders," are often found scattered about, and seem to have been transported by ice, sometimes from very great distances.

Geological Relations of Birds.

No remains or traces of Birds have yet been discovered in any of the primary or Palæozoic strata.

Certain "moulds" in the form of footprints were long ago (in 1831) found in Triassic deposits in Connecticut, but these are now believed to have been made by certain extinct, in many respects bird-like, reptiles.

The oldest undoubted Bird-fossil, or *Ornitholite*, was found in 1861, in the Jurassic formation, namely, in the Solenhofen Slate of Bavaria. This Bird is the now celebrated *Archæopteryx*, which, though provided with long feathers, differs greatly from any other Bird yet known. It was about the size of a Rook, and its remains show a bony tail as long as the body, consisting of twenty separate vertebræ with feathers implanted on either side (a pair to each vertebra), for its whole length, and radiating from its tip. It had a strongly curved "furcula" or merry-thought, and a keeled sternum. Its foot was completely like that of an ordinary bird, but in the pinion there were two distinct metacarpal bones and two curved claws. The wing was provided with long "remiges."

Remains of a Bird, the jaws of which bore true teeth, have been found in Sheppey*. It has been named *Odontopteryx toliapus*.

Two very remarkable fossil Birds have been discovered in the Cretaceous rocks of North America. One of these, called *Ichthyornis*, differed from all existing Birds in having the centra of its vertebræ concave both in front and behind. It had also true teeth lodged in distinct sockets. Its wings were well developed; its metacarpals anchylosed together, and its sternum keeled. The other form, called *Hesperornis*, had true teeth lodged, not in distinct sockets, but in continuous grooves in the jaws. The centra of its vertebræ were saddle-shaped, as in ordinary birds, but its sternum had no keel. Its most extraordinary character, however, was its extremely defective wings, in which the skeleton of not only the pinion but of the fore-arm appears to have been absent, while the humerus itself, though long, was extremely slender.

Some twenty other kinds of Cretaceous Birds have been described, most of them of wading, more or less aquatic kinds. Amongst these are *Palæotringa* and *Telmatobius*—allied to the Sandpipers and Rails.

When we advance to the Tertiary epoch, a number of Bird-remains make their appearance.

Amongst those found in the Eocene rocks in Europe are *Alethornis* and *Protornis*, the latter resembling a Lark, and *Palægithalus*, reminding us of a Nuthatch; also *Cryptornis* and *Halcyornis*, which were like Kingfishers. The last-named fossil was found in the Isle of Sheppey, where also *Lithornis* was found, which seems to have been allied to the modern American Vultures of the genus *Cathartes*. A gigantic Wading-bird, called *Gastornis*, of the size of an Ostrich, has left its remains in France. An Eocene Woodpecker, *Uintornis*, has been found in America.

* See Quart. Journ. Geol. Soc. xxix. p. 511.

In Miocene times it is evident that a multitude of species flourished very like those now existing. The fauna of Europe was then enriched with various kinds which are now more tropical, including Trogons, African Parrots, and Eastern Storks. In America, a Turkey then already existed. The Birds which have left their relics in Pliocene strata almost all belong to genera now existing, and some even to existing species.

Caves and recent deposits have made known to us various Birds more or less allied to the existing Ostrich or Emeu or Apteryx. In Brazil there is a Rhea larger than either of the existing species.

The remains of other remarkable Birds have been found in the same deposits. Amongst them is *Harpagornis*, which was a Bird of prey of so great a size as to have been able to prey upon the largest kind of *Dinornis*. Also a gigantic Goose, *Cnemiornis*. An extinct kind of Emeu (*Dromæornis*) has also beeen found in Australia.

We have already spoken * of the Dodo and Solitaire as Birds which have become extinct in historical times, as also of the *Dinornis*, *Æpyornis*, and Great Auk †. Other Birds which may be mentioned are a crested Parrot (*Lophopsittacus*), a long-billed kind of Rail (*Aphanapteryx*), and a curious Starling (*Fregilupus varius*), all formerly inhabitants of Mauritius. This Starling existed there till some forty years ago, and a specimen of it is preserved in the British Museum; as is also a large Duck (*Somateria labradora*), the last known example of which appears to have been killed in North America in 1852.

A Parrot (*Nestor productus*), which inhabited Phillip Island, near New Zealand, appears to have become extinct within the last few years.

Geographical Relations of Birds.

As to the Geography of Ornithology, we have already, in our introductory chapter, said a good deal about the distribution over the earth's surface of a considerable number of Bird-groups.

Our aim here, however, is to endeavour to point out what are the main geographical divisions, Ornithologically considered, which the world can be divided into, and then to indicate some of the more interesting or important groups of Birds which

* See *ante*, p. 64. † See *ante*, p. 22.

respectively belong to such geographical divisions. We have before spoken of groups of Birds; we will now speak of regions.

The world is thus divisible into six great "regions," termed (1) Palæarctic, (2) Ethiopian, (3) Indian, (4) Nearctic, (5) Neotropical, and (6) Australian *.

The PALÆARCTIC region includes Europe, with Spitzbergen, Iceland, the Azores, Canaries, and Madeira, Africa north of the Sahara (save that Tripoli and Egypt blend with the Ethiopian region), Asia north of the Indian Ocean and the Himalayas, including Afghanistan, Persia, and, possibly, Belochistan, with Asia Minor and Syria (save the Valley of the Jordan). Eastwards from the Himalayas it includes China north of the Yang-tze-kiang, at least the northern island of Japan, and the Kurile Islands.

This great region is divisible into "subregions," as follows:—I. The *European*, and II. the *Mediterraneo-Persic*, as described below †.

The ETHIOPIAN region is composed of Africa south of the Palæarctic region (or south of the Sahara, with more or less of Tripoli and Egypt), the Cape Verd and other islands, including St. Helena, Madagascar, Mauritius, and Reunion, the Seychelles and Socotra; and also Arabia and the Valley of the Jordan ‡.

The subregions of this region are:—

I. The *Libyan*, or all the northern part of the Ethiopian region—that is to say, a little to the north of 10° North latitude to the Nile basin, which is included in it as well as Abyssinia.

II. *West-African* or *Guinean* subregion—that is to say, the West-African coast from Sierra Leone to the Quanza, and thence eastwards to the Nile watershed in the north, its eastern boundary southwards of this being as yet uncertain.

III. The *South-African* or *Caffrarian* subregion, or Africa south of the Quanza and the northern watershed of the Zambesi, with St. Helena.

* This division was first proposed by Mr. Sclater, F.R.S. (see Journal of Linnean Society (Zoology), vol. ii. pp. 130–145). Professor Newton, F.R.S., has published an admirable article on this subject under the heading "Birds" in the last edition of the Ency. Brit. Of this article we have made much use. We have also made use of Mr. Wallace's work on the 'Geographical Distribution of Animals,' and of the aid of Dr. Bowdler Sharpe, F.Z.S.

† See p. 242.

‡ This valley possesses an Indian genus of Owls, namely *Ketupa*.

IV. The *East-African* or *Mozambique* subregion, including East Africa between Abyssinia and the watershed of the Zambesi, and extending for an uncertain distance westwards.

V. The *Madagascar* subregion, or Madagascar and the more adjacent islands.

The INDIAN region comprises all India south of the Himalaya and the rest of Asia south of the Yang-tze-kiang, with the southern part of Japan and the Indian Archipelago down to and including the islands of Bali, Borneo, and the Philippines.

This vast region seems to consist of two subregions:—

I. The *Indo-Chinese* subregion, being the Indian Peninsula or the Indian region north of the Malay Peninsula.

II. The *Malayan* subregion, or the Indian region south of Tenasserim, with the Philippine and Sunda Islands, but excluding Celebes and islands east of the line drawn by Wallace *.

The NEARCTIC region consists of North America down to about the Tropic of Cancer in the lowlands, but much further south along the mountains of Central America. It also includes the Bermudas and the Aleutian Isles. The latter, however, like Alaska, show a Palæarctic element.

This region cannot be satisfactorily divided into Ornithological subregions; but certain districts, or provinces, may, for our present purpose, be distinguished as follows:—

(1) A *Californian* province, including California, Oregon, and the narrow tract between the Sierra Nevada and the Pacific.

(2) An *Alleghanian* province, including the United States east of Texas, and thence northwards more or less near the line of 100° West longitude and the south-western part of Canada.

(3) An *Alaskan* province, or what was Russian America.

(4) A *Canadian* province, or Canada, except part on the south-west.

(5) A *Texan* province, or Texas with the adjacent parts of the Nearctic region between the Californian and the Alleghanian provinces.

(6) A *Greenland* province.

(7) A *Bermuda* province.

The NEOTROPICAL region includes the whole of South America, Central America, South Mexico excepting the central plateau, the Antilles, Galapagos, and Falkland Islands.

* This line passes between the islands of Bali and Lombock.

It is made up of six subregions, very imperfectly defined as yet:—

I. The *Patagonian* subregion, or Tierra del Fuego and the Continent thence northwards to a little north of Bahia Blanca on the East coast, and a line running thence north-west, east of Mendoza to the Andes; also all the higher slopes of the Andes to north of the Equator, and the land west of the Andes from about Truxillo southwards, including the island of Chiloe and the other islands back to Tierra del Fuego.

II. The *Brazilian* subregion, or the Continent east of the last subregion to Potosi, and thence north-east, south and east of the watershed of the Amazons, to the mouth of the Paranahyba.

III. The *Amazonian* subregion includes the basin of the Amazons as far west as the tributary of it named the Huallaga, from the mouth of which its boundary passes obliquely and irregularly to the mouth of the Orinoco.

IV. The *Peruvian* region, consisting of the lands intervening between the Andes and the Brazilian and Amazonian regions, together with the rest of the Continent north of Truxillo and the Orinoco, the Galapogos Islands and those of Trinidad and Tobago.

V. The *Central-American* subregion, or the region from the Isthmus of Panama to the boundaries of the Nearctic region.

VI. The *Antillean* region, or the West Indies excluding Trinidad and Tobago.

The AUSTRALIAN region is made up of Australia, Tasmania, and New Zealand, with the Moluccan Archipelago, up to and including the island of Lombock, with Celebes and the islands of the Pacific to the Sandwich Islands in the north.

It is divisible into four subregions:—

I. The *Papuan* subregion, or New Guinea and all the islands belonging to this region, as far as and including Celebes, New Ireland, and the Solomon Islands.

II. The *Proper Australian* subregion, or Australia and Tasmania.

III. The *Polynesian* subregion, or the islands from New Caledonia, Fiji, and the New Hebrides to the Society and Sandwich Islands.

IV. The *New-Zealand* subregion, or New Zealand with the Norfolk, Chatham, Auckland, and Macquarie Islands.

The number of species which migrate and the extent of their migrations may appear to oppose a great difficulty to the grouping of birds in geographical regions. Nevertheless this difficulty is obviated by the rule that the breeding-place of a bird is always to be considered as its real home.

The absence of any considerable or significant Ornithological group is often as important and as interesting a character as is constituted by its presence in some other region, and it may be much more interesting and important if the group thus missing is otherwise cosmopolitan or nearly so.

The Palæarctic Region is one in which it is very difficult to indicate characteristic forms as present, though it would be easy enough to enumerate extensive groups elsewhere to be found which are absent from it. Thus there are no Parrots, no Humming-birds, no Hornbills, no Toucans, &c., &c. But to enumerate such absent forms would be an idle task. Their absence will be noted in recording the presence of such bird-groups in other regions. On the other hand, the number of birds of the Palæarctic region which are also found in North America is very great, there being at least 128 genera common to both these territories, including Thrushes, Crossbills, Magpies, Goatsuckers, Woodpeckers, Swallows, Snowy Owls, Jer-falcons, and a multitude of other kinds. Waxwings, Magpies, Snowy Owls, Jer-falcons, Crossbills are just as characteristic of the Nearctic region; but the Goatsuckers and Woodpeckers are of a different type in the two regions.

Almost the only group which may be said to characterize the Palæarctic region positively, is that to which the Bearded Titmouse (*Panurus biarmicus*) belongs (but its species are very widely diffused through it from East to West). The true Hawfinches (*Coccothraustes*) are also characteristic. Of course it has peculiar genera and species. The most conspicuous is the Capercailzie, but many Finches and Buntings are confined to it.

As to the subdivisions of the Palæarctic region, the *European* subregion—which consists of Europe north of the Pyrenees, Alps, Balkans, to the Caucasus and Asia north of the desert-tract of Central Asia, and including the northern island of Japan—has an abundance of Grouse, Capercailzie, Hazel-hen, Black-game, and plenty of peculiar Buntings, Warblers, and Finches —notably *Coccothraustes*. The genus *Eurynorhynchus* is peculiar to Siberian lands.

The other division, the *Mediterraneo-Persic* subregion—which extends from Europe south of the Pyrenees, Alps, &c., to the Amoor—has many peculiar Chats and Shrikes, and it possesses Sand-grouse, Larks, and Warblers. Very many of the commoner forms in the North are represented by allied forms in this subregion. Pheasants also abound in its more eastern part. It has Vultures, Pelicans, and Flamingoes, which are wanting further north. Nevertheless it is not quite distinctly divided off, because peculiar Himalayan elements crop up again in Turkestan and the Altai Mountains—various Grosbeaks, Flycatchers, Rose-Finches, &c., &c.

THE ETHIOPIAN REGION is, as might be expected, an extremely rich one, and has whole families of birds absolutely peculiar to it. Amongst these are the *Musophagidæ*, or Plantain-eaters, the Colies, the *Irrisoridæ*, the Guinea-fowls, and the Secretary-bird, while it is the special home of the Ostrich. It possesses also Sun-birds, Hornbills, and Weaver-birds, though these are by no means confined to it.

In the *Libyan* subregion we meet with a Sun-bird and an African genus of Starlings (*Amydrus*), extending northwards into the Valley of the Jordan. One of the most peculiar of the Birds of this subregion is the *Balæniceps* * (of the Upper Nile). In Egypt the avifauna alternates with the season, the Nile valley being overrun with migrants from the Palæarctic region during the winter.

The *West-African* subregion is a very rich one †; but its distinctive forms can hardly yet be enumerated satisfactorily. It has a Pitta (a Malayan element), and several Babbling-thrushes allied to Indian species. It has three species of Guinea-fowl, and the Grey Parrot (*Psittacus*) has been said to have driven away all diurnal birds of prey from Prince's Island. Six species of birds are known to be peculiar to the island of St. Thomas. It is essentially a forest region—the home of the Gorilla and the Chimpanzee.

The *South-African* subregion has not very many peculiar forms, but *Chætops*, many Chats, Larks, and Pipits are peculiar to it, and it is the head-quarters of species which range into other subregions, as, *e. g.*, *Indicator*. The Secretary-bird appears here as a semidomestic one. In St. Helena is a race of Ringed

* See *ante*, p. 39.

† Many West-African forms range across the Lake Country; but there are many peculiar Touracous, as well as Weaver-birds, Starlings, &c. Many South-African birds range into this region, and many N.E. African birds descend into it.

Plovers (*Ægialitis sanctæ-helenæ*) which is found nowhere else in the world.

The *East-African* subregion has rather complex relations with the three subregions already described; but many absolutely peculiar forms have not yet been satisfactorily determined.

The *Madagascar* or the *Mascarene* subregion, which is so very peculiar in its beasts, possesses also, as might be expected, a very distinct avifauna.

A large number of genera are peculiar to it. More than two hundred species of birds are known to be its inhabitants, of which 120 are land-birds, five-sixths of which are absolutely peculiar to the island. But it contains ordinary as well as peculiar kinds, and there is a slight Malayan element, and also some British species. The now extinct Dodo, Solitaire, and Æpyornis * were birds of this subregion. The Dodo inhabited Mauritius, the Solitaire was found in Rodriguez, and Æpyornis was peculiar to Madagascar itself. In the smaller islands several other kinds of birds have also recently become extinct; while their remaining avifauna is very distinct. Thus Professor Newton affirms that, though Mauritius and Reunion lie within sight of each other and possess about the same number of species, they do not appear to possess more than three in common.

THE INDIAN REGION is the home of the most gorgeous Gallinaceous birds—the Peacock, the Argus, Fire-backed, Polyplectron, and other Pheasants. It is also the home of the Jungle-fowl, and possesses exclusively most of the Asiatic Hornbills. Sunbirds are found throughout the region, with Barbets, Cuckoos, Bee-eaters, brilliant Kingfishers, the glossy, noisy Mynahs (*Eulabes*), and more than twenty peculiar genera. Indeed, three whole families of birds—the Hill-tits or *Liotrichidæ*, the Bulbuls or *Pycnonotidæ*, and the Broadbills or *Eurylæmidæ*—are peculiar to it.

Of its two subregions, the *Malayan* one is distinguished by exhibiting some striking and interesting approximations to the bird-fauna of the Australian region. Thus in the Philippines we have a Cockatoo of the Australian genus *Cacatua*, and there, as well as in the Nicobar Islands and Borneo, the Australian mound-building *Megapodius* is met with. Hornbills are very characteristic of the subregion, as is likewise the Argus Pheasant,

* Other extinct forms from this subregion have been already noticed; see *ante*, p. 238.

which is, however, also found in Siam. More than thirty-six genera are peculiar to this subregion.

THE NEARCTIC REGION is one which is very poor in altogether peculiar genera. On the one hand there is an entanglement southwards with the Neotropical avifauna, while on the other there is a great sameness between the Birds of North America, Europe, and Siberia. There is, in fact, a considerable common circumpolar avifauna. Out of three hundred and thirty Nearctic genera, more than one third are common to it and the Palæarctic region.

One of the most popularly known and truly peculiar of American birds is the Turkey, and everyone has heard of the Canvas-back Duck, the Mocking-bird, and the Passenger Pigeon —which are, in summer, mostly confined to the Nearctic portion of the American continent. Those beautiful and exclusively American forms—the Humming-birds—make their appearance even in the northern part of the Nearctic region, although, of course, they become more numerous southwards. The most characteristic family of the Nearctic region is that named *Mniotiltidæ*, which contains brilliant little Warblers, which take the place of the Old-World *Sylviidæ*.

Altogether there are about twenty-four genera of birds absolutely peculiar to the Nearctic region, and besides these there are twenty-seven genera which have their home in it but migrate in winter to the Neotropical region, the relation of the avifaunas of these two regions being in Central America in the winter, like those before mentioned as existing between the Palæarctic and Ethiopian faunas in the same season.

As to the appearance of different kinds in different provinces of this region, it may be remarked as follows:—

A peculiar Wren-like bird, *Chamæa*, held to constitute a subfamily by itself, is peculiar to California, as is also the Crested Partridge (*Oreortyx picta*) and the great Californian Vulture—except that the latter ranges somewhat more northwards.

In the *Alleghanian* province we find the only North-American Parrot (*Conurus carolinensis*) and the Mocking-bird, while it is the main home of the Passenger Pigeon. Turkeys in the Palæarctic region are only found eastwards of the Rocky Mountains, and are now extinct in the settled districts of Pennsylvania, New England, and Canada. Flamingoes are found in Florida, where also a Pelican may be met with, and another in California, and a Darter, in summer, ascends to North Carolina and Illinois.

The avifauna of *Alaska* is very largely Palæarctic, only twenty genera out of sixty-three are peculiar to America.

Amongst the more northern birds are the Divers, not appearing to breed south of 45° N. latitude.

Greenland possesses two genera which are peculiar to the Nearctic region; but various species which breed there are of European kinds, as, *e. g.*, the Sea-Eagle and the Ringed Plover.

The Tropic-birds (*Phaeton*) breed in the *Bermudas*. These islands do not possess one peculiar species; but they form an important resting stage for migrants leaving their northern homes in Labrador and Greenland for warmer winter-quarters.

THE NEOTROPICAL REGION is perhaps the richest of the whole world, and only yields to that next to be noticed (the Australian) in the peculiarity of its avifauna. Not less than twenty-four families are absolutely peculiar to it, while eight others are almost so, only, as it were, straggling into the Nearctic region. Amongst the most remarkable of its peculiar families are the Toucans (*Rhamphastidæ*), the Jacamars (*Galbulidæ*), the Motmots (*Momotidæ*), the Todies (*Todidæ*), the Tinamous (*Tinamidæ*), the Hoatzin (*Opisthocomidæ*), the Trumpeters (*Psophiidæ*), and the Screamers (*Palamedeidæ*). It is also the exclusive home of the Condor, the Sun-bittern, the Cariama, the Rheas, the true Macaws, and a multitude of Humming-birds, forming one hundred and fifteen genera. The Curassows are almost entirely Neotropical, and, altogether, there are something like six hundred genera which are absolutely peculiar to this region.

The *Patagonian* subregion is specially remarkable for its Rheas and the Penguins of its shores. The family of Plant-cutters (*Phytotomidæ*) is almost peculiar to it, and altogether there are about forty-six genera of birds here found, but not found in any other of the six subregions. It is a curious fact that each of the two chief islets of the Juan Fernandez group has a Chilian Humming-bird as well as a species peculiar to it.

The *Falkland Islands* have about half a dozen peculiar species of birds.

The *Brazilian* subregion has forty-two peculiar genera. Its fauna has much affinity to that of the Amazonian Valley; but it is distinguished partly by the entrance within its southern borders of the Rhea, Cariama, and the Plant-cutters on the one hand, and by the fact that the Hoatzin, the Sun-bittern, and the

Trumpeter, as well as certain other, not less noteworthy, forms, are absent from it.

In the *Amazonian* subregion these are found, and it has altogether twenty-seven peculiar genera. It is remarkable for possessing a peculiar Goose (*Chenalopex*) not found anywhere else in America, but plentiful in the Ethiopian region.

The *Peruvian* subregion is the only one which possesses the Oil-bird (*Steatornis caripensis*), which is found in Trinidad and considered to form a family by itself. This subregion has no less than seventy-two peculiar genera, and is especially rich in Tanagers and different kinds of Humming-birds, some of which are so local that a species or two seems almost exclusively confined to the slopes of one mountain.

The *Central-American* subregion is, as we already intimated, a mixed region, having many intruders from the North. Out of ninety-three genera found within it, but in no other Neotropical subregion, just more than half are also Nearctic.

The *Antillean* subregion contains about one hundred and forty genera, of which thirty are peculiar to it, but no less than six are peculiar to Cuba and seven to Jamaica. The family of Todies is entirely confined to this subregion; and of its forty other families it shares two with other Neotropical subregions and eight with both the Neotropical and Nearctic regions, while the Frigate-birds and Trogons, though found in the Old World also, are not present in the Nearctic region.

THE AUSTRALIAN REGION is that which possesses the most exceptional avifauna of all, both with respect to groups here found and found nowhere else, and with respect to widely diffused groups which are here either remarkable by their absence or by having their head-quarters within it.

Thus the whole family of Birds of Paradise, and that of the Bower-birds (*Ptilonorhynchidæ*), the Lyre-birds (*Menura*), the Broad-billed, the Brush-tongued, and the Grass Parrakeets, the bulk of the Cockatoos, the Emeus, the Cassowaries, the Apteryx, and the Kagu *, are absolutely peculiar to this region, while the Honey-suckers † and the Mound-makers ‡ are almost so.

The Thick-headed Shrikes (*Pachycephalinæ*), the Caterpillar-

* See *ante*, p. 48.

† See *ante*, p. 9. One species has crossed the Straits between Bali and Lombock, and so just entered the Indian region.

‡ They appear in the Philippine Islands and North-western Borneo, as well as in the Nicobar Islands.

eaters (*Campophagidæ*), the Flower-peckers (*Dicæidæ*), and the Swallow-shrikes (*Artamidæ*), feebly represented elsewhere, are most numerous here, while other groups of wide distribution are here also most variously and richly developed. Amongst these are the Weaver-finches, those exaggerated Goatsuckers called "frog-mouths" or "more-porks" (*Podargidæ*), the Pigeons, and the Kingfishers.

Two fifths of the genera of Pigeons are found in this region, as well as the most beautiful and remarkable forms. Amongst the latter is the Crowned Pigeon (*Goura*) and *Didunculus*. The cosmopolitan family of Kingfishers, which includes some nineteen genera, has no less than ten of them peculiar to the Australian region.

The remarkable family of Honey-suckers (*Meliphagidæ*) is very characteristic of the region, over the whole of which it ranges, abounding in genera and species; and the peculiar Broad-tailed Parrakeets adorn it by thier gorgeous plumage.

But the absence of other forms from the Australian region is no less remarkable. Thus there are no Pheasants *, which are so remarkably characteristic of the adjacent Indian region, while the specially Oriental Green Bulbuls (*Chloropsis*) are also wanting, and the same is the case with the elsewhere widespread Vultures (*Vulturidæ*) and Barbets (*Megalæmidæ*). The generally abundant Thrushes (*Turdidæ*) are few, while of the three hundred species of Woodpeckers (*Picidæ*) only four or five penetrate from the Indian region as far as Lombock, Celebes, and very few *Pycnonotidæ* reach the Moluccas.

The *Papuan* subregion is characterized especially by its Birds of Paradise, which (save those in Australia) are not found out of it. The northern and western parts of the subregion have a considerable mixture of Oriental forms. Thus Timor and the islands grouped round it share about thirty genera with the Indian region, and thirty with the continent of Australia. *Celebes* has about one hundred and fifty genera, with ninety peculiar species of land-birds. Of those which are not peculiar, about fifty-five have been estimated † to be Indian and twenty-two Australian.

New Guinea, the Aru Islands, and New Britain are remarkable as the all but exclusive home of the Cassowaries; one only

* There is a Jungle-fowl in Celebes, which was perhaps introduced by man.

† By the late Lord Tweeddale, long known as Lord Walden.

being found in the island of Ceram and one in North Australia. Hornbills do not extend beyond the Solomon Islands.

The *Australian* subregion proper has a very special Avifauna, for out of nearly five hundred land-birds not more than five and twenty at the most are found elsewhere. Amongst the more remarkable absolutely peculiar birds are the Lyre-bird and the Scrub-birds (*Atrichiidæ*), the only two species of Emeu, and all the Bower-birds except the genera *Chlamydodera* and *Amblyornis*, which are both found in New Guinea. It is also the exclusive home of the mound-building genus *Leipoa*.

Australia has also a peculiar Bustard (*Eupodotis*). It is very rich in Parrots, and has some peculiar forms.

The *Polynesian* subregion, though one so extremely scattered, has nevertheless a very uniform Avifauna. Amongst the most noteworthy peculiar genera found therein are the Kagu (*Rhinochetus*) in New Caledonia, and the Tooth-billed Pigeon (*Didunculus*) in the Samoan Islands, whence also comes a most peculiar short-winged Water-hen (*Pareudiastes*). The Sandwich Islands alone show any very marked distinction, possessing as they do all the *Drepanididæ*. They have twenty genera of small (Passerine) Land Birds. One of them is the cosmopolitan genus of Rooks and Crows (*Corvus*), but nine are absolutely peculiar to the Sandwich Islands. Amongst them it is to be noted that there are species (of the genera *Acrulocercus* and *Chætoptila*) of that specially Australian family the Honey-suckers. There is also a peculiar Coot and Goose. In Phillip Island there is, or was, a Parrot of the genus *Nestor* (*N. productus*), which is with this exception a New-Zealand genus; and a curious form of Water-hen, now extinct (*Notornis alba*), seems to have been last seen alive in Norfolk and Lord Howe's Islands.

The *New-Zealand* subregion consists, as we have seen, principally of New Zealand, which, till the advent of man, may be said to have been a very Paradise for Birds; as then they lorded it over the rest of the living world, having nothing to fear from any beast of prey, hardly any kind of Mammal having there existed.

It was inhabited by the gigantic species of *Dinornis*, now extinct *, and by the extinct forms *Palapteryx* and *Euryapteryx*. The most characteristic living form is the Apteryx †, but one also most remarkable is the Owl-like Parrot (*Stringops*). The

* See *ante*, p. 238. † P. 64.

Weka Rail * (*Ocydromus*) and a species of the remarkable Water-hen genus *Notornis* lately mentioned (*N. Mantelli*) † are also very noteworthy peculiar forms, as is also the Parson-bird (*Prosthemadera novæ zelandiæ*) and the Huia-bird (*Heteralocha*) ‡.

The interesting genus of Parrots—*Nestor*—is also peculiar to the Island, except the species already mentioned as inhabiting Phillip Island. It is one of those—the Kea Parrot (*N. notabilis*)—which is so destructive to sheep, as we have already stated §. A genus of Ducks (*Nesonetta*) is said to be peculiar to the Auckland Islands.

* P. 63.

† *L. c.* Almost if not quite extinct now.

‡ See *ante*, p. 95.

§ See *ante*, p. 73.

CHAPTER VI.

THE CLASSIFICATION OF BIRDS.

THE great multitude of Birds—of which upwards of eleven thousand kinds at the least are known to exist—makes it obviously necessary for those who would study them to arrange or classify them in groups. Otherwise the multitude of species would be too great for our powers of imagination and memory. The arrangement in groups, or *Classification*, of Birds, follows the principles which have been adopted in the classification of Animals generally. That system is one whereby creatures are sorted into a series of groups, successively smaller, and more and more subordinate.

Animals, like plants, are, as we said at starting [1], considered as members of one great group, which has been fancifully termed a "Kingdom"—the *Animal Kingdom* containing all animals, as the *Vegetable Kingdom* contains all plants. The principles adopted by both zoologists and botanists in subdividing these "Kingdoms" are "*morphological.*" By this term it is meant that the characters upon which these classifications repose, and by which the various subordinate groups are defined, are characters taken from the shape, number, structure, and mutual relations of the parts of which the various creatures so classified are built up, and not upon what such parts *do*—the characters refer to "structure" not to "function."

The kingdom of animals is divided into a variety of *subkingdoms*, each of which is, of course, a very large group of animals indeed. Each subkingdom is again divided into subordinate groups termed *classes*. Each class is again divided into *orders*, and each order is further subdivided into *families*; each family into *genera*, and each genus into *species*—a zoological species being "a group of living organisms which differ only by inconstant

[1] See *ante*, p. 3.

and sexual characters." Sometimes when a "class" contains very many or very different "orders," the latter may be arranged in sets, each of which is termed a *subclass.* Similarly when there are many families in an order, such families may be grouped in *suborders*; and sometimes the suborders have to be further divided into sections so that the families which compose it may be arranged in different sets.

When also there are many genera in a family, such family is divided into *subfamilies* to receive different groups of such genera; and very many "subfamilies" are found in Ornithology.

As we said in our introductory Chapter [1], all Birds taken together form one class of Vertebrate, or back-boned, Animals, and all Vertebrate animals taken together constitute a primary divison of the Animal Kingdom called the *Subkingdom Vertebrata.* The class of Birds—the class *Aves*—has been at different periods divided in various ways. *Divisions*—more physiological than morphological—were instituted by both Linnæus and Cuvier, on the lines of those differences of habit, and to a certain extent, of structure, which were referred to when we spoke [2] of the Scratchers and Cooers and Climbers, and Waders and Swimmers, and birds of Raptorial habit.

By Linnæus, Birds were arranged [3] in six orders:—1. *Accipitres* (Birds of Prey). 2. *Picæ* (Humming-birds, Hoopoes, Crows, Birds of Paradise, Toucans, Trogons, Parrots, Woodpeckers, Wrynecks, Cuckoos, Barbets, Hornbills, Kingfishers, Flycatchers, Honey-eaters, and Todies). 3. *Anseres* (Aquatic Birds). 4. *Grallæ* (Waders, Ostrich, &c.). 5. *Gallinæ* (Gallinaceous Birds). And 6. *Passeres* (all the smaller Birds).

Cuvier also arranged Birds in six almost similar orders, as follows:—1. *Accipitres* (Birds of Prey). 2. *Passerinæ* (including, with Linnæus's Passeres, also the Crows, Birds of Paradise, Humming-birds, Hoopoes, Todies, and Hornbills). 3. *Scansoriæ* (the rest of Linnæus's "Picæ"). 4. *Gallinaceæ* (Gallinaceous Birds). 5. *Grallatoriæ* (Waders, the Ostrich, &c.). 6. *Palmipedes* (Aquatic Birds).

He also subdivided his Passerinæ into sections according to the shape of the beak in the way previously stated [4].

These classifications were long ago felt to be unsatisfactory,

[1] See *ante*, p. 1. [2] See *ante*, pp. 67 & 131.

[3] In the 'Systema Naturæ,' 1766, tomus i.

[4] See *ante*, p. 132.

and various attempts at improvement have from time to time been made. It was considered that these groups did not respond to or express those deeper affinities which were deemed to bind various groups of birds together.

The Class of Birds was by no means the only one in which the existence of deep or essential affinities were thought to contradict that system of grouping which the adoption of merely superficial characters had brought about. Not only was it clearly seen that Bats were far more really like Whales than they were like Birds, but it became manifest that the close association of the exclusively aquatic Dugong and Manatee with the exclusively aquatic Porpoise and Dolphin was an unnatural association.

The wide adoption of the theory of Evolution gave an easily comprehensible explanation of a difference between superficial resemblances and those which were deemed to be deep and essential ones. The latter were thenceforth assumed to be always the result of a descent from common ancestors, and certain signs of genetic affinity. It seemed the easiest thing in the world to discover what the different lines of inheritance had been, and elaborate tables of descent—tables of *phylogeny*—were rapidly drawn up by Haeckel of Jena and his followers.

Naturally the great wish of Ornithologists who aspired to become the exponents of more profound views was to discover what were the lines of descent in the class of Birds. It became their predominant desire so to classify Birds that their classification should by itself indicate what the main lines of "descent" during the process of Evolution had, as a matter of fact, been. Many zealous and admirable efforts were successively made in this direction. In the meantime, however, the phylogenetic tables, drawn up too hastily for other classes of animals, turned out one after another to be more or less unsatisfactory and untenable.

Nor can it be denied that the efforts of Ornithologists in this direction have been disappointingly destitute of satisfactory and certain results. It had gradually become recognized, with respect to other classes of animals, that many similarities of structure must have had an independent origin, and it had, and has since, become increasingly difficult to discriminate and draw safe and accurate lines between resemblances due to inheritance and resemblances due to some other cause or causes.

In the Class of Birds, the numbers of kinds in which is so prodigious, while the differences which separate them are so small, it is especially difficult to make this discrimination. Birds, moreover, are creatures which leave behind them comparatively few fossil remains, while every one now sees that the number of species which have become extinct must be enormous. The best Ornithologists, those even who are the most ardent evolutionists, have come to despair of being ever able to determine satisfactorily what the exact genetic relations of different groups of Birds really are. We think it then not only the wiser course, but the only course consistent with the interests of the student of science, to abstain from making any positive assertions as to the genetic affinities of different Bird-groups. On the other hand, we do not by any means deny the truth of the theory which would ascribe real blood-relationship to different groups of Birds. We desire to keep an open mind with respect to questions of this kind, and we would advise our readers to do the same. In the meantime we wish to avail ourselves of the most recent labours of Ornithologists in this cause, and to give the greatest weight to characters which may fairly be supposed to indicate real relationship by descent. Characters of the kind would have been regarded as essential and fundamental ones even before the theory of evolution became popular—we mean characters derived from the form of the skeleton and other anatomical peculiarities and from the mode of the process of the development of the young.

We may thus legitimately speak of "real affinity," "true relationship," and "essential connection," as existing between certain Birds, whether or not a real genetic affinity exists between them. If such genetic affinity does exist between such Birds, then such a mode of speech has a plain and obvious truth and fitness. But if such genetic affinity does not exist between them, then such expressions must be understood to denote resemblances such as were recognized as being of a "deeper" kind than some other resemblances, before questions of descent had begun to be discussed. A "deep resemblance" of this kind is one which is the sign of a great many other resemblances, whereas a "superficial resemblance" has no such significance.

This great uncertainty as to the full significance of characters which no one can call "superficial," causes the classification of Birds to be a more or less arbitrary one. The arbitrary nature of Ornithological grouping is intensified by the habit which has so long and widely prevailed of not even attempting to define the groups by any constant and universal anatomical characters.

The principal schemes for the classification of Birds which have appeared since Cuvier's are those which have been propounded by Lilljeborg [1], Huxley [2], Sundevall [3], Garrod [4], Sclater [5], Newton [6], Reichenow [7], Stejneger [8], Fürbringer [9], Seebohm [10], Gadow [11], and Sharpe [12].

Mr. Henry Seebohm deserves exceptional credit for having given us a classification founded on absolute diagnostic characters, by which, for the first time perhaps, the definite characteristics of the leading groups of Birds have been clearly summarized. On this account we gladly avail ourselves largely of his labours, and follow his grouping to a very great extent.

We will shortly proceed to enumerate the principal groups into which we think the Class of Birds is thus divisible, and to give the characters of such leading groups. The classification here offered is, however, put forward only in a tentative manner and with much diffidence, as one which we think may be found practically useful. But, before we proceed to the enumeration of the groups, we would endeavour to stimulate and arouse the interest of the Student by pointing out some striking examples of errors into which we should fall, if we rested content with merely superficial characters, such as we have mainly referred to in our introductory chapter.

Birds may be shortly defined as feathered animals, since no other animals possess such structures. They are, however, Vertebrate animals with warm blood and anterior limbs peculiarly modified. The skull always articulates with the vertebral column by a single occipital condyle [13], and the lower

[1] Proc. Zool. Soc. 1866. [2] P. Z. S. 1867.

[3] 'Methodi Naturalis Avium Disponendarum Tentamen,' Stockholm, 1872.

[4] P. Z. S. 1873 and 1874. [5] Ibis, 1880.

[6] Ency. Brit., Art. "Ornithology" (wherein a full and admirable account of the history of the science and of the works of its promoters is to be found).

[7] Die Vögel d. Zoolog. Gärten, 1882.

[8] Standard Nat. Hist., Aves, 1885.

[9] Morphologie u. System. der Vögel, 1888.

[10] 'Classification of Birds,' R. H. Porter, 1890.

[11] P. Z. S. 1889, and Bronn's Thierreich, Aves, 1890. Also a paper read before the Zoological Society while these pages were being revised for press —March, 1892.

[12] 'A Review of recent attempts to classify Birds,' 1891.

[13] By which character Birds differ from man and beasts, where there are two occipital condyles.

jaw joins the skull by the intervention of a quadrate bone. The right auriculo-ventricular valve of the four-chambered heart is muscular, and there is a single aortic arch which arches over the right bronchus. The optic lobes of the brain are lateral and depressed, and reproduction is in all cases oviparous.

We put forward, in our initial chapter, a sketch which we hoped might serve as an introduction to the whole Class of Birds. But in our treatment of the subject we deliberately adopted modes of grouping which we thought might be acceptable to the beginner, and which had spontaneously suggested themselves to the first teachers and classifiers of our science.

Now that we have, however, made acquaintance with the anatomy of Birds, the time has come to put away the notions wherewith we began, in favour of more advanced views.

We spoke [1] of Pigeons immediately after Fowls and Pheasants, and of such they were formerly regarded as allies; but now the study of anatomy has separated these groups widely. We treated [2] of the Penguin in connection with the Auk, for at first sight these erect flightless Birds present obvious resemblances. Advanced Ornithology, however, places them poles asunder. Close after the Cormorants we have spoken of [3] those yet more familiar coast-birds, the Gulls, and after them the Petrels; but we shall see that there is no real affinity between them, though they at first seem alike. Neither has the Frigate-bird any close relationship with the Albatross. The Flamingoes and the Herons, the Storks and the Cranes naturally seem to the beginner akin, but they must be widely separated by the advanced student, and the Horned Screamer of the South-American forests will by him be brought down to the level of the Goose.

The Curlew and the Ibis [4], with their long bills, look alike, but mature study shows us that the Curlew is a Plover; while Coursers and the Tinamous [5], however to the popular eye they may seem to run in couples, are seen by the scientific observer to have hardly anything in common save their bird-nature and mode of locomotion. However like to an ordinary Plover a Stone-curlew (*Œdicnemus*) may look, it turns out in reality to be far more of a Bustard.

For the sake of the beginner, we have mentioned [6] the stream-

[1] See *ante*, p. 12. [2] P. 22. [3] P. 28.
[4] See *ante*, p. 53. [5] Pp. 50 & 51. [6] P. 69.

haunting Kingfisher and the Dipper one after the other, but their essential differences are great indeed.

The large beaks of the Toucans have suggested [1] to us the large-beaked Hornbills, but in truth, as we shall see, they are in no way akin. Nor are the Colies [2] really allied to Toucans or Todies. The brilliant Trogons [3] have led us to speak of the Birds of Paradise, but the latter are really nothing but glorified Crows, while the Lyre-bird, on the other hand, is nearly as distinct in its nature as in the form of its tail. The Huia-bird, again, is but a kind of Crow; and the wonderful *Opisthocomus* turns out to be not miles asunder from a game-cock, being really an ally of the Curassows. The Bower-birds [4], on further inquiry, prove to be Birds of Paradise, which have taken to decorating their runs instead of their bodies!

The beginner will have deemed it natural that we should follow popular usage and associate the Swallows with the Swifts, but his studies will show him that they may have as little in common as have the true mole and the rat-mole amongst beasts.

Creepers and Honey-eaters [5] have been mentioned together, but they are not really allied; and the brilliant Humming-birds and Sun-birds [6], beyond being *passeriform birds*, have little but their brilliance in common, and are really groups rather distant from one another.

The Orioles and Waxwings must also be extricated from the company in which they have been provisionally placed, and the wonderful Mocking-bird will be seen not to rank with the Nightingale, but rather with the Wren.

The Piping Crow, again, is not really a Crow, but a Shrike [7].

The Osprey [8] has once more (unlikely as it seems) an outlook towards the Owls; while the American Vultures [9] have little affinity with real Vultures [10] at all, or with Eagles or Owls either, but perch by themselves ornithologically. Thus it is plain what a scientifically heterogeneous group is that which we have spoken of by the term [11] "Scansorial birds," as also that all those groups which we have distinguished [12] as having conical, slender, or widely gaping bills are not "natural" groups.

[1] Pp. 74–78. [2] P. 80. [3] P. 88.
[4] P. 95. [5] P. 99. [6] P. 101.
[7] P. 121. [8] P. 126. [9] P. 128.
[10] P. 127. [11] P. 131. [12] P. 132.

Having thus indicated a few of the more glaring mistakes into which the beginner in Ornithology, if left to himself, would in all probability fall (as our earlier scientific predecessors did fall), we will proceed to point out what we regard as the various successively subordinate groups of birds from subclasses down to genera. After each Family or Subfamily we will add a list of the genera belonging to each, with what we deem *about* the probable number of species therein contained.

We only offer the classification here proposed, after careful consultations with masters in Ornithology, and for this reason we are persuaded that it will be found to be of considerable use to the student, and a quite sufficient introduction to the systematic study of the Class, or any selected section of that Class.

The whole Class of Birds is divided into two very large, primary groups, each of which is a "SUBCLASS," and which are respectively named *Carinatæ* and *Ratitæ*.

The latter includes only the Ostrich, Rheas, Cassowaries, Emeus, and the different species of Apteryx amongst living birds, but the various kinds of *Dinornis* also belonged to it. All other Birds belong to the *Carinatæ*.

They are distinguished by the following characters:—

Carinatæ.	*Ratitæ.*
Sternum almost always with a keel.[1]	Sternum never keeled.
Coracoid and clavicle so placed as to form together an acute angle.	Coracoid and clavicle so placed as to form together a very obtuse angle.

The whole Class of Birds may be divided into eighteen "ORDERS," as follows:—I. Passeriformes. II. Coraciiformes. III. Piciformes. IV. Coccyges. V. Columbiformes. VI. Psittaci. VII. Raptores. VIII. Steganopodes. IX. Herodiones. X. Alectorides. XI. Galliniformes. XII. Limicoliformes. XIII. Tubinares. XIV. Pygopodiformes. XV. Lamellirostres. XVI. Impennes. XVII. Crypturi.

The above Orders are all the Carinate Birds.

[1] The Parrot *Stringops*, the Rail-like bird *Notornis*, and the Hoatzin, *Opisthocomus*, are the only exceptions.

XVIII. Struthiones.
This last order contains all the Ratitæ.

It is absolutely impossible to arrange the Orders which make up the Class of Birds in any linear series which shall express their affinities. A few such groups may be placed in juxtaposition, and then follows an inevitable break. On the theory of Evolution all the various groups now existing are, as it were, diverging twigs from small branches which sprang from larger branches, and these from others, and so on, till we come to the stem. It would manifestly be impossible so to enumerate the twigs of a tree in a linear series, that their linear succession should indicate their relative relationships to the trunk whence they all sprang. Just as difficult would it be to express the genetic relations of Birds by placing them in any linear series whatever, and the same may be said of their deeper structural resemblances even apart from the theory of Evolution.

The first Order, *Passeriformes*, includes by far the greater number of birds, and all those spoken of in our introductory chapter as *Passerine*[1] birds. There are doubtless more than six thousand six hundred species.

Following Mr. Seebohm, we divide this mass into three groups, of approximatively equal rank, as *suborders*, and name them: 1. *Passeres*, 2. *Eurylæmi*, and 3. *Trochili*. The third suborder includes all the Humming-birds and no others. The second suborder takes in only the Broadbills and their allies[2], while the first suborder includes all the other Passerine Birds. The characters of these groups are as follows:—

Subclass I. CARINATÆ.

Order I. PASSERIFORMES.

Perching-birds, the young of which are born helpless and need to be fed in the nest for many days, yet which hardly ever pass through any downy stage[3]. The hallux is always present as a hind toe, is well-developed, separably moveable, and furnished with a larger claw than the others. Wing-coverts somewhat few in number and rather small; greater coverts

[1] See *ante*, p. 131. [2] See *ante*, p. 77.
[3] Thickly covered with down only in the Lyre-bird (*Menura*).

arranged in a simple row not extending beyond the secondaries; colic cæca almost always present; a spinal feather-tract on a considerable part of the neck, well defined by lateral bare tracts and not split by a spinal bare tract; hind toe supplied by a tendon from the *flexor longus hallucis*[1]; no *ambiens* or *accessory femoro-caudal*; oil-gland present but nude; feet non-zygodactyle; mid-front of sternum not perforated to receive processes of coracoids; no basipterygoid processes; dorsal vertebræ never opisthocœlous; cervical vertebræ never more than fifteen.

Suborder 1. *Passeres.*

Palate ægithognathous[2]; not more than 15 cervical vertebræ; tendons of *flexores hallucis* and *longus digitorum* not connected; manubrium generally bifurcated; intrinsic vocal muscles mostly fixed to ends of bronchial semirings; lower end of trachea almost always modified into a vocal organ; bill often long and slender; rarely broad, with very wide gape; hand not very long or humerus very short.

Suborder 2. *Eurylæmi.*

Palate ægithognathous; nasals holorhinal[3]; dorsal vertebræ heterocœlous[4]; tendons of *flexores hallucis* and *longus digitorum* connected; manubrium not bifurcated; intrinsic vocal muscles fixed near the middle of the bronchial semirings; lower end of trachea not modified into a vocal organ; bill always very broad, and gape very wide; hand not very long or humerus very short: a large purse-like nest; eggs minutely spotted with brown.

Suborder 3. *Trochili.*

Palate more or less schizognathous; basipterygoid processes absent; nasals holorhinal; thyro-hyals arching over skull, as in Woodpeckers; tendons of *flexores hallucis* and *longus digitorum*

[1] See *ante*, p. 205.
[2] See *ante*, p. 186.
[3] See *ante*, p. 181.
[4] See *ante*, p. 171.

connected; manubrium not bifurcated; keel deep, posteriorly rounded and without indentations; bill always long and slender, gape always narrow; hand very long and humerus very short; no *semitendinosus* or *accessory semitendinosus*; only a left carotid present; no cæca.

The enormous suborder Passeres, which contains upwards of 6200 species, is divisible into two sections, distinguished as *Acromyodi* (or *Oscines*) and *Mesomyodi*.

In the former the intrinsic muscles of the syrinx are fixed to the ends of the bronchial semirings; while in the Mesomyodi they are fixed to the middle of the bronchial semirings[1].

The section Acromyodi is much the larger one, and may be said to contain no less than thirty-nine families of Birds.

These families and all the families of Passeres have been limited and arranged by us in accordance with the views of Dr. R. Bowdler Sharpe, F.L.S., most kindly communicated to us, and they will stand in the order adopted by him, though it is impossible to arrange them, any more than the orders of Birds (and for the same reason), in any satisfactory linear series

The student will see that the family and subfamily names are modifications of the names of the various genera which are respectively the types of such families.

Thus the first family *Corvidæ* is the family of the Crows. The second is *Paradiseidæ*, or Birds of Paradise. The third is *Ptilonorhynchidæ*, or the Bower-birds. The fourth is *Sturnidæ*, or the true Starlings; while the Tree-starlings, *Eulabetidæ*, form the fifth family. The sixth family, *Eurycerotidæ*, is constituted by a single genus and, as yet, a single species—the Blue-bill. Birds called Drongos, *Dicruridæ*[2], form the seventh family; the eighth, *Oriolidæ*, being constituted by the Orioles. The ninth, *Icteridæ*, is made up of the Cassiques and Hangnests, and the tenth, *Ploceidæ*, of the Weaver-birds. The eleventh family is that of the Tanagers, *Tanagridæ*; and the twelfth is composed of the American Creepers, *Cærebidæ*. To these succeed the Sandwich-Island Honey-eaters, *Drepanididæ*. The great family of Finches[3], *Fringillidæ*, comes next; while the Larks[4], *Alaudidæ*, and the Wagtails[5] and Pipits, *Motacillidæ*, make up the

[1] Page 214. [2] See *ante*, p. 122.
[3] P. 105. [4] P. 109. [5] P. 111.

fifteenth and sixteenth families. The next three families are the *Mniotiltidæ* or American Warblers, the true Creepers or *Certhiidæ*, and the Honey-eaters or *Meliphagidæ*; while the twentieth family is composed of the Sun-birds, *Nectariniidæ*, so apt to be confounded, popularly, with the Humming-birds. Next come the Flower-peckers or *Dicæidæ*, followed by the White-eyes, *Zosteropidæ*, and then the attractive families of Titmice [1] or *Paridæ*, and Gold-crests, *Regulidæ*. The twenty-fifth family is that of the Shrikes, *Laniidæ*; after which comes the family of Swallow-shrikes, sometimes called "Wood-swallows," *Artamidæ*, which consists of only two genera. Then follows the small family represented by our Waxwing [2] (*Ampelidæ*), followed by the Greenlets or *Vireonidæ*. The Warblers, *Sylviidæ*, form the twenty-ninth family, after which come the Thrushes or *Turdidæ* [3] (containing the Nightingale), followed by the Dippers [4] or the *Cinclidæ*, which seem to be modified aquatic Wrens and far away, indeed, from the Kingfisher in their affinities. Then come the Wrens [5], *Troglodytidæ*, followed by the *Mimidæ*, or Mocking-birds, and the Accentors or *Accentoridæ*. Next comes the thirty-fifth family, or the great family of Babblers, *Timeliidæ*, followed by that of the Bulbuls [6], *Pycnonotidæ*, that of the Cuckoo-shrikes, *Campophagidæ*, and that of the Fly-catchers [7], *Muscicapidæ*. The thirty-ninth and last family of the first section of Passeres is formed by the Martins and Swallows [8], or *Hirundinidæ*.

The second section of the suborder Passeres, the section *Mesomyodi*, contains twelve families, which are separable into divisions, distinguished as *Oligomyodæ*, *Tracheophonæ*, *Atrichiæ*, and *Menuræ*.

In the first the lower end of the trachea is not modified to form a vocal organ, but in the *Tracheophonæ* it is so modified, while in them the bronchi do not contribute to form it.

The first of the twelve families, the fortieth of the suborder of Passeres, is that of the Tyrant-birds [9] or *Tyrannidæ*; then comes a family of but three, as yet determined species, the Sharp-bills or *Oxyrhamphidæ*, followed by the *Pipridæ* or Manakins, which are small shy birds inhabiting South-American woods, and consisting of about seventy species. After this

[1] P. 102. [2] P. 106. [3] P. 108.
[4] P. 69. [5] P. 98. [6] P. 117.
[7] P. 115. [8] P. 97 [9] P. 120.

follows the forty-third family—the Chatterers, *Cotingidæ*—the type of which is the Blue Chatterer, and which also contains the other interesting birds before mentioned by us[1]—namely, the Cock-of-the-Rock, the Umbrella-bird, and the Bell-bird. The next family group consists of the Plant-cutters, *Phytotomidæ*, a small group of South-American birds. To these succeed the Wattled Ant-thrushes, *Philepittidæ*, the *Pittidæ*, or Old-world Ant-thrushes, and the very small family of New-Zealand Wrens, *Xenicidæ*, with only five known species.

The next and forty-eighth family, that of the *Dendrocolaptidæ*[2], is the first family of the division *Tracheophonæ*. It is the family of the Wood-hewers and Oven-birds[3]. To this succeeds the family of American Ant-thrushes[4], or *Formicariidæ*, and after that the small families, Gnat-eaters, *Conopophagidæ*, and the Tapaculos or *Pteroptochidæ* (that might be called "tilt-tails"), with which the second division of Passerine Birds terminates.

The third division of the section *Mesomyodi* is formed by the Scrub-birds—the fifty-second family, *Atrichiidæ*. The trachea and vocal organs are as in the *Oligomyodæ*, but the sternum is quite exceptional. The fourth and last division, the *Menuræ*, consists only of the Lyre-birds—the family *Menuridæ*. It resembles the *Oligomyodæ*, as does the third division, but is entirely peculiar, in the downy clothing of its young.

The divisions may be expressed in a tabular form, thus:—

Order PASSERIFORMES.

Suborders	*Passeres.*	*Eurylæmi.*	*Trochili.*	
Sections (of *Passeres*)	Acromyodi. (39 families)	Mesomyodi.		
Divisions (of Mesomyodi)	Oligomyodæ (8 families).	Tracheophonæ (4 families).	Atrichiæ (1 family).	Menuræ (1 family).

[1] See *ante*, pp. 91-95.
[2] P. 118.
[3] P. 120.
[4] P. 110.

The suborder *Eurylæmi* contains two families, those of the Green Broadbills, or *Calyptomenidæ*, and those of the Broadbills [1] *par excellence*, the *Eurylæmidæ*.

The suborder of Humming-birds, *Trochili*, contains but a single family, *Trochilidæ* [2], and subfamily *Trochilinæ*.

The second order, *Coraciiformes*, contains probably more than 523 species, including the Kingfishers, Swifts, and Hornbills, with their allies, and these, again following Mr. Seebohm, we group in three suborders, namely, (1) *Coraciæ*, (2) *Halcyones*, and (3) *Bucerotes*.

The characters of these groups may be thus stated :—

Order II. CORACIIFORMES.

Hallux present and connected with the *flexor longus digitorum*, and not with the *flexor longus hallucis*; plantar tendons not free; no *ambiens*; young born nearly naked; wing-coverts large; anterior toes united together at the base for some distance; outer toe a little shorter than the middle one, and with three joints; inner (or second) toe either joined to the middle one for some distance, or absent; bill long and tapering; nostrils basal, above the middle of the mandible; tongue not extensile.

Suborder 1. *Coraciæ*.

Spinal feather-tract well defined on the neck, but forked on the upper back; oil-gland generally present but not tufted; palate variously formed; a *semitendinosus* present (except in the Swifts); cæca present (except in the Swifts); basipterygoid processes [3] sometimes present; manubrium not generally forked; sternum [4] never perforated for coracoids, save in the *Meropidæ*.

Suborder 2. *Halcyones*.

Spinal feather-tract well defined on the neck and not forked on the back; oil-gland always present and generally tufted;

[1] P. 77. [2] P. 100.
[3] See *ante*, p. 184. [4] See *ante*, p. 178.

palate desmognathous; no cæca, save in Todies, where they are large; no pterygoid processes; episternal processes of sternum not perforated for coracoids; *accessory semitendinosus* present, save in the Kingfishers.

Suborder 3. *Bucerotes.*

Spinal feather-tract not defined on the neck; oil-gland tufted; palate desmognathous; no cæca; basipterygoid processes; mid-front of sternum grooved or perforated for coracoid processes; sternum with two posterior notches; *femoro-caudal, semitendinosus*, and *accessory semitendinosus* present; *ambiens* and *accessory femoro-caudal* absent; bill large, strong, and arched; wings short; female incubates enclosed in a tree.

This order contains twelve families, whereof seven belong to the first suborder and four to the second.

The families belonging to the *Coraciæ* are those of the Swifts (*Cypselidæ*); the Goatsuckers[1] (*Caprimulgidæ*); that of the Oil-bird[2]—which is thus shown to be far indeed from the Raptorial group—the *Steatornithidæ*; the Frog-mouths or More-porks, *Podargidæ*, and the family of the Cyrombo of Madagascar—the *Leptosomidæ*. Next comes the family which contains the type of the suborder *Coraciæ*, namely the common Roller[3], and, lastly, the pretty and attractive Bee-eaters[4] or *Meropidæ*.

The suborder *Halcyones* contains the very small family of Colies[5], *Coliidæ*, and the very large one of Kingfishers[6], *Alcedinidæ*; also the Motmots[7], *Momotidæ*, and the half-dozen Todies[8], *Todidæ*.

The suborder *Bucerotes* consists but of a single family, *Bucerotidæ*, containing all the Hornbills[9].

The third order of Birds, the *Piciformes*, also consists of about 650 species in three suborders:—1. *Upupæ*, 2. *Trogones*, and 3. *Scansores*. The following are their characters:—

[1] P. 86. [2] P. 123. [3] P. 96.
[4] P. 82. [5] P. 80. [6] P. 68.
[7] P. 83. [8] P. 81. [9] P. 78.

Order III. PICIFORMES.

Young born helpless, but pass through no downy stage; hallux mostly present in the form of a hind toe, but sometimes the hind toe is the fourth digit; a spinal feather-tract on a considerable part of the neck, well defined by lateral bare tracts, and not split by a spinal bare tract; hind toe, or toes, supplied by *flexor longus hallucis*; no *ambiens* or *accessory femoro-caudal*; oil-gland always present, tufted or not tufted: feet generally zygodactyle; rostrum of sternum generally not perforated for coracoids; generally no basipterygoid processes; dorsal vertebræ never opisthocœlous; cervical vertebræ never more than fifteen.

Suborder 1. *Upupæ.*

Deep plantar tendons free; sternum perforated for processes of coracoids; palate desmognathous; sternum with two deep posterior notches; oil-gland tufted; spinal feather-tract forked on the upper back; second digit not reversed; basipterygoid processes absent; no cæca.

Suborder 2. *Trogones.*

Each deep plantar tendon bifurcating to supply two toes; sternum not perforated for coracoids; sternum with four posterior indentations; palate schizognathous; spinal feather-tract well defined from nape to oil-gland, but not forked; second digit reversed; basipterygoid processes present; oil-gland present and nude; cæca present.

Suborder 3. *Scansores.*

Flexor digitorum sending a tendon to third digit only; *flexor hallucis* joining just mentioned tendon, and then supplying hallux, second and fourth digits; sternum not perforated for coracoids; palate various; oil-gland nude or tufted; spinal feather-tract well defined on the neck and forked on the lower (not on the upper) back; feet zygodactyle; basipterygoid processes absent.

There are nine families in this order: two to the first suborder, one to the second, and six to the third.

The first is the *Upupidæ*, and consists of the Hoopoes[1]. The second is the *Irrisoridæ*, which includes the Wood-hoopoes. The third embraces all the Trogons[2], and is named *Trogonidæ*.

The first family of the third suborder is called *Galbulidæ*, and contains the Jacamars[3].

The second family contains the Puff-birds[4], and is named *Bucconidæ*, while the third is the very large family of Woodpeckers[5] and Wrynecks, called, from the type, *Picidæ*. The remaining three families are the *Indicatoridæ* or Honey-guides[6], the *Capitonidæ* or Barbets[7], and the handsome but strange Toucans, *Rhamphastidæ*.

The fourth order, with more than 190 species, is *Coccyges*, which may be divided into two suborders, each containing but a single family.

The first suborder is that named *Musophagi*, and the second is called *Cuculi*.

Their characters stand thus:—

Order IV. COCCYGES.

Palate desmognathous; no basipterygoid processes; hallux always present and supplied by *flexor hallucis*; second, third, and fourth digits supplied by *flexor digitorum*; young born helpless, but not passing through a downy stage; feet often zygodactyle; dorsal vertebræ not opisthocœlous.

Suborder 1. *Musophagi.*

Plantar tendons not free; spinal feather-tract both well defined on the neck and not forked on the back; oil-gland tufted; feet may be semi-zygodactyle.

[1] P. 86. The Hoopoes are nearly related to the Hornbills, and form a transition from them to the other Piciformes.

[2] P. 88. [3] P. 77. [4] P. 76.
[5] P. 70. [6] P. 84. [7] P. 75.

Suborder 2. *Cuculi.*

Plantar tendons not free; spinal feather-tract not well defined on the neck and not forked on the back; oil-gland nude; feet zygodactyle.

The family of the first suborder is *Musophagidæ*, and contains all the Plantain-eaters [1]. Those of the second suborder are the *Cuculidæ*, or the family of true Cuckoos [2], and the *Centropidæ*, or the large-headed Cuckoos, and the *Phœnicophainidæ*, embracing the Bush-cuckoos, many of which are very beautiful. Then follow the Pheasant Cuckoos (*Neomorphidæ*), the Soft-plumed Cuckoos (*Diplopteridæ*), and the Anis (*Crotophagidæ*).

The fifth order may be named *Columbiformes*, and contains the two suborders 1. *Columbæ* and 2. *Pterocletes*, with more than 370 species, the characters of which are as follows:—

Order V. COLUMBIFORMES.

Maxillo-palatines not united across the middle line; a hallux present supplied by *flexor hallucis*; palate schizognathous; nasals schizorhinal; basipterygoid processes present; sternum not perforated for coracoids; oil-gland nude if present.

Suborder 1. *Columbæ.*

Young born helpless and requiring to be fed for many days, but not passing through a downy stage; a special feather-tract on a considerable part of the neck, well defined by bare tracts and not split by a spinal bare tract; nostrils close to margin of mandible and covered with a soft cuticle, forming a large swelling; tarsus covered with large transverse scales in front; cæca present or absent; mostly two notches on either side of sternum, but the inner pair are sometimes replaced by foramina and sometimes absent.

Suborder 2. *Pterocletes.*

Young born covered with down and able to run in a few

[1] P. 79. [2] P. 85.

hours; no lateral bare tracts on neck; two notches on each side of hinder margin of sternum; oil-gland present; no powder-down patches; no swollen soft cuticle covering nostrils; basipterygoids rather backwards; cæca present.

The first suborder includes the very large family of Doves and Pigeons [1] (*Columbidæ*), and the family which contains only the tooth-billed Pigeon, and is called *Didunculidæ*.

The second suborder has a single small family which consists of the Sand-grouse [2], and is named *Pteroclidæ*.

The sixth order, with nearly 500 species, is *Psittaci*, and is not divided into suborders. Its characters may be thus expressed:—

Order VI. PSITTACI.

Palate desmognathous; maxilla exceptionally moveable; basipterygoid processes absent; hallux always present and supplied by the *flexor hallucis*; young born helpless and nearly naked; feet zygodactyle; dorsal vertebræ opisthocœlous; spinal feather-tract well defined on the neck and forked on the upper back; plantar tendons not free; oil-gland tufted or absent; tarso-metatarsus very short compared with the length of the tibia.

There are six different families belonging to this order. The first of these, *Nestoridæ*, contains the singular Kea Parrot [3] and all the Nestors. The second family is named *Loriidæ*, and is that of the Brush-tongued Parrots and Lories. The third family, *Cyclopsittacidæ*, contains but two genera. The fourth, *Cacatuidæ*, is that of the Cockatoos. The bulk of the order is contained in the fifth family, *Psittacidæ*, in which are the Macaws, the true Parrot (which gives its name to the family), the Love-bird, *Agapornis*, and the Rose-ringed Parrakeet (*Palæornis torquatus*)—the only Parrot supposed to have been known to the ancients. The last family, *Stringopidæ*, contains only the curious Owl-like Parrot [4].

The seventh order, of more than 500 species, is that of the Birds of Prey, *Raptores*, and consists of the suborders 1. *Falcones*, 2. *Serpentarii*, 3. *Cathartes*, and 4. *Striges*.

[1] P. 13. [2] P. 12. [3] P. 73. [4] P. 72.

The characters of these groups are as follows:—

Order VII. RAPTORES.

Beak raptorial; claws long, strong, much curved, and very sharp; young born helpless and either with down or, if naked, then soon passing through a downy stage; plantar tendons united; maxillo-palatines united in the middle line; palate neither ægithognathous nor schizognathous; spinal feather-tract forked on upper back; sternum not perforated for coracoids; nasals not schizorhinal; dorsal vertebræ not opisthocœlous; cervical vertebræ not more than 18; mandible not produced backwards beyond the quadrate; hallux with more than one phalanx; oil-gland present and tufted or nude; cæca present or absent.

Suborder 1. *Falcones.*

Basipterygoid processes absent; spinal feather-tract well defined on the neck; oil-gland with a circlet of feathers; tarso-metatarsus not very elongated; *ambiens* and *femoro-caudal* present; *accessory femoro-caudal, semitendinosus*, and *accessory semitendinosus* absent; basal phalanx of third digit not generally shortened; nostrils not perforated through; dorsal vertebræ heterocœlous; hallux supplied by *flexor hallucis*; an organ of voice present.

Suborder 2. *Serpentarii.*

Palate desmognathous; basipterygoid processes well developed; spinal feather-tract well defined on the neck; oil-gland tufted; tarsi (tarso-metatarsals) very elongated; no *femoro-caudal*, but *accessory femoro-caudal, semitendinosus*, and *accessory semitendinosus* present; basal phalanx of third digit not greatly shortened; hallux supplied by *flexor hallucis*; an organ of voice present; nostrils not perforated through.

Suborder 3. *Cathartes.*

Palate desmognathous; basipterygoid processes present and large; spinal feather-tract not defined on the neck; oil-gland present, but nude: tarsi not very elongated; *femoro-caudal* sometimes absent, but *semitendinosus* and *accessory semitendinosus* present; young soon covered with down; basal phalanx of third digit not greatly shortened; no organ of voice; nostrils perforated through; lateral toes joined to middle one by a fold of skin; hallux elevated and supplied by *flexor digitorum* and not by the *flexor hallucis*; no cæca.

Suborder 4. *Striges.*

Palate desmognathous; basipterygoid processes present; spinal feather-tract well defined on the neck; oil-gland present, but nude; tarsi not elongated; *femoro-caudal* present; *accessory femoro-caudal*, *semitendinosus*, *accessory semitendinosus*, and *ambiens* absent; outer toe reversible; basal phalanx of third digit greatly shortened; hallux supplied by *flexor hallucis* and not by the *flexor digitorum*; an organ of voice present; nostrils not perforated through; eyes directed forwards.

There are seven families of Raptorial Birds, three belonging to the first suborder and two to the second.

The first family includes all the Falcons[1], Eagles, Hawks, and Buzzards, and is accordingly termed *Falconidæ.* The second family contains the Ospreys, and is called from them *Pandionidæ.* The third family, *Vulturidæ*, contains the true Vultures[2].

The second suborder has but one family, termed *Gypogeranidæ*, from the generic name of the Secretary-bird[3].

The third suborder contains only a single family, which is composed of the American Vultures, and is named from the Condor, *Sarcorhamphidæ.*

The fourth suborder, that of the Owls, contains two families. The first of these is *Bubonidæ*, and contains the great majority of the species, including the type, the Eagle-owl[4]. The second

1 P. 124. 2 P. 127.
3 P. 129. 4 P. 130.

family of Owls is named *Strigidæ* from the generic term applied to the typical species of the whole suborder—namely, the Barn-owls.

The next and eighth order, with 68 species, is that of the *Steganopodes*, the characters of which may be thus expressed:—

Order VIII. STEGANOPODES.

Palate desmognathous; plumage of neck continuous; young born helpless, passing through a downy stage; hallux supplied by *flexor hallucis*; a tufted oil-gland; cæca present; no basipterygoid processes; mandible not produced backwards beyond the quadrate; sternum not perforated by coracoids.

There are three families in this order. The first is the *Pelecanidæ*, and contains all the Gannets [1], Pelicans [2], Cormorants, and Darters [3]. The second contains the Tropic-birds [4], and is named *Phaetontidæ*; while the Frigate-bird [5] bestows its name on the third family of *Tachypetidæ*.

The ninth order, the *Herodiones*, has about 134 species, with the following characters:—

Order IX. HERODIONES.

Spinal feather-tract either not defined or not reaching far up on the neck; *flexor digitorum* not supplying the hallux; young born helpless and passing through a downy stage; palate desmognathous; basipterygoid processes absent; nasals schizorhinal or not so; semitendinosus present; dorsal vertebræ not opisthocœlous; oil-gland present and tufted.

Five families belong to this order. The first of these, *Ardeidæ*, embraces the Herons and Bitterns [6]. The second family, *Scopidæ*, includes the Umbrette [7], the Shoe-bill [8], and the Boat-bill [9]. The third family, *Ciconiidæ*, includes the Storks [10], the Adjutant [11], and the Wood Stork [12], but not the Crane [13], which belongs to quite another order. The fourth family is called

[1] P. 27. [2] P. 28. [3] P. 26. [4] P. 33.
[5] P. 32. [6] P. 36. [7] P. 40. [8] P. 39.
[9] P. 38. [10] P. 42. [11] P. 41. [12] P. 43.
[13] P. 44.

Plataleidæ from the Spoonbill[1]; and the fifth and last, *Ibididæ*, takes its denomination from the Sacred Bird of Egypt[2].

The next order, *Alectorides*, contains at least 243 species, and is divisible into two suborders—1. *Gruariæ* and 2. *Fulicariæ*, with the following characters:—

Order X. ALECTORIDES.

Spinal feather-tract forked on upper neck; if a plantar tendon goes to hallux, it is from the *flexor hallucis*; young born covered with down and able to run in a few hours; palate not desmognathous; basipterygoid processes present or absent; nasals schizorhinal or holorhinal; *ambiens* and *femoro-caudal* not simultaneously absent; mandible not produced backwards beyond quadrate; dorsal vertebræ heterocœlous; sternum not perforated for coracoids.

Suborder 1. *Gruariæ*.

Maxillo-palatines not coalescing together or with vomer; nasals schizorhinal; oil-gland present, nude or tufted.

Suborder 2. *Fulicariæ*.

Palate schizognathous; nasals holorhinal; oil-gland present or absent, nude or tufted.

There are nine families in this order, whereof four belong to the first suborder.

The first family is that of the Cranes, *Gruidæ*, and the second that of the Hemipodes[3], whence it is called *Turnicidæ*. The third family, *Rhinochetidæ*, contains the Kagu[4]; and the fourth, *Eurypygidæ*, consists of the Sun-bittern[5] alone, which is thus a very different bird from the true Bittern. The fifth family, *Otidæ*, has its name from the Bustards[6], while the sixth, *Cariamidæ*, contains but two species, one of which is that singular bird the Cariama[7]. Next follows the *Heliornithidæ*, named from the South-American bird before noticed[8]. The

[1] P. 51. [2] P. 53. [3] P. 11. [4] P. 48.
[5] P. 37. [6] P. 49. [7] P. 46. [8] P. 19.

eighth family is the *Rallidæ*, so called from the Rails[1], the Weka Rail, Coots[2], Moor-hens, and birds of the genus *Notornis*[3], which enter into it.

The last family contains but a single genus, that of the Trumpeter[4]. Hence it is termed *Psophiidæ*.

The eleventh order, *Galliformes*, contains nearly 320 species in two extremely unequal suborders—namely, 1. *Dysodæ* and 2. *Gallinæ*.

Their characters may be expressed as follows :—

Order XI. GALLIFORMES.

Young born covered with down or feathers; maxillo-palatines not united across the middle line; hallux rather or very larg and supplied from *flexor hallucis*; nasals holorhinal; oil-gland generally present, tufted, save in the Megapodes; sternum either perforated to receive the coracoids or else with a quite rudimentary keel; sternum with two notches on either side of its posterior margin; basipterygoid processes almost always present and articulating with the pterygoids as near the palatines as possible.

Suborder 1. *Dysodæ*.

Keel of sternum rudimentary; episternal processes perforated; hallux very large; oil-gland tufted; basipterygoid processes absent in the adult condition.

Suborder 2. *Gallinæ*.

Keel of sternum well developed; sternum often perforated to receive processes from coracoids; hallux moderate; oil-gland sometimes nude, sometimes absent, sometimes tufted.

There are five families in this order, of which only one belongs to the first suborder.

This first family, *Opisthocomidæ*, contains only the Hoatzin[5].

[1] P. 17. [2] P. 18. [3] P. 63.
[4] P. 45. [5] P. 94.

The second, *Phasianidæ*, includes all the Peacocks, Pheasants[1], Tragopans[2], Turkeys, Fowls, and Guinea-fowls[3]. The third family, *Tetraonidæ*, takes its name from the Capercailzie, and also includes the Partridges and Quails, the Californian Quail[4], and many others. The Curassows[5] constitute the fourth family, *Cracidæ*, whilst the last family of *Megapodidæ* consists of the Mound-builders[6], also called Megapodes and Brush-turkeys.

The twelfth order, *Limicoliformes*, of 330 species, contains the suborders 1. *Limicolæ* and 2. *Gaviæ*, which may be characterized thus:—

Order XII. LIMICOLIFORMES.

Young born covered with down and able to run in a few hours; palate schizognathous; dorsal vertebræ more or less opisthocœlous; spinal feather-tract forked on the upper back; nasals mostly schizorhinal, sometimes holorhinal; fontanelles often present on the lateral occipital bones; oil-gland tufted.

Suborder 1. *Limicolæ*.

Basipterygoid processes present; dorsal vertebræ always opisthocœlous.

Suborder 2. *Gaviæ*.

Basipterygoid processes absent; dorsal vertebræ more or less opisthocœlous.

In this order there are four families, two to each suborder. The first family, *Charadriidæ*, receives its name from the Plovers[7]; but it also contains the Curlews[8], the Woodcock, the Snipes and Stints, the Sandpipers, the Ruffs[9], Godwits and Oyster-catchers[10], the Stilts[11] and Avocet[12], the Crooked-bill Plover[13], the Thick-knees[14], the Peewit, the Coursers[15], the Pratincole[16], that very curious bird the Sheath-

[1] P. 5.	[2] P. 6.	[3] P. 7.	[4] P. 10.
[5] P. 8.	[6] P. 9.	[7] P. 59.	[8] P. 52.
[9] P. 55.	[10] P. 56.	[11] P. 57.	[12] P. 58.
[13] P. 58.	[14] P. 60.	[15] P. 50.	[16] P. 61.

bill[1], the Turnstones, and various other forms. The second family is composed of the Jacanas[2], whence it is termed *Parridæ.* The third family includes the Terns[3] and that singular species the Skimmer[4]. It is the family *Sternidæ.* The fourth and last family, *Laridæ,* includes the Gulls[5], with the Robber-gulls or Skuas.

The thirteenth order, the *Tubinares,* with about 115 species, has the following characters :—

Order XIII. TUBINARES.

Nostrils produced externally into tubes; young fed by the parents for some time in the nest; nasals holorhinal; dorsal vertebræ heterocœlous; hallux absent or reduced to one phalanx, the other toes directed forwards; spinal feather-tract well defined on neck; oil-gland tufted; basipterygoid processes present or absent.

This order contains but two families, which are named respectively from the Petrels[6] and the Albatrosses—the first *Procellariidæ* and the second *Diomedeidæ.* The genus *Pelecanoides* is by some deemed a distinct family, on account of its short wings and the entire absence of a hind toe.

The fourteenth order, *Pygopodiformes,* contains 75 species in two suborders, which may be respectively termed, 1. *Pygopodes* and 2. *Alcæ.* Their characters may stand thus :—

Order XIV. PYGOPODIFORMES.

Young almost always born covered with down or feathers; they may or may not run about or swim in a few hours; hallux very small or absent; palate schizognathous; spinal feather-tract forked on the upper back or not defined on the neck; fontanelles sometimes present in the lateral occipital bones; tail small or all but absent; thigh, tarsus, and foot short; toes webbed or lobed; wing short; no basipterygoid processes.

[1] P. 61. [2] P. 62. [3] P. 30.
[4] P. 30. [5] P. 29. [6] P. 31.

Suborder 1. *Pygopodes.*

Cnemial process of tibia very large; posterior processes of ilium almost conceal sacrum dorsally; spinal feather-tracts not defined on the neck; a small hind toe; *ambiens* present or absent: young able to run or swim in a few hours.

Suborder 2. *Alcæ.*

Cnemial process of tibia not very large; sacrum not hidden dorsally by posterior processes of ilium; spinal feather-tract forked on the upper back; no hind toe; no *ambiens*; a tufted oil-gland; cæca to intestine; nasals schizorhinal; fontanelles in lateral occipitals: young fed in the nest for many days.

The order contains five families, two for the first suborder, and three for the second. The first family is formed by the Divers [1], whence it is termed *Colymbidæ*, and similarly the second family is called *Podicipidæ*, from the Grebes [2], which compose it.

The third family *Alcidæ* consists of the Razorbills [3], Auks, and Puffins [4]. The fourth family is termed *Simorhynchidæ* (from a genus *Simorhynchus* from North America, Kamtskatka, and Japan), and the fifth and last, called *Uriadæ*, includes the Guillemots [5]; it also contains the Little Auk [6].

The fifteenth Order *Lamellirostres* embraces three suborders:—1. *Phœnicopteri*; 2. *Anseres*; and 3. *Palamedeæ*, and about 195 species.

Their characters may be thus set down:—

Order XV. LAMELLIROSTRES.

Young born covered with down and able to run in a few hours; palate desmognathous; maxillo-palatines broad, flat, and medianly united; they may be large and spongy; basipterygoid mostly represented by sessile, oval facets placed very far forwards; toes webbed, or at least united by a fold of skin.

[1] P. 20. [2] P. 20. [3] P. 22.
[4] Pp. 23 & 25. [5] P. 21. [6] P. 22.

Bill almost always flattened and laterally expanded, or, if not, then either without uncinate processes, or bill so bent that its distal part is almost at right angles with its proximal part.

Suborder 1. *Phœnicopteri.*

Basipterygoid processes absent or rudimentary; bill bent vertical almost at right angles; nasals holorhinal; uncinate processes present; mandible produced and recurved behind its articulation with the quadrate; maxillo-palatines large and spongy; frontals narrow; grooves for orbital glands; a tufted oil-gland; cæca well developed.

Suborder 2. *Anseres.*

Basipterygoid processes articulate with pterygoids as near palatines as possible; maxillo-palatines coalesced in the middle line, but not large and spongy; bill flattened and laterally expanded; uncinate processes present; mandible extending back beyond quadrate and recurved; sternum with one posterior, shallow notch; oil-gland tufted.

Suborder 3. *Palamedeæ.*

Basipterygoid processes present; bill neither laterally expanded nor vertically bent at right angles; cervical vertebræ more than 18; no uncinate processes; maxillo-palatines not large and spongy; mandible not much produced backwards but recurved; no spinal bare tract; oil-gland tufted; cæca present.

There are nine families in the order, seven of which belong to the suborder "Anseres."

The first family *Phœnicopteridæ* includes only the Flamingoes[1]; the second, *Plectropteridæ*, is named from a genus *Plectropterus*, which contains two species from Tropical Africa. The third family, *Anseridæ*, includes the true Geese[2]. The Swans[3] con-

[1] P. 34. [2] P. 14. [3] P. 15.

stitute the family *Cygnidæ*, while the Ducks[1] form that called *Anatidæ.* The sixth family *Fuligulidæ* is one of which the Harlequin Duck is a type. The family *Erismaturidæ* is one containing only about nine species, and takes its name from a genus which ranges from Southern Europe to the West Indies, Chili, the Auckland Islands, South Africa, and Australia. The eighth family is termed *Mergidæ*, from the Goosander[2], which, with allied forms, is included within it. The ninth and last family *Palamedeidæ* takes its name (as does the suborder which contains it) from that curious Horned Screamer[3] of South America, which it seems we must regard as a much modified arboreal form of Goose.

The sixteenth order, that named *Impennes*, is a small but very peculiar one, of but 19 species, in which the following characters are to be observed:—

Order XVI. IMPENNES.

First and second digits of the hand fused together in the adult condition; three metatarsals, very short and separated by deep grooves their whole length; no quill-feathers in the wing; palate schizognathous; young born helpless, and covered with down; spinal feather-tract not defined on the neck; no power of flight; coracoids very large and strong; scapula broad.

In this order there is but a single family, whereof the King Penguin[4] is a type, and which may be therefore termed *Aptenodytidæ.*

The seventeenth order, *Crypturi*, is twice as numerous as the preceding one. It has the following characters:—

Order XVII. CRYPTURI.

Keel of sternum well developed as usual, but placed on a very narrow median xiphoid process; two narrow xiphoid processes on either side of it; ilium and ischium connected by cartilage behind the acetabulum; vomer coalescing with the

[1] P. 14. [2] P. 16. [3] P. 47. [4] P. 24.

maxillo-palatines in front, and with the pterygoids and palatines behind; feather-tracts well differentiated from the bare tracts on both the upper and under parts; oil-gland tufted; cæca present; basipterygoids placed very far backwards; no pygostyle.

This order again contains but a single family named *Tinamidæ*, from the Tinamous[1] which compose it, and which are, their structure shows, widely different from the Coursers (with which we introduced them to the reader's notice) in spite of the superficial resemblance which exists between them. They lead us on, in fact, to the next and last Avian order—one which belongs to the second subclass of Birds, the subclass *Ratitæ*.

This eighteenth and last order of Birds, of about 20 species, is the Order *Struthiones*, which contains the suborders 1. *Apterygiformes* and 2. *Dromæiformes*. These groups may be thus characterized:—

Subclass II. RATITÆ[2].

Order XVIII. STRUTHIONES.

Basipterygoid processes very large and placed on the basipterygoid rather than on its rostrum; oil-gland absent; plumage of neck continuous; palatines articulating with the pterygoids and not with the sphenoidal rostrum; no power of flight.

Suborder 1. *Apterygiformes*.

A hallux present; bill greatly elongated; wing a mere rudiment.

Suborder 2. *Dromæiformes*.

No hallux; bill not greatly elongated; wing not a mere rudiment.

There are three families of this order. The first of these, *Apterygidæ*, is the only one of the first suborder and is constituted by the several species of *Apteryx*[3] alone. The second family, the *Dromæidæ*, contains the Emeus[4] and the Casso-

[1] P. 51. [2] The characters of this Subclass are given above, p. 258.
[3] P. 64. [4] P. 67.

waries [1]. The third family consists of the American Ostriches, or Rheas [2], and the true Ostrich, which, as the type, determines the name of the family to be *Struthionidæ*.

The following table expresses the groups of Birds, with the names of the genera pertaining to each family and subfamily, and a figure indicating the probable minimum number of species in each genus. These numbers are not always to be taken as expressing the total number now described, but as an approximation thereto.

Class AVES.

Subclass I. CARINATÆ.

Order I. PASSERIFORMES.

Suborder I. PASSERES.

Section A. **Acromyodi** or **Oscines.**

Family I. Corvidæ.

1. Subfamily **Corvinæ.**

Trypanocorax, 2. *Heterocorax*, 1. *Corvus*, 11. *Corvultur*, 2. *Colœus*, 5. *Corone*, 12. *Rhinocorax*, 1. *Gazzola*, 1. *Microcorax*, 4. *Physocorax*, 1. *Gymnocorax*, 1. *Macrocorax*, 2. *Nucifraga*, 4. *Strepera*, 7. *Pica*, 3. *Cyanopolius*, 2. *Urocissa*, 5. *Cryptorhina*, 1. *Dendrocitta*, 8. *Crypsirhina*, 2. *Cissa*, 3. *Calocitta*, 2. *Platysmurus*, 2. *Temnurus*, 1. *Garrulus*, 14. *Perisoreus*, 4. *Cyanocitta*, 5. *Aphelocoma*, 8. *Cyanocorax*, 16. *Xanthura*, 14. *Uroleuca*, 1. *Gymnokitta*, 1. *Psilorhinus*, 3. *Struthidea*, 1. *Picathartes*, 1. *Glaucopis*, 2. *Heteralocha*, 1. *Creadion*, 1. *Falculia*, 1.

2. Subfamily **Fregilinæ.**

Graculus, 1. *Pyrrhocorax*, 1. *Corcorax*, 1. *Podoces*, 4.

Family II. Paradiseidæ.

1. Subfamily **Epimachinæ.**

Ptilorhis, 5. *Seleucides*, 1. *Drepanornis*, 3. *Epimachus*, 3.

[1] P. 66. [2] P. 65.

2. Subfamily **Paradiseinæ.**
Astrapia, 1. *Astrarchia*, 1. *Paradigalla*, 1. *Paradisca*, 5. *Uranornis*, 1. *Paradisornis*, 1. *Cicinnurus*, 1. *Rhipidornis*, 1. *Diphyllodes*, 2. *Schlegelia*, 1. *Parotia*, 2. *Semioptera*, 1. *Lophorhina*, 2. *Phonygama*, 4. *Manucodia*, 4. *Lycocorax*, 3. *Xanthomelus*, 2.

Family III. PTILONORHYNCHIDÆ.
Ptilonorhynchus, 1. *Ælurœdus*, 6. *Chlamydodera*, 5. *Tectonornis*, 1. *Amblyornis*, 1. *Prionidura*, 1. *Sericulus*, 1.

Family IV. STURNIDÆ.
Sturnus, 6. *Spodiopsar*, 9. *Sturnornis*, 1. *Sturnopastor*, 3. *Dilophus*, 1. *Pastor*, 1. *Sturnia*, 3. *Temenuchus*, 1. *Graculipica*, 2. *Acridotheres*, 8.

Family V. EULABETIDÆ.

1. Subfamily **Eulabetinæ.**
Basileornis, 2. *Sarcops*, 1. *Eulabes*, 4. *Mino*, 2. *Melanopyrrhus*, 2. *Ampeliceps*, 1. *Psaroglossa*, 1. *Hartlaubius*, 1. *Pholidauges*, 4. *Aplonis*, 17. *Calornis*, 10. *Macruropsar*, 1. *Streptocitta*, 2. *Charitornis*, 1. *Lamprotornis*, 4. *Chalcopsar*, 1. *Cosmopsarus*, 2. *Amydrus*, 4. *Onycognathus*, 2. *Cinnamopterus*, 1. *Pilorhinus*, 1. *Galeopsar*, 1. *Hagiopsar*, 1. *Pyrrhocheira*, 1. *Lamprocolius*, 13. *Coccycolius*, 1. *Heteropsar*, 2. *Spreo*, 6. *Enodes*, 1. *Scissirostrum*, 1. *Fregilupus*, 1.

2. Subfamily **Buphaginæ.**
Buphaga, 2.

Family VI. EURYCEROTIDÆ.
Euryceros, 1.

Family VII. DICRURIDÆ.
Dicrurus, 6. *Chibia*, 9. *Chætorhynchus*, 1. *Chaptia*, 3. *Buchanga*, 7. *Edolius*, 1. *Dissemuroides*, 2. *Dicranostreptus*, 1. *Bhringa*, 1. *Dissemurus*, 1. *Dissemurulus*, 1.

Family VIII. ORIOLIDÆ.
Oriolus, 33. *Sphecotheres*, 4.

Family IX. ICTERIDÆ.

1. Subfamily **Cassicinæ.**
Clypeicterus, 1. *Ocyalus*, 1. *Eucorystes*, 1. *Gymnostinops*, 4. *Ostinops*, 8. *Cassicus*, 9. *Amblycercus*, 2. *Cassiculus*, 1. *Cassidix*, 1.

2. Subfamily **Agelæinæ.**
Dolichonyx, 1. *Molothrus*, 10. *Agelæus*, 14. *Leistes*, 2. *Xanthocephalus*, 1. *Amblyrhamphus*, 1. *Pseudoleistes*, 2. *Nesopsar*, 1. *Curæus*, 1.

3. Subfamily **Sturnellinæ.**
Trupialis, 3. *Sturnella*, 1.

4. Subfamily **Icterinæ.**
Gymnomystax, 1. *Icterus*, 38.

5. Subfamily **Quiscalinæ.**
Lampropsar, 1. *Scolecophagus*, 2. *Dives*, 3. *Quiscalus*, 15. *Macragelæus*, 1. *Hypopyrrhus*, 1. *Aphobus*, 1.

Family X. PLOCEIDÆ.

1. Subfamily **Viduinæ.**
Vidua, 2. *Tetrænura*, 1. *Linura*, 1. *Steganura*, 1. *Chera*, 1. *Penthetria*, 5. *Penthetriopsis*, 3. *Urobrachya*, 3. *Pyromelana*, 15. *Ploceipasser*, 6. *Philæterus*, 4. *Pyrenestes*, 2. *Cryptospiza*, 1. *Quelea*, 5. *Spermestes*, 7. *Amauresthes*, 1. *Ortygospiza*, 2. *Lagonosticta*, 21. *Stictospiza*, 1. *Amadina*, 3. *Staganopleura*, 1. *Zonæginthus*, 2. *Emblema*, 1. *Zonogastris*, 2. *Pytelia*, 7. *Coccopygia*, 2. *Hypochæra*, 5. *Tæniopygia*, 2. *Stictoptera*, 2. *Nigrita*, 7. *Sporæginthus*, 4. *Munia*, 22. *Uroloncha*, 15. *Aidemosyne*, 3. *Ægintha*, 1. *Bathilda*, 1. *Poephila*, 6. *Erythrura*, 11. *Chlorura*, 2. *Neochmia*, 1. *Estrilda*, 12. *Granatina*, 2.

2. Subfamily **Ploceinæ.**
Sporopipes, 2. *Icteropsis*, 1. *Anaplectes*, 4. *Heterhyphantes*, 7. *Sycobrotus*, 4. *Sitagra*, 6. *Foudia*, 2. *Nelicurvius*, 1. *Hyphantornis*, 32. *Cinnamopteryx*, 3. *Ploceella*, 1. *Melanopteryx*, 2. *Malimbus*, 7. *Nesacanthis*, 4. *Ploceus*, 4. *Spermospiza*, 3. *Amblyospiza*, 4. *Histurgops*, 1. *Dinemellia*, 2. *Textor*, 2.

Family XI. TANAGRIDÆ.

1. Subfamily **Procniatinæ.**
Procnias, 1.

2. Subfamily **Euphoniinæ.**
Chlorophonia, 9. *Euphonia*, 33. *Hypophæa*, 1. *Pyrrhuphonia*, 1.

3. Subfamily **Tanagrinæ.**
Tanagrella, 4. *Chlorochrysa*, 3. *Pipridea*, 1. *Procnopis*, 3. *Calliste*, 61. *Pseudodacnis*, 1. *Iridornis*, 5. *Delothraupis*, 1. *Stephanophorus*, 1.

Pœcilothraupis, 5. *Buthraupis*, 6. *Compsocoma*, 4. *Dubusia*, 1. *Tanagra*, 14. *Spindalis*, 6. *Rhamphocœlus*, 12. *Phlogothraupis*, 1. *Calochætes*, 1. *Pyranga*, 16. *Cyanicterus*, 1. *Orthogonys*, 1. *Chlorothraupis*, 3. *Phœnicothraupis*, 9. *Lanio*, 6. *Tachyphonus*, 11. *Creurgops*, 1. *Malacothraupis*, 1. *Eucometis*, 5. *Trichothraupis*, 1. *Cypsnagra*, 1. *Pyrrhocoma*, 1. *Nemosia*, 7. *Thlypopsis*, 8.

4. Subfamily **Lamprotinæ.**
   Lamprotes, 1. *Sericossypha*, 1.

5. Subfamily **Phœnicophilinæ.**
   Phœnicophilus, 2. *Calyptophilus*, 1.

6. Subfamily **Pitylinæ.**
   Chlorospingus, 32. *Urothraupis*, 1. *Microspingus*, 1. *Pezopetes*, 1. *Buarremon*, 35. *Nesospingus*, 1. *Arremon*, 13. *Diucopis*, 1. *Conothraupis*, 1. *Psittospiza*, 2. *Saltator*, 19. *Lamprospiza*, 1. *Orchesticus*, 1. *Oreothraupis*, 1. *Cissopis*, 2. *Schistochlamys*, 2. *Pitylus*, 8.

Family XII. Cœrebidæ.

1. Subfamily **Diglossinæ.**
   Diglossa, 16. *Diglossopis*, 1.

2. Subfamily **Dacnidinæ.**
   Oreomanes, 1. *Conirostrum*, 8. *Xenodacnis*, 1. *Hemidacnis*, 1. *Dacnis*, 14. *Certhidea*, 2.

3. Subfamily **Cœrebinæ.**
   Chlorophanes, 2. *Cœreba*, 4. *Certhiola*, 19.

4. Subfamily **Glossiptilinæ.**
   Glossiptila, 1.

Family XIII. Drepanididæ.

Drepanis, 1. *Vestiaria*, 1. *Hemignathus*, 6. *Loxops*, 2. *Chrysomitridops*, 1. *Oreomyza*, 1. *Himatione*, 9.

Family XIV. Fringillidæ.

1. Subfamily **Coccothraustinæ.**
   Geospiza, 9. *Camarhynchus*, 5. *Cactornis*, 4. *Chloris*, 3. *Eophona*, 2. *Chaunoproctus*, 1. *Hesperiphona*, 2. *Coccothraustes*, 2. *Mycerobas*, 1. *Pycnorhamphus*, 3. *Pheucticus*, 6. *Hedymeles*, 2. *Guiraca*, 6. *Oryzoborus*, 7. *Loxigilla*, 6. *Neorhynchus*, 2. *Piezorhina*, 1. *Spermophila*, 40. *Dolospingus*, 1. *Catamblyrhynchus*, 1. *Melopyrrha*, 1. *Phonipara*, 5. *Volatinia*, 1. *Amaurospiza*, 3. *Pyrrhuloxia*, 1. *Cardinalis*, 2.

2. Subfamily **Fringillinæ.**

Fringilla, 5. *Procarduelis*, 2. *Carduelis*, 2 *Chrysomitris*, 27. *Callacanthis*, 1. *Loximitris*, 1. *Acanthidops*, 1. *Telespiza*, 1. *Acanthis*, 5. *Montifringilla*, 18. *Rhodopechys*, 1. *Rhynchostruthus*, 1. *Rhodospiza*, 1. *Erythrospiza*, 2. *Petronia*, 6. *Passer*, 26. *Pseudostruthus*, 1. *Poliospiza*, 3. *Alario*, 1. *Serinus*, 19. *Sycalis*, 5. *Pyrrhoplectes*, 1. *Carpodacus*, 26. *Pyrrhospiza*, 3. *Loxia*, 2. *Pyrrhula*, 10. *Pinicola*, 1. *Propyrrhula*, 1. *Uragus*, 3.

3. Subfamily **Emberizinæ.**

Urocynchramus, 1. *Coryphospiza*, 2. *Embernagra*, 6. *Chamæospiza*, 1. *Emberizoides*, 1. *Atlapetes*, 2. *Pipilo*, 8. *Saltatricula*, 1. *Paroaria*, 6. *Haplospiza*, 2. *Diuca*, 3. *Amphispiza*, 3. *Zonotrichia*, 9. *Nesospiza*, 1. *Porphyrospiza*, 1. *Coryphospingus*, 2. *Hæmophila*, 10. *Pyrgisoma*, 7. *Gubernatrix*, 1. *Xenospingus*, 1. *Ammodromus*, 9. *Poospiza*, 14. *Peucæa*, 4. *Melospiza*, 4. *Spizella*, 8. *Fringillaria*, 7. *Melophus*, 1. *Emberiza*, 34. *Pyrrhulorhyncha*, 3. *Miliaria*, 1. *Passerculus*, 4. *Poœcetes*, 1. *Calamospiza*, 1. *Chondestes*, 1. *Spiza*, 2. *Pseudochloris*, 7. *Rhodospingus*, 2. *Lophospingus*, 1. *Tiaris*, 1. *Cyanospiza*, 6. *Phrygilus*, 12. *Spodiornis*, 2. *Passerella*, 2. *Junco*, 11. *Schistospiza*, 1. *Plectrophenax*, 1. *Rhyncophanes*, 1. *Calcarius*, 3. *Idiopsar*, 2.

Family XV. Alaudidæ.

Certhilauda, 2. *Alæmon*, 3. *Heterocorys*, 1. *Chersophilus*, 1. *Rhamphocorys*, 1. *Otocorys*, 4. *Melanocorypha*, 6. *Tephrocorys*, 2. *Spizocorys*, 1. *Alauda*, 3. *Calandrella*, 2. *Alaudula*, 2. *Mirafra*, 23. *Spilocorydon*, 1. *Spizalauda*, 1. *Heliocorys*, 1. *Galerita*, 4. *Lullula*, 1. *Calendula*, 1. *Ammomanes*, 8. *Pyrrhulauda*, 4.

Family XVI. Motacillidæ.

Motacilla, 23. *Limonidromus*, 1. *Anthus*, 33. *Xanthocorys*, 1. *Neocorys*, 1. *Oreocorys*, 1. *Macronyx*, 4.

Family XVII. Mniotiltidæ.

Leucopeza, 2. *Helminthotherus*, 2. *Helminthophila*, 9. *Protonotaria*, 1. *Mniotilta*, 1. *Parula*, 4. *Dendrœca*, 36. *Perissoglossa*, 1. *Peucedramus*, 1. *Siurus*, 3. *Oporornis*, 2. *Ligia*, 1. *Geothlypis*, 13. *Teretistris*, 2. *Granatellus*, 4. *Icteria*, 1. *Basileuterus*, 32. *Ergaticus*, 2. *Cardellina*, 1. *Setophaga*, 15. *Myiodioctes*, 4.

Family XVIII. CERTHIIDÆ.

1. Subfamily **Certhiinæ.**

Certhia, 4. *Salpornis*, 2. *Tichodroma*, 1. *Climacteris*, 9.

2. Subfamily **Sittinæ.**

Sitta, 20. *Sittella*, 7. *Hypositta*, 1.

Family XIX. MELIPHAGIDÆ.

1. Subfamily **Myzomelinæ.**

Myzomela, 27. *Acanthorhynchus*, 2.

2. Subfamily **Meliphaginæ.**

Glycyphila, 13. *Entomophila*, 4. *Meliphaga*, 1. *Ptilotis*, 37. *Cleptornis*, 1. *Pogonornis*, 1. *Meliornis*, 4. *Anthornis*, 2. *Prosthemadera*, 1. *Manorhina*, 4. *Acanhochæra*, 5. *Leptornis*, 3. *Entomyza*, 2. *Philemon*, 16. *Melitograis*, 1. *Promerops*, 2. *Moho*, 2. *Melidectes*, 1. *Euthyrhynchus*, 4. *Melirrhophetes*, 2. *Pycnopygius*, 1. *Œdistoma*, 1. *Acrulocercus*, 3. *Chætoptila*, 1.

Family XX. NECTARINIIDÆ.

Neodrepanis, 1. *Nectarinia*, 5. *Anthobaphes*, 1. *Chalcostetha*, 1. *Æthopypa*, 19. *Drepanorhynchus*, 1. *Cinnyris*, 54. *Arachnothera*, 11. *Anthothreptes*, 12.

Family XXI. DICÆIDÆ.

Dicæum, 47. *Loxioides*, 1. *Psittirostra*, 1. *Pinaroloxias*, 1. *Oreocharis*, 1. *Pardalotus*, 8. *Parmoptila*, 1. *Prionochilus*, 16. *Achmonorhynchus*, 1. *Pholidornis*, 2. *Lobornis*, 1. *Urocharis*, 1. *Melanocharis*, 4. *Pristorhamphus*, 1. *Rhamphocharis*, 1.

Family XXII. ZOSTEROPIDÆ.

Zosterops, 85. *Melithreptus*, 5. *Plectrorhynchus*, 1.

Family XXIII. PARIDÆ.

Parus, 49. *Psaltria*, 1. *Acredula*, 12. *Ægithalus*, 8. *Xerophila*, 2. *Sphenostoma*, 1. *Certhiparus*, 3. *Panurus*, 1.

Family XXIV. REGULIDÆ.

Regulus, 5. *Leptopœcile*, 1.

Family XXV. LANIIDÆ.

1. Subfamily **Gymnorhininæ.**

Pityriasis, 1. *Gymnorhina*, 2. *Cracticus*, 7.

2. Subfamily **Malaconotinæ.**

Vanga, 2. *Artamia*, 3. *Xenopirostris*, 4. *Pteruthius*, 7. *Hilarocichla*, 1. *Calicalicus*, 1. *Teleophonus*, 8. *Dryoscopus*, 22. *Laniarius*, 16. *Nicator*, 3. *Nilaus*, 3. *Neolestes*, 1.

3. Subfamily **Pachycephalinæ.**
Falcunculus, 2. *Oreoica*, 1. *Eopsaltria*, 7. *Pachycephala*, 53. *Pachycare*, 1.

4. Subfamily **Laniinæ.**
Urolestes, 1. *Laniellus*, 1. *Corvinella*, 1. *Lanius*, 47. *Tephrodornis*, 6. *Eurocephalus*, 2. *Pœoptera*, 1. *Leptopterus*, 1. *Rectes*, 7. *Pseudorectes*, 2. *Melanorectes*, 1. *Collyriocincla*, 5. *Pinarolestes*, 11. *Cuphopterus*, 1. *Fraseria*, 2. *Hemipus*, 3. *Bradyornis*, 11. *Melænornis*, 1. *Hypocolius*, 1. *Platylophus*, 3. *Prionops*, 3. *Sigmodus*, 6. *Cochoa*, 3. *Phæornis*, 1.

Family XXVI. ARTAMIDÆ.
Artamus, 17. *Pseudochelidon*, 1.

Family XXVII. AMPELIDÆ.
Ampelis, 3. *Dulus*, 2. *Phainoptila*, 1. *Phainopepla*, 1. *Ptilogonys*, 2.

Family XXVIII. VIREONIDÆ.
Vireo, 23. *Neochloe*, 1. *Hylophilus*, 17. *Laletes*, 1. *Vireolanius*, 4. *Cyclorhis*, 10.

Family XXIX. SYLVIIDÆ.

1. Subfamily **Sylviinæ.**
Sylvia, 23. *Phylloscopus*, 25. *Hypolais*, 9. *Acrocephalus*, 15. *Locustella*, 8. *Lusciniola*, 13. *Cettia*, 11.

2. Subfamily **Bradypterinæ.**
Sphenœacus, 6. *Dromæocercus*, 2. *Stipiturus*, 1. *Psamathia*, 1. *Bebrornis*, 2. *Sphenura*, 3. *Amytis*, 4. *Schœnicola*, 2. *Phlexis*, 1. *Bradypterus*, 4. *Euryptila*, 1. *Rhopophilus*, 3. *Laticilla*, 2. *Ellisia*, 1. *Megalurus*, 8. *Chætornis*, 1. *Calamocichla*, 2. *Calamonastes*, 2. *Origma*, 1.

3. Subfamily **Eremomelinæ.**
Apalis, 4. *Euprinodes*, 5. *Dryodromas*, 5. *Drymocichla*, 1. *Phyllolais*, 1. *Eroessa*, 3. *Sylviella*, 5. *Eremomela*, 12. *Camaroptera*, 6. *Hylia*, 1. *Stiphrornis*, 3.

4. Subfamily **Cisticolinæ.**
Suya, 5. *Prinia*, 8. *Burnesia*, 9. *Scotocerca*, 2. *Sutoria*, 3. *Orthotomus*, 10. *Phyllergates*, 2. *Thamnornis*, 1. *Spiloptila*, 2. *Graminicola*, 1. *Cisticola*, 28. *Chthonicola*, 1. *Acanthiza*, 10. *Sericornis*, 11.

Family XXX. TURDIDÆ.

1. Subfamily **Turdinæ.**

Geocichla, 40. *Turdus*, 48. *Merula*, 53. *Mimocichla*, 3. *Catharus*, 12. *Erithacus*, 16. *Monticola*, 10. *Sialia*, 6. *Ruticilla*, 13. *Myrmecocichla*, 8. *Saxicola*, 32.

2. Subfamily **Thamnobiinæ.**

Turnagra, 2. *Myiophoneus*, 11. *Callene*, 4. *Pentholæa*, 3. *Pinarochroa*, 2. *Pseudocossyphus*, 1. *Notodela*, 2. *Brachypteryx*, 7. *Lamprolia*, 2. *Trichixus*, 1. *Cossypha*, 16. *Chimarrhornis*, 1. *Thamnolæa*, 5. *Thamnobia*, 2. *Alethe*, 4. *Copsychus*, 3. *Gervaisia*, 2. *Ædonopsis*, 1. *Cichladusa*, 3. *Erythropygia*, 8. *Lioptila*, 1. *Hodgsonius*, 1. *Cercotrichas*, 2. *Cittocincla*, 6.

3. Subfamily **Myiadectinæ.**

Myiadectes, 11. *Cichlopsis*, 2. *Platycichla*, 1.

Family XXXI. CINCLIDÆ.

Cinclus, 12.

Family XXXII. TROGLODYTIDÆ.

Cinnicerthia, 4. *Campylorhynchus*, 22. *Odontorhynchus*, 1. *Thryophilus*, 17. *Thryothorus*, 32. *Cistothorus*, 6. *Troglodytes*, 9. *Urocichla*, 1. *Spelæornis*, 2. *Salpinctes*, 2. *Anorthura*, 9. *Elachura*, 2. *Catherpes*, 2. *Sphenocichla*. 1. *Uropsila*, 1. *Henicorhina*, 3. *Cyphorhinus*, 8. *Microcerculus*, 8. *Pnoepyga*, 4.

Family XXXIII. MIMIDÆ.

Cinclocerthia, 3. *Rhamphocinclus*, 1. *Cichlherminia*, 6. *Melanoptila*, 1. *Nesocichla*, 1. *Oreoscoptes*, 1. *Galeoscoptes*, 1. *Mimus*, 16. *Harporhynchus*, 11. *Mimodes*, 1. *Melanotis*, 2. *Donacobius*, 2. *Rhodinocichla*, 2.

Family XXXIV. ACCENTORIDÆ.

Accentor, 13. *Ephthianura*, 4.

Family XXXV. TIMELIIDÆ.

1. Subfamily **Chamæinæ.**

Chamæa, 1.

2. Subfamily **Henicurinæ.**

Henicurus, 6. *Hydrocichla*, 4. *Microcichla*, 1.

3. Subfamily **Crateropodinæ.**

Orthonyx, 3. *Cinclosoma*, 6. *Eupetes*, 6. *Pycnoptilus*, 1. *Drymaœdus*, 4. *Hylacola*, 2. *Chætops*, 3. *Psophodes*, 2. *Hypergerus*, 1. *Babax*, 1. *Pterorhinus*, 1. *Trochalopterum*, 26. *Acanthoptila*, 1. *Ianthocincla*, 4. *Gampsorhynchus*, 2. *Argya*, 14. *Megalurulus*, 1. *Pinarornis*, 1. *Sibia*, 2. *Malacias*, 6. *Pomatorhinus*, 25.

Xiphorhamphus, 1. *Garrulax*, 16. *Stactocichla*, 1. *Grammatoptila*, 1. *Melanocichla*, 1. *Allocotops*, 1. *Rhinocichla*, 2. *Dryonastes*, 11. *Actinodura*, 5. *Neocichla*, 1. *Crateropus*, 16. *Aëthocichla*, 1. *Conostoma*, 1. *Suthora*, 13. *Chleuasicus*, 2. *Schæorhynchus*, 2. *Paradoxornis*, 3. *Cholornis*, 1. *Grallina*, 2. *Cinclorhamphus*, 2. *Calamanthus*, 2.

4. Subfamily **Timeliinæ.**

Timelia, 2. *Pyctorhis*, 3. *Dumetia*, 3. *Elaphrornis*, 1. *Pellorneum*, 5. *Scotocichla*, 1. *Crossleyia*, 1. *Tatare*, 7. *Bernieria*, 1. *Macrosphenus*, 1. *Mystacornis*, 1. *Stachyris*, 7. *Turdinus*, 14. *Ptyrticus*, 1. *Thringorhina*, 2. *Drymochæra*, 1. *Erythrocichla*, 1. *Drymocataphus*, 8. *Ortygocichla*, 1. *Trichocichla*, 1. *Gypsophila*, 1. *Trichostoma*, 1. *Malacopterum*, 6. *Xanthomixis*, 1. *Oxylabes*, 2. *Kenopia*, 1. *Dasycrotapha*, 1. *Mixornis*, 9. *Neomixis*, 1. *Chlorocharis*, 1. *Macronus*, 2. *Ptilopyga*, 2. *Ptilocichla*, 1. *Malia*, 1. *Androphilus*, 1. *Anuropsis*, 2. *Crateroscelis*, 2. *Amaurocichla*, 1. *Corythocichla*, 2. *Turdinulus*, 1. *Rimator*, 2.

5. Subfamily **Liotrichinæ.**

Stachyridopsis, 6. *Oligura*, 3. *Minla*, 7. *Sittiparus*, 1. *Ixulus*, 3. *Staphidia*, 4. *Alcippe*, 9. *Rhopocichla*, 3. *Fulvetta*, 3. *Moupinia*, 1. *Dendrobiastes*, 1. *Yuhina*, 4. *Myzornis*, 1. *Herpornis*, 1. *Siva*, 4. *Liocichla*, 1. *Mesia*, 2. *Liothrix*, 1. *Cutia*, 1.

Family XXXVI. PYCNONOTIDÆ.*

Ægithina, 3. *Aethorhynchus*, 2. *Chloropsis*, 16. *Hypsipetes*, 8. *Ixocincla*, 4. *Hemixus*, 7. *Iole*, 8. *Pinarocichla*, 1. *Poliolophus*, 1. *Micropus*, 6. *Criniger*, 23. *Trichophoropsis*, 1. *Tricholestes*, 1. *Alcurus*, 1. *Trachycomus*, 1. *Xenocichla*, 16. *Andropadus*, 7. *Chlorocichla*, 4. *Phyllostrophus*, 5. *Ixonotus*, 1. *Pycnonotus*, 36. *Otocompsa*, 5. *Kelaartia*, 1. *Tylas*, 5. *Rubigula*, 7. *Spizixus*, 3. *Irena*, 7.

Family XXXVII. CAMPOPHAGIDÆ.

Artamides, 16. *Campochæra*, 1. *Pteropodocys*, 1. *Graucalus*, 18. *Edoliisoma*, 20. *Chlamydochæra*, 1. *Lobotus*, 1. *Campophaga*, 11. *Pericrocotus*, 20. *Lalage*, 18. *Symmorphus*, 2.

* This family is sometimes named PHYLLORNITHIDÆ.

Family XXXVIII. MUSCICAPIDÆ.

Hemichelidon, 2. *Micrœca*, 4. *Alseonax*, 8. *Batis*, 7. *Diaphorophyia*, 3. *Bias*, 1. *Artomyias*, 2. *Platystira*, 4. *Newtonia*, 1. *Humblotia*, 1. *Muscicapa*, 20. *Dioptrornis*, 1. *Petrœca*, 13. *Pratincola*, 13. *Erythromyias*, 3. *Poliomyias*, 2. *Muscicapula*, 5. *Smicrornis*, 2. *Gerygone*, 7. *Pseudogerygone*, 24. *Chasiempis*, 2. *Muscylva*, 1. *Miro*, 3. *Laniturdus*, 1. *Metabolus*, 1. *Heteromyias*, 1. *Monachella*, 1. *Pœcilodryas*, 11. *Hyliota*, 2. *Xanthopygia*, 4. *Tarsiger*, 7. *Lioptilus*, 2. *Oreicola*, 3. *Stenostira*, 1. *Polioptila*, 9. *Parisoma*, 3. *Aethomyias*, 1. *Chloropeta*, 2. *Hypothymis*, 6. *Cyanomyias*, 1. *Chelidorhynx*, 1. *Todopsis*, 5. *Chenorhamphus*, 1. *Clytomyias*, 1. *Malurus*, 15. *Erythrocercus*, 2. *Trochocercus*, 3. *Rhipidura*, 52. *Neomyias*, 1. *Zeocephus*, 3. *Terpsiphone*, 14. *Elminia*, 3. *Philentoma*, 2. *Rhinomyias*, 2. *Culicicapa*, 3. *Myiagra*, 18. *Pseudobias*, 1. *Megabias*, 1. *Smithornis*, 2. *Machærorhynchus*, 4. *Cryptolopha*, 18. *Sisura*, 2. *Arses*, 5. *Piezorhynchus*, 24. *Heteranax*, 1. *Monarcha*, 5. *Peltops*, 1. *Pomarca*, 2. *Stoparola*, 7. *Siphia*, 19. *Digenea*, 5. *Niltava*, 4. *Cussinia*, 2.

Family XXXIX. HIRUNDINIDÆ.

1. Subfamily **Hirundininæ.**

Chelidon, 6. *Cotile*, 6. *Tachycineta*, 7. *Phedina*, 2. *Hirundo*, 27. *Cheramœca*, 1. *Progne*, 7. *Atticora*, 7. *Petrochelidon*, 9.

2. Subfamily **Psalidoprocninæ.**

Psalidoprocne, 7. *Stelgidopteryx*, 3.

Section B. **Mesomyodi.**

Division I. OLIGOMYODÆ.

Family XL. TYRANNIDÆ.

1. Subfamily **Tæniopterinæ.**

Agriornis, 8. *Myiotheretes*, 3. *Tænioptera*, 9. *Ochthodiæta*, 4. *Ochthœca*, 19. *Mecocerculus*, 6. *Ochthornis*, 1. *Sayornis*, 4. *Fluvicola*, 4. *Arundinicola*, 1. *Alectrurus*, 2. *Cybernetes*, 1. *Sisopygis*, 1. *Cnipolegus*, 11. *Lichenops*, 1. *Muscipipra*, 1. *Copurus*, 2. *Machetornis*, 1 *Muscisaxicola*, 13. *Centrites*, 2. *Muscigralla*, 1.

2. Subfamily **Platyrhynchinæ.**
Platyrhynchus, 9. *Todirostrum*, 16. *Oncostoma*, 2. *Euscarthmus*, 15. *Ceratotriccus*, 1. *Pseudotriccus*, 1. *Cænotriccus*, 1. *Lophotriccus*, 2. *Orchilus*, 3. *Colopterus*, 2. *Hemitriccus*, 1. *Phylloscartes*, 1. *Hapalocercus*, 4. *Habrura*, 1. *Culicivora*, 1. *Pogonotriccus*, 4. *Leptotriccus*, 2. *Stigmatura*, 2. *Serphophaga*, 7. *Anæretes*, 5.

3. Subfamily **Elaineinæ.**
Cyanotis, 1. *Mionectes*, 4. *Leptopogon*, 11. *Capsiempis*, 2. *Phyllomyias*, 4. *Myiopatis*, 2. *Ornithion*, 4. *Tyrannulus*, 3. *Tyranniscus*, 11. *Elainea*, 24. *Empidagra*, 2. *Legatus*, 1. *Sublegatus*, 3. *Myiozetetes*, 7. *Rhynchocyclus*, 12. *Conopias*, 3. *Pitangus*, 10. *Sirystes*, 3. *Myiodynastes*, 7.

4. Subfamily **Tyranninæ.**
Megarhynchus, 1. *Muscivora*, 4. *Hirundinea*, 4. *Cnipodectes*, 2. *Myiobius*, 21. *Pyrocephalus*, 4. *Empidochanes*, 5. *Mitrephanes*, 5. *Empidonax*, 17. *Lawrencia*, 1. *Contopus*, 9. *Blacicus*, 8. *Myiochanes*, 2. *Myiarchus*, 25. *Empidias*, 1. *Empidonomus*, 2. *Tyrannus*, 11. *Milvulus*, 2.

Family XLI. Oxyrhamphidæ.
Oxyrhamphus, 3.

Family XLII. Pipridæ.

1. Subfamily **Piprinæ.**
Piprites, 5. *Chloropipo*, 3. *Xenopipo*, 1. *Ceratopipra*, 2. *Cirrhopipra*, 2. *Metopia*, 1. *Masius*, 2. *Metopothrix*, 1. *Pipra*, 18. *Neopipo*, 1. *Machæropterus*, 4. *Chiroxiphia*, 5. *Helicura*, 1. *Chiromachæris*, 7.

2. Subfamily **Ptilochlorinæ.**
Ptilochloris, 2. *Heteropelma*, 9. *Schiffornis*, 2. *Neopelma*, 1. *Heterocercus*, 2.

Family XLIII. Cotingidæ.

1. Subfamily **Tityrinæ.**
Tityra, 5. *Hadrostomus*, 6. *Pachyrhamphus*, 14.

2. Subfamily **Lipauginæ.**
Chirocylla, 1. *Lathria*, 8. *Aulia*, 2. *Lipaugus*, 3.

3. Subfamily **Attilinæ.**
Attila, 12. *Casiornis*, 2.

4. Subfamily **Rupicolinæ.**
Phœnicocercus, 2. *Rupicola*, 3.

5. Subfamily **Cotinginæ.**
Phibalura, 1. *Tijuca*, 1. *Ampelion*, 4. *Pipreola*, 11. *Cotinga*, 8. *Xipholena*, 3. *Carpodectes*, 2. *Doliornis*, 1. *Heliochera*, 2. *Iodopleura*, 4. *Calyptura*, 1.

6. Subfamily **Gymnoderinæ.**
Hæmatoderus, 1. *Querula*, 1. *Pyroderus*, 3. *Cephalopterus*, 3. *Gymnocephalus*, 1. *Gymnoderus*, 1. *Chasmorhynchus*, 4.

Family XLIV. PHYTOTOMIDÆ.
Phytotoma, 4.

Family XLV. PHILEPITTIDÆ.
Philepitta, 2.

Family XLVI. PITTIDÆ.
Anthocincla, 1. *Pitta*, 43. *Eucichla*, 5. *Coracopitta*, 1.

Family XLVII. XENICIDÆ.
Acanthidositta, 3. *Xenicus*, 2.

Division II. TRACHEOPHONÆ.

Family XLVIII. DENDROCOLAPTIDÆ.

1. Subfamily **Furnariinæ.**
Geobates, 1. *Geositta*, 8. *Furnarius*, 11. *Upucerthia*, 8. *Cinclodes*, 6. *Henicornis*, 2. *Clibanornis*, 1. *Lochmias*, 2.

2. Subfamily **Synallaxinæ.**
Oxyurus, 2. *Sylviorthorhynchus*, 1. *Schizœaca*, 4. *Phlœcryptes*, 2. *Leptasthenura*, 4. *Synallaxis*, 38. *Siptornis*, 29. *Xenerpestes*, 1.

3. Subfamily **Philydorinæ.**
Coryphistera, 1. *Anumbius*, 1. *Limnophyes*, 1. *Limnornis*, 1. *Pseudocolaptes*, 2. *Berlepschia*, 1. *Phacelodomus*, 6. *Thripophaga*, 5. *Homorus*, 3. *Automolus*, 17. *Philydor*, 13. *Thripadectes*, 3. *Ancistrops*, 1. *Heliobletus*, 1. *Anabazenops*, 8. *Xenops*, 2. *Anabatoides*, 1.

4. Subfamily **Sclerurinæ.**
Sclerurus, 6.

5. Subfamily **Dendrocolaptinæ.**
Sittosomus, 3. *Margarornis*, 6. *Glyphorhynchus*, 1. *Pygarrhicus*, 1. *Dendrornis*, 16. *Dendroplex*, 2. *Dendrexetastes*, 2. *Hylexetastes*, 1. *Xiphocolaptes*, 4. *Picolaptes*, 17. *Nasica*, 1. *Drymornis*, 1. *Xiphorhynchus*, 5. *Dendrocincla*, 10. *Dendrocolaptes* 9.

Family XLIX. FORMICARIIDÆ.

1. Subfamily **Thamnophilinæ.**

Cymbilanius, 1. *Batara*, 1. *Thamnophilus*, 55. *Biatas*, 1. *Thamnistes*, 2. *Pygoptila*, 2. *Nectantes*, 1. *Clytoctantes*, 1. *Dysithamnus*, 14. *Thamnomanes*, 2.

2. Subfamily **Formicariinæ.**

Myrmotherula, 24. *Herpsilochmus*, 8. *Formicivora*, 15. *Terenura*, 4. *Psilorhamphus*, 1. *Rhamphocænus*, 6. *Cercomacra*, 10. *Pyriglena*, 4. *Gymnocichla*, 2. *Percnostola*, 3. *Heterocnemis*, 4. *Myrmeciza*, 12. *Hypocnemis*, 17. *Pithys*, 4. *Gymnopithys*, 3. *Rhopoterpe*, 1. *Phlogopsis*, 5. *Formicarius*, 7.

3. Subfamily **Grallariinæ.**

Chamæza, 5. *Pittasoma*, 2. *Thamnocharis*, 1. *Grallaria*, 31. *Grallaricula*, 5.

Family L. CONOPOPHAGIDÆ.

Conopophaga, 9. *Corythopis*, 2.

Family LI. PTEROPTOCHIDÆ.

Scytalopus, 9. *Merulaxis*, 1. *Liosceles*, 3. *Pteroptochus*, 2. *Rhinocrypta*, 2. *Hylactes*, 2. *Acropternis*, 1. *Triptorhinus*, 8 *.

Division III. ATRICHIÆ.

Family LII. ATRICHIIDÆ.

Atrichia, 2.

Division IV. MENURÆ.

Family LIII. MENURIDÆ.

Menura, 3.

Suborder II. EURYLÆMI.

Family I. CALYPTOMENIDÆ.

Calyptomena, 3.

Family II. EURYLÆMIDÆ.

Psarisomus, 1. *Serilophus*, 2. *Sarcophanops*, 1. *Eurylæmus*, 2. *Corydon*, 1. *Cymborhynchus*, 2.

* There is a genus *Zeledonia*, which I am unable to locate at present, its affinities as yet being quite undetermined.

Suborder III. TROCHILI.

Family I. TROCHILIDÆ.

1. Subfamily **Trochilinæ.**

Group 1. Trochili serrirostres *.

Heliothrix, 3. *Schistes*, 2. *Augastes*, 2. *Rhamphodon*, 1. *Androdon*, 1. *Hemistephania*, 4. *Glaucis*, 2. *Chlorostilbon*, 13. *Sporadinus*, 3. *Iache*, 5. *Phæoptila*, 1. *Aithurus*, 1. *Microchera*, 2. *Calliphurus*, 1. *Panychlora*, 7. *Eupherusa*, 3. *Elvira*, 2. *Thalurania*, 14. *Hypuroptila*, 5. *Lampornis*, 10. *Pinarolæma*, 1. *Avocettula*, 1. *Eulampis*, 2. *Petasophora*, 7. *Chrysolampis*, 1.

Group 2. Trochili intermedii.

Pterophanes, 1. *Heliomaster*, 1. *Lepidolarynx*, 1. *Diphlogæna*, 3. *Helianthea*, 7. *Bourcieria*, 5. *Eudosia*, 1. *Lampropygia*, 7. *Cyanolesbia*, 4. *Zodalia*, 2. *Sappho*, 3. *Neolesbia*, 1. *Lesbia*, 4. *Metallura*, 9. *Eustephanus*, 3. *Panterpe*, 1. *Heliangelus*, 7. *Heliotrypha*, 5. *Urosticte*, 3. *Adelomyia*, 4. *Anthocephala*, 1. *Phlogophilus*, 1. *Polytmus*, 3. *Doleromyia*, 1. *Leucochloris*, 1. *Agyrtria*, 22. *Ariana*, 1. *Cyanomyia*, 8. *Leucippus*, 4. *Amazilia*, 30. *Floricola*, 4. *Cyanophaia*, 3. *Damophila*, 2. *Polyerata*, 2. *Eucephala*, 10. *Hylocharis*, 3. *Chrysuronia*, 5. *Basilinna*, 2.

Group 3. Trochili lævirostres.

Eutoxeres, 4. *Threnetes*, 5. *Phaethornis*, 16. *Pygmornis*, 8. *Sphenoproctus*, 2. *Campylopterus*, 8. *Eupetomena*, 2. *Aphantochroa*, 3. *Phæochroa*, 2. *Sternoclyta*, 1. *Urochroa*, 1. *Eugenes*, 2. *Cœligena*, 1. *Oreopyra*, 4. *Delattria*, 4. *Clytolæma*, 2. *Lamprolæma*, 1. *Docimastes*, 1. *Eugenia*, 1. *Heliodoxa*, 4. *Iolæma*, 3. *Lampraster*, 1. *Phæolæma*, 3. *Hylonympha*, 1. *Lafresnaya*, 2. *Florisuga*, 2. *Topaza*, 2. *Oreotrochilus*, 6. *Oreonympha*, 1. *Oxypogon*, 3.

* I am indebted to the great kindness of Mr. Osbert Salvin, F.R.S., and of Dr. Günther, F.R.S., for the use of Mr. Salvin's Manuscript Catalogue, from which the above names of genera and their division into three groups are taken. These groups are not considered by their author to have the rank of subfamilies, the differences between any of the Trochili not being sufficient for such a subdivision, though the multitudinous genera may be conveniently grouped as Mr. Salvin has suggested, and as is here expressed.

Rhamphomicron, 8. *Opisthoprora*, 1. *Patagona*, 1. *Aglæactis*, 4. *Bellona*, 3. *Loddigesia*, 1. *Cephalolepis*, 2. *Abeillia*, 1. *Klais*, 1. *Eriocnemis*, 21. *Panoplites*, 3. *Spathura*, 5. *Rhodopis*, 2. *Doricha*, 5. *Tilmatura*, 1. *Calliphlox*, 2. *Smaragdochrysis*, 1. *Ptochoptera*, 1. *Calothorax*, 2. *Selasphorus*, 8. *Trochilus*, 2. *Calypte*, 3. *Acestrura*, 4. *Mellisuga*, 1. *Catharma*, 1. *Atthis*, 2. *Stellula*, 1. *Chætocercus*, 4. *Myrtis*, 2. *Thaumastura*, 1. *Lophornis*, 11. *Prymnacantha*, 4. *Discura*, 1. *Heliactin*, 1.

Order II. CORACIIFORMES.

Suborder I. CORACIÆ.

Family I. CYPSELIDÆ.

1. Subfamily **Cypselinæ.**
   Cypselus, 34. *Panyptila*, 3.

2. Subfamily **Chæturinæ.**
   Chætura, 32. *Cypseloides*, 4. *Collocalia*, 7. *Rhaphidura*, 1.

3. Subfamily **Macropteryginæ.**
   Macropteryx, 5.

Family II. CAPRIMULGIDÆ.
Caprimulgus, 72. *Eleothreptus*, 1. *Nyctidromus*, 2. *Scotornis*, 2. *Macrodipteryx*, 3.

Family III. STEATORNITHIDÆ.
Steatornis, 1.

Family IV. PODAROIDÆ.
Podargus, 3. *Chordeiles*, 13. *Eurostopodus*, 7.

Family V. LEPTOSOMIDÆ.
Leptosoma, 3.

Family VI. CORACIIDÆ.

1. Subfamily **Brachypteraciinæ.**
   Brachypteracias, 1. *Geobiastes*, 1. *Atelornis*, 2.

2. Subfamily **Coraciinæ.**
   Coracias, 11. *Eurystomus*, 9.

Family VII. MEROPIDÆ.
Nyctiornis, 2. *Meropogon*, 1. *Merops*, 17. *Dicrocercus*, 2. *Melittophagus*, 13.

Suborder II. HALCYONES.

Family I. Coliidæ.

Colius, 9.

Family II. Alcedinidæ.

1. Subfamily **Alcedininæ.**

Alcedo, 10. *Corythornis*, 3. *Alcyone*, 5. *Ceryle*, 17 *Pelargopsis*, 11.

2. Subfamily **Daceloninæ.**

Ceyx, 18. *Ceycopsis*, 1. *Myioceyx*, 2. *Ispidina*, 4. *Syma*, 2. *Halcyon*, 53. *Dacelo*, 4. *Sauromarptis*, 3. *Todirhamphus*, 4. *Monachalcyon*, 2. *Carcineutes*, 2. *Tanysiptera*, 20. *Cittura*, 2. *Melidora*, 2. *Clytoceyx*, 1.

Family III. Momotidæ.

Momotus, 11. *Urospatha*, 1. *Baryphthengus*, 1. *Hylomanes*, 2. *Prionirhynchus*, 2. *Eumomota*, 1. *Aspatha*, 1.

Family IV. Todidæ.

Todus, 9.

Suborder III. BUCEROTES.

Family I. Bucerotidæ.

Bucorax, 2. *Buceros*, 2. *Dichoceros*, 1. *Hydrocorax*, 3. *Anthracoceros*, 5. *Gymnolæmus*, 1. *Penelopides*, 7. *Cranorrhinus*, 4. *Aceros*, 1. *Rhytidoceros*, 4. *Ceratogymna*, 2. *Anorrhinus*, 1. *Philolæmus*, 2. *Ocyceros*, 3. *Lophoceros*, 17. *Bycanistes*, 9. *Berenicornis*, 1. *Ortholophus*, 2. *Rhinoplax*, 1.

Order III. PICIFORMES.

Suborder I. UPUPÆ.

Family I. Upupidæ.

Upupa 5.

Family II. Irrisoridæ.

Irrisor, 4. *Scoptelus*, 2. *Rhinopomastus*, 3.

Suborder II. TROGONES.

Family I. Trogonidæ.

Pharomacrus, 4. *Euptilotis*, 1. *Tmetotrogon*, 1. *Prionotelus*, 1. *Trogon*, 24. *Hapaloderma*, 3. *Harpactes*, 9. *Hapalarpactes*, 2.

Suborder III. SCANSORES.

Family I. Galbulidæ.

1. Subfamily **Galbulinæ**.
   Urogalba, 2. *Galbula*, 10. *Brachygalba*, 6. *Jacamaralcyon*, 1. *Galbalcyrhynchus*, 1.

2. Subfamily **Jacameropinæ**.
   Jacamerops, 1.

Family II. Bucconidæ.

Bucco, 20. *Malacoptila*, 7. *Micromonacha*, 1. *Nonnula*, 5. *Hapaloptila*, 1. *Monacha*, 7. *Chelidoptera*, 2.

Family III. Picidæ.

1. Subfamily **Picinæ**.
   Geocolaptes, 1. *Colaptes*, 13. *Hypoxanthus*, 2. *Gecinus*, 17. *Chloronerpes*, 17. *Campothera*, 13. *Chrysoptilus*, 8. *Chrysophlegma*, 8. *Gauropicoides*, 1. *Gecinulus*, 2. *Asyndesmus*, 1. *Melanerpes*, 29. *Sphyropicus*, 3. *Hypopicus*, 2. *Dendrocopus*, 31. *Picoides*, 5. *Xenopicus*, 1. *Dendrocoptes*, 1. *Liopicus*, 1. *Dendropicus*, 9. *Thripias*, 2. *Iyngipicus*, 19. *Dendrobates*, 25. *Mesopicus*, 7. *Xiphidiopicus*, 1. *Sapheopipo*, 1. *Lepocestes*, 2. *Miglyptes*, 5. *Micropternus*, 5. *Brachypternus*, 3. *Tiga*, 3. *Nesoceleus*, 1. *Celeus*, 14. *Cerchneipicus*, 3. *Crocomorphus*, 2. *Chrysocolaptes*, 10. *Campophilus*, 14. *Ipocrantor*, 1. *Hemicercus*, 3. *Microstictus*, 4. *Hemilophus*, 1. *Thriponax*, 9. *Ceophlœus*, 5. *Dryotomus*, 2. *Picus*, 1.

2. Subfamily **Picumninæ**.
   Picumnus, 33. *Nesoctites*, 1. *Verreauxia*, 1. *Sasia*, 3.

3. Subfamily **Iynginæ**.
   Iynx, 4.

Family IV. Indicatoridæ.

Indicator, 9. *Prodotiscus*, 2.

Family V. Capitonidæ.

Pogonorhynchus, 1. *Erythrobucco*, 1. *Melanobucco*, 13. *Tricholæma*, 7. *Gymnobucco*, 2. *Heliobucco*, 1. *Smilorhis*, 2. *Barbatula*, 14. *Stactolæma*, 3. *Calorhamphus*, 2. *Megalæma*, 2. *Chotorhea*, 4. *Cyanops*, 20. *Mesobucco*, 2. *Xantholæma*, 6. *Psilopogon*, 1. *Trachyphonus*, 10. *Capito*, 15. *Tetragonops*, 2.

Family VI. Rhamphastidæ.

Rhamphastos, 14. *Andigena*, 6. *Pteroglossus*, 18. *Selenidera*, 7. *Aulacorhamphus*, 14.

Order IV. COCCYGES.

Suborder I. MUSOPHAGI.

Family I. MUSOPHAGIDÆ.

Turacus, 14. *Musophaga*, 2. *Gallirex*, 2. *Corythæola*, 1. *Schizorhis*, 4. *Gymnoschizorhis*, 2.

Suborder II. CUCULI.

Family I. CUCULIDÆ.

Coccystes, 6. *Pachycoccyx*, 2. *Calliechthrus*, 1. *Surniculus*, 3. *Hierococcyx*, 6. *Cuculus*, 10. *Cercococcyx*, 1. *Cacomantis*, 10. *Misocalius*, 1. *Chrysococcyx*, 4. *Chalcococcyx*, 13. *Coccyzus*, 8. *Urodynamis*, 1. *Eudynamis*, 6. *Microdynamis*, 1. *Rhamphomantis*, 1. *Scythrops*, 1.

Family II. CENTROPODIDÆ.

Centropus, 33.

Family III. PHŒNICOPHAINIDÆ.

Saurothera, 5. *Hyetornis*, 1. *Piaya*, 3. *Zanclostomus*, 1. *Taccocus*, 1. *Rhopodytes*, 6. *Rhinortha*, 1. *Phœnicophaës*, 1. *Rhamphococcyx*, 1. *Rhinococcyx*, 1. *Urococcyx*, 2. *Dryococcyx*, 1. *Ceuthmochares*, 3. *Dasylophus*, 1. *Lepidogrammus*, 1. *Coua*, 12.

Family IV. NEOMORPHIDÆ.

Carpococcyx, 1. *Neomorphus*, 5. *Geococcyx*, 2. *Morococcyx*, 1.

Family V. DIPLOPTERIDÆ.

Diplopterus, 1. *Dromococcyx*, 2.

Family VI. CROTOPHAGIDÆ.

Crotophaga, 3. *Guira*, 1.

Order V. COLUMBIFORMES.

Suborder I. COLUMBÆ.

Family I. COLUMBIDÆ.

1. Subfamily **Treroninæ**.

Treron, 37. *Ptilonopus*, 51.

2. Subfamily **Columbinæ**.

Carpophaga, 63. *Lopholaimus*, 1. *Columba*, 51. *Ectopistes*, 4. *Œna*, 1. *Geopelia*, 6. *Macropygia*, 19. *Turtur*, 25.

3. Subfamily **Gourinæ**.

Chamæpelia, 8. *Columbula*, 6. *Zenaida*, 14. *Peristera*, 48. *Starnœnas*, 1. *Ocyphaps*, 1. *Petrophassa*, 1. *Chalcophaps*, 10. *Trugon*, 1. *Henicophaps*, 1. *Phaps*, 3. *Goura*, 3.

Family II. DIDUNCULIDÆ.
Didunculus, 1. *Geophaps*, 1.

Suborder II. PTEROCLETES.

Family I. PTEROCLIDÆ.
Pterocles, 14. *Syrrhaptes*, 2.

Order VI. PSITTACI.

Family I. NESTORIDÆ.
Nestor, 5.

Family II. LORIIDÆ.
Chalcopsittacus, 7. *Eos*, 12. *Lorius*, 10. *Calliptilus*, 1. *Vini*, 2. *Coriphilus*, 2. *Trichoglossus*, 12. *Psitteuteles*, 4. *Ptilosclera*, 1. *Glossopsittacus*, 5. *Hypocharmosyna*, 9. *Charmosynopsis*, 2. *Charmosyna*, 3. *Oreopsittacus*, 1.

Family III. CYCLOPSITTACIDÆ.
Neopsittacus, 3. *Cyclopsittacus*, 15.

Family IV. CACATUIDÆ.

1. Subfamily **Cacatuinæ.**
Microglossus, 1. *Calyptorhynchus*, 7. *Callocephalon*, 1. *Cacatua*, 15. *Licmetis*, 2.

2. Subfamily **Calopsittacinæ.**
Calopsittacus, 1.

Family V. PSITTACIDÆ.

1. Subfamily **Nasiterninæ.**
Nasiterna, 10.

2. Subfamily **Conurinæ.**
Anodorhynchus, 3. *Cyanopsittacus*, 1. *Ara*, 15. *Rhynchopsittacus*, 1. *Conurus*, 28. *Conuropsis*, 1. *Cyanolyseus*, 2. *Gnathosittaca*, 1. *Henicognathus*, 1. *Microsittace*, 1. *Pyrrhura*, 19. *Myopsittacus*, 2. *Bolborhynchus*, 7. *Psittacula*, 9. *Brotogerys*, 11.

3. Subfamily **Pioninæ.**
Chrysotis, 42. *Pachynus*, 1. *Pionus*, 10. *Deroptyus*, 1. *Triclaria*, 1. *Pionopsittacus*, 9. *Gypopsittacus*, 1. *Urochroma*, 8. *Caica*, 4. *Pœocephalus*, 14.

4. Subfamily **Psittacinæ.**
Psittacus, 2. *Coracopsis*, 5. *Dasyptilus*, 1.

5. Subfamily **Palæornithinæ.**
Eclectus, 6. *Geoffroyus*, 15. *Prioniturus*, 7. *Tanygnathus*, 8. *Palæornis*, 23. *Polytelis*, 3. *Ptistes*, 3. *Aprosmictus*, 8. *Pyrrhulopsis*, 5. *Psittacella*, 3. *Psittinus*, 1. *Bolbopsittacus*, 3. *Agapornis*, 7. *Loriculus*, 20.

6. Subfamily **Platycercinæ.**
Platycercus, 13. *Porphyrocephalus*, 1. *Barnardius*, 3. *Psephotus*, 6. *Neophema*, 7. *Cyanorhamphus*, 14. *Nymphicus*, 2. *Nanodes*, 1. *Melopsittacus*, 1. *Pezoporus*, 1. *Geopsittacus*, 1.

Family VI. Stringopidæ.
Stringops, 2.

Order VII. RAPTORES.

Suborder I. FALCONES.

Family I. Falconidæ.

1. Subfamily **Falconinæ.**
Falco, 25. *Hierofalco*, 6. *Hieracidea*, 2. *Cerchneis*, 22. *Baza*, 10. *Harpagus*, 3. *Ictinia*, 2. *Microhierax*, 4. *Poliohierax*, 2. *Spiziapteryx*, 1. *Harpa*, 1.

2. Subfamily **Aquilinæ.**
Gypaetus, 2. *Uroaetus*, 1. *Aquila*, 9. *Nisaetus*, 4. *Lophotriorchis*, 2. *Neopus*, 1. *Spiziastur*, 1. *Spizaetus*, 14. *Lophoaetus*, 1. *Asturinula*, 1. *Herpetotheres*, 1. *Dryotriorchis*, 1. *Circaetus*, 5. *Spilornis*, 6. *Butastur*, 4. *Helotarsus*, 2. *Haliaetus*, 7. *Polioaetus*, 2. *Gypohierax*, 1. *Haliastur*, 2. *Elanoides*, 1. *Nauclerus*, 1. *Milvus*, 7. *Lophoictinia*, 1. *Rostrhamus*, 3. *Leptodon*, 4. *Gypoictinia*, 1. *Elanus*, 5. *Gampsonyx*, 1. *Henisapernis*, 1. *Machærhamphus*, 2. *Pernis*, 3.

3. Subfamily **Accipitrinæ.**
Polyboroides, 2. *Circus*, 15. *Micrastur*, 7. *Geranospizias*, 2. *Urotriorchis*, 1. *Erythrocnema*, 1. *Melierax*, 6. *Astur*, 30. *Nisoides*, 1. *Accipiter*, 23.

4. Subfamily **Buteoninæ.**
Urospizias, 1. *Heterospizias*, 1. *Tachytriorchis*, 2. *Buteo*, 18. *Archibuteo*, 4. *Buteola*, 1. *Asturina*, 7. *Busarellus*, 1. *Buteogallus*, 1. *Urubitinga*, 12. *Harpyhaliaetus*, 1. *Morphnus*, 1. *Thrasaetus*, 1.

5. Subfamily **Polyborinæ.**
Polyborus, 2. *Ibycter*, 8.

Family II. Pandionidæ.
Pandion, 1.

Family III. Vulturidæ.
Vultur, 1. *Gyps*, 6. *Pseudogyps*, 2. *Otogyps*, 2. *Lophogyps*, 1. *Neophron*, 4.

Suborder II. SERPENTARII.

Family I. Gypogeranidæ.

Gypogeranus, 1.

Suborder III. CATHARTES.

Family I. Sarcorhamphidæ.

Sarcorhamphus, 2. *Cathartes*, 1. *Catharistes*, 1. *Rhinogryphus*, 5.

Suborder IV. STRIGES.

Family I. Bubonidæ.

I. Subfamily **Buboninæ.**

Ketupa, 3. *Scotopelia*, 3. *Bubo*, 17. *Scops*, 25. *Nyctea*, 1. *Surnia*, 1. *Carina*, 3. *Heteroglaux*, I. *Speotyto*, 2. *Gymnasio*, 2. *Ninox*, 25. *Sceloglaux*, I. *Glaucidium*, 20. *Microthene*, 1.

2. Subfamily **Syrniinæ.**

Asio, 9. *Syrnium*, 29. *Nyctala*, 2.

Family II. Strigidæ.

Strix, 5. *Phodilus*, 1.

Order VIII. STEGANOPODES.

Family I. Pelecanidæ.

1. Subfamily **Pelecaninæ.**

Pelecanus, 10. *Sula*, 9.

2. Subfamily **Phalacrocoracinæ.**

Phalacrocorax, 39. *Plotus*, 4.

Family II. Phaetontidæ.

Phaeton, 4.

Family III. Tachypetidæ.

Tachypetes, 2.

Order IX. HERODIONES.

Family I. Ardeidæ.

1. Subfamily **Ardeinæ.**

Ardea, 62.

2. Subfamily **Botaurinæ.**

Botaurus, 6. *Tigrisoma*, 4. *Nyctiardea*, 10.

Family II. Scopidæ.

1. Subfamily **Scopinæ.**

Scopus, 1.

2. Subfamily **Cancrominæ.**
Cancroma, 1.

3. Subfamily **Balænicipitinæ.**
Balæniceps, 1.

Family III. Ciconiidæ.

1. Subfamily **Ciconiinæ.**
Ciconia, 6. *Mycteria*, 4. *Leptoptilus*, 3. *Tantalus*, 5.

2. Subfamily **Anastomatinæ.**
Anastomus, 2.

Family IV. Plataleidæ.
Platalea, 5.

Family V. Ibididæ.
Ibis, 24.

Order X. ALECTORIDES.

Suborder I. GRUARIÆ.

Family I. Gruidæ.
Balearica, 2. *Grus*, 15.

Family II. Turnicidæ.
Turnix, 23. *Ortyxelos*, 1. *Pedionomus*, 1.

Family III. Rhinochetidæ.
Rhinochetus, 1. *Mesites*, 1.

Family IV. Eurypygidæ.
Eurypyga, 1.

Suborder II. FULICARIÆ.

Family I. Otidæ.
Otis, 2. *Eupodotis*, 24.

Family II. Cariamidæ.
Cariama, 1. *Chunga*, 1.

Family III. Heliornithidæ.
Heliornis, 1. *Podica*, 4.

Family IV. Rallidæ.

1. Subfamily **Rallinæ.**
Ocydromus, 6. *Rallus*, 27. *Rallina*, 16. *Aramus*, 18. *Aramides*, 26. *Crex*, 25. *Porzanula*, 1. *Himathornis*, 1.

2. Subfamily **Gallinulinæ.**
Porphyrio, 15. *Notornis*, 1. *Tribonyx*, 3. *Gallinula*, 16. *Pareudiastes*, 29. *Habroptila*, 1. *Fulica*, 12.

Family V. Psophiidæ.
Psophia, 6.

Order XI. GALLIFORMES.

Suborder I. DYSODÆ.

Family I. Opisthocomidæ.
Opisthocomus, 1.

Suborder II. GALLINÆ.

Family I. Phasianidæ.

1. Subfamily **Pavoninæ.**
Pavo, 2. *Polyplectron*, 5. *Argus*, 4. *Crossoptilon*, 1.

2. Subfamily **Lophophorinæ.**
Lophophorus, 3. *Tetraophasis*, 1. *Tragopan*, 5. *Pucrasia*, 4.

3. Subfamily **Meleagrinæ.**
Meleagris, 3.

4. Subfamily **Phasianinæ.**
Phasianus, 13. *Thaumalea*, 2.

5. Subfamily **Euplocaminæ.**
Euplocamus, 12. *Ithaginis*, 2.

6. Subfamily **Gallinæ.**
Gallus, 4.

7. Subfamily **Numidinæ.**
Phasidus, 1. *Agelastes*, 1. *Acryllium*, 1. *Numida*, 9.

Family II. Tetraonidæ.

1. Subfamily **Perdicinæ.**
Galloperdix, 1. *Hepburnia*, 2. *Francolinus*, 36. *Perdix*, 15. *Coturnix*, 20.

2. Subfamily **Rollulinæ.**
Rollulus, 3.

3. Subfamily **Odontophorinæ.**
Odontophorus, 17. *Dendrortyx*, 3. *Cyrtonyx*, 3. *Eupsychortyx*, 5. *Ortyx*, 13. *Callipepla*, 5. *Lophortyx*, 2.

4. Subfamily **Caccabininæ.**
Lerwa, 1. *Caccabis*, 8. *Tetraogallus*, 5.

5. Subfamily **Tetraoninæ.**
Tetrao, 12. *Bonasa*, 4. *Lagopus*, 6.

Family III. Cracidæ.

1. Subfamily **Cracinæ.**
Crax, 8. *Nothocrax*, 1. *Pauxi*, 1. *Mitua*, 2.

2. Subfamily **Penelopinæ.**
Steganolæma, 1. *Penelope*, 13. *Penelopina*, 1. *Pipile*, 3. *Aburria*, 1. *Chamæpetes*, 2. *Ortalida*, 18.

3. Subfamily **Oreophasinæ.**
Oreophasis, 1.

Family IV. Megapodidæ.
Megacephalon, 1. *Leipoa*, 1. *Talegallus*, 7. *Megapodius*, 19.

Order XII. LIMICOLIFORMES.

Suborder I. LIMICOLÆ.

Family I. Charadriidæ.
Œdicnemus, 9. *Charadrius*, 29. *Ægialitis*, 11. *Anarhynchus*, 1. *Vanellus*, 13. *Lobivanellus*, 13. *Cursorius*, 10. *Glareola*, 10. *Dromas*, 1. *Chionis*, 2. *Attagis*, 4. *Thinocorus*, 4. *Himantopus*, 8. *Recurvirostra*, 3. *Hæmatopus*, 7. *Ibidorhynchus*, 1. *Numenius*, 12. *Phalaropus*, 3. *Totanus*, 17. *Limosa*, 4. *Ereunetes*, 4. *Strepsilas*, 3. *Machetes*, 1. *Tringa*, 14. *Eurynorhynchus*, 1. *Phegornis*, 3. *Rhynchæa*, 3. *Scolopax*, 4. *Gallinago*, 16.

Family II. Parridæ.
Parra, 10. *Hydrophasianus*, 1.

Suborder II. GAVIÆ.

Family I. Sternidæ.
1. Subfamily **Sterninæ.**
Hydrochelidon, 3. *Sterna*, 38. *Nænia*, 1. *Gygis*, 2. *Anous*, 6.
2. Subfamily **Rhynchopinæ.**
Rhynchops, 3.

Family II. Laridæ.
1. Subfamily **Larinæ.**
Pagophila, 1. *Rissa*, 2. *Larus*, 43. *Xema*, 2.
2. Subfamily **Stercorariinæ.**
Stercorarius, 6.

Order XIII. TUBINARES.

Family I. Procellariidæ.
Puffinus, 23. *Procellaria*, 21. *Fulmarus*, 33. *Œstrelata*, 18. *Prion*, 7. *Pelecanoides*, 3.

Family II. Diomedeidæ.
Diomedea, 10.

Order XIV. PYGOPODIFORMES.

Suborder I. PYGOPODES.

Family I. Colymbidæ.
Colymbus, 4.

Family II. Podicipidæ.
Podiceps, 31. *Podilymbus*, 3.

Suborder II. ALCÆ.

Family I. Alcidæ.
Alca, 2. *Fratercula*, 8.

Family II. Simorhynchidæ.
Cerorhinca, 2. *Simorhynchus*, 9.

Family III. Uriadæ.
Brachyrhamphus, 7. *Uria*, 8. *Alle*, 1.

Order XV. LAMELLIROSTRES.

Suborder I. PHŒNICOPTERI.

Family I. Phœnicopteridæ.
Phœnicopterus, 8.

Suborder II. ANSERES.

Family I. Plectropteridæ.
Anseranas, 1. *Plectropterus*, 2. *Sarkidiornis*, 2. *Chenalopex*, 3.

Family II. Anseridæ.
Cereopsis, 1. *Anser*, 14. *Branta*, 18. *Nettapus*, 4.

Family III. Cygnidæ.
Cygnus, 11.

Family IV. Anatidæ.
Dendrocygna, 10. *Tadorna*, 3. *Casarca*, 5. *Aix*, 2. *Mareca*, 4. *Dafila*, 6. *Anas*, 18. *Querquedula*, 18. *Chaulelasmus*, 2. *Spatula*, 5. *Malacorhynchus*, 1. *Cairina*, 1.

Family V. Fuligulidæ.
Fuligula, 1. *Fulix*, 5. *Aythya*, 7. *Bucephala*, 5. *Harelda*, 1. *Hymenolaimus*, 1. *Camptolaimus*, 2. *Stelleria*, 1. *Somateria*, 4. *Oidemia*, 6.

Family VI. Erismaturidæ.
Biziura, 1. *Thalassornis*, 1. *Erismatura*, 6. *Nesonetta*, 1.

Family VII. MERGIDÆ.
Merganetta, 3. *Mergus*, 6. *Mergellus*, 1.

Suborder III. PALAMEDEÆ.

Family I. PALAMEDEIDÆ.
Palamedea, 1. *Chauna*, 2.

Order XVI. IMPENNES.

Family I. APTENODYTIDÆ.
Spheniscus, 1. *Eudyptes*, 16. *Aptenodytes*, 2.

Order XVII. CRYPTURI.

Family I. TINAMIDÆ.

1. Subfamily **Tinaminæ.**
Tinamus, 7. *Nothocercus*, 3. *Crypturus*, 16. *Rhynchotus*, 2. *Nothoprocta*, 4. *Nothura*, 4. *Taoniscus*, 1.

2. Subfamily **Tinamotinæ.**
Calodromas, 1. *Tinamotis*, 1.

Subclass II. RATITÆ.

Order XVIII. STRUTHIONES.

Suborder I. APTERYGIFORMES.

Family I. APTERYGIDÆ.
Apteryx, 4.

Suborder II. DROMÆIFORMES.

Family I. DROMÆIDÆ.
Casuarius, 9. *Dromæus*, 2.

Family II. STRUTHIONIDÆ.
Struthio, 1. *Rhea*, 2. *Pterocnemis*, 1

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