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THE STATUS OF THE ALGO-LICHEN HYPOTHESIS.

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IN treating this subject it will not be out of place to give first a short history of the growth of knowledge concerning lichens and their structure. The earlier lichenologists knew but very little of lichens as now understood, and comparatively nothing as to their internal structures. As the magnifying power of microscopes was increased, so the knowledge of the lichen thallus was increased. The affinities of lichens to the discomycetous fungi on the one hand and to the algæ on the other were early noticed and commented upon, and some species have been alternately placed among the fungi, then among the lichens, and others have been repeatedly changed from lichens to algæ, and vice versa. Later authors, as Cornu and Tulasne, consider the lichen very near if not belonging to the Ascomycetes, while De Bary, Krabbe, and others place them among the Ascomycetes without any doubt as to that being the proper place for them.[1] Lately Cora and several other genera have been placed among the lichens under the name of Hymenolichens—*i.e.*, lich-

[1] Stahl found the reproductory organs of Collema to be very similar to those of the Discomycetes. Borzi confirmed Stahl's observations by his own. Fünfstück, after a study of the development of the apothecia of Peltigera and Nephroma, believed that "the reproduction is by apogamy, with rudimentary sexual organs, as in Podosphæra among the Discomycetes." De Bary says (Morph. and Biol. of Fungi, etc.): "The formation of the perithecia of lichens from the primordial coils of hyphæ follows in general the same course as that of Xylaria, Polystigma, etc." This is confirmed by the observations of Krabbe, Füisting, and others who have made an extended study of the Cladoniæ, Sphyridium, Lecanora, Lecidea, etc.

ens which, according to Johow, are made up of the hyphal elements of a hymenomyceteous fungus and an alga. Massee claims to have discovered a Gasterolichen. So that now we have lichens placed among the Ascomycetes and the Basidiomycetes, and by good authority.

Wallroth (1825) was the first to make any study of the gonidia. He was followed by Koerber (1839), who studied them more fully than did Wallroth. But not until 1851 was made anything like an explanation as to their probable origin and subsequent growth. This was done by Bayrhoffer. He asserted that the gonidia came from the "fibrous stratum, the fibres of which swelled at the top and produce male gonidia." Speerschneider, who was the next to study the gonidia, differed from Bayrhoffer on some points, but agreed as to their probable origin. Schwendener, in his earlier works, took a similar view, basing his argument on the fact that the gonidia, many of them, seemed to be connected with the ends of the hyphæ. De Bary, in his work of 1865, agreed with Schwendener as to the heteromerous lichens, but in case of such species as belong to the Collemaceæ, etc., he said: "Either the lichens in question are the perfectly developed states of plants whose imperfectly developed forms have hitherto stood among the algæ as Nostocaceæ and Chroococceæ, or the Nostocaceæ and Chroococceæ are typical algæ, which assume the form of *Collema, Ephebe,* etc., through certain parasitic Ascomycetes penetrating into them, spreading their mycelium into the continuously growing thallus and becoming attached to their phycochrome-containing cells." This gave to Schwendener the idea of *dualism* which he afterward formulated and presented to the world. Such was the beginning of the much-debated "Algo-Lichen hypothesis." Schwendener in this famous theory declares that all lichens, so-called, are dual organisms, consisting of a fungus, parasitic upon an alga, whole colonies of which it envelops with hyphæ. These algæ he divides into two classes, Phycochromaceæ, or those with bluish-green coloring matter, phycochrome, and Chlorophyllaceæ, or those containing chlorophyll. The first of these he divides into five types: 1, Sirosiphoneæ; 2, Rivularieæ; 3, Scytonemeæ; 4, Nostocaceæ; 5, Chroococceæ. The latter he separates into three types: 1, Confervaceæ; 2, Chroolepideæ; 3, Palmellaceæ. To some one of these types, he claimed, the gonidia of every lichen could be referred.

About this time Famentzin and Baranetzky by cultivating the gonidia of several lichens (*Physcia* [*Theloschistes*] *parietina,* etc.)

produced zoospores. These in time developed into unicellular algæ, and by judicious management they produced several generations. Although they drew different ideas from this the Schwendenerians immediately took this as an argument for the dualism of lichens. Later (1872) Woronin confirmed the observations of Famentzin and Barentzky by his own experiments made with *Parmelia pulverulenta*.

When Schwendener propounded his theory one of the first to accept it was E. Bornet. He immediately began a series of observations and experiments to prove it. In his treatment of this subject (*An. de Sc. Nat.*, vol. 17, ser. 5) he divides his observations into two divisions corresponding to those of Schwendener—*i.e.*, those made upon lichens with chlorophyll-bearing gonidia, and lichens with phycochrome-bearing gonidia. Under the chlorophyll-bearing gonidia he found those belonging to such genera as Trentepohlia, Phyllactidium, Protococcus, Cystococcus, Pleurococcus, etc. He found the gonidia of several of the Opegraphæ, as *O. varia*, to be Trentepohlia. The branches of the alga were found ramifying the tissues of the bark, frequently going so far that the hyphæ of the lichen-fungus could not follow them. As they near the outer surface of the bark the hyphæ and algæ became more and more interlaced until they reached the thallus proper. When studied at all ages of the thallus the nature of the relations between the two were easily seen to be such as to preclude every chance of the one being developed from the other. The study of other lichens with similar gonidia, as *Verrucaria nitida, Rocella phycopsis, Chiodecton nigrocinctum*, etc., led to the same conclusions.

The gonidia of *Opeg. felicina* he found to be a Phyllactidium. The broad thallus of this alga was so large that the hyphæ did not entirely envelop it, but by gradually branching, surrounded parts of it and even sent small branches *into* it. He found in an old thallus of *Opegrapha varia* the normal filaments of Trentepohlia together with sporangia, showing that it could not be the "first stage of the lichens," but was an entirely separate plant. He sowed the spores of *Physcia* (*Theloschistes*) *parietina* on *Protococcus viridis*, and found that the hyphæ of the germinating spores readily enveloped the algæ, and did not envelop any other objects with which they came in contact. He also sowed spores apart from the algæ, and although germinating and producing hyphæ as did the others, they produced no gonidia and died as soon as the nourishment from the spore was consumed. He obtained similar results with *Biatora muscorum*.

As to those lichens containing phycochromgonidia, he found that Colothrix furnished gonidia for *Lichina pygmæa* and *confinis;* Scytonema and Lyngbya were found in such genera as Pannaria, Erioderma, and Stereocaulon (Cephalodia); Nostoc was found in Collema and allied genera; Etigonema in Ephebe, Spilonema, etc. ; and Glœocapsa in Synallisa, Cora, Omphalaria, and similar genera. Sometimes he found the alga to be very little changed by the parasitism as in Ephebe and Spilonema; at others they were so changed as to be recognized only with difficulty. Two modes of contact were noticed : 1. Where the hyphæ are applied simply to the surface of the algæ, as in Peltigera, Stictina, etc. 2. Where the hyphai branches enter the algal cells, as in Physcia, Omphalaria, etc. From these observations he draws the following conclusions: that since Trentepohlia, Phyllactidium, etc., are so complex in their nature, and since no instance of the hyphæ enlarging and producing them has been found, and since these algæ (Phyllactidium, Trentepohlia, Nostoc, Protococcus, etc.) are found in the free state, there can be no doubt of the dual nature of those lichens containing them, and that, 1st, all gonidia can be referred to some algal type; and, 2d, the relations between hyphæ and gonidia are such as to exclude all possibility of one being produced from the other, and the theory of parasitism alone can explain these relations satisfactorily.

Reess made a series of cultivations with spores of *Collema glaucescens* sown with *Nostoc lichenoides.* By careful manipulation he produced a complete Collema thallus, but lacking the fruits. He saw the germinating spores "send out hyphæ which branched and forced themselves into the Nostoc."

Treub used the gonidia of one species of lichen and the spores of another. His success was similar to that of Reess

Stahl uses the hymeneal gonidia and spores of *Endocarpon pusillum* and spores of *Thelidium minutulum.* He succeeded in producing a fully developed thallus, showing that these hymenial gonidia are ejected at the same time as the spores, to serve as gonidia for the young plants. He cultivated these hymenial gonidia separately, and found them to grow and divide just as do the undoubted unicellular algæ. Lately Bounier has succeeded in producing a complete lichen thallus with mature fruits by using lichen spores and algæ.

Among the botanists in the United States who have favored Schwendenerism in their later works are Dr. Asa Gray, Dr. Bessey, H. Willy, etc.

Most of the English lichenologists, together with Koerber, Nylander, and Th. Fries, oppose the theory of "dualism of lichens." There are, however, several different ideas as to the origin of the gonidia, Fries holding one opinion, Nylander another, and Crombie, taking a mean between the two, seems to believe either. Muller supports the "micro-gonidia" theory of Dr. Minks, as did the lamented Professor Tuckerman. Nylander, while acknowledging the external similarities between lichens and ascomycetous fungi, asserts, as does Crombie, that there are too many differences between them to admit of their being placed together. "The hyphæ of lichens," he says, "are perennial, tough, thick-walled, straight, and insoluble in hydrate of potassium, while the hyphæ of all fungi are soft, thin-walled, flexuous, immediately dissolved in hydrate of potassium." Besides the "Lichenian reaction" is seen in all lichens and in none of the fungi. Both these points are denied by many eminent lichenologists and fungologists. De Bary has found the "Lichenian reaction" in several undoubted fungi. Hartog, de Seynes, etc., say that fungal hyphæ are no more soluble in hydrate of potassium than are lichen hyphæ.

Nylander also speaks of the "improbability" of the lichen hyphæ being endowed with the reason and sagacity necessary to search out a peculiar kind of algæ which it may imprison and press into service." [1] He further urges, as does Crombie and others, that no algæ will grow in such bare, exposed places as those chosen by most lichens. Cooke, who uses this same argument, says further that those lichens that do grow in low, wet places, as Collema, etc., are by some authors supposed to be algæ themselves and therefore should not be used in an argument for Schwendenerism. Nylander, however, takes an opposite view and places many of the algæ of Schwendener and Bonet, etc. (such as Sirosiphon, Scytonema, Stig nema, Nostoc, Trentepohlia, etc.) among the lichens, as he has found fruits upon them. But he finds no hyphæ. From these discoveries he argues that even if there is parasitism, it is not that of a fungus upon an alga, but rather of a lichen upon a lichen. He was one of the first to place Cora among the lichens.

Crombie says that finding and producing of zoospores in free gonidia does not prove that gonidia are identical with algæ, but that they are *only similar to them.*

The autonomists raise quite an objection as to the relative size of

[1] Why is it that any parasite, either vegetable or animal, is generally limited to but one or at most to but a few species upon which it feeds?—Heredity, etc.

"Parasite" and "Host," and insist that there can be no such a thing as a "mutual benefit" parasitism in nature as is claimed to be present in case of the lichen-fungi and the algæ. The latter objection Sargent explains (*Am. Mo. Mic. Jour.*, Feb., 1887) by saying that while the algæ furnish the necessary nourishment for the fungus, the latter in turn protects the former from excessive dryness and sunshine, allowing only enough softened light as is necessary to decompose the carbon dioxide, and, by acting as a sponge, takes up water readily and retains it, thus insuring at least a moderate supply of water for the algæ even in dry weather ; moreover, it is a well-known fact that fungi in growing give off carbonic dioxide. This the lichen hyphæ furnish to the algæ, and they in turn give back oxygen, etc., to the hyphæ. As to the fact that some lichens grow in comparatively dry places, he thinks that this is not a very serious objection, since in some lichens we have hymenial gonidia which are ejected together with the spores ; in others soredia, by means of which new plants can be formed without the aid of spores. Again, the species of algæ supposed to act as gonidia are those species that have become adapted to the frequent dry spells incident to terrestrial life. He further insists that the differences between the fungal-algal elements of a lichen and free-living fungi and algæ are just those differences that would result from the parasitical relationship claimed by the dualists.

Nylander says that in no case do the gonidia arise from the hyphæ, but from the parenchymatous cortical cells observed by him in the prothalline filaments of germinating spores. Crombie formerly held that the gonidia might come from the hyphæ or the hyphæ from the gonidia. Later, he says the gonidia are of thalline origin. He claims to have seen the germination of spores and growth of young lichen thalli on rocks, etc., where no algæ or gonidia could be seen. At first only the young hyphæ were seen. Later, gonidia were found. These he believes to have originated in certain glomerules noticed on the young hypothallus. These glomerules he claims contain gonidia in various stages of development. They finally become thicker and form the cortical layer. He then uses Nylander's explanation as to the free state of the gonidia in the interior of the thallus: "The cortical stratum gradually increasing and extending is at the same time dissolved (resorbed, physiologically speaking) beneath, and the gonidia consequently become free." Crombie says further that "the contact between the hyphæ and gonidia is in no way genetic or parasitic. . . . The gonidia are neither adnate to or penetrated by the hyphæ, but only adherent to them by the lichenin. . . . In all cases the apparent union is simply amylaceous adherence, and the fancied penetration the result of erroneous observation." He says that Stahl's observations are of no account, as he is a very careless observer, etc.

Koerber, who is one of the best of observers, while he opposes Schwendener, admits that "the germinating spores must have free gonidia belonging to the same species in order to develop a complete thallus," but that "these gonidia are not algæ belonging to the lichens as a fungus, but *gonidia* previously separated from the thallus and which have become 'asynthetic.'" He practically admits the whole thing.

Hartog says, speaking of Crombie's arguments, that he either utterly ignores the strongest points in favor of "Parasitism" or laughs at them and says "improbable," or that they are the result of "poor work" and "erroneous observation." To use a favorite Cookian phrase, both Cooke and Crombie answer many of the best arguments in favor of "Dualism of Lichens" simply by "rhetoric."

It is a noticeable fact that in a new country where new groves of trees are being planted, before the trees show any signs of lichens they are covered, especially on the north side, by "green slime," and the thicker the "green slime" the more rapid is the growth of the lichens when they do appear. Again, it is noticeable that when lichens begin to grow on fences and trees they take the dampest, coolest, shadiest places first, and gradually, if it all, extend to the dryer places, as seen on fences where boards cross the posts, where the lichens may be seen to extend a short way from the post along the centre of the board, avoiding the dry, windy edges. Our largest lichens are almost always found in the darkest woods. These facts show that lichens in general are not the "lovers of light, dry places," as one author claims. But on the contrary, while they do not choose such places as do the saprophytic fungi, they generally choose places where plenty of the lower algæ are to be found.

Most of the botanists who have made any experiments with spores, gonidia, and algæ have obtained results conclusive enough to convince them that Schwendener is right.

In conclusion, we now have lichens belonging to the Ascomycetes, the Hymenomycetes, and the Gastromycetes, according to most of our latest and best authors. The gonidia are pretty conclusively proven to be algæ, notwithstanding Crombie's "rhetoric;" and the parasitism of the fungus hyphæ on the algæ has not only been shown to be possible but quite probable, and to be the only way to explain the peculiar relations existing between hyphæ and algæ satisfactorily. Schwendenerism, like "The Heterocism of Rusts," may be considered as a settled fact, and our "beloved lichens" must sooner or later be placed among the fungi, where they rightly belong.

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AMONG THE ANCIENT GLACIERS OF NORTH WALES.

BY F. JOHNSTON EVANS.

THERE are few spots in the British Isles which present so many attractions to the geological tourist as that most picturesque of localities into which the traveller by rail from Holyhead is suddenly ushered when the "Wild Irishman" express, which had been rushing at the rate of some sixty miles an hour across the Island of Anglesea, after emerging from the Menai tunnel, somewhat abruptly pulls up at Bangor station. Around on every side are piled strange rock formations, tilted and upturned in every conceivable fashion. Within a comparatively short distance are the famous slate quarries of Penrhyn, in themselves a beautiful study; while in nearly an opposite direction are visible the lofty summits of Snowdon and Cader-Idris. Let the reader accompany me in imagination into the midst of this magnificent mountain region, our special object being to wander and speculate, for a brief space, among the ancient glaciers of North Wales. Proceeding through the Vale of Llanberris, we perceive, lying high above the road, near the top of the pass, a huge block of stone which has long attracted the notice of even the least observant traveller. It is perched on the edge of a rock a few hundred feet above the bottom of the valley, on its northern flank—that is to say, on the left hand of the traveller who is ascending the pass. It is from fifteen to twenty feet long, and six or seven feet high, sharp and angular as on the first day that it was detached from the parent mass. It rests on a face of rock which, for a few feet, slopes sharply towards the valley beneath, and then ends in a perpendicular face of rock, and it is so lightly poised on its narrow base, that a finger-touch would seem sufficient to dislodge it from its precarious position. The thought involuntarily occurs, how came it there? What agency could have transplanted it thither without rounding or breaking off a single corner, and left it where it stands, with so cautious and gentle a hand that it rests securely not at the edge but on the side of a steep and smooth incline? It is utterly impossible that it could have rolled thither; for if so, the momentum which carried it to its present position, must have precipitated it down the cliffs below. In all probability, any force which could have moved it three inches from the top of the incline on which it rests would have been sufficient to send it crashing down to the bottom of the valley. Hardly any traveller can have passed up the vale—from one part of which this rock forms a very conspicuous object—without having had some such thought presented to his mind. Those, however, who are aware that the existence of a great glacier in this valley at some remote period is a geological certainty, will be at no loss to recognize in this rock a remarkable and most characteristic specimen of those transported blocks whose occurrence in various parts of the world, at great distances from the parent formation, was so long a mystery to the philosophic inquirer, but which are now recognized as among the surest indications of glacial action.

Climbing now from the high road to the block I have been describing, we perceive that it is only one—although much the larger—of a great number of similar blocks, which are deposited in the same manner on the sides and at the edges of the sloping or precipitous faces of rock which flank the northern side of the Vale of Llanberris. The greater part of these extend in a well-marked and tolerably regular line, and at elevations varying from 300 to 500 feet above the course of the stream, for perhaps a mile further down the valley—until, in fact, its sides become too steep and precipitous to admit of such deposits being made. Clambering along this side of the valley, we examine the faces of the rock around and beneath these blocks, and find many of them—especially such as have not been exposed to the action of the water-courses which trickle down here and there into the stream below—deeply scored with the characteristic striæ of glacial action. If we now cross to the opposite or southern side of the valley (the flank which lies beneath Snowdon), we shall find all the indications of glacial force—the deep notchings of the striæ, the polished and rounded surfaces which continental geologists term *rochers moutonnés,* and the transported blocks poised in the most critical manner upon slopes which seem too steep to give them support—still more clearly and unmistakably exhibited.

The transported blocks and glacier scratches in the Vale of Llanberris are so well known to geologists that I simply refer to them to call to the mind of the reader the general aspect of the phenomena which I am about to describe as occurring in other parts of the Snowdon district, where they are not so well known, or so universally ascribed to the action of an extinct system of glaciers. Just at the top of the Vale of Llanberris, there is a hollow in the profile of the ridge which forms its northern boundary. It lies exactly between the cluster of houses called Gorphwysfa on the south, and the lake of Cym-ffynnen, at the base of the two Glyders, on the north. A few hundred yards to the east or southeast of the lowest part, at a distance of not more than 300 yards from the great block of the Vale of Llanberris, there is a little round knoll of rock which rises by itself above the neighboring parts of the ridge. It is something like an inverted basin, so that the ground falls away pretty steeply on either side, and the top is nowhere less than fifteen or twenty feet higher than the surrounding parts. Perched on the very top of this knoll, resting on three points of contact at most, is an irregular piece of rock, of a different formation from that upon which it rests, seven or eight feet long, three or four broad, and as many high. It has never been subjected to any process of abrasion or rounding, for every corner is perfectly sharp and angular—presenting in this respect a marked contrast to the rock on which it rests, which is round and smooth, and somewhat weather-worn. What could have brought this block to its resting-place? To have rolled thither it must have rolled some twenty-five feet up-hill, from whatever direction it had come. The ridge, for some hundreds of yards on either side of the knoll, rises but gently, and presents an undulating surface, along which a sharp oblong, irregular block of stone could by no possibility have preserved for any distance a considerable velocity: and between this knoll and the spur of the Glyder Fawr—the only considerable altitude within a mile of the spot—there is a hollow at least 150 feet in depth. But a little below the top of the knoll, on its eastern slope, is a still more remarkable block. It is about the same size as that which is seated on the summit of the knoll, and similarly sharp and angular, but consists of a coarse conglomerate of a very marked and peculiar kind, in which large round white pebbles, apparently of quartz, are imbedded in a kind of matrix, which looks like a coarse red sandstone. The most incurious person can hardly fail to be struck with the great difference between the character of this rock and the clay slate upon which it rests. If the observer casts his eye around him, he will be unable to see in any direction traces of a similar geological formation in the neighboring rocks. A few feet further on, however, he will observe a third angular block of stone, larger than the others, but resting, like them, upon two or three points alone. He can hardly fail to be struck with the fact that these three blocks are in as exact and regular a line as if their places had been laid down by the nicest measurement. They run nearly northwest and southeast —about half a point to the west of N. W. and to the east of S. E.— that being the general direction of the ridge which descends from the spur of Glyder Fawr.

If we now remount to the top of the knoll, we shall perceive that the side of the steep inclines towards the hollow referred to before, is dotted here and there with large blocks of stone resting gently upon the sloping rock, or imbedded in the turf. All these, on examination, will turn out to possess the same sharp and angular character ; and all of these suggest the question : Is it possible they could have rolled so far up hill ; and were it possible, could they be as sharp and unrounded as they are? Still. however, we see no sign of the red conglomerate. As we pursue our way northwest towards the spur of the Glyder, we find the ridge growing rapidly steeper, but still we see this regular line of sharp blocks, deposited often on their sharpest edges, and nearly on the edge or backbone of the rock. As we mount, they become larger and more frequent, and amongst the higher rocks are one or two small fragments of red conglomerate—until at length, just behind a huge mass of clay-slate of a size which would do credit to any moraine in Switzerland, we come suddenly upon a block of conglomerate fifteen feet long and ten feet high, large enough and sufficiently overhanging to afford us no mean shelter from a Welsh mountain storm. Five minutes' further climbing in the same direction brings us to a most gratifying sight—a large patch, seventy or eighty yards wide, of the red conglomerate *in situ*—of exactly the same character in every respect as that which we first observed resting on the side of the clay-slate knoll some two miles away. Looking back we shall be able to trace distinctly the line of stones by which we have been guided in our ascent. It is so regular that they might almost have been dropped one after the other by a railway train. On each side of the principal line of stones we may observe other though less regular lines, by which we may very nearly map out the exact extent of the ancient moraine to which they belonged. The last deposited blocks are not a hundred feet higher than the outcropping of conglomerate ; and we are now standing nearly upon the brink of the huge lake of ice which must have filled up the bason of the Glyder Fawr and the Glyder Fach, and poured out through the opening above the well-known little inn of Pen-y-gwryd into the valley of Gwryd, and terminated in the open space of the wide valley. Many of the rocks on the southern side of the opening, just above the lake which now occupies the bottom of the hollow between the two Glyders, present the general appearance of glacier-rounded rocks. But the material is so soft, and therefore so ill adapted for preserving the minuter and more indisputable marks of glacier action, that it would be unsafe to draw conclusions from their configuration, were they not supported by the independent testimony of the old moraine, which, with the exception perhaps of the moraine of the great glacier that filled up the whole basin of Snowdon, is the best defined that we may see in North Wales. The southern side of this hollow—forming the northern flank of the ridge along which lies the moraine of the Glyder—is also of a soft and easily disrupted stone, and much covered with turf and mould ; and accordingly we are unable to find any very distinct marks of striæ. The places where the rock is least covered and has been least exposed to the obliterating action of trickling water, are the places where such indications could not be expected to exist—namely, near the top of the ridge, and on its southern flank, high above the Vale of Llanberris.

It is not easy to say to what system the great block in the Vale of Llanberris belongs. An attentive examination will show that it lies higher than the well-defined line of deposits which extend along the same side of the valley. Indeed, it is considerably above the level of the actual crest or col of the pass ; and there is no precipitous or disintegrated height in its immediate neighborhood from which it could very well have been detached. Indications appear to be not wanting that the great glacier of the Glyder, at some remote period, rose above the lowest part of the hollow in the ridge toward the Vale of Llanberris, and overlapped the southern flank of the ridge. If so, this block, instead of belonging to the Llanberris glacier proper, is really a contribution from the stones of the Glyder glacier, and was brought down upon its surface from some of the precipitous heights near the outcropping of the red conglomerate. Of this, however, it is difficult to speak with confidence.

We shall now select a new, and possibly a still more interesting route. At the head of the valley of Nant Francon, towering above Lake Ogwen and the high road from Bangor to Capel Curig, is the sharp and rugged peak called Tryfan—the most precipitous summit and the finest single mountain in North Wales. It is separated by a short, sharp ridge, running nearly north and south from the range of the two Glyders. Tryfan is an irregular continuation of this ridge, terminating abruptly on the Bangor road, and forming the western, as a spur of the Glyder Fach forms the eastern flank, of the romantic and secluded valley known by the name of Cwm Tryfan. The general level of this valley is considerably higher than the road, from which it is little seen, and as the approach to it is over broken and boggy ground, its very existence is unknown to multitudes of those who pass from day to day within a few minutes' walk of the spot. Yet it is one of the most curious in Wales. The explorer, on rounding the shoulder of Tryfan, comes suddenly upon a deep valley of gentle and tolerably regular inclination, half a mile wide and a mile and a half long, full, from one end to the other, of rounded and polished rocks of the most marked and characteristic aspect. They exist, not by the dozen, but by the hundred, and crop out from the moist turf all along the bottom of the hollow and to the height of several hundred feet along its sides. They are found up to nearly the same elevation along both sides of the valley, and above a well-defined line they cease altogether. Sometimes they are mere rounded knolls protruding through the turf and peat, but many of them are broad slabs and walls of living rock, hundreds of feet in length, every corner and angle of which has been carefully and elaborately rounded and polished off. More perfect specimens of the *rochers moutonnés* it would be hardly possible to imagine. Below the level of the glacier boundary, a sharp rock is not to be found, from one end of the valley to the other ; and the vast number of the rounded knolls and shoulders, together with the general coincidence in their forms and in the directions of the polished surfaces, affords conclusive proof that they were subjected to the action of one uniform, regular and constant force. The glacier which filled up this valley must have been, like the glacier of the Aar in Switzerland, remarkable for the evenness of its surface, and for the uniformity of its motion. It must have been almost a *normal* glacier —for there are no sudden contractions of its channel, no anomalous elevation of its bed. The direction of its flow must have been very nearly uniform, from its origin just beneath the ridge which connects Tryfan with Glyder Fach to its termination in the broad valley which the Capel Curig road pursues. Such a confirmation is unfavorable alike to the development of a large moraine and to the existence of that excess of pressure against the sides and bottom of the glacier which causes the deepest striations of the polished surface : and hence these indications cannot be expected to be found of so striking and unmistakable a character as in the "Cwy Dyll," the great hollow of Snowdon, with its irregular bed and contracted orifice, or in the narrow outlet of the gorge of Aberglaslyn. Nor is the rock of a kind favorable to the preservation of the minuter traces of glacier action. Still, some may be seen of a peculiarly interesting and instructive nature. The extreme regularity of the bed of the glacier, the unusual absence of all disturbing or anomalous conditions, has given rise to the formations of striæ of great length and regularity. Some of those which score the rounded rocks on the southern flank of the valley are as much as fifteen or twenty feet long, and very distinctly marked. They are the more interesting as they intersect the line of stratification, and are crossed at right angles by the superficial markings caused by the dropping of water. From the upper end of the valley the view is very striking. If we stand by the shore of the ancient sea of ice which has now melted from the sight, we can define with precision the limits which bounded it on every side, and look down upon a succession of worn and rounded surfaces, which though upon a smaller scale, are hardly less curious or characteristic than the old glacier bed of the Höllenplatte, which is crossed by the traveller from Meyringen to the Grimsel.

While one considerable glacier thus poured from the eastern base of Tryfan, one of immensely greater extent—so long, indeed, that it would bear comparison with some of the existing glaciers of Switzerland—streamed down to the northwest, occupying for many miles the valley of Nant Francon. This glacier had its origin in the romantic amphitheatre of rocks and precipices which surround Lake Idwal, one part of which is well known as the "Twll Du," or "Devil's Kitchen," and extended for at least five miles down the valley towards the spot on which Bangor now stands. The rounded and striated rocks which still tell the history of this glacier are to be found in considerable abundance, and of very characteristic form and aspects, all along the Vale of Nant Francon. No better specimen of a *rocher moutonné* exists in Switzerland than is to be seen on our left hand, as we are descending the valley, at the bridge just below Lake Ogwen, and within a few feet of the road. On the other side, the rocks rise precipitously above the road, and the glacier must have been borne with great force against the wall of rock which there checked its progress and altered its direction. Although the rock is not of a very durable kind, it is conspicuously rounded to a height of some 250 feet, where the limits of the glacier level are apparent. The upper rocks overhang the lower, and are very rough and jagged, with a trace of rubbing. Below the road on the left hand, terrace after terrace of rock is rounded and smoothed. This is the part of the valley where the glacier traces are most prominent and striking. Here, they actually obtrude themselves upon the eye, but they do not cease for many miles. The gently descending line of the glacier level may be easily traced from the road along the opposite side of the valley, the smoothing action being the more apparent from the contortion of some of the strata, as seen in the upper and unworn faces of the rock. Between five and six miles from Bangor is a very interesting group of rocks which crop out from the turf in a little wood above the road. They formed somewhat of an elevation in the glacier bed, and have consequently been subjected to severe pressure. They are worn very round and polished quite smooth, and the striæ are most distinct, passing sometimes up-hill, over the undulating surfaces.

The most striking evidences of glacier action, however, are to be found in the great hollow of Snowdon, which is literally full of them. From some distance above the Copper Lake, almost to the bottom of Nant Gwynant, they stare at us in the face at every step. The "Cwm Dyll" was one vast mass of ice from whose bosom the peak of Snowdon rose to the height of some 1000 or 1200 feet at most. Grib Goch, Grib-y-ddysgyl, Snowdon, and Lliwedd formed an amphitheatre of mountain peaks enclosing the great Snowdon glacier, as the chain of the Aiguille Verte and the de l'Echand guard the Jardin and the glacier du Talèfre; names doubtless more familiar to American travellers than those of the subsidiary peaks in the Welsh mountain ranges. A large proportion of the rock in the basin of the Snowdon range is very hard and smooth, and has preserved, in singular freshness, even the minutest scratches. It is curious to trace, as we descend from the summit of Snowdon into the bosom of the hollow, the gradually diminishing inclination of the glacier and its increasing pressure, as marked by the diminishing slope and deeper *intaglio* of the striæ. The moraine also of this glacier is wonderfully perfect. The cart-road from the now abandoned copper works is cut partly through the lateral and terminal moraines; and the sections might, save for the different geological character and the smaller size of the blocks, be that of the ancient moraine of the Mer de Glace between Les Tines and Lavanchi in the valley of Chamouni. There is the same utter absence of sorting in the disposition of the materials, and the same angularity in individual blocks—the whole being cemented together by a fine deposit of grit and sand. To use the words of Professor Forbes, in his description of the Chamouni moraine: "We find the mound to be almost entirely composed of detached fragments, rough and angular, or only rounded by partial friction, and accumulated in the utmost disorder, mingled with sand, without any appearance of stratification." Among the fragments of stone exposed by the cutting are some very interesting ones. They have originally belonged to the bed, or to the containing wall of the glacier, much higher up, from which they have been detached after being highly polished and deeply striated; and being now uncovered, they display the notchings and scourings, not, of course, in their proper and original directions, but just as they happened to have fallen when the stones were deposited in the places they now occupy.

It must have been a strange scene of desolate magnificence that North Wales presented at the epoch I am writing of. There were Snowdon and his associated peaks, the centres of one vast system of glaciers, pouring down on every side, east, west, north, and south—the Vale of Llanberris choked with ice, and fed from the heights and recesses on either side—a great glacier, taking its origin in the deep basin between Snowdon and Lliwedd, streaming up the valley of Nant Gwynant, diverted a mile or two above the site of the sleepy little hamlet of Beddgelert, by the opposing rocks at the lower extremity of Llyn y-Ddinas, and at length struggling through the narrow gorge of Aberglaslyn, rounding and scoring its rugged sides to the height of hundreds of feet. Another great glacier probably descended through the deep inlet which reached from below Llanberris to the very heart of Snowdon, extending to within four or five miles of the present coast line, and leaving records of its passage which to this day are apparent on every uncovered surface of rock along the Llanberris and Carnarvon road. Nor did the Snowdon glaciers, though the greatest, constitute the only glacier system in Wales. It is certain that from the group of the Glyders and Tryfan, no less than three glaciers—one of vast extent—poured into the vales and plains below; and probably round every peak or group of nearly equal height, and whose masses are broken up into those deep hollows and amphitheatres which are so favorable to the collection of a reservoir of snow—and, in a climate of variable temperature, to the consequent development of glaciers—similar ice-streams must have filled up the valleys and choked the gorges in every direction. The great peculiarity of this scenery must have been the small elevation of the peaks and mountain ranges above the general level of the glaciers. In Switzerland the summits commonly tower for thousands of feet above the highest parts of the highest glaciers, properly so-called; and the great glacier basins and reservoirs are commonly bounded by huge aretes of bare and rugged rock, specked only with snowy deposits, such as the ranges which hem in the glaciers de l'Echand, the central tributary of the Mer de Glace, or which block up the extremities of the glacier of the Aar and the lower glacier of Grindelwald. In Wales, the corresponding heights must have been measured by hundreds, instead of thousands of feet, for many of the glacier basins themselves lie high; and in this respect, despite the magnificent effect of such a wide expanse of snow and of broken and crevassed ice, the difference must have been unfavorable to the grandeur of the scenery. Something of the same kind may be seen in the northern glaciers of Norway, though the heights which surmount them are higher above the glacier level than was probably the case in North Wales, and there is no reason to suspect the existence in Wales of those vast fields of snow whose aspect and distinguishing peculiarities are so essentially different from those glaciers, and which give to the scenery of Norway a character so unique and extraordinary.

THE FOOD OF THE OWLS.

BY W. S. STRODE, M.D.

A FEW years ago Pennsylvania, Ohio, and some of the more eastern States enacted laws offering a bounty of fifty cents per head for all hawks and owls that should be killed.

This munificent bounty aroused the professional hunters, and for the time being legitimate game was abandoned in many sections of these States for the more remunerative business of hawk and owl shooting. Thousands were killed and the Raptores seemed in a fair way to be exterminated.

This merciless slaughter arrested the attention of ornithological and scientific societies, and they at once set to work to devise means to check the work of destruction.

Committees and individuals were appointed to investigate the food habits of the hawks and owls. Hundreds of dissections of stomachs were made, and after a thorough research the following report was made :

"*Resolved*, That the hawks and owls are of great benefit to the farmer and render him far greater service than injury, and that it is unwise to select any of them for destruction."

This report was concurred in by the leading naturalists throughout the length and breadth of the land, and as a consequence these obnoxious laws have been repealed.

A partial exception was made against the Sharp-shinned Hawk, Coopers' Hawk, and the Great-horned Owl.

It is to the latter bird that I will mainly give attention.

As the eagle heads the list of the diurnal birds of prey, so is the Great-horned Owl the most noble of the nocturnal birds, and the ancients chose well when they assigned to Minerva this bird as the emblem of wisdom.

Owing to a suitable habitat probably more of these owls are to be found in the Spoon River country of Central Illinois than in any other section of like limits in the United States. From my boyhood to the present they have always excited within me a lively interest and curiosity.

Their unsavory reputation as chicken thieves has led to their being destroyed whenever possible, and as a consequence in many parts of the country where they were once quite common they are now extinct.

This bad reputation and consequent destruction of this owl, in my experience and observation, is not all deserved.

Many times when a lad have my slumbers been broken in upon by my mother's voice calling up the stairway, "Get up quick ! an owl is after the chickens." A careful investigation would reveal the intruder perched in the top of an apple-tree or on a limb close by the side of an old hen that would be waking the echoes of the night with her squalling. The owl in the meantime would be bowing and swaying his body to and fro, occasionally uttering a low hoo! hoo! hoo! seemingly regarding the whole performance as a huge joke.

Unfortunately for the owl, this comedy would sometimes be quickly turned to a tragedy by a load from my shotgun, bringing him to the ground, and perhaps the hen also.

The principal food of the owl in the Spoon River country consists of small rodents, and the gray rabbit furnishes the greater part of it. Reference to my note-book for the years 1887–8 shows the following:

March 20, '87. Found a Bubo's nest in a large red oak tree, forty feet to first limb, seventy-five to nest. A tremendous climb, but with the aid of a splendid pair of climbers I got up to it, finding it occupied by a trio of downy baby owls of different sizes, who tried to look very fierce at my intrusion. In the nest with them was a whole rabbit and parts of another.

March 27, '87. Great-horned Owl's nest in white oak tree, standing in a steep hollow. Could see young birds from hillside above. An easy climb to the nest found it containing two half-grown young and half of a rabbit.

March 30, '87. Discovered a Great-horned Owl's nest in a cavity of a soft maple tree, thirty feet from ground. Found in it three young and parts of several rabbits.

March 31, '87. Located a Bubo's nest in an elm snag fourteen feet high, standing on a creek bank. Found in the nest three young owls with their feathers turned wrong end to, snapping their bills wrathfully and looking the very personification of fierceness. The largest of the three was half-grown, while the smallest was near the size of a quail.

In the cavity was one whole rabbit, the hindquarters of another, a flying squirrel, and a quantity of fish-scales. While I was sitting on a limb by the side of the cavity, watching the little fellows, the parent owls suddenly appeared upon the scene, and I had a cyclone about my ears for a few minutes. Such a whirl of feathers, claws, fierce eyes, snapping beaks, hootings and screechings about my head was calculated to terrorize one unaccustomed to the actions of this, the greatest of all the owls.

After continuing these demonstrations for a few minutes, one of them, the male I supposed from his coarse voice and white crescent under the chin, settled down upon a limb a few feet from the ground just over the creek.

His manner now underwent a change. Swaying to and fro for a short time, he fell off the limb to the ground, and then tumbled about in the leaves in an apparently very crippled and helpless condition. My dog, that had been sitting all this time in a perfect frenzy of excitement at the foot of the stub, watching the owl, now forgot his training and made a headlong rush through the creek for the owl, but it was up and away, leaving him disappointed and crestfallen. I returned to the ground and departed, leaving this interesting family to the enjoyment of their well-furnished larder.

I subsequently learned that these young Bubos came to a tragic end. Some boys, finding them in the stub, threw them out into the creek, where they were worried to death by their dogs.

March 28, '88. Found a Great-horned Owl's nest containing two young owls, parts of a rabbit, and a flying-squirrel. Nest in a cavity in a soft maple.

March 29, '88. Bubo's nest in top of a white oak tree. An old nest of Red-tailed Hawk, two small young owls, a whole rabbit, and a half rabbit—a great deal more rabbit than owl.

March 30, '88. Nest in a wild cherry tree. A crow's nest preempted and reconstructed. Contained one young owl, a rabbit, a flying squirrel, and a robin. This is the only nest in which was found the remains of any bird.

Last spring, while out hunting Bubo's nests, I found a dead Screech Owl lying on the upper side of a broken plum tree limb. Its back, from the neck to the tail, was as neatly laid open as it could have been done with a sharp knife. I credited this piece of wantonness to the Great-horned Owl.

One bright day in March, '87, I was returning from a professional call. At this season of the year, when the hawks and owls are nesting, it is my custom, when not hurried by business, to leave the highways and ride haphazard through the woods, regardless of fences, hills, hollows, or creeks.

On this day I was riding leisurely along through heavy timber, down "Johnson's Creek," when my attention was arrested by the noisy cawing of a large flock of crows on the hillside two or three hundred yards to my right.

I at once guessed the cause of all this tumult to be a Great-horned Owl, for of all the denizens of the forest none other will so arouse the uncontrollable indignation of the family Corvidæ.

I had not thought of disturbing this camp-meeting of the crows, until suddenly a regular pandemonium of shrieks, and directly the scurrying by of a number of the sable birds, each one shouting bloody murder at the top of his voice, plainly told me that something terrible had happened in the dark woods on the hillside above. Turning my horse loose, I went noiselessly up the hillside on a tour of investigation.

Presently a large Bubo flew up from the ground a few rods in front of me, and upon going to the spot I discovered the cause of the sudden great consternation of the crows. The owl had wreaked summary vengeance upon one of his tormentors, and the smoking body lay upon the ground in two halves, having been divided transversely instead of lengthwise as in the case of the Screecher. A part of the viscera had been devoured.

Last spring, while wandering about in the woods on "Geetur Creek," a tributary of the Spoon, I was attracted by the barking of my dog, and on going to him, found a young Bubo that had fallen out of the parent nest. It was in a little creek bed, and the parent owls had nicely concealed it by covering it up with leaves.

I decided at once to make a pet of it. A few days later I took from a family of four in a hollow sycamore a half-grown Barred Owl (*Syrnium nebulosum*), and placed it with the first, with the intention of studying and comparing the habits and dispositions of the two birds.

They are now full grown and have indeed proved to be very interesting pets. They have the run of an outhouse that gives them plenty of room to fly about in. They have become very much attached to each other, and if one is removed from their apartment the other is inconsolable until its return. And then such a bowing and nodding to each other is ludicrous indeed. The disposition of the two birds is very dissimilar. The Bubo is by far the nobler bird —as tame as a cat, good natured and intelligent, pleased at the appearance of familiar faces, but suspicious of strangers. Always greets my appearance at the door of the owl-house with a low hoo ! hoo ! hoo ! followed immediately by a shrill screech or at times almost a quack. Greatly enjoys having his head scratched; shuts his eyes, and his voice will sink almost to a whisper.

The Syrnium is just the opposite; untamable, sneaking, revengeful ; suspicious alike of everything and everybody. Anything from mussels to cats is relished as food. Fat or tallow they will not touch. Mice, rats, ground-squirrels, kittens, chicken-heads and small birds are first thoroughly crushed by their beaks and are then usually swallowed whole. Before swallowing birds they first pluck out their feathers.

It is said that if an owl once gets a taste of fish he is a fisherman ever afterwards, and of this fact I have seen many demonstrations.

At Thompson's Lake, on the Illinois River, I have several times in the dusk of the evening seen the Barred Owl feasting on discarded fish. The shutting down of the water-gates of the mill often leaves many small fish stranded on the gravel bed of the river, just below my house, and I have many times witnessed a pair of Great-horneds fly down from the trees on the opposite bank to feast upon them.

During the summer months small fish formed the staple diet of my pair of pets, and a pound of shiners three times a day was about the amount they required.

Their manner of feeding is very different. When a canful of minnows is poured out to them the Bubo will jump into their midst, and, as my boy sometimes remarks, "Just hog them down," two at a time.

The Syrnium will pick out a particularly lively minnow, eye it for a moment, then spring upon it and grasp it in the talons of one foot, and after holding it for a few seconds quickly transfer it to his beak, after which he will gaze about defiantly for a short time and then swallow it.

This bird has developed a great hatred for the boys, probably as a result of their disposition to guy him whenever an opportunity offers. This dislike has lately taken shape by his making a dive at every boy that enters his house, raking the top of his head with his claws as he passes over him, and then giving vent to his peculiar, laughing cry of "Who ! hoo ! hoo are you !" This trick he has played so often on the "gamins," that, at present, not one of them can be induced to enter his apartments.

Some days ago a venturesome lad laid his eye up to a knot-hole in the side of the owl-house to take a peep at them. His lusty screams quickly brought me from my office to his side. The blood was running freely down his cheek. The aim of the Syrnium had been unerring. From his perch on the opposite side of the building he had made a dive for the eye, and running one foot through the hole had lacerated the skin badly, but luckily not injuring the eye.

Sometimes I put a live rabbit in the owl-house, and then there is fun to see the Bubo getting up courage to attack it. No bully ever gave better evidence of a mixture of cowardice and bravado. He will bow and sway his body to and fro, run along his perch and back again, look to me for encouragement, then bow, look at the rabbit and bow, all the while uttering his shrill scream, which becomes more and more fierce as his courage rises. Finally, after assuring him that he is a brave fellow, and no coward, to go for it, etc., he makes the attack. And now his whole nature suddenly changes, and instead of a hesitating bully he more nearly resembles a raging lion.

It is said that the tiny Downy Woodpecker more nearly resembles the great Ivory-billed than does any other of the many species of the family Picidæ.

The same may be said of the Little Screech and the Great-horned Owl, the little Scops being a tiny image in action and appearance of its great relative, from whom it probably evoluted.

In the spring and summer of 1887, at the request of Dr. R. W. Shufeldt, U. S. A., I was making a collection of nestlings of representative American birds, that was to be sent to Prof. Parker, of London, to be utilized by him in his great work on "Avian Osteology." Among the many birds brought to me by my boy collectors was a family of four young Screech Owls. Downy little fellows, all beak, claws, and eyes. Wishing to use but one of them as an alcoholic specimen, I was at a loss what to do with the others, as the nest from which they were taken was on a creek five miles away. I finally concluded to adopt them, and a family of kittens, which they resembled in many respects, would not have proved more interesting and trusting pets.

From first to last small fish was their main diet, and it was amusing, indeed, when their food was brought, to see the downy little fellows rush and tumble over each other in their eagerness to get at it. If a mouse was given to them it would first be put through a bone-breaking process and then swallowed. Small birds would be thoroughly picked and then swallowed head first.

After they became able to fly about, they were taken from the box in which they had been kept and put into the apple trees growing in my yard to shift for themselves. But they refused to shift; on the contrary, seemed to consider themselves as a part of the family, and for weeks remained about the yard, and in the dusk of the evening would come at once on being called, sometimes from the mill a hundred yards away, or from the trees across the river.

A very interesting feature connected with these little Scops was the manner in which they were treated by the other birds of the vicinity. About once a day the birds would assemble to harass and scold them, the usual time being a little before sundown. At a signal, generally from the Robin, they would come from all directions—the Jay and the Purple Grackle from their nests in the apple trees; the Rose-breasted Grosbeak from the top of the hackberry; the Cardinal and Wood Thrush from the box elders across the river; the Orioles from their swinging nests in the elm and sugar maple; the Bee Martin and Warbling Vireo from the silver-leaved; the Jenny Wren from the eaves of the portico; the Cat-bird and Brown Thrasher from the gooseberry bushes, and the Maryland Yellow Throat from his nest in the thick weeds on the river's bank—all would come to devote a few minutes to scolding their common enemy.

The Jay, the Grackle, the Cat-bird, and the Robin would do the aggressive business, while the other birds, from a respectful distance, would be the spectators. The Robin, in particular, would show the greatest excitement in these attacks. He would often fly down to the ground near where I sat and in the most frantic manner try to call my attention to the fact that there was a terrible owl in the apple tree.

At first these attacks almost frightened the Screechers to death; but they soon became accustomed to them, and, in fact, seemed rather to enjoy this bird matinée.

One of these interesting birds was stoned to death by a man as it was perched upon the fence near his repair-shop. Another was shot and killed by a *kind-hearted* lady that wished to display her marksmanship. A third is still about town, and his tremulous notes are often heard around my premises in the dusk of the evening.

PRIMITIVE ARCHITECTURE.

I.

Sociological Influences.

BY BARR FERREE.

FOOD and shelter constituted the first and chief wants of primitive man, and to their satisfaction he devoted his dormant energies. At first, unable to construct his own shelter, he was obliged to depend upon such as nature furnishes. The *cave* was at once the most convenient and the safest. Its universal use in primitive times is attested by the vast number of remains and relics we find therein. Its use by the Rock Veddahs—one of the rudest races of mankind—has continued to the present day. History, however, furnishes other reasons for the use of the cave. Thus hermits affect them that they may be uncontaminated by worldly things, and the fisherman of the Yank-tse still uses them, as they are most convenient for his occupation.

As man became more accustomed to his surrounding, as his ideas became stronger and more definite, he set about building his own shelter. At first it was a mere pile of leaves and branches. If subject to a constant wind, he arranged a semi-circle of branches thrust upright into the ground, and often built a fire in the open side.[1] In a more advanced stage he builds a circle of branches, brings their tops together, and ties them with a strip of bark. But the hut is still incomplete, and remains so until the frame is interwoven with cross-branches and twigs, sometimes, as with the Fuegians, only on the windward side, sometimes, as with the Damaras, over the whole.

The shed has an origin equally early as the hut, although it was developed differently. In fact it depended on the material on hand whether this form or the other was adopted. In Australia,[2] where large strips of bark are readily obtained by the natives, a lean-to is the usual form; in Fernando Po.[3] on the other hand, a coarse matting stretched out on four poles is in universal use. The latter may be considered the normal form of shed. and we can trace its progress from these slightly inclined roofs to the elaborately finished, high-pitched roofs of the hot regions of South America.

The early habitations of man may be roughly classified as circular and rectangular. Much speculation has been indulged in as to the causes of this difference, and it is a singular fact that the two styles of dwellings are frequently found side by side in districts where there does not seem to be a natural cause for any distinction. It has been suggested that rectangular houses are characteristic of the communistic manner of living and circular ones of single families. The members of a single family can readily sleep around one fire ; when several families are congregated under one roof several fireplaces are required, and the house is extended, usually in one direction. While this is true, there are many circular houses occupied in common, and there are also numerous instances among the rudest

[1] Tasmanian Journal, i., 250.

[2] Angas's Aust. and N. Zealand, ii., 212.

[3] Allen and Thompson's Narrative, ii., .197

peoples of one family occupying rectangular dwellings. The truth is, that the development of both the rectangular and the circular house is merely a plain case of natural development. First, we have a simple breakwind, a single strip of bark. Then comes one on two sides, another is added, and it is only necessary to close the remaining side to complete the square. These changes can be illustrated by numerous examples, but it is only necessary to mention two; the breakwind of the Australian savage represents the first stage, and the Patagonian tent,[1] formed of skins stretched on three sides of a square, the second. The shape of the dwelling does not, as might be supposed, depend on the manner in which the logs forming the sides are laid. When horizontal. we invariably have the rectangular hut, but they are placed vertically in both rectangular and circular dwellings. Nor is the explanation difficult, for the shed, supported by upright poles, is easiest enclosed by placing logs parallel to the first, and the rectangular house with walls of vertical logs is obtained.

The manner of life is an essential element in determining the form and character of a dwelling. In the earliest times man was constantly moving, seeking new shelter, new resting-places, new food. He could carry nothing with him in his migrations, for he had no means of conveyance. He was equally satisfied with a cave or a heap of leaves. Later, when he has learned to use a few simple tools, to skin animals, to prepare their skins, and to build his hut with some little care, he carried it with him. Hence the dwellings of nomadic peoples fall naturally into the two divisions of transportable and non-transportable, and the former are again subdivided into those covered with mats and those covered with skins.

Dwelling of Nomads	non-transportable	
	transportable	Mats skins

Being easy of construction, mat tents are used by the rudest peoples. The Abipones pass their lives under two poles and a mat; the Zulus, standing higher in the social scale, find comfort in cages of pliant sticks, covered with finely woven rush mats.[2] Skin tents are used by more advanced races, since their use implies knowledge of the manufacture of the weapon with which to kill the animal, and of the mode of skinning and preparing the skin. They are

[1] Anthro. Jour., i., 197.

[2] Burchell's Travels in Africa, ii., 198.

used alike both by pastoral and hunting tribes, but seldom by purely agricultural ones, by the hunting Indians of North America, the Dakotas and Chippeways, by the pastoral bands of the extreme east and the far south, the Arabs and the Patagonians.

The agricultural nomads, moving less often than do the hunting and pastoral ones, build more permanent dwellings. Some, as the Gonds, move every few years. Their houses are of wattle and daub, thatched with teak-leaves ; within are two rooms, separated by a row of grain baskets, or by a bamboo screen, one serving as a living room, the other for storing.[1] Greater care is shown by the Bodo and Dhimals,[2] who, in addition to the central dwelling, build a cattle-shed ; and if the family is a large one, complete the quadrangle with two other dwellings. The Santals,[3] moving only when they have exhausted the soil at one place, build even a more elaborate group of buildings ; a verandah is placed at the gable end, and pigstys, buffalo-sheds, and dove-cots built within the common enclosure.

Many other causes than the fertility of the soil occasion the removal of the agriculturist. The Khonds[4] abandon their dwellings on decay ; the Western Kareens[5] seek new quarters on the encroachment of their enemies ; while the diseases generated by the heat expel the Caribs from theirs.

Turning to communism, which is, perhaps, as early a phase of life as the nomadic, we find that it also produces numerous variations in structure. And, first of all, it is interesting to trace the origin of communism as shown in the dwelling. The protection gained by numbers led many tribes to adopt this form of life. Such, for example, are the Pueblo Indians,[6] who erect large terraced buildings, often with no opening on the ground floor. Such, also, are the Mandans,[7] an unaggressive people, brave, but unable to contend with their powerful neighbors, the Sioux. Their houses are circular, from 40 to 60 feet in diameter; the walls are of thick logs, the roof of beams supported by posts, thatched with willow-boughs and prairie grass, and the whole covered with several feet of earth and clay. Two doors of buffalo skin protect the entrance.

[1] Forsyth, Highlands of Central India, 99.

[2] B. H. Hodgson in Jour. As. Soc. Bengal, xviii., 741.

[3] Jour. As. Soc. Bengal, xx., 570.

[4] Macpherson, Report upon the Khonds of Ganjam and Cuttack, 59.

[5] Parrish in Jour. As. Soc. Bengal, xxxiv., 145.

[6] Morgan, 136.

[7] Ib., 126.

In addition the whole village is fortified. To the same cause may be attributed the peculiar villages of the Tupis, which consist of several houses arranged with their entrances opening on a common court, and the whole surrounded with a strong palisade.

The greater facilities communism affords for obtaining subsistence led the Iroquois to adopt that form of life. Those residing in villages lived in common, all partaking of the common store, while the venturous brave who went out after food lived a solitary life. To the same reason may be probably attributed the all but universal custom of communism among the North American Indians. The natives of Guiana furnish a curious variation of the women and children living in a detached cook-house.

In the far north cold has produced communism. The desire for greater warmth induced the Kamtschatdales, the Ostyaks [1] and the Esquimaux [2] to live in common during the long, cold months of winter, while light cool dwellings suffice for their abode in summer.

In studying the effect of communism on the structure of the dwellings, we note, first, that all communistic houses are very much larger than those intended for single families. They are of all sizes, from the Ojibwa wig-e-wam [3] for two or three families, up to the immense Long House of New Guinea, 30 x 300 feet and more, or the American Pueblo of a thousand rooms. As the size varies with the number of the inhabitants, so does the construction. The greater the number of people engaged in erecting a building, the greater the care taken and the better will be the materials used. Such is found to be the case with the dwellings of the Clatsops and Chinooks,[4] the walls of which are of white boards sunk in the ground, with a roof of timber fastened by cords of cedar bark and covered with two or three ranges of light poles. The Long House of the Seneca-Iroquois is another example. It is formed of a strong double frame of poles, with either a triangular or a semi-circular roof, enclosing large strips of elm bark, tied to it with strings or splints.[5] The Esquimaux furnish even a more striking instance, for the huge blocks of snow and ice used in their dwellings cannot be moved without the assistance of many men. The great care taken in the construction of communal dwellings is further shown by the use of

[1] Latham's Des. Eth., i., 454.
[2] Cook's Sec. Voyage, ii., 237.
[3] Morgan, 113.
[4] Ib., 111.
[5] Ib., 120.

larger material than is possible or even desirable in individual dwellings, as is shown in the huge pieces of bark covering the Ojibwa wig-e-wam, and the Iroquois Long House. Finally, it should be noted that communism sometimes produces remarkable changes in the appearance of the dwelling. Perhaps the most noteworthy instance is the village of the Yakut nation of Southern California,[1] consisting of a row of conical or wedge-shaped wig-e-wams, with a continuous awning of brushwood in front.

Although the changes produced by communism are of a limited nature on the exterior of the dwelling, it causes a great variety in the interior. First of all, we note variation in the number of partitions and in their construction. Some dwellings, as those of the Dakotas and of the Tupis—the latter containing from 20 to 30 families—are without any partition whatever. Others, as those of the Chinooks, have partitions in the larger houses—80 families—but none in the smaller. Then come partial partitions ; some, as in the elliptical lodges of the Kutchin tribe, radiating towards a central open space; others, as in the Iroquois Long House, having side partitions only. Finally, there are complete partitions, separate cabins under the same roof. These last are found in the houses of New Guinea,[2] huge edifices containing cabins of bamboo 10 feet square, with doors at the side and a fireplace between every two cabins. The Mishmis,[3] with similar dwellings, have a fireplace in each compartment.

Quite as much variety is found in the distribution of the passageways. First, none at all, as in the Kutchin lodges; next, a straight aisle down the middle, as in the Iroquois Long House. Differing from this only in position are the houses of the Mishmis, with a passage along one side, and the Kareens,[4] who form a passage all around the house. Finally, there is a perfect maze of passages, as in the dwellings of the Brokpas.[5]

A similar evolution is found in the arrangement and number of the fireplaces. Many, as with the Powhatans and Dakotas, the Kutchins and the Mandans,[6] have but a single fire in the centre of the dwelling. Others, again, as the Iroquois[7] and the Uraupes,

[1] Morgan, 107.

[2] Jukes, Narrative of the Surveying Voyage of H. M. S. Fly, 272.

[3] Griffith in Jour. As. Soc. Bengal, vi., 333.

[4] Mason in Jour. As. Soc. Bengal, xxxvii., Pt. 126.

[5] Jour. As. Soc. Bengal, xlvii., Pt. 1, 34.

[6] Morgan, 126.

[7] Ib., 65.

arrange the fires in the central aisle, so that one fire serves for four cabins. More developed are the dwellings of New Guinea, with a fire to every two cabins, and of the Mishmis, with a fire to each cabin. Another form is found among the Mayas, who build a separate cook-house where the cooking for the whole village is done. The Ostyaks keep their food safe from the dogs in a village store-house.

There is no more singular mode of building than that of elevating the dwelling on poles. It is of most frequent occurrence among communistic peoples, but is by no means confined to them. Its origin has been long a favorite subject for controversy among students of primitive architecture. The historians of Timor allege that it arises from the fear of the reptiles that infest that fertile island, and we are also informed that such houses are constructed at Kurrecchane that the children may sleep safely at night. However well this custom in these places may be explained by these statements, it is sufficiently obvious that the explanation is not a universal one, and its origin must be looked for elsewhere. The best theory yet proposed is that of M. Frederick Troyon,[1] but which, though it is supported by many facts, fails when put to the test of universality. Beginning with the observation that all such buildings are built over or near water, M. Troyon argues that the rafts used in the early migrations afforded little protection to their owners, especially when the men were off hunting. Safety, however, was readily obtained by mooring in midstream, while, when pulled ashore, the raft was best kept from being washed away by the waves, by being elevated beyond their reach. Unfortunately for his theory, however, M. Troyon has ignored the fact that elevated houses are to be found both on the coast line and in interior districts where rafts would be impractical. Other and possibly many causes have contributed to the custom; among them especially the desire for greater protection. It is not sufficient for the Sumatrans[2] that they hide their dwellings amid the trees on a hill-top, to which there is but one, or at most two, narrow paths of access, nor is a high and strong fence enough. They elevate their houses on posts and enter by means of movable notched poles. The theory of protection is confirmed by the solitary houses being more elevated than are the village houses. If the custom of building elevated houses

[1] Troyon, Habitations Lacustres des temps anciens et modernes. Lausanne: 1860.

[2] Marsden, History of Sumatra, 56.

originated with the natural fear of man for his race, then, in houses built over the water, the land side should be the strongest portion of the building, while the water side should be open or only lightly constructed. This is found to be the fact in the houses of New Guinea,[1] which have a stage on the water side that affords a convenient place for keeping the canoes. A confirmation of this explanation is seen in the custom of many maritime tribes of placing their dwellings where embarkment is attended with the greatest difficulty. Again, this mode of building is found prevalent among both warlike tribes, as the northern Kareens, and peaceful ones, as the Mishmis. All such instances point in the direction of the same cause; that they may better defend themselves against their enemies.

But greater protection is not the sole reason for the building of elevated houses. High floods make it imperative, as with the Waraus, or else drive the natives to elevated bits of land, as in the basin of the Orinoco. Tribes living near the coast and supporting themselves by fishing adopt this style of dwelling almost exclusively, while interior tribes prefer houses built directly on the ground. This distribution is especially marked in the East Indies.

Besides acting as an integral factor in producing communistic and elevated dwellings, the desire for better protection has brought about many other variations in structure. The location of the village is frequently selected with this end in view. Sometimes the hill-top is chosen, as by the Maiwar Bhils—who have a back door conveniently arranged for flight; with others the most secluded valleys are sought, as is done by the Santals;[2] others, again, hide their dwellings in clumps of trees. Some, also, as the Khonds,[3] place their villages in close proximity to each other, while the Bushmen[4] take the opposite course of building in high open spots where they cannot be attacked without warning.

A suitable site selected, the next step is to defend it. This leads to a judicious arrangement of the dwellings; a favorite plan being a circle with the entrances opening towards the central space, which is usual among the Andamese, the Bushmen, and the Kaffirs. When the chief of the village has developed into an important personage, his dwelling, for greater safety, is placed in the centre of the enclosing village. The Rajput and Bihé villages are illustrations of this fact.

[1] Forrest's Voyages, 95.

[2] Jour. As. Soc. Bengal, xx., 569.

[3] Campbell, Wild Tribes of Khondistan, 49.

[4] Burchell, Travels into the Interior of Southern Africa, ii., 55.

The mere arrangement of the houses does not, however, furnish sufficient protection to the timid or the warlike tribes. Artificial fortifications must be raised. These are of two general kinds, those intended for the whole village and those only for single houses. The former include palisades, sometimes erected at the end of the street, as in the Khond villages, and as is usual in Africa, sometimes continued around the whole settlement, when it becomes a wall. The second class includes a great variety of expedents, dependent, chiefly, upon the ingenuity of the builder. Some, as in New Caledonia, are satisfied with building a fence close to their dwellings; others, as the Angain Nagas, surround themselves with a stone wall; others, again, as the New Zealanders, barricade their doors and windows with strong bars.

Rank and wealth have their influence upon dwellings. This is chiefly to be seen in their construction and size. The poor of every society, the lowest as well as the highest, live in meaner houses than do the wealthier classes. Not only will a rich man's house be larger than a poor man's, but in warm climates it will consist of more parts. The wealthy Kalmuck has a separate cooking tent, and the palace of a Javanese prince resembles a walled city.

Rank is further indicated by sundry external forms; for example, by the height of the dwelling, the elaboration of ornament, the shape and number of the roofs. The house of a Javanese chief has eight roofs, while the mass of the people are restricted to four.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The American Society of Naturalists at its recent meeting in Baltimore passed a resolution which requests its Executive Committee to consult with the corresponding representatives of certain other scientific bodies as to the next time and place of meeting. The societies referred to are all newly organized, and are: The American Physiological Society, the Society of Anatomists, and the American Geological Society. One of these, the Geological Society, arranged to meet during the Christmas holidays at Ithaca, N. Y., and it was stated that several of the geological members of the American Society would probably prefer to attend the meetings of

PLATE XXI.

Part of the Cascade Range.

the Geological Society should they be held contemporaneously in future. It was also plainly seen that the multiplication of societies would reduce the membership of the body then in session at Baltimore, and a remedy for such contingency was proposed and discussed.

The proposition is that the four societies hold their meetings in future at the same time and place, so that the members of one of them can have the advantages of the others. The plan was generally acceptable to the members of the American Society, and it is to be hoped that it will be so to the other societies as well. Such an arrangement has much in its favor, and the only objection arises from the slight difficulty to be experienced in making the preliminary and local arrangements. The existence of so many societies necessarily diminishes the strength of each one, since few naturalists can hold, for various obvious reasons, a membership in more than one of them. The co-operation of these societies once obtained, the result will be beneficial to American science. It will be, in fact, a national scientific body intermediate in character between the National Academy and the American Association. Such a body will produce a distinct impression on the energies of its members, as well as on the attention of the public. If the membership is properly guarded, it will have a distinctly valuable influence on the administration of scientific trusts of all kinds. That the membership can be guarded we fully believe, since the American Association is the popular body and furnishes every opportunity for expansion in that direction. The new body would furnish a winter meeting for naturalists of all departments, under the influence of a festive season, in every way well calculated to encourage and stimulate them in their often locally isolated labors. We hope that the three societies named will take this view of the subject, and that next winter will see a combined meeting of all of them at some accessible point.

THE NATURALIST informs its readers that it commences the year 1889 with a new department, that of Bacteriology, under the editorship of Professor W. T. Sedgwick, of the Institute of Technology, Boston. The department of Physiology will be edited by Professor Frederick S. Lee, of Bryn Mawr College, Pa.

The numbers of the NATURALIST for 1888 were issued on the following dates : January, Feb. 3 ; February, April 2 ; March, April 21 ; April, May 25 ; May, June 29 ; June, Aug. 8 ; July, Aug. 30 ; August, Sept. 30; September, Oct. 24; October, Nov. 22; November, Dec. 13 ; December, Dec. 26. Postal delays caused the omission of some plates from the December number. These will be issued with the January and other numbers of the present year. Haste in the printing of the December number caused the numerous typographical errors which it contains, and neither authors nor editors are responsible for them. The publishers have made new arrangements for printing, so that the delays in issuing the magazine to subscribers, and separate copies to contributors, will not again occur.

ERRATA.—In November number, p. 955, fourth line from bottom, for 1700 read 700. Do.. p. 997, for 1,600,000 read 160,000. Do., p. 1029, for *Clione* read *Cleome*. In December number, p. 1073, for *Septocladus* read *Leptocladus;* do., Plate xxvii., for *facies* read *brevifacies.*

RECENT LITERATURE.

THOMAS' BURIAL MOUNDS.[1]—To one who, like the present reviewer, received most of his archæological knowledge at the feet of that most accurate student of the American Indian within the historic period, Mr. Lucien Carr, of Cambridge, Dr. Thomas' monograph appeared like an old friend. There is, indeed, much new material, and a new presentation of old facts, but there is, too, the same conclusion which we have been led to hold as true: that those mounds which dot our Western and Southern States and which have given rise to such an amount of speculation and hypothesis, were built by the Indians in possession of that region within the historic period or by their ancestors. The facts brought out by Mr. Carr in his essay on the "Mounds of the Mississippi Valley Historically Considered" have not been controverted, and the present paper but adds to the evidence that there is no necessity for invoking the aid of a special race of "Mound-Builders" distinct from the Indians found in possession of the eastern half of the United States at the time of its discovery.

Dr. Thomas takes up the subject in the following order : (1) Burial Mounds of the Wisconsin District ; (2) Burial Mounds of the Illinois District ; (3) The Ohio District ; (4) The Appalachian District; (5) The Cherokees probably mound-builders; (6) Concluding remarks; while in a supplementary note he gives an account of the burial customs of the Hurons, translated from the pages of the martyred Brebeuf in the "Relaçion" of 1636.

In the cases of the mounds of Wisconsin as well as of those of the Illinois district (including Northern Illinois, Eastern Iowa and

[1] Burial Mounds of the Northern Section of the United States. By Cyrus Thomas. Extr. Fifth Annual Report of the Bureau of Ethnology. Washngton, 1888, pp. 119.

Northeastern Missouri) it is clearly shown that the historic Indians did build burial mounds, but in the case of Ohio this is not so easy. History and tradition tell us almost nothing of the aboriginal inhabitants of that State, for soon after the advent of the French in the new world, the Iroquois rendered that whole region an uninhabited wilderness. It is true that we have references to the Eries or Cat nation and legends of the Tallegwi, but what the affinities of these tribes were, history tells us nothing. Dr. Thomas, however, compares the Ohio mounds with those near Charleston, West Virginia, and gives much evidence to show that both were made by the same people and more than suggests the identity of the Tallegwi with the Cherokees. These latter are shown beyond much possibility of doubt to have been a mound-building people even in post-Columbian times. Among the other conclusions drawn may be mentioned these: That there is no evidence of human sacrifice in mortuary rites; that nothing indicates that the people building the mounds had arrived at any higher culture-status than had some of the historic Indian tribes of the same region; and that the period of mound-building could not have continued for more than a thousand years, and hence its commencement probably does not antedate the fifth or sixth century.

COMSTOCK'S ENTOMOLOGY.[1]—This work is nearer our ideal of what a text-book of entomology should be than anything, American or foreign, which has appeared for many years. It is concise, clear, and bears evidence of careful preparation and abundant knowledge, while most of the illustrations are new and fresh, many being engraved by Mrs. Comstock expressly for the work. In the present part the subjects treated are (1) The Characters and Metamorphoses of Insects, (2) The Anatomy of Insects, (3) The Orders of Hexapoda, (4) Thysanura, (5) Pseudoneuroptera, (6) Orthoptera, (7) Physopoda, and (8) Hemiptera. In the second part (which we sincerely hope may not be long delayed) the remaining orders will be taken up, and with them we are promised chapters on economic entomology, directions for collecting and preserving insects, a bibliography, a glossary, and an introductory chapter.

In the treatment of the different orders we notice a lack of uniformity; in some analytical tables extending down to genera are given, while others are treated less fully. This is doubtless owing to the present state of entomological science, and those groups which are left in the more imperfect condition are just those where there remains work for the systematist. We are glad to see that only the Hexapods are included, for the Myriapods are at best an uncertain group, while recent investigations have shown that the Arachnida, aside from being Arthropods, have no relationships with either Hexapods or Myriapods. With the sequence of orders some fault might be found. A division of Hexapoda above Thysanura into

[1] An Introduction to Entomology. By John Henry Comstock. Ithaca, N. Y.: published by the Author, 1888. [Pt. I., pp. 234, with 201 figures.] $2.00.

Ametabola and Metabola is convenient, but it accords too high a rank to an adaptive feature. Complete metamorphosis is but a comparatively recent introduction in the life of insects, and with it as a basis forms closely allied in structure are necessarily widely divorced. Again, in our opinion, the Orthoptera are clearly lower than the Pseudoneuroptera, a view which is not negatived by palæontological evidence nor by embryology.

We notice a few slips which can readily be corrected in the promised introduction. On the first page the author writes "Vermes" where he clearly means "Annelida," and the unnatural group of Tracheata is referred to on the same page. On the seventh page chitine is stated to be deposited "in" the body-wall. On the eighth page it is stated that the eyes may possibly be modified legs, a view which is completely negatived by embryology. On the twenty-third page the sting of certain insects should have been stated to be a modified ovipositor. Perhaps the greatest omission of all is the absence of any account of the embryology of Hexapoda. Still these, with the exception of the last, are minor points, and this exception we hope to see rectified before the volume is completed. As a whole, the work is of great value. The illustrations and descriptions will make it a true guide to the young student of insects, the accounts of noxious insects will aid the agriculturist and horticulturist. and we venture the prediction that it will be the most often referred to of any book on the shelves of the working entomologist.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

Asia.—According to a letter in a recent number of the *Revista de Geografia Comercial,* the population of the Philippine Islands is very unequally distributed, since while there are sections which, without being the most fertile, contain 223 inhabitants to the square kilometre, other sections, and these among the most fertile, have only three or four inhabitants to the same area. According to the same periodical, the sanitary conditions of the port of Paraqua Island (*Puerto-Princesa*) have become much more favorable since the forest, which formerly extended to the coast, has been cut down for a width of six kilometres, and the cleared space has been occupied with plantations of coco palms, plantains, and cacaos.

Paraqua is the third in size of the Philippine Islands, and measures 445 kilometres in its greatest length, by 44 in its greatest width. Upon its coasts are many excellent and well-sheltered ports and bays, the principal of which are Vyalampaya, Puerto-Princesa, and Ulugan. A range of mountains, the culminating points of which are Montalingahan (2.080 m.) on the S., and Victoria (1.372 m.) more to the N., parts the island into two parts. Rich alike in fertile soil and in valuable woods, this island has hitherto been greatly neglected by its owners. Its population does not exceed 28,000—viz.: 10,000 Christians in the N.; 6000 Mahometans on the S., about 6000 Tachanuas, 500 negritos, 1500 tandalanos, and 4000 manguianes.

Easter Island.—The *Revista de Geografia Comercial* (Nov. 15, 1888) states that the Republic of Chili has resolved to annex Easter Island, which was discovered by Juan Fernandez, and which in 1470 was formally taken possession of in the name of King Charles III., of Spain. Easter Island is of triangular form ; 35 kilometres in circuit, and its highest point in the extreme northwest is 597 metres above the sea. It is emphatically a land of extinct volcanoes ; one of these is placed at each angle ; Kau on the south, Horni on the north, and Utuiti on the east. There are many other smaller volcanoes. The volcano Kau has an elevation of 408 m. and its crater, which is 200 m. deep and 1500 m. in diameter at the bottom, is remarkable for the regularity of its shape. In the bottom of this crater there are springs of potable water and fine plantations of sugar-canes and plantains.

[1] Edited by W. N. Lockington, Philadelphia, Pa.

The inhabitants are probably not more than 200 in number. The average height of the men is 1.57 m., that of the women, 1.50.

Easter Island is celebrated for its gigantic statues which the natives call *moai,* and also contains ruins of houses, vast platforms, and cemeteries. The statues represent the upper part of the body as far as the hips, with the arms united to the sides, the hands embracing the hips, and the face with a disdainful expression. They are carved from a compact gray lava which abounds in the crater of Utuiti, but have crowns of red lava of conical shape and about three feet in height. Most of these statues are from fifteen to nineteen feet in height, but some are much larger, notably two which are stretched upon the ground near Utuiti. In one of these the body alone is 12 m. high, and the nose 3.40 m. The interior of the crater of Ronororaka contains forty of these statues, all with the face turned towards the north; and the summit of this mountain seems a great workshop of unfinished statues. One of the platforms, on the south coast, is .9 m. high, and 100 m. long, is enclosed with a wall, and contains numerous overthrown statues as well as some low columns which apparently served as altars. The cemeteries (Papakoo) are double platforms, the upper one containing sepulchral chambers. Wooden slabs with hieroglyphics exist upon the island, but no one can decipher them, so that the origin of the huge ruins is unknown. There is, however, great similarity between the statues and the sculptures of the Aymaras of Peru.

JAPAN.—According to the first official statistics published by the Japanese Government, the empire contains 381,845 square kilometres, and has a population of 38,151,271. The number of men greatly exceeds that of the women, and divorces are so numerous that they amount annually to 3 in every 1000 inhabitants The mortality is low compared with that of most European countries, since it is only 19 per 1000. Japan has 721 towns with more than 2000 inhabitants, and five of more than 100,000—viz.: Tokio, 912,837; Osaka, 353,970; Kioto, 235,403; Nogoya, 126,898; and Kanakasa, 104,020. The production of tea each year is about 23,000,000 of kilograms and that of silk 3,000,000 of kilograms. The amount of rice, wheat, barley, sugar-cane, and other agricultural products, is such as to prove that either the soil is superior to that of Europe, or that it is better cultivated. The very considerable extent of forest that still remains may perhaps partially explain the fertility. Two hundred and fifty six telegraphic and 92 telephonic offices exist in the empire. A carpenter earns about 35 cents a day, a stone-mason about 44 cents.

AMERICA. CASSIQUIARE.—The *Revista de Geografia Comercial* dissects sarcastically the *discoveries* of M. Chauffanjon in the region of the Upper Orinoco. If the *Revista* is correct, and it certainly fortifies its assertions with names and dates, M. Chauffanjon's achievements are similar to those of the immortal Captain Glazier. The

Revista states that in 1743, the Jesuit P. Roman passed along the Cassiquiare from the Orinoco to the Rio Negro; that Diaz de la Fuente and Bobadilla followed the Orinoco nearly to its source and 87 leagues above the separation of the Cassiquiare; that the Marquis of Socorro, with Hurriage and other commissioners deputed to fix the boundaries of Brazil, found the latitude and longitude of the point of origin of the Cassiquiare, and calculated its altitude at 337 Spanish yards above sea-level; and that the mountains which M. Chauffanjon has rebaptized bear the title of Parima, though in different portions of their extent they are called Tapiraperú, Patuibiri, Arihuana, Maritani, Humirida, Pacaraima, etc.

GEOGRAPHICAL NEWS.—The principal articles of export from Spain, besides wine, are iron, copper, lead, cork, and oranges. The values of these articles during the first four months of 1888 were, according to the *Revista de Geografia Comercial*, respectively \$2,166,000, \$2,921,000, \$1,626,000, \$3,363,000, \$1,351,000, and \$1,783,000. The value of wine exported during the same four months was \$20,466,800.

A project to run a line of steamers between Vigo and New York has been set on foot by the Spanish Chamber of Commerce at the latter place. Vigo is only 60 miles further from New York than Queenstown, and is 231 miles nearer than Havre. The lower latitude, independent route, and comparative freedom from fog and wind, will more than compensate for the slightly increased distance.

The Manchester ship canal, now in course of construction, will be 35 miles long, the width varying from 170 to 260 feet at the top, a width at the bottom in no case less than 130 feet, and a minimum depth of 25 feet. The contract is let for £5,750,000, but the company has a subscribed capital of £8,000,000. The opening of this canal will practically make Manchester a seaport. As the city with its suburbs contains 850,000 souls and will be geographically the nearest port for 7,000,000 of people, the construction of this canal cannot but be injurious to Liverpool.

The province of Santandar, Spain, contains in operation 360 zinc mines, 312 iron mines, 30 lead, 19 copper, and 17 coal mines. Less than a fourth part of its area is cultivated, and rather more than a fourth is in pasture.

The population of Belgium, according to the census of Dec. 31, 1887, amounted to 5,974,000.

GEOLOGY AND PALÆONTOLOGY.

Fish Otoliths of the Southern Old-Tertiary.—In a recent article[1] Dr. E. Koken in Berlin describes the fish otoliths collected by Dr. Otto Meyer in the Old-Tertiary of Mississippi and Alabama. The locality "Jackson River" of Mr. Koken ought to be "Jackson, Miss.," and the locality "Newton, Miss.," cannot be considered as belonging to the Vicksburg beds. Changed accordingly, Mr. Koken's table of species is given below.

	Claiborne, Ala.	Newton, Miss.	Jackson, Miss.	Vicksburg, Miss.
Otolithus (Carangidarum) americanus......			+	+
" (Apogonidarum) hospes..........			+	
" (Pagelli) elegantulus.............			+	
" (Sparidarum) insuetus............			+	
" (Sciænidarum) radians...........				+
" " gemma...........			+	
" " eporrectus........		+		+ and Red Bluff, Miss
" " claybornensis.....	+		+	
" " intermedius.......	+			
" " similis...........			+	
" " decipiens..........	+			
" (Trachini) lævigatus.............			+	
" (Cottidarum) sulcatus............			+	
" (Triglæ) cor.....................			+	
" (Cepolæ) comes..................			+	
" (Mugilidarum) debilis............			+	
" (Gadidarum) meyeri.............			+	
" " elevatus............	+			
" " mucronatus........	+			
" (Platessæ) sector..................	+		+	+
" (Soleæ) glaber....................			+	
" (Congeris) brevior................			+	
" (incert. sedis) aff. umbonato......		+		

We see that Mr. Koken has succeeded in determining the genera or families of all fishes which are represented by these ear-bones, with the single exception of one worn specimen from Newton. The enumerated families and genera indicate a strictly litoral fauna, no abyssal form is among them. It is different in its character from the fish fauna of the German Tertiary, which has been studied also

[1] "Neue Untersuchungen an tertiaeren Fisch-Otolithen." Zeitschrift d. deutsch. geolog. Gesellsch., 1888, p. 274, 3 plates.

by Mr. Koken from the otoliths, but resembles in general the present fauna of the Gulf of Mexico, of the West Indies, and the Southern coasts of the United States. The dissimilarity of the fish faunas on both sides of the Atlantic existed, therefore, already during the earlier Tertiary. We are indebted to Mr. Koken for having developed an entirely neglected subject, the study and determination of fossil fish otoliths, to such an extent that important conclusions can be derived.—*O. Meyer.*

CATALOGUE OF FOSSIL REPTILIA AND BATRACHIA OF THE BRITISH MUSEUM Pt. I., by Dr. Lydekker. In this volume we have what has been long needed, a synopsis of the fine collection of British and such other European extinct reptiles of the orders Ornithosauria (Crocodilia), Dinosauria, Squamata and Rhynchocephalia, which is embraced in the national museum of Great Britain. This synopsis is, like its predecessors, systematically arranged, and the text is enlightened with comments on the structural relations of the forms embraced in it. Many of the forms, especially of Dinosauria, described by English authors, have been hitherto in a state of obscurity to foreign observation, and a great deal is done in the present volume towards clearing this away. Especially valuable are the diagnoses of families and genera of the Crocodilia, in which the mesozoic formations of Europe are so productive. While we accord generally with the systematic views expressed by Dr. Lydekker, we must point out a few points of divergence. We cannot perceive the *raison d'etre* of an order Proterosauria, which the author, indeed, seems to regard as provisional. We do not believe that the Opisthocœla (Sauropoda) is distinguishable as an order from the Crocodilia. In nomenclature, we find the two divisions of the true Dinosauria to accord exactly with our own, and not with those of Professor Marsh, yet the names of the latter author are adopted. As usual, we find some generic names adopted, which were never characterized, as Trachodon instead of Hadrosaurus. Finally, we must make an appeal on behalf of the name Belodon for the genus usually so called, as against the prior name of Phytosaurus. Phytosaurus for an entirely carnivorous animal is a gross misnomer, and is nauseating to the scientific stomach. Not only this, but the typical specimen exhibits only mineral casts of the pulp cavities in place of teeth, so that name belongs to mineralogy rather than to palæontology. In case Belodon has been previously otherwise used, there are other available names, as Centemodon Lea, for instance.

In concluding this review, we must record our appreciation of the author's method of clear definitions for all divisions he proposes and adopts, a custom which is the necessary basis of all good taxonomic work.—*E. D. Cope.*

GEOLOGICAL NEWS.—GENERAL.—M. M. Bertrand (*Bull. d. l. Soc. Geol. de France,* No. 7, 1888) endeavors to reconcile the opposite views of French and German geologists relative to the relations between the structure and age of eruptive rocks. While French geologists have, by long study of the eruptive rocks of France, come to the conclusion that their structure shows indubitable traces of the youth, maturity, and old age of the earth, the German school has from its studies concluded that there is no relation between the structure of eruptive rocks and their age, but that all varieties may have been produced at any time in the world's history. Mr. Bertrand believes that the fact that, in the Tertiary period, a series of ancient textures reappeared in consequence of the long period of repose that preceded that period, may be brought in to reconcile the two beliefs. If there was one such recurrence, others, greater or less, may have occurred from similar causes. Still, M. Bertrand believes that there are variations between these recurrences, and sets himself the task of explaining them.

"All the eruptions of the same period (in Europe) are grouped around their corresponding chain, the most ancient around the Caledonian or in the more northern regions; those of the Permian and Carboniferous around the Hercynian chain, those of the Tertiary round the Alps. If the entire globe is studied, at every age rocks of all compositions and structures will be found, which bears out the idea of the German school; but if the same zone is studied, details of structure in relation with the age of the rocks can be found."

M. Bertrand considers the continent of Europe to be formed of four zones, each of which exhibits its series of folds. These zones are: (1) the Huronian, which has its principal European extension in Russia, Finland, and Sweden; (2) the Caledonian, which occupies Ireland, Wales, Scotland, and Norway, thus introducing itself wedge-like into the sinuous outline of the Huronian; (3) the Hercynian or Carboniferous, the northern edge of which, in both Europe and America, is marked by a line of coal measures; (4) the Alpine, comprehending the Pyrenees, Alps, Carpathians, and Balkans. By a curve in its outline the Hercynian mass takes in the Asturias and the central plateau of Spain. Mr. Bertrand gives diagrams of the distribution of the zones in Europe, of their folds, and of the masses of eruptive rocks connected with them, and enters into details regarding the separate masses.

PALÆOZOIC.—Charles Barrois notes the presence in the Pyrenees of a species of Oldhamia found in the palæozoic schists in the department of Haute-Garonne. The new species is named *O. hovelacquei*. The presence of this species, distinct from *O. antiquus*, discovered by Oldham in Ireland in 1844, proves the existence of the Cambrian age in the Pyrenees.

M. D. P. Oehlert describes some Devonian Acephala (Aviculidæ) found in the Devonian strata of France. Three new forms of Pterinea, five of Avicula, one of Palæoneilo, and two of Modiomorpha are added to those previously known.

Mesozoic.—M. Deperet (*Bull. Soc. Geol. France*, No. 7, 1888) treats of a brackish-water horizon in the Huronian; and describes a new species of Cassiope, one of Cerithium, and one of Corbula from it. The horizon occurs at La Mede and Callauch, near Marseilles.

M. H. E. Sauvage (*Bull. Soc. Geol. France*, No. 7, 1888) describes the reptiles of the Upper Portland series of Boulogne-sur-Mer. These include *Megalosaurus insignis*, *Iguanodon prestwichii* *Caulodon precursor*, a Dinosaurian not yet named; three chelonians, two crocodilians (*Machimosaurus interruptus* and *Goniopholis undidens*), an Ichthyosaurus near to *I. thyreospondylus*, and two Plesiosauri.

The Cretaceous region of the southwest of France presents (*Bull. Soc. Geol. de France*) characters strongly contrasting with those of the Jura, Pyrenees. and Brittany. The beds offer both vertical and horizontal continuity, the country not having experienced the disturbances of other Cretaceous basins. There is a considerable hiatus between the Jurassic and the Cretaceous of the southwest of France. The Wealden, Neocomian, Urgonian, Aptian, and Gault are absent, the Cretaceous sea did not invade this region until the Cenomanian period. The Turonian and Danian are present.

Louis Dollo (*Ann. Soc. Geol. du Nord*, July–Aug., 1888) states that *Pachyrhynchus* Dollo, *Erquelinnesia* Dollo, and *Glossochelys* Seeley, are equal to *Euclastes* Cope.

Tertiary.—M. Gosselet (*Ann. Soc. Geol. du Nord*, July, 1888) disputes some of the conclusions of Prof. Prestwich regarding the correlation of certain Eocene beds of England with those of Belgium and the north of France, and proposes a table in place of that drawn up by Prof. Prestwich. M. Gosselet believes, contrary to the opinion of Prof. Prestwich, that the London clay is represented in the basin of Paris.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In a recent number of *Tschermak's Mittheilungen*[2] Mr. Hyland gives a most interesting and detailed account of the lavas of Kilimandjaro, a volcano in eastern equatorial Africa, and of the rocks in its vicinity. Pegmatite, gneiss, amphibolite, basalt-obsidian, limburgite, nepheline- and feldspathic-basalts, tephrite, basanite, tufas, and other fragmental rocks are described. The basalt-obsidian was taken for andesite glass by Bonney,[3] whereas it really contains no augite—the mineral regarded as augite by Bonney being olivine. Among the limburgites three types are recognized. In one porphyritic olivine predominates over augite ; in a second the olivine is subordinate to augite and hornblende ; in the third hornblende is absent and augite is more abundant than olivine. The first and second kinds are closely allied to the feldspathic basalts, and the third to the nepheline-basalt. The olivine in these rocks contains a large number of inclusions of magnetite, augite, and spinel. It is zonally developed and is frequently surrounded by a rim of augite needles. The feldspathic basalts embrace hornblendic varieties, in which the hornblende is corroded and surrounded by an opacitic rim, composed of augite, magnetite, and olivine, and porphyritic varieties in which the large prophyritic crystals are anorthite. The nepheline-basanites are especially interesting because of the occurrence in them of anorthoclase so well developed that Hyland was enabled to determine its optical properties with great accuracy. This mineral is undoubtedly triclinic. Its extinction on the basal plane varies between 0° and 3½°, and on the orthopinacoid between 5° and 6°. Its specific gravity is 2.63. Freed from impurities and analyzed it yielded :

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O
61.3	23.1	3.02	5.34	7.11	.09

A leucite basanite contains almost ideally developed leucite crystals—the first discovered in Africa.[4] The other rocks described in the paper present no features of especial interest.—An important contribution to the study of the younger nepheline rocks has recently been made by Stock,[5] of the University of Leipzig, who has thoroughly investigated the material composing the basalt hills near Löbau, Saxony. This material comprises nepheline- and

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.
[2] Min. u. Petrog. Mitth., x., p. 203.
[3] Report Brit. Ass., 1885, p. 682.
[4] Cf. Amer. Naturalist, Nov., 1888, p. 1024.
[5] Min. u. Petrog. Mitth., ix., p. 429.

plagioclase-basalt, and nepheline-dolerite. The latter rock has been classed by Rosenbusch[1] among the nephelinites because of the supposed non-existence of olivine in it. The nepheline rocks have been erupted since the beginning of Tertiary time and are older than the plagioclase-basalt, which occurs in them in the form of dykes. The normal constituents of the nepheline rocks are augite, olivine, nepheline, apatite, biotite, and magnetite. The dolerite contains these as idiomorphic crystals in a groundmass composed of microlites of the same minerals and plagioclase in a devitrified base. In the finer grained variety the nepheline occurs principally as the interstitial substance between the other constituents. In both varieties this mineral possesses a tendency to pass into natrolite, phillipsite, and stilbite. The olivine is often so filled with magnetite that its true nature can be distinguished only with great difficulty. Twins of this mineral parallel to $P\breve{\infty}$ are not rare. Apatite is abundant, and frequently contains inclusions of the groundmass. Rubellan was discovered in a large number of sections, and hyalite and aragonite were found filling druse cavities. Both varieties of the nepheline rock are regarded as portions of the same magma. The dolerite is over the basalt, and is supposed to have cooled first. Inclusions of it are common in the underlying rock. Foreign inclusions, found also in this rock, consist of augite and sanidine, of which the former is usually on the exterior. Other common constituents of these inclusions are hematite, green spinel, and orange-colored rutile. The plagioclase-basalt contains quartz inclusions surrounded by rims of augite crystals.—Prof. Judd[2] calls attention to the fact that petrographical classification is based on the qualitative and not the quantitative determination of the constituents of rock masses. He shows that rocks composed of the same minerals may have widely varying compositions, even when their groundmass is approximately the same. Five examples of hypersthene andesites having the same mineralogical composition are taken, and it is shown that their content of silica ranges from 51.8% to 70%. The fact that the same minerals are found in rocks possessing such differences in composition is explained by supposing them to have crystallized in the earlier stages of the rock's solidification and then to have been separated from the residual magma, and finally to have recombined with this in proportions different from those in which they first occurred. Since the residual portion is much more acid than the individualized portion, it is easy to imagine rocks of any degree of acidity to have been formed by the mingling of the two portions in different amounts. The effect of the presence of water in lowering the fusing point of a rock is also discussed, in relation to its bearing on volcanic phenomena.

MINERALOGICAL NEWS.—*Note.*—In the mineralogical notes for the current year the crystallographic axes will always be repre-

[1] Mikroskopische Physiographie, ii., 1887, p. 791.
[2] Geol. Magazine, Jan., 1888, p. 1.

sented by the italicized small letters, *a, b, c,* and the axes of elasticity by the italicized capitals *A, B, C,* the latter indicating respectively the axes of greatest, mean, and least elasticity.—*New Minerals.*—*Sulphohalite* is a transparent, pale greenish-yellow mineral, crystallizing in the form of a dodecahedron, that was obtained from a drill-hole at the depth of thirty-five feet below the surface of the alkaline deposit at Borax Lake, California. It was associated with *hanksite,* and only one specimen was secured. The only two other specimens known to exist are in the collection of Mr. Bement, of Philadelphia. The mineral has been examined by Messrs. Hidden and Mackintosh.[1] Its specific gravity is 2.489, and its hardness 3.5. Its composition is represented by Na_2 ($\frac{3}{4}$ SO_4. $\frac{1}{4}$ Cl_2) or 3 Na_2SO_4 + 2 Na Cl, a formula analogous to that of the rare mineral *connellite,* which is thought to be a copper sulphato-chloride.—*Auerlite* is a new thorium mineral from the zircon mines in Henderson County, N. C. It is described by Messrs. Hidden and Mackintosh[2] as occurring in disintegrated granite and gneissic rocks, intimately associated with *zircon,* and frequently implanted upon this mineral in parallel position. The color of the new mineral on a fresh fracture varies between a lemon-yellow and a brownish-red. Its weathered exterior is of a dull yellowish-white. It has a waxy lustre, is subtranslucent to opaque, and is very brittle. Its hardness is 2.5–3, and its specific gravity 4.422–4.766. In crystallization it is tetragonal with the simple P and ∞ P faces. Its composition corresponding to $ThO_2 \left\{ \begin{matrix} SiO_2 \\ \frac{1}{3} P_2O_5 \end{matrix} \right\} H_2O$ is:

$H_2O.CO_2$	SiO_2	P_2O_5	ThO_2	Fe_2O_3	CaO	MgO	Al_2O_3
11.21	7.64	7.46	70.13	1.38	.49	.29	1.10

Auerlite thus appears to be a *thorite* in which part of the SiO_2 has been replaced by P_2O_5—the first recorded replacement of this kind in mineralogical literature.—Two new *sulphantimonites* are reported by Mr. Eakins[3] from Colorado. The first was found at the Domingo mine, Gunnison County, in aggregates of small acicular dull grayish-black crystals in the cavities of a gangue composed of siliceous material and calcite. Its analysis yielded:

Ag	Cu	Pb	Fe	Mn	Sb	S	Gangue
tr.	tr.	39.33	1.77	tr.	36.34	21.19	.52

corresponding to $(Pb\ Fe)_3\ Sb_4\ S_9$. The second is also found in little groups of crystals, of a bright steely-gray color. The individual crystals are larger than those of the first mineral, and occur together with pyrite and sphalerite in a siliceous gangue. Their composition is $Pb_5\ Sb_4\ S_{11}$, resembling *freieslebenite* in which the silver has been replaced by lead. Analysis gave:

[1] Am. Jour. Sci., Dec., 1888, p. 463.
[2] Ib., p. 461.
[3] Ib., p. 450.

Ag	Pb	Fe	Sb	S (calculated.)
tr.	55.52	tr.	25.99	18.98

General.—Scacchi[1] has published a complete catalogue of the minerals occurring at Mount Vesuvius. He divides them into (1) crystallized minerals occurring in pieces of foreign rock cast up during the eruptions of Monte Somma and the earlier eruptions of Vesuvius; (2) those forming lava bombs; (3) those occurring in the Monte Somma conglomerate, as a result of contact action; (4) those produced in the fumaroles by sublimation; (5) those formed in the lava during its cooling; and (6) those present on the walls of the amygdaloidal cavities in the lava. One hundred and twenty five mineral species are briefly described, and the name of the writer first mentioning them is given. The catalogue will prove of great convenience to collectors in the region and to those in charge of collections embracing many Vesuvian specimens.—Brezina[2] would add *tellurite* to the group comprising the oxides *claudetite* and *valentinite*. Crystals obtained from a porous sandstone at Facebaja were measured and found to be orthorhombic with $a : b : c = .4566 : 1 : .4693$. The predominant faces are $\infty \breve{P}_{\infty}$, $\infty \breve{P}_{2}$, $\infty \breve{P}_{4}$, ∞P and P, and the plane of the optical axes is $\infty \bar{P}_{\infty}$.—In the limestone near Bagnères de Bigorre, France, are little crystals of black *albite*, which, according to Lacroix,[3] have the following composition:

SiO_2	Al_2O_3	Na_2O	CaO	Ign	Specific gravity
67.04	20.45	10.57	.65	1.30	2 563

—Limur[4] describes a *staurolite* crystal from Moustoir-Ac, Morbihan, France, which consists of a core, composed of quartz and staurolite material, surrounded by two zones of staurolite, one with a granular structure, and the other with a fibrous structure, due to the arrangement of little needles perpendicular to the prismatic faces of the crystal.

New Books.—Rutley's "Rock-Forming Minerals."[5]—This little volume constitutes an excellent book for beginners in the study of microscopical geology. It includes an introduction to the methods made use of in the investigation of the optical and other physical properties of minerals, discusses the theory of polarized light, explains what is meant by "optical axes," "bisectrices," double refraction, etc., describes the polarizing microscope and other instruments used in the examination of minerals, and gives the principal characteristics of those minerals which enter into the composition of rocks. The explanations of the phenomena presented by sections of minerals when observed in polarized light, are given

[1] Neues Jahrb. f. Min., etc., 1888, ii., p. 123.
[2] Ref. N. J. B., 1888, i., p. 206.
[3] Bull. Soc. Franc. de Min., xi., p. 64.
[4] Ib., xi., p. 61.
[5] Rock-Forming Minerals. By Frank Rutley. With 126 ills. and 252 pp Thos. Murby, 3 Ludgate Circus Buildings, London, 1888.

with great clearness, with the aid of good figures, most of which are new. The second part, which deals with the properties of the individual minerals, is not as full as is Mr. Idding's translation of Rosenbusch's manual, but is entirely sufficient for all the purposes of students. Although a most excellent text-book for colleges, Mr. Rutley's work is hardly full enough in its special part for those who desire to make a specialty of petrography as an important aid in geological work. For those who wish merely to become acquainted with the methods of the science, there is no better book in any language.

"DAS MINERALREICH,"[1] the fifth volume of Lenze's Natural History Series, has been revised and brought up to date. In its present shape it is a handy little volume of five hundred and forty-four pages. It treats of the universal and special properties of minerals in a manner adapted to the wants of general readers and others, who are desirous of becoming acquainted with these substances, but who are unwilling to enter into their technical study. In the special part a large amount of space is devoted to those properties of the various minerals which make them suitable for economic use. As a consequence this portion of the book is much more interesting than the corresponding part in most text-books. In general style "Das Mineralreich" reminds one of Quenstedt's Mineralogie.

CROSBY'S "TABLES FOR THE DETERMINATION[2] OF COMMON MINERALS," has a great advantage over all other similar tables in common use, in that it deals only with those minerals with which the student is likely to meet in his every-day work. The determinative methods are based upon the physical properties rather than upon the blowpipe characteristics of the individual species. The tabulation is carefully done, and the little book will surely be welcome in those schools which are not provided with complete sets of blowpipe apparatus.

[1] Das Mineralreich. Bearbeitet von Dr. Otto Wünsche. V. Auf. Gotha, Thieanmanns Hofbuchhandlung, 1887. 544 pp., 16 Taf.
[2] Second Edition. By W. O. Crosby. Boston, 1888.

BOTANY.[1]

"FORTUITOUS VARIATIONS IN EUPATORIUM" is the title of a paper recently read by Lester F. Ward before the Biological Society of Washington. This was an interesting and suggestive talk without being a set paper, and led to many remarks by members present. Several definitions of life have been given, but Prof. Ward considered the best to be "a general tendency on the part of living matter to multiply itself, to increase its quantity." This increase may take place in all directions, and often does take place in more than one. If it is not in all directions it i because of obstacles in the way, and the real increase is in the direction of least resistance. Many variations are noticeable in both plant and animal world, that are apparently of no special advantage to the organism. These chance or fortuitous variations can scarcely have been produced by natural selection, inasmuch as there is no appreciable or even imaginable value in them to the plant or animal. There are, to be sure, many which are of advantage, and these are acted upon and improved through natural selection. Darwin has said, though with many reservations, that only advantageous variations are selected and preserved. This does not seem to be at all universally the case. Quantity not quality is the end for which nature strives, and this may be considered an almost universal law. Perfection in structure is a secondary consideration, while increase of quantity is of primary importance. Prof. Ward did not believe all variations were of use to plants. The general tendency to vary in every direction is often counterbalanced by a determined progress in one direction, and this is generally useful. The specimens of Eupatorium were so arranged as to show the variations in the leaves, these being more prominent than in the flowers. The leaves varied from finely dissected to linear, then to lanceolate and ovate. One hybrid with intermediate leaves was shown. There are about four hundred species in the genus, most of them South American, one Australian, and about thirty North American. The fact of great variation in the plants was undoubted. The fact of these being all beneficial is not proved. How a sharp or an obtuse point, a serrate or a crenate margin to a leaf would be of any benefit to a plant in any situation he could not see. Therefore it seemed to him that many of these variations should be considered fortuitous or chance variations due to the general tendency of all life to increase in all directions and so adding to the total quantity of life in the world.

Dr. Merriam rather dissented from the views of Prof. Ward, he believing the variations to be generally of some slight advantage,

[1] Edited by Charles E. Bessey, Lincoln, Neb.

though to us it may be inappreciable. Dr. Goode mentioned analogous variation in fishes, especially in the number of scales, the real usefulness of a greater or less number of these being unknown. Some families (as the Cyprinidæ) are remarkable for these variations, while others (*e.g.* Perches) are noted for few or no variations, the species being very distinct in all their characters. Prof. Riley fully agreed with Prof. Ward. His studies of insects showed the existence of many variations which were undoubtedly useful, but at the same time many others the purpose of which was not in the least apparent.—*Jos. F. James.*

ASTER SHORTII.—Mr. E. S. Burgess has noted the occurrence of *Aster shortii* in the vicinity of Washington, D. C., a plant which had not been previously recorded. Prof. Ward in this connection mentioned he had found a species of *Lemna* new to the flora, and Dr. Vasey said he had found a species of *Festuca* not before known from the locality.—*Jos. F. James.*

"CAUSES OF CONFIGURATION OF TREES."—Prof. Fernow, Chief of Division of Forestry, read a paper upon this subject. He exhibited several photographs of trees growing upon the sides of hills The trunks of these formed nearly a right angle with the slope, and the branches were parallel with the slope. It was suggested by Prof. Ward that possibly the photographs represented an abnormal mode of growth, and that they were due to unusual conditions. It was also suggested that the peculiar direction of growth of branches was due to the cropping of cattle. Few of those present had ever seen trees similar to these, and most were inclined to the opinion that they represented something abnormal.—*Jos. F. James.*

THE NEED OF MAKING MEASUREMENTS IN MICROSCOPICAL WORK. —It is greatly to be desired that all workers with the microscope should make much more general use of the micrometer than is now the custom, particularly in botany. It is still a common thing to find descriptions of tissues accompanied by plates or figures with little to guide the reader as to the absolute size of the objects. In this the fathers sinned more than we. but we are by no means sinless, as may be seen by taking up almost any descriptive paper on botany. Cells, cell masses, filaments, hyphæ spores of all kinds, pollen cells, etc., etc., should all be subjected to careful measurement. We may say that so many measurements are needless, but so the older botanists thought, greatly to our present discomfort.

In our botanical laboratories the student should be not only taught to make measurements of everything he studies, but the making of such measurements should be *a part of the study* of the object. No laboratory microscope should be used which does not have as one of its accessories always at hand an efficient micrometer.

Such a micrometer need not cost much. A simple disk of ruled glass dropped upon the diaphragm of the eye-piece will answer every purpose in ordinary work. Or it may be a slip of glass which may be pushed through a slot in the eye-piece. Neither one ought to cost more than from one to two dollars, and ought to be afforded for every microscope in use in the laboratory.—*Charles E. Bessey.*

THE QUESTIONS OF NOMENCLATURE.—For some months a lively discussion has been going on in this country and England upon a few questions as to the proper interpretation of the laws relating to botanical nomenclature, the discussion in some cases broadening out so as to take in the inquiry as to the validity of certain laws, and the expediency of enacting new ones. "Shall we rigidly enforce the law of priority?" is the question which is causing the greatest disquiet just now. On the one hand we have those who urge its rigid enforcement, while on the other are those who say with Prof. Babington, "I think that we are going too far in enforcing the rule of priority in nomenclature as it is now attempted." (*Jour. Bot.*, Dec., 1888.)

Then there is the question as to the citation of the authority in case of a removal of a species from one genus to another. Shall we cite Linnæus still in case we remove one of his species into a genus which he may not even have known? If we do, we make him (say those of one party) say what he never said, while to cite as the authority the name of the author of the combination makes us lose sight of Linnæus as the originator of the specific name and the describer of the species. Upon this we merely inquire now whether we are to consider primarily the men who *have worked* in systematic botany, or the men who are working now and who will work after we are gone. Is all this matter of the citation of authorities for the purpose of "doing justice" to men, or for conducing to scientific accuracy? Do botanists think more of the "glory" of the individual, or the advancement of the science? We shall return to this erelong.—*Charles E. Bessey.*

BOTANY IN ST. LOUIS.—The recent reception of a volume of the Transactions of the Academy of Science of St. Louis (Vol. V., Nos. 1 and 2) reminds us of the work in botany which is being done in this Western city. Of the thirteen papers published, five are botanical, as follows: A Revision of the North American Linaceæ, by William Trelease; Description of *Lycoperdon missouriense,* by William Trelease: On the Pollination of *Phlomis tuberosa* L. and the Perforation of Flowers, by L. H. Pammel; Measurements of the Trimorphic Flowers of *Oxalis suksdorfii,* by W. G. Eliott. Jr.; Observations suggested by the preceding paper, by William Trelease.

In the first-mentioned paper twenty-one species of Linum are recognized as natives of North America. They are grouped under three tribes, viz.: (1) Eulinum, which includes *L. lewisii* Pursh (= *L. perenne* Auct). (2) Linastrum, including *L floridanum* Trelease (L. *virginianum,* var. *Floridanum* Planch). *L. virginianum* L., *L. striatum,* Walt., *L. neo-mexicanum* Greene, *L. kingii* Watson, *L. sulcatum* Riddell, *L. rupestre* Engelm., *L. aristatum* Engelm., *L. rigidum* Pursh, and var. *puberulum* Engelm., *L. berlandieri* Hook., *L. multicaule* Hook. (3) Hesperolinon, including *L. digynum* Gray, *L. drymarioides* Curran, *L. adenophyllum* Gray, *L. breweri* Gray, *L. clevelandi* Greene, *L. micranthum* Gray, *L. spergulinum* Gray, *L. californicum* Benth., and var *L. confertum* Gray, *L. congestum* Gray. Two good plates illustrate the fruits, petals, and filaments.

The new Lycoperdon (*L. missouriense*) is 3 to 4 inches high and 2 to 4 inches in diameter, narrow below and enlarged and rounded above (*i.e.*, somewhat pear-shaped). Color of interior buff, spores globose, smooth, yellow $2\frac{1}{2}$–$3\frac{3}{4}$ μ in diameter. It grows in sod under trees.

Mr. Pammel's paper is a valuable one, but too long for a synopsis here, as are also the two remaining ones.

Arbor Day Literature.—This annual tree planting day, which has spread from the place of its origin on the Nebraska plains eastward to many of the States, has given rise to a number of books, the latest of which is the neatly bound and printed volume, "Arbor Day," by R. W. Furnas. It makes no pretence to profundity, nor poetry, but gives in sketchy way the history of the tree planting movement in the West, with appeals for the growth of trees for beauty and for profit, and includes lists of those most valuable for various regions, with practical suggestions as to methods. The book is dedicated to and contains a fine portrait of the "author of Arbor Day." Mr. J. Sterling Morton, of Nebraska. It is a pretty and pleasant contribution to the literature of a part of botany too often neglected or ignored by botanists.

Another School Botany.—Verily in botany "of making many books there is no end," and if one were obliged to study some of them he might well say with the wise man of old, "Much study is a weariness of the flesh." The last work to claim attention is one with the ambitious title of "Botany for Academies and Colleges, consisting of Plant Development and Structure from Seaweed to Clematis," by Annie Chambers-Ketchum, and brought out by the house of J. B. Lippincott Company, of Philadelphia.

The book is a book of definitions. and often not good ones at that. In the first paragraph we read that "Natural Science treats of all things in nature. Nature is a synonym for the Universe," and paragraph 5, "The plant is the vital link between the mineral and the animal. Plants feed on minerals and digest them into organic food." The style is sometimes rather lively, as, for example, in a note on zoospores (p. 7), "These little creatures are very social; they dance among themselves, circling merrily, but never jostling; no human dancers could be more polite; then when the heyday of youth is over, they withdraw their ciliæ (*sic*), produce an outer wall, send out root-like projections, and develop into staid mother plants"!!

In her attempt to make matters plain the author uses some odd terms, as "Virgin-parentage," "The Man's House," "The Woman's House," etc.

The second part of the book consists of a manual which is said to include " All the known orders with their representative genera." In this the Algæ constitute the first order, the Fungi the second, and the Lichens the third!

Without question the book cost the author a great deal of hard work, and it is a pity that it has been such a waste of energy.—*Charles E. Bessey.*

A VALUABLE BOOK FOR THE HERBARIUM.—Indispensable as Bentham and Hooker's *Genera Plantarum* is in the herbarium, it is often a troublesome book to handle on account of its great size. When one is obliged to search through the three volumes for some obscure genus the time taken is so much lost from work, and the wear and tear of the book itself from so much use is such as to threaten its early destruction. This is especially the case in those herbaria where advanced students have free access to the books and specimens.

The recently issued *Index Generum Phanerogamorum* by Th. Durand, of Brussels, is intended to take the place of the Genera Plantarum for much of the work in the herbarium. The orders and genera have the same sequence as in Bentham and Hooker's work. The mode of treatment may be made out from the following, taken from page 1:

ORDO I. RANUNCULACEÆ.

TRIBUS I. CLEMATIDEÆ.

1. **Clematis** L. G. I. 3 et 953.—Sp. descript. ultra 200, a cl. Kunze ad 66 reduct. Orbis. fere tot. reg. temp. et trop.
   Sect. 1. **Viticella** DC., Viticella Mörch.
   Sect. 2. **Cheiropsis** DC., Atragene L., Cheiropsis et Viorna Spach.
   Sect. 3. **Flammula** DC., Meclatic Spach.
2. **Naravelia** DC. G. I. 4.—Sp. 2 v. 3, Asia trop.

The first column of figures consists of a running enumeration of the genera which extends throughout the volume, the second column enumerates the genera of the orders merely.

In the prefatory conspectus the following table is given, showing the number of species (estimated) for the Phanerogams:

		Ordines.	Genera.	Species.
Dicotyledones	Polypetalæ	90	3,050	28,300
	Gamopetalæ	46	2,885	37,800
	Monochlamydeæ	36	849	12,100
		172	6,784	78,200
Monocotyledones		35	1,587	19,600
Gymnospermæ		3	46	2,420
Summa		210	8,417	100,220

The book is published in Berlin by the brothers Borntraeger, at about 20 marks.—*Charles E. Bessey.*

BACTERIOLOGY [1]

A New Atlas of Bacteriology.—An important announcement is just received of a new photomicrographic "*Atlas der Bacterienkunde,*" shortly to be issued by Doctors Fraenkel and Pfeiffer, of the University of Berlin. The names of the authors and their connection with Koch's laboratory make it probable that the undertaking will be of great service and will supply to working bacteriologists a convenient standard of reference. The plan which will be followed in issuing the "Atlas" is, to give "a systematic representation of the most important bacteriological objects." Accordingly, there will be given "first, the bacteria in general, in the various stages of their life history, and, then, in particular, the microörganisms of the principal infectious diseases of men and the lower animals."

The figures will be accompanied by an explanatory text; and extreme care is promised to secure unusual mechanical excellence. The "Atlas" will appear in from 12–15 parts, each containing about 10 photographs. The first is promised in January, 1889, and the others at intervals of about six weeks. The number of copies is to be limited, and the cost, per part, is to be 4 marks. The "Atlas" may be had of Hirschwald, in Berlin.

The Bacteriology of Natural and of Artificial Ice.—One of the latest numbers of the *Centralblatt für Bakteriologie* (IV., 22, 673) contains a summary of a recent paper by Heyroth, in which the latter gives the results of some three years of investigation of the purity of ice, and brings the subject, so far as it has been pursued by himself and others, up to 1888.

The usual "plate" cultures were employed, and the conclusions finally arrived at are :

1. Water on freezing into ice always excretes from itself, so to speak, a portion of its chemical and organic contents.

2. Certain organic substances are less affected than are inorganic salts.

3. Above all, the microörganisms, and among these not merely the ordinary harmless water bacteria, but also disease-producing forms, are able to withstand the process of freezing as it occurs in nature, and even a protracted exposure to the frozen condition, without loss of vegetative capacity or enfeeblement of their virulence.

The investigations of artificial ice did not make for it as favorable a showing—or, at least, not in all cases. It appears that the water

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

employed is not always as unobjectionable as ordinary drinking water, and also that the water employed is sometimes rendered more or less impure by the careless use of the process it undergoes. Accordingly, figures as high as 528, 960, 1323, and even 1610 bacteria per cc. were found, although, on the other hand, specimens were found which were absolutely sterile.

The following conclusions were reached, viz.:

1. That the ice used for preservative purposes and for the cooling of drinks ought, no matter how prepared, to be made of such water only as has already been found to be pure, and at least as good as that adapted for a public water supply.

2. For the sake of the continuous protection of its composition periodical and repeated examinations should be made of the ice supply and its sources.

DISSECTION OF THE DOG AS A BASIS FOR THE STUDY OF PHYSIOLOGY.—A handsome and conveniently arranged guide to so much of anatomy as may be learned from a fairly thorough dissection of the dog has been prepared by W. H. Howell, of Johns Hopkins University, and published by Henry Holt & Co., of New York. The work is avowedly done by a physiologist for physiological purposes; and in our opinion it has been done wisely and with discrimination. The worker who is endeavoring to get broad ideas of the position and relation of organs and parts as mechanisms, should never be buried under anatomical minutiæ to him of secondary importance, or confused beforehand by being told minutely what to do, or worse yet, what to see. By giving undue attention to his guide he is distracted from the objects before him, and sooner or later is in danger of losing both the interest and pleasure of discovery and, above all, the final reward of increased power and independence.

The book is not too large, possesses the great merits of simplicity and brevity, and ought to prove a real help to classes of a certain grade, in physiology.—*W. T. Sedgwick.*

ZOOLOGY.

THE ANATOMY OF PROTOPTERUS.—Prof. W. N. Parker communicates to *Nature* (XXXIX., pp. 19–21) a preliminary note on the anatomy and physiology of *Protopterus annectans,* of which abundant material has recently been received at Freiburg. The whole epidermis is packed with goblet cells, and besides contains here and there multicellular glands like those of Amphibia. The normal epidermal cells are covered with a cuticular cap. The muscles of the body serve as a food supply during the period of hibernation, their substance being carried away by leucocytes. The account of the nervous system is reserved for a later paper, but the fact is mentioned that the pulmonary nerves cross at the base of the lungs. A sympathetic system was not found. The body is well supplied with epidermal sense organs except on the paired fins. The author has no suggestion to make concerning the rich nerve supply of these latter organs. The olfactory organ partakes of the character of that in both Fishes and Amphibia, having the accessory cavities of the latter and the epithelium of the former. The eye has a large lens, the choroid is rudimentary and pigmentless, and iris and pupil are absent. No sense-cells were seen in sections of the tongue. A curious tube-like epithelial organ opens on the floor of the mouth in front of the tongue. Except the large liver no glands were connected with stomach or intestine, digestion being largely performed by the instrumentality of leucocytes. Parker cannot verify Ayres' supposition that the lymphatics connect directly with the lumen of the stomach. The so-called urinary bladder is a cloacal cæcum, having much the position of the rectal gland of Elasmobranchs, and probably has no homology with the urinary bladder of other forms. The corpuscles of the blood are large, and the white are very abundant. The red corpuscles are oval and measure from .040 to .046 mm. in length and from .025 to .027 mm. in breadth. Of the white corpuscles two kinds may be distinguished: (1) large leucocytes of the ordinary form, and (2) leucocytes of various sizes, which, besides the ordinary pseudopodia, form stiff filamentous processes. Experiments render it probable that the latter convey nutriment from the alimentary canal to the blood and there disintegrate. Hyrtl's description of the circulatory apparatus of Lepidosiren would answer almost equally well for Protopterus There are no nephrostomes in connection with the kidneys. In a male with immature spermatozoa the anterior parts of the Müllerian ducts were present, each with an abdominal opening like that of the oviduct. In sexually mature individuals all traces of the Müllerian ducts disappear. The spermatozoa are carrot-shaped and are provided with two long cilia. The head of the spermatozoan was about .04 mm. in length.

Another Specimen of Hyla Andersonii.—On June 1, 1888, I found a single specimen of *Hyla andersonii* Baird in a wet place on the border of a pine barren, at May's Landing, N. J. It was quite lively when caught, but it soon became sluggish in confinement. Its voice was shrill and light, comparatively speaking ; and it consisted of a repetition of the same note three or four times in regular succession, in a sort of "peep, peep, peep, peep," as nearly as I can give it. The specimen was sent alive to Dr. C. C. Abbott, of Trenton, N. J., who says, in his "Catalogue of the Vertebrate Animals of New Jersey" (*Geology of N. J.*, Cook, 1868, p. 805) that it is "a Southern species, a single specimen of which was found in Camden Co. in 1863" by Dr. J. Leidy.

Jordan's "Manual of the Vertebrates," 5th ed., says "N. J. to S. C. rare," which statement is still further confirmed by my discovery as given above.

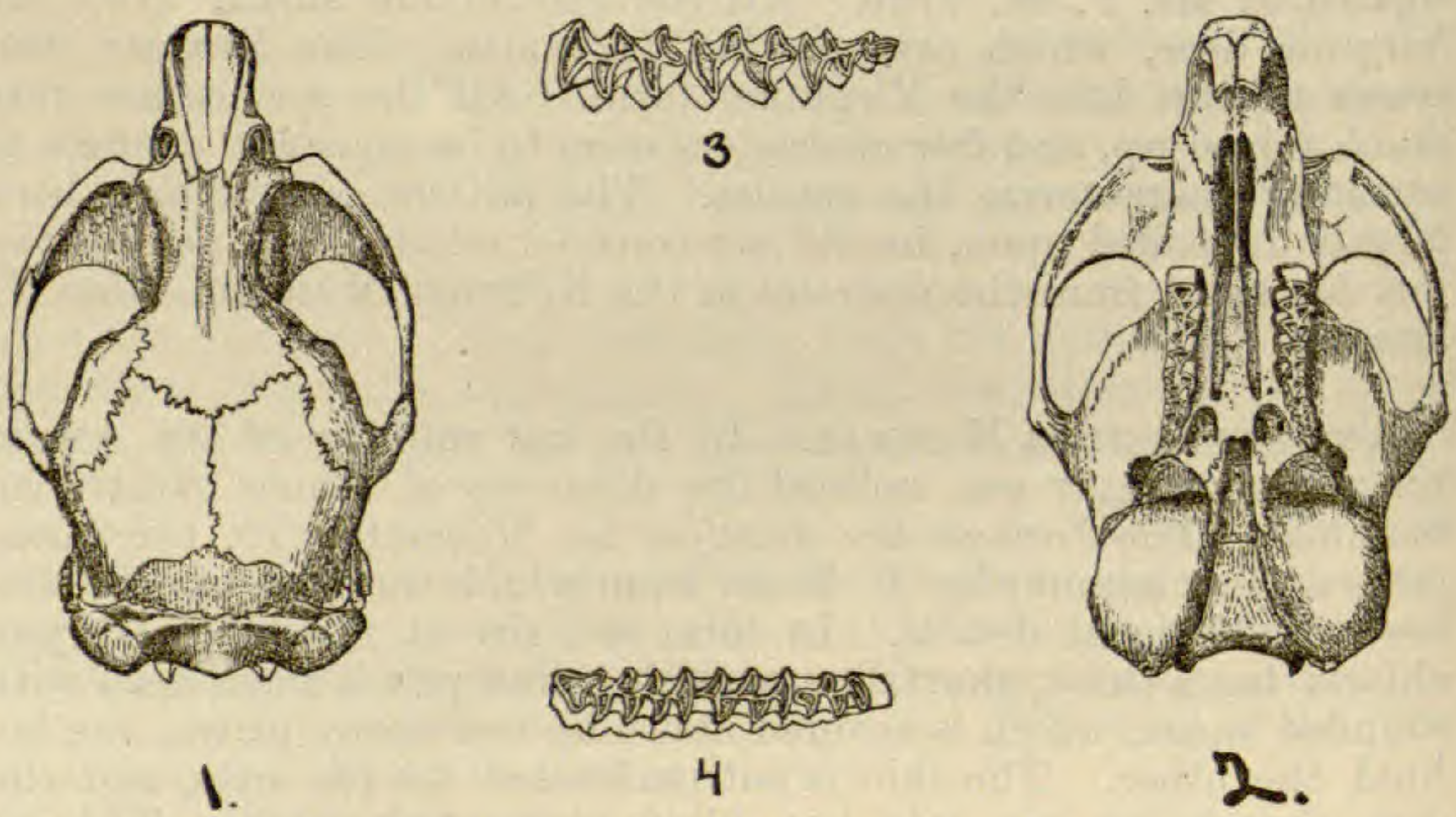
The specimen is still alive, and may be seen by applying to George Pine, Esq., Trenton, N. J.—*John E. Peters, Sc. Doc., May's Landing, N. J.*

A New Spermophilus.—Dr. Merriam has recently described a new species of ground-squirrel from the Sierra Nevadas of California. He calls it *Spermophilus beldingi*. The characters are taken from the coloration and from certain peculiar features of the skull. A broad band of rufous brown runs down the back of the new species, while in the one nearest allied to it the whole back is covered with small spots, giving it a peculiar maculated appearance. The difference in coloration of the two is not due to seasonal changes, as suites of the two species were collected at the same period of the year.—*Jos. F. James.*

The Deer of Central America have been recently investigated by Mr. F. W. True. All the species are small, even the Virginia deer, which extends that far south. The Mexican deer seems to pass into the Virginian form. All the species are very much mixed up, and few characters seem to be constant enough to certainly characterize the species. The antlers. which have been largely depended upon, he did not consider reliable. A new species was described from the material in the National Museum.—*Jos. F. James.*

An Interesting Mammal.—In the last number of the American Naturalist was noticed the discovery of a new Australian mammal. The *Zoologischer Anzeiger* for November 19, 1888, contains a short account by A. Zietz. from which we condense the following additional details. In form and size it resembles Chrysochloris. has a thick, short, fine whitish-yellow pelt, a small head with rounded snout, which is covered above by two horny plates, one behind the other. The skin is not perforated for the eyes, and the eyes themselves are only two black-pigmented points. The ear openings are covered by the fur; the nostrils lateral and slit-like. The salivary glands are very large. The fore feet are short, stout, and directed outwards, and the hands are folded longitudinally, bringing the fingers into two series, one of which is composed of the short digit 1 and digits 2 and 3 with long pointed nails. The other (outer) series consists of the 4th digit, with a small elongate, and digit 5, with a large triangular shield-like nail. The soles of the hinder feet are directed outwards; the toes, which are connected by skin, are armed with broad claws. The long, strong tail is hairless, but has strong transverse ridges and ends in a button. On the belly there is a well-marked pouch, 3 mm. long and 2 mm. (? cm.) wide. No external genital openings were seen. The dentition is very peculiar and appears related to that of Amphitherium of the English Oölite. A clavicle is present. Only a single specimen is known, and that lacks the viscera and is partially decayed. It was found in the sandy region 500 miles north of Adelaide and 150 west from Charlotte Waters. The natives were questioned about it, and only one old woman could recall having seen one before. It appears to be a burrowing animal, and a portion of the alimentary tract which was preserved was filled with the remains of ants. It also appears to be a monotreme, and if the dentition can be relied upon. it forms an interesting remnant of the ancient fauna, and is to-day the oldest living mammal.

A Correction: Arvicola (Chilotus) pallidus.—The August number of the American Naturalist contains a description of the above-named species (Vol. XXII., 1888, pp. 702–705). Through a most unfortunate blunder, the illustration accompanying this description (p. 704), instead of being the drawing sent with the manuscript, is a figure of *Arvicola* (*Pedomys*) *minor*, which was published with a description of that species in the preceding number of



No. 4431. Female *Arvicola (Chilotus) pallidus* Merriam. From Ft. Buford, Dakota (Type) 1 and 2, skull, double natural size; 3, upper molar series, × 5; 4, lower molar series, × 5.

the Naturalist (July, 1888, p. 599), the same cut being made to illustrate two very distinct subgenera! The accompanying figure is that of *Arvicola* (*Chilotus*) *pallidus*, and should be substituted for that on p. 704 of the August number. In the lettering under the skull of *Arvicola* (*Pedomys*) *minor*, p. 599, the skull number is given as 2245. It should be 2224. C. Hart Merriam.

Zoological News.—General.—Prof. J. B. Steere says (*Nature*, XXXIX., p. 37) that the Philippine Islands are readily divisible into several distinct sub-provinces clearly distinguishable by their faunæ.

These are (1) Northern Philippines, consisting of Luzon and Murinduque and a few small islands around Luzon; (2) Mindoro; (3) Central Philippines, embracing Panay, Negros, Guimaras, Zebu, Bohol, and Masbate; (4) Eastern Philippines, comprising Samar and Leyte; (5) Southern Philippines, made up of Mindanao, Basilau, and perhaps Sulu; and (6) Western Philippines, consisting of Palawan and Balabac.

ECHINODERMS.—Prof. P. Herbert Carpenter is studying the Comatulæ of the "Blake" explorations in the Caribbean Sea.

WORMS.—F. E. Beddard (*Nature*, XXXIX., p. 15) describes some very large hooked bristles upon the caudal end of an earthworm (? Urochæta) received from Bermuda which he suggests are correlated with the habit which most earthworms have of lying with the anterior part of the body out of the ground, only the tail being kept within the hole. These bristles would thus form very efficient anchors.

FISHES.—At a meeting of the Biological Society of Washington, Dec. 1, 1888, Dr. Gill made some remarks on the Psychrolutidæ, a small family of fishes established by Dr. Günther on a specimen found in the Gulf of Georgia. Later, another species found in New Zealand was referred to the same family, and a third was recorded from Patagonia. There seems little reason for making a new family for these three species. They probably belong to a section of the Cottidæ. The occurrence of species in New Zealand and in South America is interesting, inasmuch as it shows representatives of the Cottidæ exist in the Southern as well as in the Northern hemisphere.—*Jos. F. James.*

ENTOMOLOGY.[1]

ON PREVENTING THE RAVAGES OF WIRE-WORMS.—In a recently published paper,[2] the editor of this department makes a preliminary report on an investigation of wire-worms, now in progress. In the course of this investigation a method of combating these pests has been devised which promises to be of considerable importance.

At the beginning of our study of wire-worms, experiments were tried to ascertain if it were practicable to protect the seed and young

[1] This Department is edited by Prof J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Bull. Cornell Univ. Agr'l Exp. Station, iii., pp. 31–39.

plants in a corn-field by furnishing the worms with other food. Baits of sliced potatoes, clover, corn-meal dough, and corn-meal dough sweetened with sugar. were placed in various positions in a badly infested field. This was soon after the field had been planted and before the corn came up. In most cases the baits were placed on the surface of the ground and covered with small boards. Boards were used instead of earth for covering the baits to facilitate the examination of them. It now seems probable that more worms would have been attracted had the baits been buried.

The results of our efforts to trap wire-worms were very different from what we had expected. A few were taken in traps baited with sweetened dough, not enough, however, to be of much practical importance. But to our surprise, large numbers of click-beetles were taken. This at once opened a new line of investigation. If it is possible to trap and destroy the beetles before they have laid their eggs, we have at our command a much more effectual method of preventing the ravages of wire-worms than by destroying the larvæ after they are partially grown.

As indicating the possible efficiency of this method, I will cite a single instance. A series of twelve traps, which had been left undisturbed for only three days, yielded 482 beetles, or an average of more than 40 beetles per trap. And this notwithstanding that a considerable number had been attracted to other traps in the immediate vicinity.[1]

Of the substances used as baits clover attracted by far the larger number of beetles. The clover baits were small bunches about one-quarter pound in weight, of freshly cut stalks and leaves. Next to clover in the order of efficiency was sweetened dough. This was made by mixing one part sugar with ten parts corn-meal and sufficient water to make a dough. About one-half a teacupful was used in each trap. Unsweetened dough and sliced potatoes proved to be of nearly equal value, but much less attractive than sweetened dough.

We thus demonstrated that it is an easy matter to trap click-beetles in the places where they abound—that they will collect in large numbers upon baits of clover or of sweetened corn-meal dough. The collection of the beetles, however, from such baits involves considerable labor. We therefore conducted experiments to ascertain if this labor could be saved, and obtained the following results:

Many beetles were collected from our traps and placed in breeding cages. Some of these cages were supplied with clover, others with sliced potatoes, others with dough, and still others with sweetened dough. In one series of cages these substances were poisoned. In another, used as a check, the food was not poisoned. At the same time an extensive series of traps were placed in the corn-field. In this case alternate traps were poisoned, the others not.

[1] More than one-half of the click-beetles collected in these experiments were *Agriotes mancus*. Next in abundance was *Drasterius dorsalis*. A few specimens of *Agriotes pubescens* were also taken.

As was to be expected, no dead beetles were found in the traps that were not poisoned ; nor did the beetles die soon in those cages supplied with unpoisoned food. But where the clover or dough was poisoned the beetles in most cases were destroyed, proving that they feed upon these substances, and suggesting a practical method of combating them.

Although these experiments were conducted in a field from which a large number of the beetles had been removed, twelve examinations of the traps baited as described above yielded an average of 23½ dead beetles per trap. In some cases twice that number were found at one time in a single trap.

When we take into consideration the small amount of labor involved in distributing poisoned baits as described, and in renewing them once or twice per week during the early part of the summer, and consider also the large number of beetles that can be destroyed, many of them doubtless before they have laid their eggs, we feel warranted in earnestly recommending that these important pests be fought in this way.—*J. H. Comstock.*

NOTE ON CHINCH BUG DISEASES.—Two diseases of *Blissus leucopterus*, apparently efficient in suppressing an outbreak of this species in 1882, were described by me in my report for that year as State Entomologist of Illinois (pp. 47–54) ; but neither of these has been distinctly recognized since, until the present season. Now, however, the chinch bugs of the southern part of Illinois are being very rapidly destroyed by both these diseases, and a third not hitherto recognized—the last (seen by me first in July, 1887) due to a Botrytis distinct from the species (*B. bassiana*) well known as the characteristic fungus of muscardine in the silkworm.

One of the two first mentioned is caused by an Entomophthora whose specific affinities I have not been able to learn.

The other is due to a microbe (the *Micrococcus insectorum* of Burrill[1]) principally developed in the alimentary canal, and especially in its cæcal appendages, which are often literally crammed with it from end to end. This disease somewhat resembles that known as *schlaffsucht* or *flacherie* in the literature of the silkworm. Its germ is freely cultivable both in beef broth and in solid gelatine media, by the processes usual in bacterial investigation.

Both the Entomophthora and the Botrytis finally imbed the insect in a white fungus—the efflorescence of a spore-bearing mycelium. The Botrytis has been much more abundant and destructive in Illinois than the Entomophthora, although seemingly less so at present than the bacterial form.

It now seems likely that these diseases, occurring as they do

[1]American Naturalist, xvii., p. 319. This microbe, studied anew by Prof. Burrill from my recent cultures, solid and fluid, and from the affected chinch bugs themselves, proves to be a Bacillus of peculiar character, and not a Micrococcus.

spontaneously over a large area, will soon suppress what has probably been the longest continued destructive outbreak of the chinch bug known in the history of that insect. Their present activity is illustrated by the fact that in a single field in Southern Illinois dead chinch bugs imbedded in this mould were found by an assistant, Mr. John Marten, so numerous as to suggest a recent flurry of snow.—*S. A. Forbes* (in *Psyche*, Oct., 1888).

Poison of Hymenoptera.—One of the most interesting phenomena met by the student of the habits of insects, and one that has long excited wonder, is the fact that the Digger-wasps or Fossorial Hymenoptera sting the insects with which they provision their nests in such a way that the insects are paralyzed, but not killed.

It has been commonly believed that the Digger-wasps could easily destroy their victims if they chose to do so; but instead of doing so they sting them "just enough to paralyze them but not enough to kill them;" for they know instinctively that on the one hand dead insects would not be suitable food for their young, and on the other, that if the insects with which the nest is provisioned are left uninjured, the larva which hatches from the egg placed with them would be unable to overpower them.

Some have held that the paralyzing of the prey is accomplished by making a slight sting in one of the ganglia of the ventral nervous system. This, however, implies an instinctively obtained knowledge of insect anatomy which is to say the least remarkable.

A very different explanation of the phenomenon is now offered by M. G. Carlet.[1] In an earlier note[2] he showed that the wound inflicted by the Hymenoptera with a barbed sting (Bees and true Wasps) always resulted in a mixture of two liquids; one, an acid, the other, an alkali, each secreted by a special gland. And he also showed that the venom produced the usual results only when it contained these two constituents. He has now studied the poison of Hynenoptera with a smooth sting (Philanthus, Pompilus, etc.), and finds that with these the alkaline gland either does not exist or is rudimentary. These are the Hymenoptera whose incomplete poison does not kill the insects with which they provision their nests, for the purpose of feeding their larvæ with living prey. In M. Carlet's opinion it is the presence of the two liquids or of one only which produces respectively the mortal poison or the anæsthetic, and not the asserted power to select the point of the body at which the Digger-wasp will sting its victim.

Report of the State Entomologist of New York.—Dr. Lintner's Fourth Report has just appeared. It makes a volume of 237 pages, and includes accounts of a large number of insects, some of which are described here for the first time. This report, like those that have preceded it, is the result of a great amount of pains-

[1] Comptes Rendus, cvi. (1888), pp. 1737–40.
[2] Ib., seance du 23 juin 1884.

taking labor, and is a valuable addition to the literature of Economic Entomology. The number of subjects described is so large that it is impracticable to give an abstract of the report.

THALESSA AND TREMEX.—A paper was recently read by Prof. Riley, entitled "Notes on the Economy of *Thalessa* and *Tremex*." *Thalessa* is an Ichneumon fly having in some species an ovipositor six and seven inches in length. The eggs are laid in the burrow of the larva of *Tremex* and not in the larva itself, so it is an external and not an internal parasite of the larva. The ovipositor performs the part of a saw and drills a hole in the bark over the burrow of *Tremex*. Owing to the great length of the ovipositor, it was long a question how the insect could reach the bark to deposit its eggs. It is accomplished by the insect so manipulating the organ with its feet as to form a double coil in a special membrane between the last two segments of the abdomen, then curving it over and passing it downward so as to reach the wood. In the pupa this ovipositor is bent round and along the ventral surface and then backwards again along the dorsal surface.

A "HUMAN PARASITE."—Prof. Riley mentions in a general way the occurrence of parasites upon or in the human body. He mentioned particularly the case of a lady in Washington who felt herself stung by some insect. In the course of a few weeks she was annoyed by a pimple on her neck. When pressed, there was forced from the spot a small larva, of some species of bot-fly, but as nothing was known of its parent, its identification was impossible. Reference was also made to another parasite noticed by a physician of New Orleans, an account of which had been given in a late mumber of "Insect Life."
—*Jos. F. James.*

EMBRYOLOGY.[1]

THE BYSSUS OF THE YOUNG OF THE COMMON CLAM (*Mya arenaria* L.).—During the past summer Mr. Vinal N. Edwards, the well-known collector of the U. S. Fish Commission, at Woods Holl, found young clams adhering in great numbers to the surface of floating timbers in the harbor of New Bedford, Mass. They were associated with Ascidians (*Molgula*) in this unusual position, and very naturally attracted the attention of so observant a field-naturalist as Mr. Edwards, who very kindly brought me an abundant supply of specimens. The masses as they came into my hand were in flakes formed of marine algæ and earthy matters, sand, and mould, which

[1] This Department is edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

had been peeled off of the surface of the floating timbers. These masses were traversed superficially by a mat of fibres which were found to be derived from the outer tunic or mantle of the Ascidians, by means of which the latter were adherent to their support.

At first, in separating the young clams from their singular place of support, it was supposed that their rather firm adhesion was altogether due to their having been caught during the very early veliger stage in this mat of fibres formed about the bases of the Ascidians. As they grew larger it was further supposed that they were held fast in their unusual position by the fibres and cement substance secreted by the mantles of their Ascidian neighbors, and thus were suffered to attain a considerable size (from two to fifteen millimetres) before they finally became free and sank into a more favorable position on the bottom. However, further investigation showed that in this I was in error, for after a careful search, a few individuals were found from which a single byssal thread was found to proceed, invariably from the point where the tip of the foot is thrust through the median opening in the mantle. To make it still more certain that there should be no mistake, the byssal thread was pulled out of its insertion in several specimens, when it was found to present the irregular swollen proximal end usually found to characterize the intraglandular portion of the byssus in molluscs which possess this organ. The subject at this point became sufficiently interesting to warrant farther study, and, inasmuch as but a few individuals were found which had the byssal thread in place, that structure being usually torn loose in removing the specimens from their support amongst the Ascidians, it became necessary to resort to the methods of sectioning to determine if there was a byssal gland present in the foot.

To this end a number of specimens were treated first with a dilute chromic acid solution (one-half per cent.). After this had fixed the tissues, the solution was renewed and acidulated with nitric acid (one-half per cent.), and allowed to act until all of the calcareous matter had been removed from the shell. This left the specimens in good histological condition for cutting, after which the specimens were washed, dehydrated, and saturated with celloidin, in which they were embedded and sectioned on a Schanze microtome.

The sections were cut parallel to the median longitudinal plane, or so as to coincide with the union of the edges of the mantle along the margins of the valves. Besides disclosing the unmistakable anatomical structure characteristic of *Mya,* there was found in the sections of the median region at the apex of the foot a median saccular depression which was undoubtedly the byssal gland with the thread in place or with remains of the secretion from which the byssal thread was formed.

This discovery leaves no doubt as to the fact that this well-known mollusc is provided with a byssus during its early life. One series of sections in my possession, from a specimen ten millimetres long, shows the structure admirably. How much longer than usual the young clams were kept suspended in this instance on account of their accidental and supplementary adhesion to the Ascidians cannot be determined, but it is fair to suppose that their period of suspension would be prolonged on that account beyond the usual time.

The presence of a byssal attachment in *Mya arenaria* reopens the question of the life-history of this important shell-fish. In fact, it is probable that some of its allies may have an unknown byssal stage, and, perhaps, types somewhat distant from it in the system, but with similar habits in the adult condition, such as *Glycimeris* and *Panopæa,* may also have such a stage. In that case the methods hitherto proposed to be adopted in order to secure the young for purposes of transplanting would have to be greatly modified. It is very probable that this arrangement is a protective one and that the suspension of the young of *Mya arenaria* is for the purpose of protection during the early and most precarious period of existence of the animal. To obtain the early stages of the young ti will accordingly be necessary to resort to some form of "collector" or cultch, such as is used in oyster-culture, to allow the fry to affix itself.

While there is a very sharply defined homogeneous larval shell or protoconch in the young oyster, this seems to be absent or not sharply defined in the young of *Mya arenaria* in specimens two to three millimeters long. In *Chlamydoconcha* the protoconch or larval shell is preserved even in individuals supposed to be adult, since here both valves are completely invested by the closed mantle sac, the shell being internal. The detection of a byssus in the young of *Mya* is of interest also from the fact that it suggests that such organs are probably present in the young stages of still other Lamellibranchs, where it has not been hitherto suspected.—*John A. Ryder.*

PHYSIOLOGY.[1]

On the Rhythm of the Mammalian Heart.—Prof. John A. McWilliam,[2] of the University of Aberdeen, extends to a study of the mammalian heart the methods of work which in the hands of Gaskell, Mills, himself, and others have led recently to such valuable results concerning the organ in Fishes, Amphibians, and Reptiles. He experiments with cats, dogs, rabbits, hedgehogs, guinea-pigs, and rats, partly on the excised heart and partly on the heart *in situ,* and obtains many interesting data, which he compares with the known facts in the cold-blooded animals. As in the latter, so in

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] The Journal of Physiology, Vol. 9, p. 167.

mammals the contractions of the heart muscle are always maximal, and a rhythmic rise and fall occur in the muscular excitability—a fall immediately succeeding the contraction, followed by a gradual rise during the phase of relaxation ; hence the more rapid the beat, the less powerful it is, and *vice versa.* Constant currents and weak induction currents are alike in causing an acceleration of beat in an already active heart, and the appearance of a rhythmic series of beats in one previously quiescent. As in all other Vertebrates, the mammalian heart-beat partakes of the nature of a progressive contraction beginning at the venous end of the organ. The place of origin of the contraction seems to be the walls of the great veins, and the time of origin is the same for the venæ cavæ and the pulmonary veins. Whether the mammalian cardiac rhythm is nervous or myogonic—*i.e.*, whether it is a property of nervous or muscular tissue—is impossible at present to decide. That heart muscle has a spontaneous rhythmic power of its own is abundantly proved for Fishes, Amphibians, and Reptiles, although it seems that normally, in the auricular muscle at least, such power is in abeyance. The following facts concerning the mammalian heart muscle will help in the future to elucidate this subject. All parts of the heart are endowed with independent rhythmic power, as is proved by the continuance of rhythmic contractions in parts separated from each other—*e.g.*, in ventricles separated from auricles ; the independent ventricular rhythm seems at times to be myogonic, for by increasing the local excitability, as by the local application of heat, the contraction may be made to begin in the apex, where, according to the researches of the author and those of Kasem Beck, nerve-cells do not occur ; the automatic rhythmic property is not equal in the various parts of the heart, being apparently highest in the venous terminations, and lowest in the ventricle, as indicated, among other things, by the slow rhythm in the isolated ventricle (which is in harmony with what exists in the lower Vertebrates) ; the rhythm originating at the venous terminations apparently dominates the whole heart, and determines the rate of its action ; hence the causes determining the rhythm of the intact heart are to be sought for at the venous end of the organ. The usual order of contraction may be altered and even entirely reversed by artificially stimulating a portion of the surface—*e.g.*, stimulation of the ventricle is followed by contraction of the ventricle, then auricle, then venous terminations.

The question of the mode of propagation of the normal contraction over the auricles and ventricles is discussed by the author at some length, in view of the fact that Gaskell has urged that in the tortoise the phenomenon is simply one of muscular conduction. Such an explanation is negatived at once for the mammalian heart, as regards the passage from auricle to ventricle at least, by the fact that here is a distinct break in the muscular continuity, the auricles and ventricles being separated by a considerable amount of connective tissue. It seems impossible to account for the sequence on purely physical grounds, such as the distension of the ventricular cavities, the electric variation accompanying the auricular beat, or the sudden tension of the chordæ tendineæ resulting from the contraction of the auricular muscle fibres which go down into the auriculo-ventricular valves. The author is hence forced to a belief in the existence of a nervous mechanism for the propagation. What this mechanism is, is not known, but it is possible that an extensive nerve plexus exists throughout the whole of the cardiac wall. Passage of the contraction through the substance of the auricle is independent of the great nerve-trunks, since these may be destroyed and the wall even cut into zigzag strips without interfering with the action.

CONNECTIONS OF MEMBRANOUS LABYRINTH.—In Fishes, Amphibians, and Reptiles the *ductus endolymphaticus* of the inner ear has long been known not to constitute a closed cavity, but to join the exterior (Elasmobranchs) or the lymph-spaces of the cranial cavity. Rüdinger[1] finds an analogous arrangement to exist in mammals and man. The ductus does not here end blindly, as has hitherto been supposed, but by means of several branched canals is in communication with the subdural lymph-spaces of the dura mater. These canals are probably homologous with those of the lower vertebrates. The author regards the ductus as an elastic bag, the function of which is to enable the differences of pressure occurring within the labyrinth to be readily balanced. The size, the bladder-like form, and the situation of the ductus in the cranial cavity, instead of within the bony labyrinth, favor such a theory.

FUNCTION OF THE COCHLEA.—The most commonly accepted hypothesis regarding the mode of analysis of composite sounds by the cochlea is that of Hensen, according to which a small portion of the basilar membrane is put into vibration by the incoming waves; deep tones affect the membrane where it is widest—*i.e.*, at the apex of the cochlea; high tones affect the narrow portion at the cochlear base. This theory is supported by an observation of Munk that a dog, in whom the base of the cochlea had been injured, could hear low tones only. Stepanow[2] has recently tested the theory experimentally by destroying the apex of the cochlea in the guinea-pig, in which animal the cochlea projects freely into the auditory bulla. Different instruments, comprising the violin, piano, harmonica, Galton's whistle, B-bass, tuning-fork, etc., were employed to test the power of hearing; and the perception of sound was inferred from the reflex movement of the ears. In spite of destruction of a considerable portion of the apical region of the cochlea, accompanied by loss of endolymph, the animals reacted to all tones, and, what is especially

[1] Sitzungsber. d. math.-phys., Cl. d. k. bayer., Akad. d. Wiss., 1887. Heft. 3, p. 455. Cf. Münchener Med. Wochenschr., 1888, p. 139.

[2] Monatschr. f. Ohrenh., xxii., p. 85. Cf. Centralblatt f. Physiologie, 1888, p. 298.

important, perception of the deep tones did not seem to be wanting. The author regards Hensen's hypothesis as not proved, and inclines to the theory of Voltolini that each nerve fibre of the cochlea recognizes all tones.

A RECENT STUDY OF "RIGOR MORTIS."—Some important work on rigor mortis has lately been done in the Physiological Institute at Königsberg by Max Bierfreund, cand. med.[1] Since the time of Nysten (1811) physiologists generally have suspected that the nervous system has some appreciable influence upon the time of appearance of rigor, and possibly upon its subsequent intensity. Munk, Bleuler and Lehmann, v. Eiselsberg, Tamassia, and others have investigated the question and have come to quite contradictory conclusions. Tamassia asserts that rigor is completely independent of the nervous system, and supports this theory by the results of a number of experiments on frogs, sparrows, and guinea-pigs. A. v. Gendre, v. Eiselsberg, and now Max Bierfreund have, on the other hand, arrived at the opposite conclusion. Bierfreund has found in all the experiments performed by him decided evidence that some influence proceeds from the nervous system. When he cut the sciatic nerve of a freshly-killed animal he found that rigor mortis always set in on that side 10–20 minutes later than in the muscles of the uninjured leg. This indicates that the nervous system exercises a quickening influence upon rigor, and this view is fully borne out by experiments upon the central nervous mechanism. Division of the lateral columns of the spinal cord or extirpation of one of the cerebral hemispheres will cause a delay in the appearance of rigor on the side which is dependent on the part removed. Bierfreund found, also, as might have been anticipated, that destruction of the central organs diminished the intensity of the rigor.

The red muscles stiffen much later than the white (11–15 hrs. as against 1–3 hrs.) ; and the time taken for completion of the rigor in the red muscles is much longer (52–58 hrs. as against 10–14 hrs.). Bierfreund sees in this fact an explanation of the so-called law of Nysten that the muscles of the body fall into rigor in a fixed and definite order. He observed, for example, that in rabbits the muscles of the hind limbs, where white muscles predominate, invariably stiffen sooner than those of the fore limbs, where the muscles are exclusively red.

High temperatures hasten the onset and the subsequent disappearance of rigor. Narcotics (chloroform and ether) if inhaled, delay it, but, if injected into the blood, produce a condition similar to rigor by their direct effect on the muscle substance. Chloral, which has no direct influence upon the muscle, effects a retardation of rigor when injected into the blood. Curare, according to von Eiselsberg and von Gendre, appears to destroy completely the influ-

[1] Untersuchungen über die Todtenstarre, Pflüger's Archiv, Bd. XLIII., S. 195.

ence of the nervous system. Stimulation of the sciatic on one side with a subminimal electric current causes rigor to appear later on that side.

The disappearance of rigor is not due to the fact that putrefaction liquefies a coagulated proteid. Putrefaction and rigor do not run parallel courses; frogs are occasionally found in a state of rigor in spite of intense putrefaction. If putrefaction be checked by injection of carbolic acid or corrosive sublimate into the blood-vessels of the animal the rigor disappears just as quickly as in an animal in which putrefaction is given full sway.

Bierfreund regards as highly significant the fact that rigor vanishes of itself and independently of the putrefaction. He looks upon rigor mortis as the last contraction of the muscle, the last act in the life-history of the muscle fibre; but by what stimulus or stimuli this contraction is called forth, he leaves us still uncertain. —*E. D. Jordan, Boston.*

THE MECHANICAL ORIGIN OF THE HARD PARTS OF THE MAMMALIA.—A paper on this subject was read by the writer before the American Philosophical Society, Jan. 3.

Summarizing the investigation, the author stated that the structures of the mammalian skeleton and dentition may be referred broadly to the two general classes, excess of growth and defect of growth. Each of these may be again divided into two series as follows:

Excess of growth { Use. / Luxuriance.
Defect of growth { Disuse. / Poverty.

The paper dwelt principally with the first two conditions, which have frequently co-operated in the development of structures. These were classified under the following mechanical energies as causes:

A. Motion in articulation.

1. Impact only.
   Facetting of distal end of radius in Diplarthra.
   Expansion of proximal end of radius in Diplarthra,
   Grooving of distal end of tibia by astragalus.
   Grooving of proximal end of astragalus by tibia.
   External trochlea of humerus in Rodentia (Leporidæ), and metapodials and humerus in Diplarthra.
2. Torsion only.
   Alternation of carpal bones in Anthropomorpha.
   Symmetrical flanges of ulnar cotylus in Anthropomorpha.
   Unsymmetrical flanges of ulnar cotylus in other mammalia.
   Rounding of head of radius in Edentata and Quadrumana.
   Involution of eygapophyses in Diplarthra, etc.
3. Torsion and impact without flexure.
   Alternation of carpal and torsal bones in Ungulata.

4. Torsion, impact, and flexure in one plane.
   Tongue and groove joints in many orders.
5. Flexure in two planes.
   Saddle-shaped cervical vertebræ in Quadrumana.
6. Flexure in several directions.
   Ball and socket vertebral articulation.
   Heads of humerus and femur.

AA. Motion not in articulation. (Teeth.)

7. Displacement of cusps of triconodont molars by crowding.
   Tritubercular molars.
8. Transverse thrust.
   The Vs of molars teeth in various orders.
9. Longitudinal thrust.
   The Vs of the Multituberculata.
   Obliquity of molars in many Rodentia.
10. Stimulation of pressure and strain.
   Incisors of Rodentia, Multituberculata, etc.
   Prismatic molars of Diplarthra, Rodentia, etc.
   Confluence of cusps into crests generally.
   Sectorial teeth of Carnivora.
   Canine teeth in general.
   Incisors of Proboscidia, Monodon, Halicore, etc.

As a general result we may assert that that it is a general law of animal as of other mechanics—viz., that *identical causes produce identical results.* The evidence for this law may be arranged under two heads, as follows :

I. The same structure appears in distinct phyla which are subjected to the same mechanical conditions. Examples of this are: the identical character of the articulation of the limbs in Diplarthra and Rodentia which possess powers of rapid locomotion. The identical structure of the head of the radius in Edentata and Quadrumana which possess the power of complete supination of the manus. Identical reduction of the number of the digits under increased use of the limbs in many of the orders. Identical modification of dental cusps into longitudinal Vs and crescents under transverse strains in several orders, and into transverse crescents under longitudinal strains, in the Multituberculata. Identical modifications of the form and development of crests of the skull under identical conditions of use of the canine teeth for defence, in all the orders where the latter are developed.

II. Different structures appear in different parts of the skeleton of the same individual animals in consequence of the different mechanical conditions to which these parts have been subjected. Examples: the diverse modification of the articulations of the limbs in consequence of difference of the uses to which they have been put, in mammals which excavate the earth with one pair of limbs only, as in the fossorial Edentata, Insectivora, and Rodentia. The reduction of the number of digits in the posterior limb only, when this is exclusively used for rapid progression, as in leaping ; this is seen in the kangaroos and jerboas, in the orders Marsupialia and Rodentia.

There are a good many structures in the skeleton of the Mammalia which have not yet received a satisfactory explanation on the ground of mechanical necessity. Such, for instance, appears to me to be the condition of the history of the origin of the canine tooth; that is its use in preference to an incisor for raptorial purposes. Such may be also the history of the origin of the complex vertebral articulations of the American Edentata, as compared with the simple articulations of the Old World. In these, as in similar cases, however, an element enters which must be taken into account in seeking for explanations; that is, that every evolution is determined at its inception by the material or type from which it originates. Thus is explained the fact that identical uses have not produced identical structures in the limbs of all aquatic animals. The fin of the fish is essentially different from the paddle of the Ichthyosaurus or the whale. The beak of the rapatorial bird is different from the canine tooth of the rapacious mammal. When this principle is duly considered, many mechanical explanations will become clear, which now seem to be involved in difficulty or mystery.—*E. D. Cope.*

PSYCHOLOGY.

Grasshopper Reasoning.—I was on the railroad train from Newport, Vermillion County, for Terre Haute. A grasshopper in a heedless spring lit on the glass window of the coach. It was a warm, dry, dusty day of the drouthy summer. That little hopper looked through the glass and seemed astonished; the car was moving with increasing velocity, and thus surrounded by the current of air, the quiver and rattle of the car, seemed afraid to jump; and perhaps recalling the terrors of railroad accidents, was too cautious to fall off. So, calmly studying the situation, he decided to stay and ride to the next station.

On the polished surface of the giving, dusty glass, his feet became dry and his footing insecure. Mental resources came to his rescue. His memory and reason notified him that he must keep the suction cushions of his feet wet to insure an adhesive vacuum. So, after carefully planting his feet in safety, he carefully raised one foot to his mouth or lips and moistened it. It was a success, as reason and old memories and hopper philosophy had told him. Another and another foot was so moistened, and the hopper, armed with memory, prudence, and philosophic reason, rode on the train to the next station, affording entertainment to several admiring friends. Hon. John Whitcomb, of Clinton, first called our attention to the cute little fellow.—*C., in Indiana Farmer.*

Frogs Eating Snakes.—For several months I have kept in the house a sort of "zoological garden" in which there have been a few specimens of frogs, salamanders, and snakes. A few weeks ago I placed therein two full-grown leopard frogs and a hog-nosed viper about nine or ten inches in length. There were already in the box two garter-snakes two feet long and three salamanders—nothing else at that time. For a time everything went well, but about two weeks later the little viper was missing. A diligent search failed to find it, and careful examination of the cage showed no place of escape. The disappearance seemed quite mysterious, and the conclusion reached was that it had fallen a victim to cannibalism on the part of one of the other reptiles, although neither showed any signs of having feasted so extensively. Ten or fifteen days later a friend and I went to take a look at the pets. We found in the excrement of one of the frogs what on examination proved to be the skin, etc., of a snake, apparently the lost viper. When first found not more than half the length had passed, and the process was evidently causing the frog considerable effort. It was using its hind feet to assist in freeing itself.

Was the inference that the frog had swallowed the snake justifiable? I had never heard of such an occurrence; nor have I since been able to find any one who has. I was greatly surprised, for it seemed to me almost impossible. The swallowing of frogs by snakes I have several times seen, but I have never known the operation to be reversed, except in this instance.—*H. L. Roberts, Lewistown, Ill.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

The American Historical Society held its fifth annual meeting in the National Museum at Washington, D. C., beginning December 26, and continuing three days.

Among the many papers read, about the only one bearing upon Anthropology was that of Major Powell, introducing a "Language Map of North America." This map was displayed before the audience and the different Indian languages depicted thereon by different colors. An abstract of the Major's remarks and description is as follows:

[1] This Department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

"There is but one human species; but one human race. All differences are but variations of the one and original species. There were two great peoples of this one human species living on the two different hemispheres, unknown to each other. Columbus, voyaging from the one, discovered the other. and introduced them together. Further acquaintance developed the fact that even before his time there was a greater number of living languages in America than in Europe. If there was not more civilization, there was certainly more philosophy. We have failed to comprehend the extent to which this is true.

"Fifteen years ago I was called upon in my official capacity to classify the North American Indians. After various attempts and much consideration, I decided that the only practical or satisfactory classification was that to be made by language. Other persons had treated the subject in the light of zoology, and had attempted to classify man as an animal. Divers measurements of the crania were resorted to, anthropometry was put in active operation, tests were made of the color of the skin, hair, eyes, etc., but all such have failed as means of classification. We discovered as we progressed that classification by language was fundamental and wrought a classification in civilization, sociology, religion, mythology, art, etc.

"This map exhibits our conclusions so far as our work has been completed. It is intended to represent the condition and location of Indian tribes as manifested by their languages at the advent of the white man, though succeeding epochs have sometimes necessarily been shown.

"The Eskimos occupy the northern coast line like a fringe from Labrador to Alaska. They speak practically the same language. The Athabascan, occupying almost the entire territory of British North America, speak many languages, each distinct from the other, and yet belonging to the same stock and showing that they were the same people. We find this language scattered in spots through California and Old and New Mexico.

"The next group of languages, forty or fifty in number, scattered over the eastern and northeastern United States and Canada. was the Algonkin, and yet we find the Arapahoes down near the Gulf of Mexico to belong to the same stock. Likewise the Iroquois, variously called the Five or Six or Seven Nations, have a modern representative in the language of the Cherokees.

"The Siouan group had its habitat on the prairies between the Mississippi and Missouri. The Shoshonian group comprises twenty-five different languages. The Pueblo Indians employed four or five different stocks, but they all belong to the Shoshonian language.

"We have gathered material showing seventy-three different stocks of languages and nigh eight hundred dialects among the Indians of North America, and we have been aided in our work by the labors of missionaries, scholars, and of volunteers.

"Our work has made us more conservative. We now depend more on evidence and less on theory. Our arrangement is based on the vocabulary—the roots of words. We have not depended upon the structure of their language. Structure means only different grades or degrees in development. A single language in its different dialects may exhibit at one and the same time both the highest and the lowest grade of structure or development. This is true of the Shoshonian. The language of some of the Indian tribes had a higher order of structure and a better grammar than had the English. The grammar of a language is born in barbarism.

"An attempt has been made in the present day, by a German, to construct a new language, and its inventor or maker has declared his purpose to take the good things of all languages and put them together for his new language. Suppose a zoologist should attempt to construct a new animal, or a new species, upon the same line, and, for instance, for the extremities of the body, he takes the hoofs of the horse, the wing of the bird, the fin of the fish, and the hand of man, and uses them all in the construction of his new animal because they all served a good purpose in the old. The result would be the same as in the new language, Volapük—the conglomerate monster of modern language."

We have seen the Linguistic Map of North America prepared by Major Powell and his assistants. It is a great work, worthy all commendation. The science had need for it, and it could scarcely ever have been done by private enterprise. It was fit and proper that it should be done under Government patronage, and all credit is due to the men who have made it.

In giving it this commendation, we do not at all assent to Major Powell's criticisms of other means of classification, and his laudation of language as the only correct or valuable one.

His may be, or may not be, the best system for the classification of the modern North American Indian tribes, but certainly is not for the real prehistoric races, whether of the Western or Eastern Hemispheres. However much we may theorize concerning their means of communicating ideas to each other, we are absolutely without knowledge as to the language they employed. But we make no dispute with Major Powell. This work done by him has enough of good in it to receive our approval, without wasting our strength in disputing over his criticism of other methods. The truth is, that all systems, all means, all methods, of determining the differences between the various Indian tribes, and, perhaps, between all races of men, are necessary and important in establishing the true classification. We may not pin our faith to one alone, but may use all, getting from each whatever of good it may furnish. The other method of classification will continue to be used, and Time, the great leveller, will set all things right. We can afford to wait.

APPROPRIATIONS BY CONGRESS FOR THE U. S. NATIONAL MUSEUM.—"England has become thoroughly aroused to the necessity of encouraging science and art. Availing herself of the fifty thousand volumes and the hundreds of cases of natural history left by Hans Sloane, a native of Ireland, she founded the British Museum. Later in the century she spent half a million dollars on the National Gallery, and has annually bestowed upon it a liberal allowance. The South Kensington Museum, the National Portrait Gallery, and the India Museum are all of comparatively recent origin, and have cost the Treasury millions for their foundation and support. Museums of art have been opened in the provincial towns, supported in part by corporate, in part by private, and in part, indirectly, by Parliamentary aid. The effect of Kensington and other training-schools upon the industry of England has been such that last year a leading French authority cried out that if France did not bestir herself, England would take from her the markets of the world, which the superior technic and taste of the French designers have monopolized for a century, or since the establishment of art schools throughout France. Parliament expended last year upon the science and art of England nearly $5,000,000, and upon science and art in Ireland nearly $300,000."—*Margaret F. Sullivan, in December Century Magazine.*

If comparisons were not "odorous," one might be drawn between the policy and action of the United States Government and that of Great Britain as set forth in the foregoing extract.

The United States National Museum is the only institution supported by the United States Government which stands as a representative of the British institutions mentioned above, and on which its Government has spent millions.

The appropriations made by the United States Government for the National Museum are barely sufficient to keep it alive. They are provision for its daily running expenses, and barely adequate for that. What the museum, its contributors and correspondents, persons throughout the country interested in kindred scientific pursuits, and the public generally, have good right to complain of is that no provision is made in these appropriations for the purchase or securing of specimens, however great their value or importance, nor for the enlargement or increase of the collections. The Congress, it would seem, fails to comprehend the scope and purpose of the National Museum. It seems to consider it as a mere gathering of curiosities (maybe monstrosities) which may serve to amuse and interest for an afternoon a stray constituent who may have come in from the rural districts and seek attention at his Congressman's hands. The Congress at large seems not to know, or, if it does, ignores the fact that the National Museum is an extensive, and ought to be fully equipped, organization for the education of the people and for conducting investigations in science not possible to be done by private individuals.

In other countries it would be liberally supported and generously sustained. With a geographic area larger than combined Europe the United States treats its science, especially its science of archæology, with less interest, or care or attention, if we measure these things by the appropriations made, than do the third-rate powers, such as Portugal, Denmark, Sweden, Switzerland, etc. Yet the area of the United States is as rich and as new, and will pay as largely for cultivation, as any like area in Europe. The States of Ohio, or Wisconsin, or West Virginia, or Mississippi, not to mention New York or New England, have either of them within their borders as much unstudied, unsearched, and unclassified archæologic riches as has any one of the great countries of Europe: England, France, Germany, Spain, or Italy. Yet these countries, each of them, do more for their archæology than equals the combined efforts of the United States and all the State governments.

I confess to a feeling of depression when, on visiting the Prehistoric Museum at Salisbury, England, I found there stored and displayed, in a beautiful building, erected in the midst of a lovely park, for its sole occupancy, the prehistoric collection of Squier and Davis, gathered by them from the mounds of the United States in the Ohio and Mississippi valleys. It went begging through the United States, knocked at the door of Congress, and besought a purchaser at the ludicrous price of $1000, but without finding a response. And in disgust with their countrymen, and in despair of ever being able to interest their Government or fellow-citizens, they sold their collection to England and retired from the field of archæologic investigations.

The National Museum courts the fullest investigations into its mode of conducting business. It is willing to be held to the strictest accountability for its expenditures. These should be made imperative. But it should receive at the hands of Congress an intelligent co-operation and a generous response to its efforts for the elevation and education of our people.

The Secretary of the Smithsonian Institution and Director of the National Museum has labored with all zeal to establish a zoological park and garden in the environs of Washington for the preservation and display of our native wild animals, now rapidly on the road to extinction. Looking in that direction, a few of these animals have been received as gifts under the promise that they would be protected and cared for. And they have been established in temporary wooden buildings, and a park, with a wire fence around it, as big as an onion patch, in the Smithsonian grounds, in expectation that they might form the nucleus of a future zoological park and garden. The House Committee on Appropriations seem to calculate or figure how much refuse meat, how many bushels of corn and bales of hay, how little of provision would support these animals, keeping them from starvation during the coming year, and so has reduced the appropriation by one-half from the estimates. One might suppose that the Secretary, meeting with such responses, would grow weary of his efforts in well-doing and retire from the further contest disappointed, if not in despair.

However, the people of the United States are not niggardly in the matter of money needed for the benefit of science, if the object be properly explained and fairly understood. It rests upon the Secretary and Board of Regents to do this, and the people will justify them in asking for any reasonable amount so long as they shall be satisfied, as they may be under the present administration, that it is honestly expended and faithfully accounted for. Legislators seeking a reputation for economy will not be sustained by the people in refusing to vote the appropriations sufficient to secure, in these matters, a degree of excellence which will cause the United States to compare favorably with other countries.

FORGERIES OF PALÆOLITHIC IMPLEMENTS IN EUROPE.—Mr. John Evans, of Nash Mills, Hemel Hempstead, England, the distinguished numismatist and prehistoric archæologist, says in a private letter lately received: "We have lately had very extensive forgeries of palæolithic implements in the neighborhood of London. Many of them are of great size and remarkably well made. Several collectors have been taken in, and I should not be surprised if some of our dealers exported a few to America. I recommend you to be on your guard."

Monsieur Boucher de Perthes, of Abbeville, the discoverer of the palæolithic age and implements in the valley of the river Somme, was often deceived by the workmen on whom he had to depend in his search for these implements. It was in the beginning of all knowledge of this subject, and no one could claim to be an expert or have much experience in their detection. Monsieur Boucher de Perthes stored his collection, if he did not make it a donation, to the Archæologic Museum of the town of Abbeville, and died without knowlege of the frauds of which he had been the victim. His son-in-law, M. D'Ault Dumesnil, the geologist, equally learned and practised as a prehistoric archæologist, became director of that museum. In the classification made by him of the palæolithic implements he detected the forgeries and withdrew them from exhibition. The United States National Museum has to thank him for a series which are there exhibited as specimens of these forgeries. So habile did M. Dumensil become in the detection of these forgeries that he was able to tell from an inspection of them, not only when they were forgeries, but from their peculiarities he could determine the identity of the forger. The "personal equation" was so manifested in this work as to enable him to do this.

INTERNATIONAL CONGRESS OF PREHISTORIC ANTHROPOLOGY AT PARIS, 1889.—The International Congress of Prehistoric Anthropology will profit by the French Exposition of 1889, and hold a meeting at Paris, in August of this year. These Congresses were organized in 1866–67, and have held their meetings in various capitals of Europe with greater or less regularity until the last one at Lisbon, in 1880. A session was organized for Athens, in 1883, but failed, owing to the rumors of approaching war. We are glad to hear of this revival at Paris for 1889.

A few individuals (I dô not know whether they were enough to make it the plural number), living less that a hundred miles from the city of New York, having a greater desire for notoriety than to benefit the human race, attempted last spring and summer to organize a private international congress of prehistoric anthropology. The list of complimentary officers, Vice-Presidents, etc., was formidable, and comprised most, if not all, distinguished foreigners, and the farther away the more there were of them. The list appeared to have been copied from the records of some young and ambitious anthropological society, and to have contained all its honorary associates and corresponding members. The scheme was doomed from the beginning, as an international affair, for, while no anthropologists at home were consulted, or at least gave their adhesion, the time was too short to perfect arrangements with foreign countries and have their societies represented. But one foreigner of any note attended, and he—well, he concealed his disappointment with that suavity which belongs to his nation. No great harm was done to the science of prehistoric anthropology by the failure of this pretended International Congress, for no one was greatly deceived ; but its instigators should take warning from this attempt and not repeat the fiasco. Think of getting up such a congress without the co-operation of any of the members of the anthropological section of the Association for the Advancement of Science, and without a representative from any of the anthropological societies of the United States except the local one interested.

ANTHROPOLOGICAL NEWS.—Dr. A. B. Meyer, of Dresden, writes to *Nature* (XXXIX., p. 30) to state that there are no autochthonic Papuans or Negritos in Celebes, and to express doubts of their occurring in other islands to which they are attributed by Quatrefages and Flower.

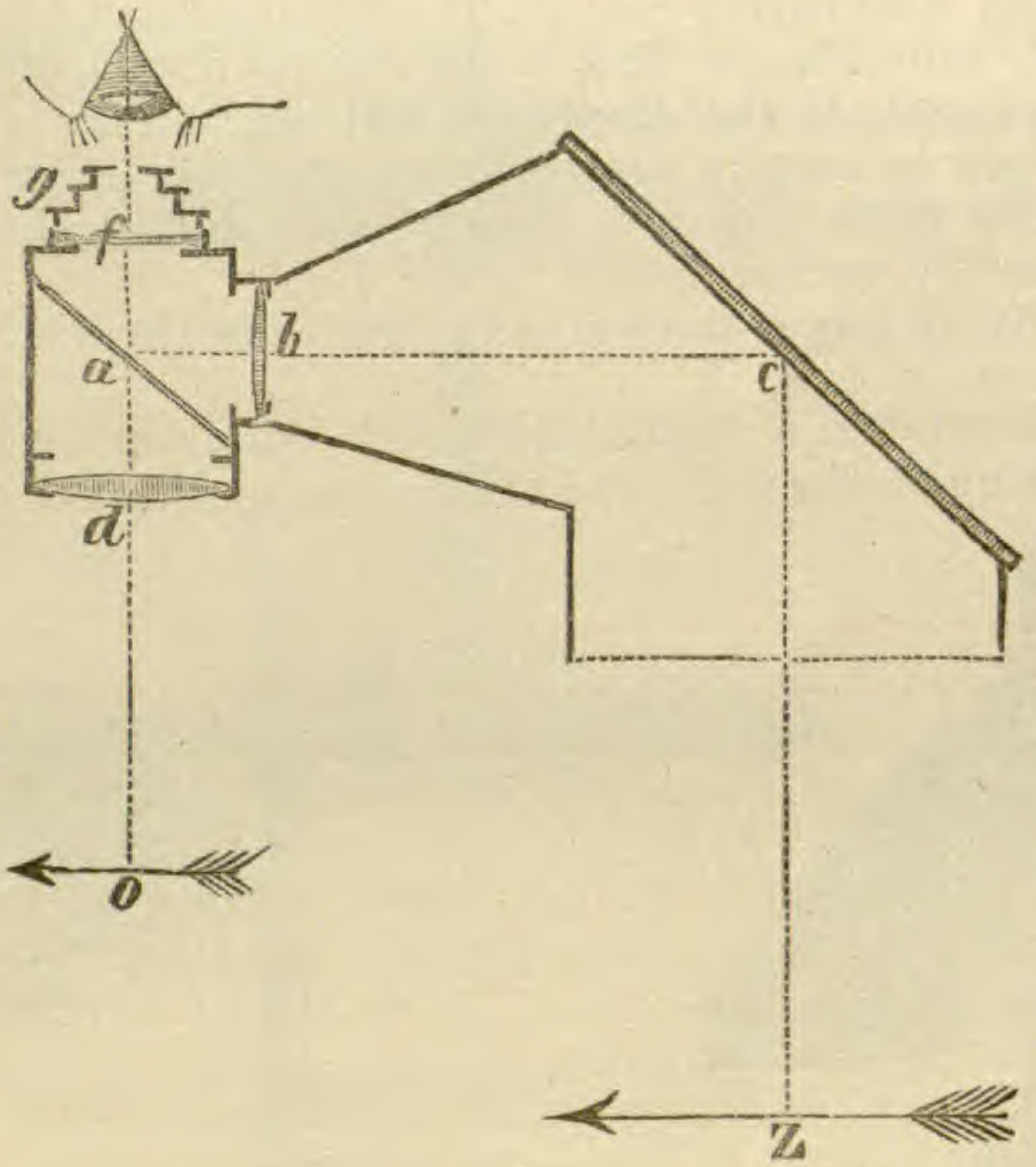
The first discovery of remains of cave-dwellers in Scandinavia has recently been made in a cave on a small island near Gottland. The remains consisted of the old fireplaces, and the bones of various animals, pottery, flint chips, etc. Most of the bones had been broken to extract the marrow. In the upper strata the bones of pigs, horses, etc., predominated, but in the lower those of seals increase.

During the past summer the museum at Copenhagen has explored a large kitchen-midden in Jutland, situated in a forest a couple of miles from the sea. Besides the usual assortment of bones and shells, many flint implements and fragments of pottery were found, as well as some bone and horn tools, a few of the latter showing traces of ornamentation.

MICROSCOPY.[1]

THOMA'S CAMERA LUCIDA.[2]—The cameras now in use are not well adapted for a low magnifying power (1–6), nor is any allowance made in their construction for the refractive index of the eye. In order to obtain sharp images one is often obliged to bring the drawing-paper nearer the eye, thus materially reducing the field of vision.

In the construction of Thoma's camera the above difficulties are avoided, and it is specially recommended for drawing with a magnifying power of from 1–10 times, and for the production of *reduced drawings.*



1.

The camera consists of a blackened, metallic frame containing two mirrors, one of which, fig. 1,*a*, is an unsilvered glass plate from 0.15 to 0.20 mm. in thickness, while the other (*c*) is a plain silvered mirror. Both mirrors are parallel with each other and inclined at an angle of 45° to the horizon.

In order to draw an object magnified four times, we place at *o* a convex eye-glass with a focal distance of 40 cm., and then fasten the camera upon the vertical rod so that the distance *b c* and *c z* = 40

[1] Edited by C. O. Whittman, Director of the Lake Laboratory, Milwaukee.

[2] Zeitschrift f. wiss. Mikroskopie, v. 3, p. 297, Sept., 1887.

cm. As the distance *b c* is constant, 10 cm., *c z* must be 30 cm., and may be easily found on the ruled rod that supports the camera.

Next a convex eye-glass of 10 cm. focal distance is inserted at *d*, and the upper end of the sliding ring to which the stage is attached brought within 10 cm. of the lower edge of the ring to which the camera is fastened.

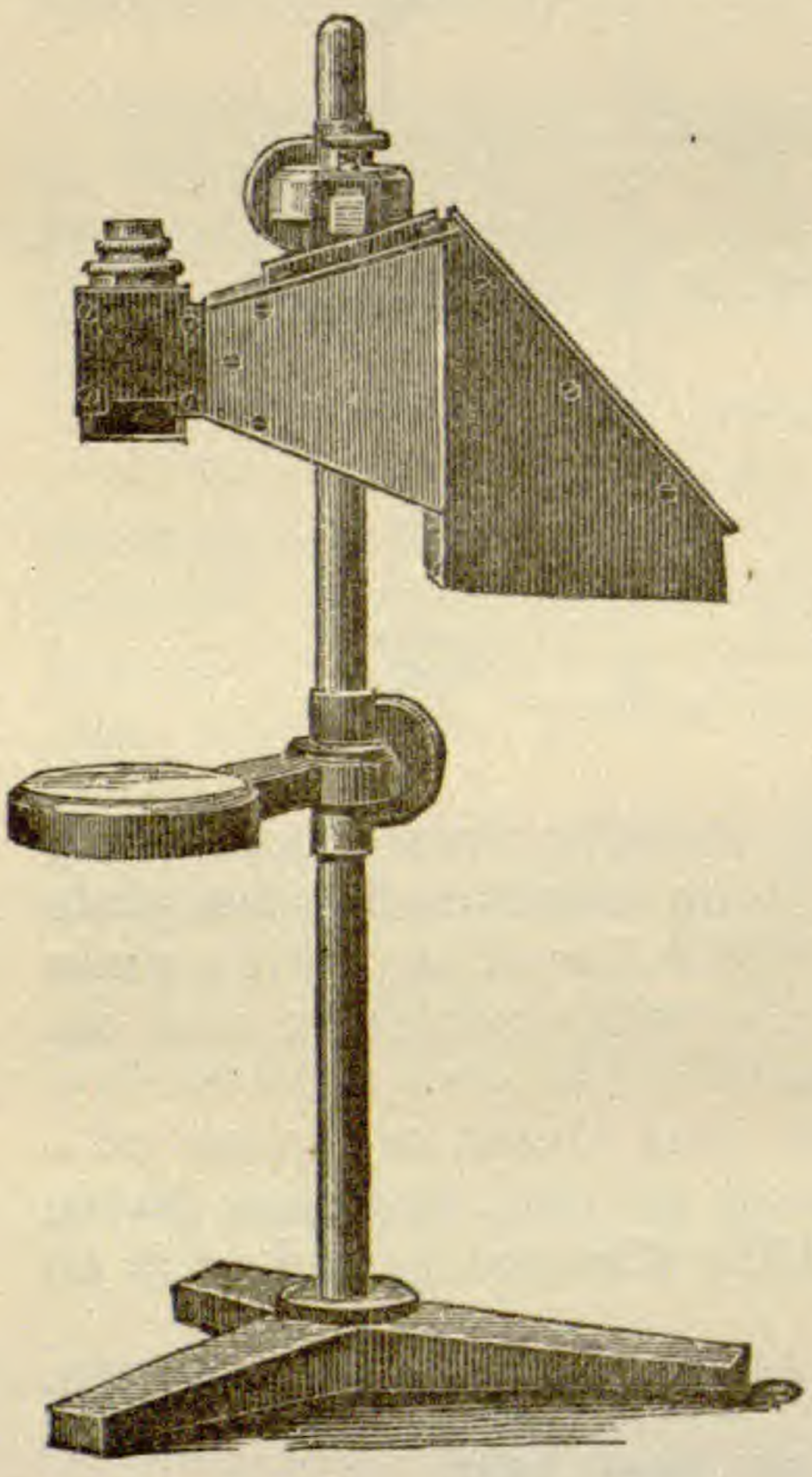
The amount of light is regulated by means of smoked glasses inserted above the convex glass at *d*.

If the eye of the observer is myopic. it is necessary to insert at *f* an eye-glass for correction. A myopic person will often find it convenient to use a glass a little stronger than is required in looking at distant objects.

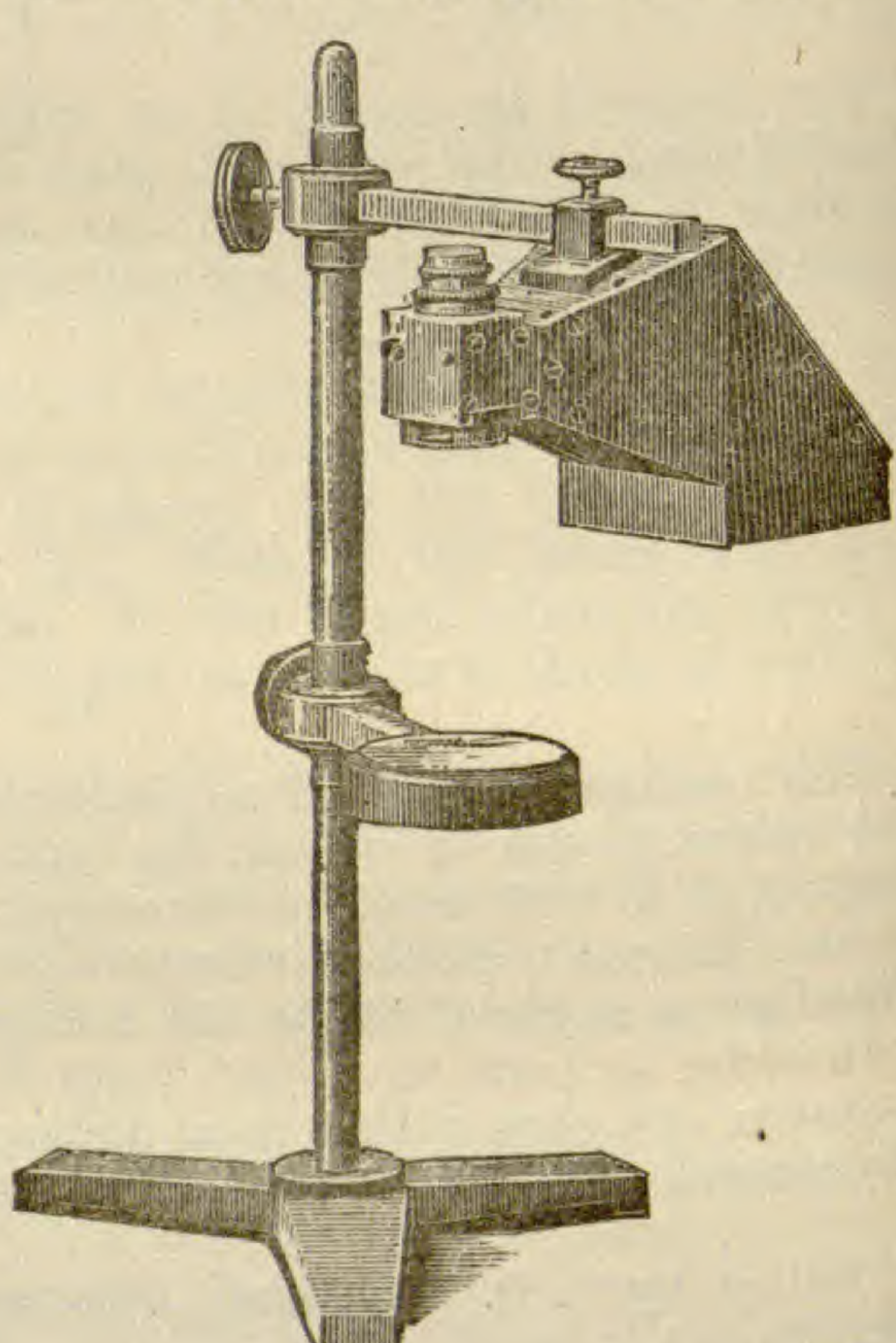
Finally, in all cases, except where a magnifying power of from 1 to 2 times is used, a diopter (*g*) must be placed above *f*. In using the high magnifying powers the focal points of both systems do not exactly coincide, so that a parallactic displacement of the images is produced, if the diopter is left out. This is a defect of all cameras and is usually corrected by the use of small prisms, while here the same object is equally well, and at the same time more conveniently, accomplished by the diopter.

The magnifying power is equal to the ratios of the distances. *b c z* and $d = 40 : 10 = 4 : 1$.

In using the camera, it must stand before the observer, as in fig. 2, with the drawing on the right and the diopter and object on the left.

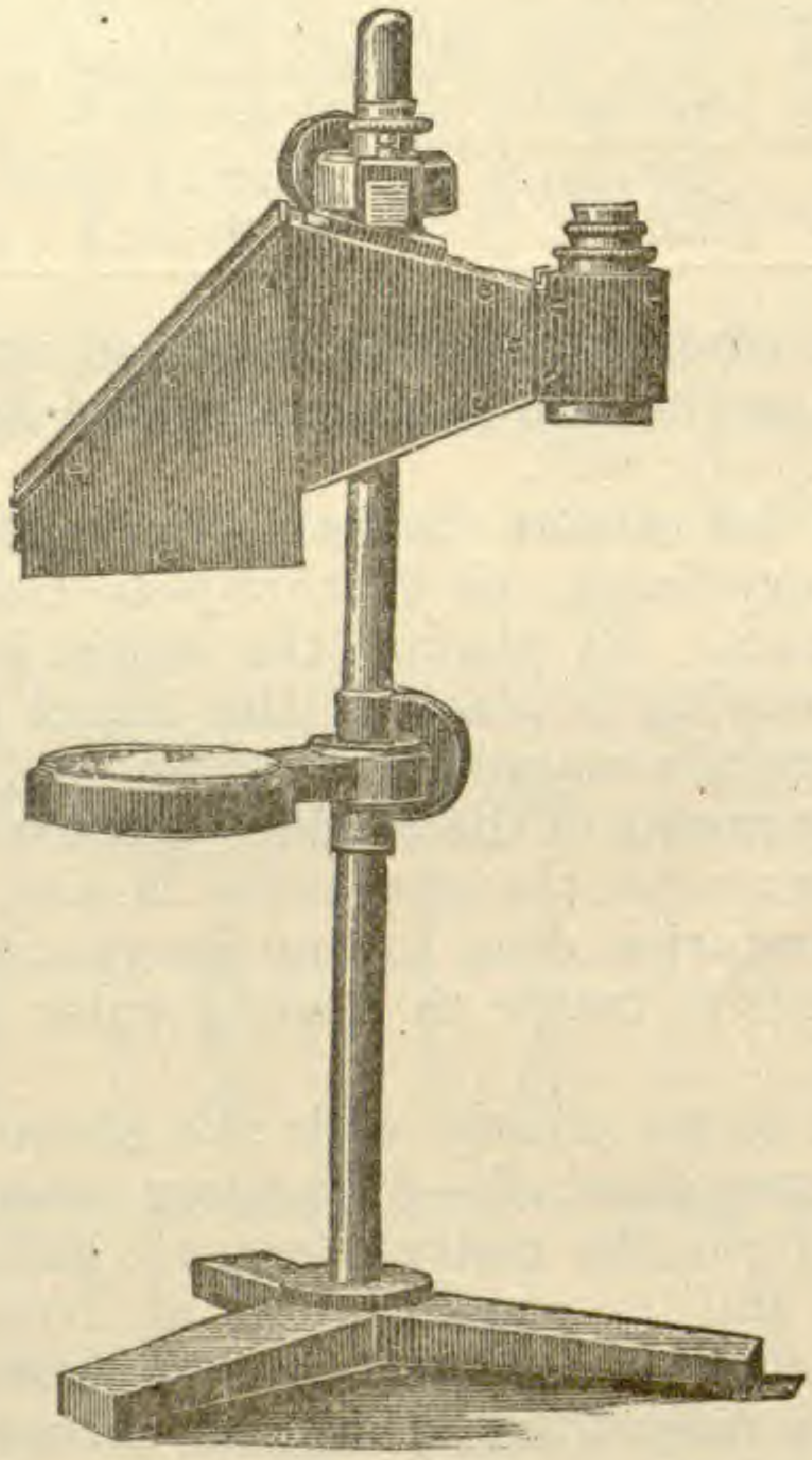


2.



3.

Only in using a magnifying power of from 1–1½ times is the position of the camera reversed, the drawing and object maintaining the same position as before (fig. 4). In this way we look directly at the drawing, while the object is seen through the two mirrors.



4.

For other powers than that given above, the following table may be used:

MAGNIFICATION TABLE.

I.

Diopter and object on the left, drawing and silvered mirror on the right, as in fig. 2.

Diopters of the convex lens necessary at *d* in fig. 1.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification	Diopters of the convex lens necessary at *b* in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens *b*.
+ 15 = 10 + 5	c	66 mm.	6	+ 2.5	—	400 mm.
+ 12.5 = 12 + 0.5	c	80	5	+ 2.5	—	400 "
+ 10	c	100	4	+ 2.5	—	400 "
+ 10.5 = 10 + 0.5	c	95	3½	+ 3	—	333 "
+ 7.5	d	133	3	+ 2,5	—	400 "
+ 6.25 = 6 + 0.25	d	160	2½	+ 2.5	—	400 "
+ 5	d	200	2	+ 2.5	—	400 "

II.

Object and silver mirror on the left, diopter and drawing on the right, as required for a magnification of 1–1½ times, as in fig. 4.

Diopters of the convex lenses necessary at *b* in fig. 1.	Smoked glass, No.	Distance of the object from convex lens *b*.	Magnification	Diopters of the convex lens necessary at *d* in fig. 1.	Smoked glass, No.	Distance of the drawing paper from the convex lens *b*.
+ 5	—	200 mm.	1½	3.25=3+0.25	d	300 mm.
+ 4	—	250 "	1	+4=3+1	c	250 "

When in use the whole apparatus is placed upon the drawing-paper, which serves as the source of transmitted-light, but reflected light may be used equally well.

One advantage of this camera is that, even with low powers, the field of vision is very large, so that objects from 6–10 cm. in diameter may be drawn. By placing the object in the place of the drawing, and the drawing in place of the object (using the above table), one can reduce the magnification from 1–⅙.

While it is easy by means of the concave glasses to accommodate any eye to the instrument, the apparatus is also a safe and convenient help in laboratories, even to the unexperienced. But as in all such instruments it is better to draw a ruler at the same time with the object.

If one who is able to see clearly with the above combination by inserting at *f* a concave glass of —5 diopters, then, since the distance of this glass from the convex lenses is 3.8 cm., the concave lens may be omitted and the convex lenses at *b* and *d* replaced by others, 6.25 diopters smaller. With a concave glass of + 5 D. at *f*, it is possible to obtain a magnifying power of 8 times by inserting at *d*, 50 cm. from the object, a convex glass of + 20 D., and at *b*, a convex glass of + 2.5 D., 400 mm. above the drawing-paper. If the concave at *f* is omitted, then, leaving object and lens in same position as before, it will be sufficent to place at *d* a convex glass of + 20 — 6.25=13.75 diopters, and at *b* one of + 2.5 — 6.25= — 3.75 Ds. One may thus obtain an 8-fold power without using too strong glasses. For eyes of a different refractive index, the number of diopters to be deducted changes.

If in the previous combination it is necessary to have at *f* a concave glass of — 1 D., this may be removed by deducting 1 D. from the glasses at *d* and *b*.

In the same way,

A concave glass of — 2 D's at *f*, may be replaced by — 2.16 D's at *d* and *b*.
" " — 3 " " " — 3.40 " "
" " — 4 " " " — 4,72 " "
" " — 5 " " " — 6.17 " "
" " — 6 " " " — 7.75 " "
" " — 7 " " " — 9.52 " "
" " — 8 " " " —11.50 " "

If in the first named combination a concave glass of — 2 D. is necessary at *f*, a myopic condition of — 8 D. may be produced if a convex glass of + 6 D's is placed in front of the one at *f*.

In the same way:

For an eye of		— 3 D's—	we must	add	+ 5 D.
"	"	— 4	"	"	"	+ 4 "
"	"	— 5	"	"	"	+ 3 "
"	"	— 6	"	"	"	+ 2 "
"	"	— 7	"	"	"	+ 1 "
"	"	— 8	"	"	"	0 "
"	"	— 9	"	"	"	— 1 "
"	"	—10	"	"	"	— 2 "

in order to produce a myopic condition of — 8 D's. When this condition is produced, we may obtain higher magnifying powers, as follows:

III.

Diopter and object on the left, drawing and silver mirror on the right, as in figure 2.

Diopters of the convex lens at *d*.	Smoked glass, No.	Distance of the object from the convex lens *d*.	Magnification.	Diopters of the concave lenses at *b*.	Distance of the drawing paper from the convex lens *b*.
+7	d	57 mn.	7	—9	400 mm.
+8.5 =7.5+1	d	50	8	—9	400 "
+11 = 6+5	c	44	9	—9	400 "
+13.5 =7.5+6	c	40	10	—9	400 "

These combinations produce perfect images, except when the strongest magnifying power is used, when a slight distortion is visible on the edge of the field of vision.

The above described camera, together with a case of 25 glasses, may be obtained of R. Jung, Mechanic and Optician, in Heidelberg, for 120 marks.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Society for Psychical Research; Boston, Dec. 12, 1888.—Dr. J. W. Warren read the report of the Committee on Mediumistic Phenomena, of which the following is the substance:

"Your committee desires to report a moderate progress in the investigations pertaining to its work. During the year the committee, as such, has undertaken the careful examination of the results obtained by one well-known trance medium. We were aided very materially by the generous co-operation of the medium. Thus far we have been able to have only light on 10 sittings, stenographically reported. The results thus obtained are not of such a character as to warrant any very decided judgment as to the nature of the phenomena under examination, but they throw some light on the questions involved. An extension of the investigation would be very desirable, provided a sufficient amount of money could be placed at our disposal. As to materializing or etherealizing mediums, it is learned that seven—nearly every one of whom had been highly recommended to our special attention—have come to grief here in Boston during the past two or three years. Still, we are ready to examine these phenomena on the receipt of tangible experiences on the part of trustworthy persons, provided we are permitted to impose such conditions as seem to us reasonable and necessary."

Secretary Richard Hodgson read the report of the Committee on Thought Transference. In the experiments made by this committee, an attempt was was made to "will" the subject to name a number selected by the other party to the experiment. By pure chance, one might be expected to guess 10 numbers out of 100 correctly, but the results varied in each series of 100 from 10 to 28. Out of 3000 numbers selected, 584 were guessed correctly, instead of 300, which fact, the members of the committee think, points to some other influence than chance. It was noticed that when the right guess was made in the first place, the subject displayed no desire to change it, and it was only in cases where the first guess was wrong that the subject showed any uncertainty in announcing it, or attempted to change it afterward.

Prof. J. Royce read the report on phantasms and presentiments. He declared that, in his opinion, the methods of research adopted by the committee on phantasms and presentiments had been justified by the results obtained. After he had stated the subdivisions he had made of his subject, he gave his special attention to what he called "pseudo-presentiments" and to coincidences that seem to have some bearing on telepathy. Under the head of pseudo-presentiments he cited a number of cases where individuals, after events have happened, persuade themselves that they had presentiments of the events before they occurred. He also spoke of the feeling people often have, when visiting a strange place, of "having been there before." These hallucinations, he said, were attributable to surprises which make so strong an impression upon a man's mind as to lead him to think that the subject has long had a lodgment in his brain. He spoke of three cases of telepathic coincidences, supported by documentary evidence, but these were all of them mentioned in his report of last year. These cases he considers very valuable for the purposes of the society, but as to the cause for them he expressed no opinion.

Dr. James made a short speech, setting forth the aims and needs of the society. It was the intention to extend the work of the society, and that specially interesting psychical cases in all parts of the country were to be scientifically investigated. Information in regard to alleged haunted houses was often received, many of which the society was unable to investigate, owing to a lack of funds, but there were over 700 cases now being investigated. The society, in self-defence, would be forced to publish more than it had ever done before, and all these matters required money. The new members, he said, had more than supplied the loss by withdrawals, so that the society was growing a little.

BIOLOGICAL SOCIETY OF WASHINGTON.—December, 15, 1888.—The following communications were read: Prof. Lester F. Ward, "Fortuitous Variation as Illustrated by the Genus *Eupatorium*, with exhibition of specimens;" Prof. C. V. Riley, "Note on a Human Parasite;" Mr. E. S. Burgess, "*Aster shortii* near Washington."

December 29.—The following communications were read: Dr. Theobald Smith, "Contagion and Infection from a Biological Standpoint;" Mr. F. A. Lucas, "Notes on the Diseases of Menagerie Animals;" Mr. Th. Holm, "Notes on *Hydrocotyle americana* Linn.;" Dr. Cooper Curtice, "Notes on the Sheep Tick, *Melophagus ovinus* Linn."

SCIENTIFIC NEWS.

— Dr. G. Ruge, of Heidelberg, has been called to the Professorship of Anatomy at Amsterdam.

— The results of the explorations of the late N. M. Prjewalski in Central Asia are to be published by the Imperial Academy of Sciences of St. Petersburg, at the expense of the Crown Prince Nikolas Alexander. The first part of the first volume of Zoology has appeared and contains the Mammals by E. Büchner. Prjewalski was just starting on a new journey to Central Asia when his death occurred, Nov. 1, at Karacol. He belonged to a noble family and was born in 1839. His first Siberian journey was undertaken with ridiculously small means ; it lasted thirty-four months and cost 6000 roubles ($4200). His second journey (1877) was under the auspices of the Russian War Department and resulted in the rediscovery of the Lob-Nor, which had not been seen by a single European since the days of Marco Polo. His third journey resulted in his discovery of the ancestor of the domestic horse (*Equus prjevalskii* Poliaeff). The fourth journey (1883) had for its objective point Thibet, and the fifth, on which he had just started when his death occurred, was an attempt to reach H'lassa, the sacred city of Lamaism. Prjewalski's natural history collections embraced 700 specimens of mammals, 5000 birds, 1200 reptiles and batrachia, 800 fishes, 2000 molluscs, 10,000 insects, and between 15,000 and 16,000 plants.

— Prof. A. C. Haddon, of Dublin, who sailed last summer for Torres Strait, has arrived there safely, and is engaged in studying the Sea Anemones, Nudibranchs, and the habits and placentation of the dugong or southern sea-cow. He is also collecting all the ethnological material obtainable, as the native population is rapidly dying out.

— The Copley Medal of the Royal Society is this year awarded to Prof. T. H. Huxley for his investigations on the morphology and histology of vertebrate and invertebrate animals. Baron Ferdinand von Müller receives the Royal Medal for his investigations of the Flora of Australia.

— The Costa Rican government has established a National Museum at San José.

— Samuel P. Fowler of Danvers, Mass., died Dec. 14, 1888, aged 88 years. He was a contributor to the AMERICAN NATURALIST in its early years.

— Prof. T. Kjerulf, the well-known geologist of Christiania, Norway, died in that city, Oct. 25, 1888

— Mr. Francis Darwin has been elected University Reader in Botany in the University of Cambridge in succession to Dr. Vines, now Professor at Oxford.

— Mr. Charles B. Cory, chairman of the Committee on Hypnotism of the American Society of Psychical Research, has issued his report. He believes that its use in connection with nervous diseases is worthy of consideration.

— Mr. H. A. Pilsbry is continuing the Manual of Conchology, Structural and Systematic, begun by the late Geo. W. Tryon. Part 39 of the first and Part 15 of the second series have recently been issued.

— G. Bellonci. Professor of Anatomy in the University of Bologna, died July 1, 1888, aged 30 years.

— G. Johann Kriesch, Professor of Zoology in the Polytechnicum at Budapesth, died October 21, aged 54 years.

— Dr. Robert Lamborn has presented a cast of the *Phenacodus primævus* to the American Museum of Natural History, New York. He has also deposited a fine collection of Mexican antiquities in the Metropolitan Art Museum, New York, and a collection of Tuscan antiquities in the Museum of the School of Industrial Art, Philadelphia.

— Professor Joseph Leidy, of Philadelphia, has received the Cuvier prize of the French Academy of Sciences in recognition of his important work in Natural History.

— A work on the Extinct Mammalia, by Professors Scott and Osborn, of Princeton, N. J., has been announced by D. Appleton & Sons, New York.

— Mr. E. T. Dumble has been appointed State Geologist of Texas.

— Prof. J. T. Branner recently reported unfavorably on the supposed silver and gold mines of Arkansas, of which State he is Geologist. The abuse he received from the papers of the alleged mining regions was extraordinary and unparalleled, but when he offered to submit the question to the judgment of other geologists, they did not accept his challenge.

Two Interesting Models for Anatomical Studies.—Everybody who has visited the British Museum of Natural History in London has noticed the highly instructive anatomical preparations in the Central Hall of this wonderful building. A great part of these preparations are made by the very skilful hand of Mr. Richard S. Wray, B.Sc., one of Prof. Flower's assistants.

Besides these specimens Mr. Wray has prepared some very good models for the Museum ; two of these can be now obtained from him.

1. Model of Amphioxus, showing the general relations and dispositions of the organs as seen from the left side. Price, £2 2s. ($10, about.)

This is a reproduction of the original wax model forming part of the series of models and drawings prepared to illustrate the structure of Amphioxus for the Index Museum of the British Museum (Natural History). The different organs are distinctively colored, and the model shows at a glance all the more important anatomical relations of the animal. The disposition and relations of the central nervous system, notochord, alimentary canal (pharynx, liver, anus, etc.), the epipleural cavity with its backward extension towards the anus, the cardiac and dorsal aortæ, are all clearly shown together with other details.

2. Enlarged model of the left side of the lower jaw of a young Ornithorhynchus, showing the tooth germs *in situ.* Price, 10s. 6d. ($2.60, about.)

The following quotation from the label attached to the original preparation and model in the Index Museum of the British Museum (Natural History) will fully explain its nature :

"In the Ornithorhynchus teeth are absent in the adult,................ In the young state, there are, however, distinct tooth rudiments with calcified cusps, beneath the region in which the horny plates are afterwards developed.

"The small glass vessel contains the left side of the lower jaw of a young Ornithorhynchus, prepared to show the tooth germs *in situ,* the characters of which are more clearly shown in the enlarged model placed by it."

Communications relating to the above to be addressed Richard S. Wray, 23, St. Germain's Road, Forest Hill, London, S. E.

I can only recommend these highly instructive models to every student of Biology. G. BAUR, New Haven, Conn.

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A CONTRIBUTION TO THE KNOWLEDGE OF THE GENUS BRANCHIPUS.

BY O. P. and W. P. HAY.

1. *The Hatching of the Eggs of* B. VERNALIS *Kept in Dried Mud. Branchipus vernalis* is, according to our present knowledge, distributed from Eastern Massachusetts to Western Indiana. It lives in ponds which are filled with water during the colder parts of the year, but which are dry during the summer months. The eggs, therefore, which when laid by the females sink down into the mud, remain during the hot months enclosed in the dry and baked earth and resume their activity and complete their development only when the cold autumn and winter rains come on.

The species of Branchipus whose life-history has been most thoroughly studied is *B. stagnalis* of Europe. As long ago as 1820, Benedict Prevost experimented with its eggs. Some of these were kept in dried mud for six months and at the end of that time on being put in water developed into swimming larvæ. Some of the eggs, similarly dried, were sent to M. Jurine at Geneva, and this naturalist also succeeded in obtaining the young.[1]

Naturalists have hitherto not been so successful in hatching out the eggs of our species. In Dr. A. S. Packard's "Monograph of

[1] Claus, *Branchipus stagnalis*, etc. Göttingen, 1873, p. 1.

the Phyllopod Crustacea of North America,"[2] Dr. Paul F. Gissler gives the results of his efforts to obtain the larvæ from dried mud: "During the whole summer of 1880 I experimented with dry mud from ponds inhabited by either the normal or pale race of this Branchiopod, but all in vain. Neither jars kept on ice in a large refrigerator, nor frozen dampened mud, gradually or suddenly thawed, developed any larvæ. The mycelium of a fungus, a few Daphniidæ and microscopic organisms were the only result."

Some time during April, 1888, the junior author collected a considerable number of females of *B. vernalis*, and selecting such as had their ovisacs filled with eggs, put them into a jar of water, in the bottom of which was placed earth taken from the garden. These females were allowed to remain here until they died, which was within about two weeks. The water was allowed to evaporate, the mud became dry and was moistened only once or twice during the summer. It was, of course, as dry as dust the greater portion of the time. On September 27, this dirt was broken up and put into another jar and covered with water. Immediately numbers of the eggs came to the surface and remained floating there about two days, when they went again to the bottom. On October 9, larvæ were, for the first time, observed swimming about in the jar and soon large numbers appeared. This experiment proves that the hatching of the larvæ of *B. vernalis* is by no means difficult to bring about, and that we may almost at will obtain them for observation. It also shows that it is not necessary that the eggs should ever be subjected to a freezing temperature.

That we have in our experiments succeeded in getting a view of the larvæ immediately after their exclusion from the eggs, we are not wholly certain. They could, at all events, have escaped but a short time before they were seen. One specimen was observed while in the act of escaping from the egg-shell; but the specimen seemed to be unable to extricate itself and may have been sticking there for some time and meanwhile undergoing change.

One thing, however, appears to be evident, namely, that the larva differs in some important respects from that of *B. stagnalis* as figured and described by Dr. C. Claus in his paper, "*Zur Kenntniss des Baues und Entwickelung von B. stagnalis und Apus cancriformis;*"

[2] U. S. Geol. and Geog. Survey Wyoming and Idaho for 1878. Washington, 1883.

and it is highly probable that it leaves the egg in a more advanced stage of development.

According to Dr. Claus the nauplius of *B. stagnalis* on leaving the egg is of a dull yellow (*trubgelb*) color, which has, as its cause, a multitude of bright granules and globules, and this color is so decided that for some time the view of the internal anatomy is obscured. The larva of *B. vernalis*, on the contrary, is very pale, and will, therefore, more readily lend itself to investigations on the early condition of its internal organs.

In the case of *B. stagnalis* the post-cephalic portion of the body is at first globular, but later becomes more elongated and oval,and finally, when the limbs have begun to bud out, changes to a conical form. The same portion of the body of *B. vernalis* is from the first proportionately shorter and broader. Furthermore, there are, in the earliest stages seen by us, the lateral buds of three or four pairs of post-maxillary appendages. The most striking difference between the larvæ of the two species appears, however, to be found in time of appearance of the paired eyes. According to Claus those of *B. stagnalis* do not appear until the first and second pairs of thoracic segments have become four-lobed and ten or eleven segments have been marked out. The larva of *B. vernalis* appears to possess both the median and the paired eyes at the time of escape from the egg; at least the paired eyes are plainly visible in the earliest observed stages, when there are but the merest swellings to indicate the positions of the first four thoracic limbs. Thus the true nauplius condition of *B. vernalis* appears to be passed through before the larva escapes from the egg; it is excluded as a metanauplius.

It is interesting to note that the larva which we saw endeavoring to escape from the ruptured egg-shell was enveloped in a thin transparent membrane. Whether this was the inner egg-membrane or a blastodermic moult we do not undertake to say. Zaddach's observations on Apus will be recalled in this connection. (*De Apodis cancriformis, 1841*).

Our smallest larvæ measured in length ⅔ inches.

II. *Description of a supposed new species of Branchipus*, B. GELIDUS. Male conforming closely to the description of *B. bundyi*, Forbes[3], except that the caudal stylets are linear-lanceolate instead of broad and blunt. Frontal appendages long and narrow. Clas-

[3] Illinois Museum Nat. Hist., Bulletin No. 1. p. 25.

pers grooved on inner side near the tip, and terminally tridentate rather than bifid, there being a third process which is situated on the anterior edge of the tip of the clasper; this process rounded instead of pointed. Female characterized by a structure that could hardly have been overlooked had it been present in *B. bundyi.* This consists of two prominent processes of a conical form that grow out from the dorso-lateral surface of the tenth thoracic segment, one on each side, and project backward, across the eleventh segment and for a short distance on the segment that contains the genital organs. The posterior ends of these processes stand out free from the body. The ninth segment with a similar but much smaller process on each side, which overlaps the one on the tenth segment. Ovisac about as broad as long and with a prominent median process.

The function of these dorsal outgrowths is not known to us. It may be suggested that they furnish means for the male to retain firm hold of the female. The claspers of this species are far less powerful than are those of *B. vernalis* and may not be alone equal to the task imposed on them. Possibly the rounded tubercle found at the base of the second joint of the claspers is applied to the processes on the back of the female and hold retained by means of the minute suckers on the tubercles.

In order to ascertain the nature of the outgrowths found on the females, consecutive series of sections were cut from hardened and stained specimens. The organ in question is, of course, bounded outwardly by a chitinous wall; but it is also, at most points, distinctly separated from the rest of the body by another wall of chitin. This is, however, incomplete, so that the cavity of the process is in communication with the cavity of the body. From the interior wall there radiate outward to the external wall a great number of bands or trabeculæ also apparently of chitin. These bands, as they pass outward, divide and anastomose so that the interior of the process is divided into communicating cells. Where the process frees itself from the body these bands soon cease to be seen. For some little distance behind the points where the processes leave the body there is found, along the middle of the back, the double-wall arrangement, with chitinous bands running from the inner wall to the outer. In the meshwork of chitinous bands, especially of the processes, there are found numerous small nucleated cells or corpuscles. The extremities of the processes are filled with these.

As to the habits of this species little is known. In the pond where large numbers occurred in the spring, no specimens of *B. vernalis* were seen. This fall when the same pond was visited not a specimen of the new species was to be found, while *B. vernalis* abounded.

It was observed that while the males were swimming about, the long and narrow frontal appendages were frequently rolled up and again extended. They present under the microscope a beautiful network of muscular fibres, in the meshes of which are numerous ganglionic cells.

A CORNER OF BRITTANY.

By J. WALTER FEWKES.

"BILLET pour Roscoff, s'il vous plait." The train is waiting a the Gare St. Lazare in Paris, and in a few moments we are hurried along beyond the fortifications, past Bellevue, Sevres and Versailles, through a wooded country, alternating with rich farms and beautiful fields. All day long we ride through Normandy and Brittany, looking out of the window of the coupé on one of the most interesting landscapes of France, crowded with towns and cities of historic interest and scenic beauty, every hour presenting some new phase of life to relieve the monotony of the trip. What is our destination and what leads us to turn from the beaten tracks of European travellers? We have abundant time to answer these questions before we reach the end of our journey.

Our destination is Roscoff, a town in the department of Finisterre, frequented by artists, better known to naturalists, and too rarely visited by travellers, who have penetrated into all the most picturesque corners of Europe. Roscoff, a fishing village, truly Breton in character, preserving many features of the old France, and presenting a pure example of ancient Brittany, unchanged by modern innovations. Roscoff has not a casino nor knows the swarms of pleasure seekers which many other towns on the coast of France draw to themselves every summer. It has no delightful promenades, no beautiful forests, but it has its wonderful rocks, its soft, laughing climate, its southern flora, its fertile lands, its hardy fishermen with their original costumes, its picturesque homes, and its beautiful church. Of more importance than all to the naturalist, it attracts him as the site of one of the most interesting of all those institutions for the study on the sea-shore of marine animals, the Laboratoire Experimentale et Générale, founded by Prof. Lacaze-Duthiers. It is this establishment which turned me to this distant corner of Finisterre, where I was permitted to spend two of the most charming months of a summer's vacation in Europe.

Roscoff is situated on the confines of Brittany, on a peninsula which juts out into the English channel, about opposite Plymouth in England. Away from beaten lines of travel it is unaffected by the changes which are being made in the larger cities about it, and remains, as it was when Mary Stuart landed on its shore, a veritable survival of the old Brittany of three centuries ago. Artists know it, and naturalists have long studied the rich life which peoples its coast and the waters which bathe its shores. Lovers of nature find there a sea most savage, and cliffs most rugged and picturesque. The blue sky of the Mediterranean and the beautiful water ever changing and never tranquil are here. Its islands are eroded by the ocean into fantastic shapes so that their contours rival our own "Garden of the Gods" in their grotesque shapes. The whole appearance of the coast, changed in a few hours by the great tides, the wonderful scenery on all sides, these are some of the beauties of nature which once seen retain the visitor in this interesting place day after day and week after week.

The place is situated on a small peninsula, the main street extending along the sea, and terminating at either end on the coast. Near one end of this street there rises a bald cliff capped by an ancient chapel of Sainte Barbe and a small fortress called the Bloson. At the other end this road broadens and opens into a place called the Vil upon the sides of which arise the Hotel du Bains Mer, the church, and the Marine Laboratory. On either side the main street of the town is lined with picturesque old houses, many of which date three centuries back, bearing the stamp of an old civilization. Small side passages lead to the shore on one side of the street, while on the other are narrow passage ways leading into tortuous alleys which extend out into the cultivated fields. Midway in the course of the main street, between the chapel of Sainte Barbe and the Vil or place of the church, is the port, an artificial structure, forming a high breakwater in the hospitable protection of which lie a few small craft. At high tide these vessels swing at anchor, but the retreating sea leaves them stranded high and dry on the shore.

The old houses which line the main street of Roscoff date back to the sixteenth and seventeenth centuries and are all built in the peculiar style of those times. The doors are low with oftentimes a small lookout or window at one side of the entrance. The object of these windows carries one back to the times of the corsaires, when the prudent inhabitant was obliged to have some means of observation before he opened the door and allowed a visitor to enter his home. The windows are placed high upon the roofs and are ornamented with rudely-cut, grimy faces and grotesque heads of dragons. The long sloping roofs, sparsely covered with plaster, give the appearance of a recent snow storm. The houses are built of granite much eroded and with their walls often whitened by lime. With the exception of the apothecary and one or two other modern buildings none of the shops have visible signs to denote the wares which are on sale. Glass is rare in the windows and the cellars open obliquely to the pavement of the street. On the seaward side the houses are separated from the ocean by courts and gardens protected from the ravages of the ocean by high walls, which form the fortifications of the place. At intervals on the walls there are lookout towers in which, no doubt, many a time the old Breton corsaires have watched a strange vessel on the channel, or from which the wreckers perhaps have enticed a passing ship to its doom.

These houses are now the homes of the sailor and the fisherman, but in times past the smuggler found there a secure refuge from his enemies. These mysterious, small, narrow streets, leading down to the water's edge, all remind us of the trade of the smuggler and the wrecker. These men have long since disappeared from Roscoff, but the old houses, the narrow tortuous passage ways still remain and recall the history of the romantic times of the past.

On the western side of the peninsula on which Roscoff stands there is a sandy beach out of which rises in the form of a marine monster a precipice called Roch-Croum. Seaward from this cliff a number of islands much eroded project in fantastic shapes, a scarred battlement broken in points by the resistless ocean. In the forms of these rocks we can trace many a giant's head, or fancy many a monster rising out of the waves which continually beat at their bases.

The eastern side of the peninsula is still more picturesque than the western. It forms a part of the magnificent bay of Morlaix and its cliffs rise abruptly out of the sea. Here the fortress of Taureau, a wonder of Brittany, projects out of the ocean from a submarine reef.

There is but one road leading to Roscoff from the mainland, and that bisects the peninsula entering the main street near the church. It is the national road to the neighboring city called Saint Pol. On either side there branch off true Breton lanes lined by lofty embankments thrown up by the farmers. No trees, nothing but sandy fields of onions and potatoes line its borders. Everywhere the, land swept by the high winds of the Atlantic, has a somber, melancholy look. The hills are low, and here and there rocks project through the thin covering of sand, but otherwise the landscape is little varied.

The sea, however, at Roscoff makes up the interest where the land fails to attract. Nowhere have I seen such a variety in the sky and horizon, nowhere a more savage coast resisting a more determined ocean.

There are many neighboring islands, the largest of which is called the Ile de Batz, a strange name, taken from a tongue reaching back before the origin of the modern French tongue. Near by this Island there are the so-called Bourguinous, and still further away Tisosou, "the house of the English." Some miles more distant seaward the rock of Pighet, all of which islands are remnants of a former battlement which, resisting the inroads of the sea, are fast loosing their form and size in protecting the mainland. Sown here and there are submerged rocks most fatal to navigation around which course "cailloux" or currents which render the approaches to the port so dreaded by sailors. As one glances across the channel from the island, Roscoff seems a very large city. Its sea-wall, its row of houses along the shore and the elegant church would lead one to exaggerate the size, but the town is simply a crescent of houses, enclosing fertile fields of potatoes and onions.

Such is a brief sketch of the place to which we are hastening through Brittany by way of the railroad from Paris to Brest. We alighted at Morlaix, a picturesque old town, which has contributed many a sketch to the artist's portfolio, early in the evening, and take a branch road to Roscoff. Somewhat later the train halts and we have reached our destination.

"A La Maison Blanche," says a man near me, in an accent which is immediately distinguished from that of the Parisian "cocher." "Oui!" is replied in a confident tone as if a knowledge of the whole French language was at the tongue's end. He asks if I am the American who is going to work in the laboratory and I reply that I am. We trudge down the dark road unlighted by a single lamp, and in a few moments the hostess of "La Maison Blanche" had me in charge. The hotel looks comfortable but its surroundings are very strange. The threshold of the entrance is lower than the pavement of the street. Along the entry hang rows of chickens, legs of lambs, sausages and vegetables. A crowd of Roscovites hang about the bar, which is elaborately filled with all the necessities.

The hostess has picked up a little English from the numerous sailors who frequent her house and gives me a good reception. A bed of purest white and an excellent cup of coffee and bread in the morning form a cordial introduction to a town in which I was destined to pass many, very many, happy days.

French naturalists were the first to found special institutions on the seashore for the study of marine zoology. There are many problems connected with the study of marine life which cannot be successfully taken up without a residence near the localites where the animals live, for they must be worked out either on living or fresh material, and it must be possible to have ready access to the habitats of these animals to study these questions. A first step in this work is to watch the animals in aquaria and carefully study their mode of life. With the improvement in methods of research a work room near the aquaria thus becomes a necessity for a successful answer to many problems.

One of the earliest laboratories founded especially for the study of marine life on the shore was created by Prof. Lacaze-Duthiers at Roscoff. This institution is an "Annexe" of the Sorbonne in which the founder holds a professorship of Natural History, and over the door is placed this significant inscription, so often found on public buildings in Paris, "Liberté, Egalité, Fraternité." This motto has here a new significance, and I thought as I approached the building of the well-known laboratory in Roscoff on the morning after my arrival, how much that motto means in the organization of the institution. The advantages are free to all of every nation, French, English American, Russian. Every specialist is freely given without expense the advantages of the institution. All are equal who enter its walls with a love of nature and a desire to study, or to investigate. No one who has known its hospitality can question the justice of the third word of the legend.

The laboratory founded by Prof. Lacaze-Duthiers is a laboratory for students as well as investigators, and it numbers among its workers those who have earned the title of naturalists as well as those who have just begun their studies. It is not too much to say that every facility which experience and money can suggest are here placed without expense within reach of every student of zoology who makes a choice of Roscoff for a working place.

Everything is free, microscopes, reagents, boats manned by experienced collectors, books, work-table, instruction, all are given with a lavish hand, with no distinction of nationality or peculiarity of scientific belief. There is no charge for an opportunity to contribute to the advance of knowledge or to take the first steps in the acquisition of methods of research.

The students in the laboratory are even furnished with sleeping rooms near their working tables, so that no time may be lost or expense incurred. In liberality there is no known institution outside of France which does more or even as much for those who wish to investigate marine animals.

The laboratory at Roscoff is a laboratory for summer work and is supplemented by a second creation of the same founder at Banyuls-Sur-Mer on the Mediterranean Sea, for research in winter. These two, both connected with the University of France, offer a continuous opportunity at all times of the year for the study of marine animals of the two shores of France. They open to students two different faunas under the most experienced instructors, the most favorable influences under the most liberal circumstances.

The laboratory at Roscoff not only furnishes material for investigation, but it also presents opportunities for collecting, and for the study of marine animals in their native habitats.

In the study of marine animals on the shore, as well as in museums and laboratories situated inland, students may become closet naturalists. It is recognized that it is a good thing to collect as well as to study animals after they are collected. Two methods of work on marine animals are possible. Either the naturalist may remain at his work-table and have experienced collectors bring him what he desires to study, or he may himself visit the localities where the animals live and find them himself. Both methods have advantages, but the latter gives a wider knowledge of the whole subject than the former, for it familiarizes one with natural conditions of the life of the animals.

The laboratory at Roscoff not only permits a study at the work-table but also offers facilities for collecting. Excursions are made to grounds where certain animals occur and in that way the possibilities of knowing more of their mode of life are increased. This feature in the marine laboratories of Prof. Lacaze-Duthiers is certainly a most important one and one which particularly commends itself to a person whose sole knowledge of animals is based on specimens preserved in a museum or brought to him by a professional collector. We may study the histology, or anatomy of an animal without knowing whether it lives in the sand or is free swimming, whether it is dredged or inhabits the shore line, but it is better to combine with that knowledge some familiarity with its natural habitat and its mode of life. One excellent feature in the Roscoff laboratory and one which attracted me to it is the fact that it offers facilities for both kinds of work.

There are two different departments in the laboratory at Roscoff, one for students who are beginners, the other for those who are investigators engaged in original research. These two departments work harmoniously and the advantages are equal for both.

The apparatus of a laboratory and the manner of investigation belongs to the technique of zoological work, a consideration of which would take me too far into details for this article. There are many excellent features in which this laboratory differs somewhat from those of other institutions of this kind, but in all marine laboratories with the readiness with which new methods are made public there is a surprising uniformity in technique in all marine stations. I should say that at Roscoff there is a proper regard to the relative importance of all branches of marine research, toxonomy, histology, anatomy and embryology, although perhaps the published results in the latter branch may show that it is not at present given the predominance that it has in some other similar institutions.

An excellent feature in the laboratory at Roscoff is the existence of a small local collection identified for the use of investigators and students. For the information of those engaged in the study of animals found there a card catalogue with a notice of the time of collecting the genus, locality where it is found, the time of laying its eggs is an excellent help. Anyone describing a new species or genus is expected to deposit in the collection a single specimen to serve as a type for the good of those who may later avail themselves of the advantages of the place.

In our own marine zoological stations the existence of a catalogue stating the time when ova, embryos, or adults could be found or had been collected and where they occur in abundance, would be an excellent thing, and must in the course of time be made by competent observers.

The beach of Roscoff is one of the richest grounds for collecting marine animals which I have ever visited. The enormous tides lay bare an extent of bottom which is extensive, and betrays the home of a very large number of different genera of animals which live along the shore. Moreover the character of this life is greatly influenced by a branch of the Gulf Stream, which making its way from the main current bathes this part of Brittany and imparts to it the mild climate which it has. This same current also tempers the climate of the Scilly Islands, which lie in its direct track, so that several plants, which are limited to the shores of the Mediterranean, here flourish in a more northern latitude.

The rich fauna of the coast at Roscoff is, no doubt, more or less modified by the warm action of this branch of the Gulf Stream, still the floating life which distinguishes this great ocean current off the coast of the United States is almost wholly wanting. Now and then some straggling "Portuguese man-of-war" drifts into the channel, or some medusa, whose home is in the tropics, is captured, but these are exceptional. The wealth of floating marine life which the Gulf Stream brings even to the coast of New England is not found inshore on the coast of Brittany.

The most interesting building at Roscoff is the church, the steeple of which is to been seen from almost all sides of the city. This church, which has an appearance wholly Breton, has also a style partly Florentine, partly Spanish ; for the interior, at least of many of the Breton churches, has a true Italian appearance, and the style of the exterior is characteristic.

The most curious part of the church is the steeple, which, as we approach the city from the sea, rises light and airy and seems almost to hang from the sky. On the side of its bell-tower, pointed toward England, the hereditary enemy of the Roscovite, there are two cannon, cut in stone, forming parts of the varied ornamentation of the steeple.

At the base of the tower on either side of the entrance one sees at right and left bas-reliefs ascribed to the fourteenth century, representing the Passion and Resurrection of the Savior, while above the entrance is one of the most interesting bas-reliefs of all the sculptures of Roscoff, a ship of the fifteenth or sixteenth century, carved in stone with scrupulous exactness. This ship is found on the walls of the church and on the hospital situated on the way to Saint Poll and seems to be the coat-of-arms of the city. Its bizarre shape, recalling the old ship of the corsaires is of very great archæological or, at all events, historical interest.

The church itself is surrounded by a low wall enclosing many trees. On either side of the main entrance there are two small buildings one ornamented with a bas-relief of the ancient ship ; the other a small mortuary chapel. These are ossuaires which in old times served for receptacles of the dead. When the church-yard was full, these buildings received the overflow. Their little niches are now empty, but they still remain mute remnants of the manners and customs of a time not long past.

In the neighboring city of Saint Pol, however, we find the ossuaires in the cemetery still occupied by the little boxes in each of which is a human cranium, and around the altar of the church in the same place, we find similar relics of the dead. In the cemetery of Saint Pol these ossuaires are small buildings with covered shelves along which is seen a row of boxes each resembling a dove cot with a roof-shaped top. Each box has a small opening, diamond or heart-shaped, through which the skull of some old inhabitant can be seen, and each box bears the name of the dead. Around the altar of the church these boxes are arranged in a melancholy row. " It is considered an honor," said the father who showed me about, " to have the head thus preserved near the altar, an honor which only a few and those the most influential are permitted to share.

This survival of a habit of burial once widely spread in Brittany and France is archæologically very interesting, but at the present day the custom is wholly given up.

The church of Notre-Dame de Croatz-Batz with its interesting ossuaires may be called an historic monument of France and is an instructive relic of times long past, but there is another church, now in ruins at Roscoff, which also merits our attention. This is one of the few places of this distant town connected with the general history of France. Nothing now remains of this chapel but the bare walls, a veritable ruin looking out on the main street of the place. Mary Queen of Scots landed at Roscoff on the 14th of August, 1548, on her way to espouse the Dauphin of France. Years after a chapel was dedicated to a Scottish Saint, Saint Ninien, in commemoration of this event.

Mary Stuart was but six years old when she landed at Roscoff. She remained there but a short time and then proceeded to Morlaix where she was officially received by Seigneur de Rohan. Afterwards she went to Saint Germain en Laye, where she is said to have remained until she was eighteen. Long after, when the widow of Francois II., she returned to Scotland and to the sad history which awaited her in England, the hereditary foe of the Bretons, on whose land she had set her foot in happier days long before.

The chapel which marks the event of her landing was for many years ornamented with many presents and remained a magnificent monument of her generosity. Later it fell in ruins and now after many years the Roscovites have placed on its wall a tablet that tells to the curious the event which the building of the chapel commemorates.

Not far from the chapel of Mary Stuart, there stands a house rebuilt in modern style, the interior of which is always interesting to visit. This house is separated from the chapel by a narrow street, and in it one still sees the remnant of an ancient cloister, with a beautiful garden protected from the sea by a tall wall in the form of the prow of a vessel. Once a cloister, then a place of meeting of merchants, it now remains an interesting relic of the Roscoff of the past, its sold columns and architecture recalling some old Italian palace of mediæval antiquity.

Many other interesting houses exist in the quaint old town of Roscoff. The many hiding places for bandits and smugglers, the dark cellars, narrow streets, all recall the old days when much of the enterprise of the place was turned to the plunder of passing merchantmen, or equally nefarious practices. The history of the Roscovite corsaires has yet to be written, but the story of Le Negrier still preserves something of the romance of the past. Here we read of the old hotel Terard, where the notorious Captain Le Bihan recounts his escapades. We also read of a ball of the corsaires in which all the inhabitants of the place participated.

The little port of Roscoff was the rendezvous of the corsaires who fled to its hospitable walls protected by the Ile de Batz. There secure from English cruisers, they remained until another opportunity gave them a chance to sally forth on their marauding expeditions.

There are many other interesting old houses in Roscoff. As we follow the road to St. Pol, we pass the famous Hospital built in 1598, on the walls of which stand out the escurian of the Compte de Leon, boldly cut above the gate. More distant still the monastery of the Capuchins, in the garden of which may still be seen, the giant fig-tree, a marvel of Roscoff, and a proof of the wonderful fertility of the soil. This gigantic tree was planted long ago by Capuchin monks and still remains contributing its fruit—a tree more than two centuries old.

One should not neglect, in visiting Roscoff, to see the place called Kersaliou. Midway in the route from Roscoff to St. Pol, hidden in the trees, and approached by a by-path, is the retired house known in the country round as the Kersaliou, an interesting place where one can at the present time study the true Breton home. Our visit to Kersaliou gave us a good sight of the mode of life of the Breton farmer and his family.

The old house, Kersaliou, was evidently formerly the residence of men of more property than at present. It stands back from the road hidden in the trees, and as one approaches it from the main road to St. Pol, it has a most picturesque outlook. We pass through the gateway, an elaborate stone edifice, into a small court yard in which the poultry of the farm find their home, through the low door into the living room of the families which at present occupy the place, The room on the lower floor is certainly a study. At one end of the apartment there is a large fireplace on which the fire continually burns or smothers in the coals. On either side are seats where children sit in the recesses of the high chimney. No matches are used to light the fire, but a small pan of sulphur hangs near by and a bundle of sticks. When there is need of more fire these sticks are used, their tips dipped in the sulphur and ignited by the live coals. There is a cemented floor to the apartment, which is kitchen, dining room and sleeping room combined. On one side we notice a large cabinet, like a huge bureau with elaborately carved wooden front—it is an enormous wall cabinet with what appears to be many drawers, which are the beds, and as the house-wife pulls them out one by one, in the depths we see the whitest bed clothing. These drawers are beds in which sleep the three generations of two families which live in this house.

A small box covered with a lid in which holes are pierced, is the cradle from which ominous cries have already issued indicative of the contents. It was time for the afternoon meal when we visited Kersaliou, and we were invited to share their repast with the hospitable family. The house-wife had already placed fourteen rough, earthen bowls on the table, and was breaking in each fragments of bread. The soup was boiling over the fire, and in a few minutes the dinner was ready. Each bowl received its share of liquid poured over the bread, and the family began their simple meal. Above the table hung a frame on which were placed wooden spoons and each one took his spoon from the common source. There was no need of knives or forks. The kind-hearted inhabitants of Kersaliou were true Bretons, conservative, religious, hospitable and industrious. Two grandmothers, two mothers, their husbands and a host of children, of whom only one little girl spoke French. All converse in the antique language of Gaul, a Celtic tongue allied to the Gaelic of Wales. We do not have to travel far from Roscoff to lose the soft, melodious French and then hear on all sides the old Breton, which is not a patois, but the original celtic language that dates into the remote past, and which no effort can eradicate from the country.

The old language is the common language of the country. French is an innovation which makes its way slowly but surely. The preaching in the cathedrals and churches is in Breton ; the common people use no other language, and all localities bear names which will probably recall this tongue even when unspoken by the descendants of those who now inhabit the land.

Brittany is full of those curious stone structures antedating historic times, and called cromlechs and dolmens. Everywhere we find these druid monuments, at one time formed by circles of stones simply stuck up in the ground, by lines of huge rocks as at Carnac, or simple slabs placed on uprights. Roscoff has one of these monuments in its immediate vicinity. On the road to St. Pol near the latter place, we turn off from the main road into a field of cabbage, and not far off we find the dolmens of Roscoff, high upright rocks, upon which is placed a horizontal slab. Unfortunately one of these horizontal slabs has fallen, for a hunter for buried treasure has dug under the foundation and undermined it, but one can still study the general character of the monument. This monument, as all the others of similar kind, is associated with the worship of the Druids, and dates back to ancient times. More of its use we do not know, but we were well repaid for our short visit. We turn back towards Roscoff from this antique structure along the road. In the distance we see the beautiful cathedral of St. Pol, but we must reserve our visit to this city to another time. The far distant sea, the Ile de Batz and the beautiful town of Roscoff stretching along the shore lies just before us, lit up by the rays of a setting sun.

The Roscovite is a Celt with traces of the Spaniard. He is industrious and frugal, always conservative and religious. He still retains the costumes of his fathers, his *gilet* with conspicuous buttons, his waist girt by a highly-colored band, his round hat with ribbons falling on his shoulders. He wears the sabots, he clings to the old language of Gaul.

The women are not beautiful, but they have fine eyes and well-preserved teeth. They also still retain the old costumes. The small white bonnet, worn at all times, is so tightly bound about the head that nothing can be seen of the hair. On the days of baptism or marriage, however, when the bonnet is taken off, a charming coiffure is seen and the beautiful hair bursts forth in all its charms from its hermetically-sealed prison. Each town in Brittany has a peculiar bonnet and that of the young maidens differs from the matrons.

If you wish to see religious faith go to Breton, to Roscoff. Modern science, modern free thought, has not yet a hold in this place. The Breton is religious by nature. Every one goes to the church and the whole population turns out *en masse* to the morning service. According to Reclus, Brittany is still pagan, but while the inhabitants do not worship the forces of nature, the rocks, the fountains, or the trees, they repeat the same prayers to God in the Christian church, which they have made for two thousand years, only addressed to a new divinity. "It is always the same religion continued from century to century without the inhabitants of the land perceiving the change in their divinities." The geographer, however, has drawn an exaggerated picture. The country has emerged from its old beliefs, but while much of the middle-age thought still clings to the religion, it moves less rapidly, more conservatively than in many other lands.

No one who visits Roscoff should fail to see the giant fig-tree. The soil of France nourishes no greater marvel of plant-life than this wonderfully vigorous growth of the ages. This tree, situated not far from the main road in an enclosure in which it is sheltered by a high wall, yearly bears its fruit in a latitude which in America is half the year buried in the snows of Labrador. The mild climate which Roscoff owes to the Gulf Stream, gives to this land an exceptional flora, and the intelligent cultivation of the soil has transfomed the country into a great garden for the raising of all kinds of vegetables. The potatoes, onions, beans, cauliflowers of Finisterre are well known in England, and many an English vessel is engaged in the transportation of them across the channel. The inhabitants cultivate one of the most storm-swept coasts of France, but the yearly products of their industries is inferior to no other in quality or in quantity.

Roscoff is also a shipping port for the lobster and the Palinurus, many of which are found in the restaurants of distant Paris. A huge vivier where these animals are kept before shipment has been built near the entrance to the harbor. This vivier is supplied from the waters around the place and even from the distant coast of Spain Thousands of these animals are yearly sent to the great cities of France and England from this little town.

The shrimps of Finisterre are well known far and wide and the "crevette" fisherwomen with their huge nets are often found in the pictures which artists have brought home to their Parisian studios, after their vacations in Brittany. When the tide is out these toilers of the sea take advantage of the small pools in which the shrimps are retained and fill their nets with this much-desired crustacean. The table of the hotels in Roscoff know also the periwinkles, a small gastropod which is universally eaten. The sea furnishes many a food fish which has not yet been adopted in other lands.

As the days go by all too fast and the time of our tarry in Roscoff is more and more reduced, we came to love its quaint old streets and church, its old houses and its antique walls more and more, but the summons back to Paris is imperative and we find ourselves back again at the station of the railroad to Morlaix. We bid adieu to the Maison Blanche, the Café de la Marine and the hospitable walls of the Laboratoire. We say good-bye to the naturalists who still linger there to finish their researches, with many a regret. In a few moments all are left behind, but we retain what can never be effaced from memory, a souvenir of the happiest two months of scientific study which we have ever past. May the splendid marine station at Roscoff and its enthusiastic master long continue the work which has had so much influence on French science, and may its liberality and hospitality be imitated and fostered in other lands by other people.

ON THE PERMIAN FORMATION OF TEXAS.

BY CHARLES A. WHITE.

[1] Published by permission of the Director of the U. S. Geological Survey.

DURING the past ten years Prof. E. D. Cope has from time to time published descriptions and figures of vertebrate remains from Texas which he referred to the Permian,[2] although other authors have generally regarded the formation from which the fossils were obtained as of Triassic age.

A year ago Mr. W. F. Cummins, Assistant State Geologist of Texas, who had collected a large part of the vertebrate fossils just referred to, gave me a small suite of invertebrate fossils which he had collected from the same formation with the vertebrates. I found these fossils to possess so much interest that I afterward, in company with Mr. Cummins, visited the region in question and made collections from, and observations upon, the formation containing them.

Thirty-two species of invertebrates were collected, about one-half of which were readily recognized as well-known Coal-measure species, but a few of them were new, among which are two belonging to mesozoic types. It is this paleontological feature, in connection with important correlated facts, that especially excited my interest in the formation from which the fossils were obtained.

Although I have personally examined a considerable portion of the region within which this formation occurs, I am indebted to

[1] This article is an abstract from a bulletin of the Survey now in course of preparation.

[2] For his summary of North American Permian vertebrates, including this Texan fauna, together with references to the places of publication, see Trans. Am. Philos. Soc. Vol. XVI, pp. 285-288.

Mr. Cummins for a large part of the facts upon which the following description of it is based. This is especially true with regard to the extent of the area which it occupies.

In Texas this formation occupies an area, many hundred square miles in extent, which constitutes the western part of the southern extremity of the great central paleozoic region of the continent. The southern boundary of this area is not now definitely known, but it lies at least as far south as the Concho river. Its eastern boundary may be approximately designated as extending from Red river to the Colorado through Clay, Young, Shackelford, Callahan and Runnels counties; and its western border as extending from the Canadian river to the Concho through Hemphill, Wheeler, Donley, Briscoe, Motley, Dickens, Garza, Borden and Howard counties. The formation is known to extend northward far within the Indian Territory, but in this article special reference is made only to that portion of it which is found in Texas; and the description which is herein given is drawn mainly from observations made in Baylor, Archer and other contiguous counties.

This formation rests directly and conformably upon another series of strata in which a characteristic Coal-measure fauna prevails but which is not now known to include any fossils of mesozoic types, if we except the *Ammonites parkeri* of Heilprin, which he states was obtained from Carboniferous strata in Wise county.[3] Notwithstanding the mesozoic character of a part of the molluscan fauna of the upper formation, the preponderance of evidence makes it necessary to regard it as belonging to the great Carboniferous system, and as constituting an upper member of it. For these and other reasons yet to be stated I have little or no hesitancy in designating this Texan formation as Permian, as Prof. Cope has done; but I shall briefly discuss in following paragraphs the propriety of the use of that name for all of the North American strata to which it has been applied.

The Texas Permian is distinguishable in general aspect and in lithological character from the formation which underlies it and which represents at least a large part of the Coal-measure series as the latter is known in the Upper Mississippi Valley. And yet the Permian strata blend so gradually with those of the Coal-measures beneath, and with the gypsum-bearing beds, above that it is difficult to designate a plane of demarkation in either case.

[3] Proc. Acad. Nat. Sci. Philad., Vol. XXXVI, pp. 53-55.

The strata of the Texas Permian consist of materials which are somewhat difficult to describe, but they may be stated in a general way to consist mainly of sandstones and sandy and clayey shales, which are sometimes calcareous, with a few layers of impure limestone, besides one somewhat important limestone horizon. A common characteristic of many of the layers is the presence of an abundance of small, hard, rough concretions, which usually become separated and accumulate upon weathered surfaces as the imbedding clayey material is removed by erosion. But what strongly impresses the general observer is the prevailing reddish color of the formation, which is due to the prevalence of red oxide of iron in most of its component materials. During the rainy season the waters of the streams which traverse the formation are reddened by the abundant ferruginous, clayey sediment, which they obtain by erosion.

The stratification is generally more or less regular, but in the district here especially referred to it contains comparatively few compact, evenly-bedded strata. Therefore the formation having been, in this district, only slightly disturbed since its deposition, few striking features in the landscape occur. That is, the district is a comparatively plain country, the surface of which, in the, general absence of forests, is diversified only by shallow valleys of erosion and low hills of circumdenudation, with here and there a hill or bluff of like origin which reaches a height of one or two hundred feet above the general level. From the top of these higher elevations extended views are to be obtained, which are of much advantage in the study of geological structure in that region.

Because of the slight disturbance which the Permian strata have suffered in the district referred to, and the general absence of bold escarpments, it is difficult to arrive at an accurate measurement of its thickness, but it is approximately estimated at 1,000 feet. By distant view from the hills before mentioned, a general, gentle dip to the westward of the whole formation is plainly discernable. It is from a succession of such observations of the dip, together with measurements of the thickness of exposed strata and estimates of that of the unexposed, that the foregoing estimate of the full thickness of the formation has been made.

A list of all the species of invertebrate fossils that have been discovered in the Permian of Texas is given on a following page. Prof. Cope's list of vertebrate species, already referred to, shows that the same formation has furnished 10 species of fishes, 11 of batrachians and 33 of reptiles ; 54 species in all.

The full thickness of the Coal-measure series in Texas is not yet known, its base not having been observed ; but the portion that has been examined reaches an estimated thickness of 1800 feet. The strata are generally somewhat evenly bedded, and consist of bluish and gray limestones, gray and ferruginous sandstones, bluish and carbonaceous shales and clays ; and several coal horizons are now known in the series there.[4] These strata have furnished at numerous localities, and in greater or less abundance, such characteristic Coal-measure invertebrates as the following : *Terebratula bovidens* Morton, *Spirifer cameratus* Morton, *Athyris subtilita* Hall, *Productus cora* d'Orb., *P. nebrascensis* Owen, *P. costatus* Sowerby, *P. semireticulatus* Martin, *Hemipronites crassus* Meek and Hayden, *Myalina subquadrata* Shumard, *Allorisma subcuneata* M. and H., *Nuculana bellistriata* Stevens, *Pleurotomaria tabulata* Conrad, *Bellerophon carbonarius* Cox, *B. percarinatus* Conrad, and *Macrocheilus ponderosus* Swallow. Many other species also have been found associated with those which have been just named, but the latter are quite sufficient to characterize the strata containing them as belonging to the Coal-measure series. No attempt has been made to subdivide the Coal measure series of Texas into upper, middle, and lower portions as has been done in the Upper Mississippi Valley, and they are probably not capable of such a subdivision in this southern region. The Lower or Subcarboniferous portion of the system has also not been recognized in Texas.

Along the western boundary of the Texas Permian, as it has been indicated in a previous paragraph, a series of strata, about 250 feet in maximum thickness, now generally known as the "gypsum-bearing beds" and thought by many to be of Triassic age, rests conformably upon the Permian. In general aspect, in a prevailing reddish color, and in general lithological character, except in the prevalence of gypsum in many of the layers and the somewhat greater prevalence of clayey material, these overlying beds resemble the Permian strata upon which they rest. With only one known exception these gypsum bearing beds have furnished no fossils. The exception referred to is the discovery by Mr. Cummins in Hardiman county, in an upper stratum of those beds, of a thin magnesian layer containing

[4] Mr. Cummins informs me in an unpublished letter that he has distinguished no less than nine coal horizons there.

numerous casts of a species of Pleurophorus. This being a characteristic genus among Permian molluscan faunas and a prevailing form in the Permian strata beneath the gypsum bearing beds, the question is suggested whether the latter ought not to be regarded as constituting an upper portion of the Permian. If these beds are not separable from the Permian, it seems to be doubtful whether the Trias has any representation in Texas.

It will be seen from the foregoing remarks that in the part of northern Texas to which special reference has been made, there is a great conformable series of strata having a slight general dip to the westward, its base being covered from view by mesozoic and later formations. The estimated thickness of this older series, so far as it is exposed to view, is 3050 feet. The lower 1800 feet, together with an unknown thickness beneath, is referred to the Coal-measures. The next overlying 1000 feet of strata are designated as Permian; and the upper 250 feet of the series is doubtfully referred to the Trias, although as already intimated there seem to be reasons for regarding the latter beds as constituting the upper part of the Permian. Cretaceous strata rest unconformably, and with a contrary dip, upon the earlier eastern portion of this series; while upon the later western portion they rest with apparent conformity; although their real conformity there may be properly questioned because the Jura seems to be entirely wanting, and at most the Trias is only slightly developed.

As already stated, the Cretaceous strata appear to rest conformably upon the gypsum-bearing beds; and the latter beds lie quite conformably with the Permian and Coal-measures beneath, all having a westward dip. On the contrary, all the beds from the Dinosaur Sands, which are regarded as the lowermost Cretaceous formation in Texas, to the Tertiary inclusive, have an easterly dip and seem to lie unconformably with the Coal-measures and Permian. It is not certain, however, that the Carboniferous and older strata do not dip to the eastward beneath the Cretaceous strata, forming an anticlinal axis. Having thus shown the stratigraphical relation of the Texas Permian with the other formations, the following remarks will be confined to the Permian alone.

The following descriptive section of the Texas Permian is taken from Mr. Cummins' field notes, but it has been in large part verified by my own personal observation. The different members of this section, which are indicated by consecutive numbers, are not distinctly definable from one another, but the section is presented in this form for convenience in making reference to the respective horizons at which collections of fossils have been made.

DESCRIPTIVE SECTION OF THE PERMIAN OF TEXAS.

1. Reddish and mottled sandy clays, with occasional layers of sandstone.

2. Variously colored clayey and sandy concretionary strata, with a few irregular layers of impure concretionary limestone ; embracing near its middle a somewhat persistent stratum of limestone of greyish blue color.

3. Sandstones alternating with clayey and sandy concretionary layers and a few fine grained silicious layers.

4. Reddish and buff colored clayey and sandy shales with occasional layers of sandstone.

5. Sandstones and sandy shales ; with beds of reddish sandy clay ; passing gradually into the Coal-measures beneath.

Vertebrate remains, which Prof. Cope confidently refers to the Permian, occur at numerous localities and at many horizons from the base to the top of this section ; but invertebrate remains have hitherto been discovered only in strata which are included in Nos. 2 and 3 respectively of that section. The lowermost known horizon of invertebrates is about 400 feet above the base of the series, and the uppermost is about as much below the top of the same. That is, the invertebrate fossils described and figured in this article come from the middle 200 feet in thickness of the Permian series as it has just been defined.

The localities at which these fossils were obtained, only three in number, are in Baylor and Archer counties ; and as the country is still an unsettled one, they can be designated only in an indefinite way. The first of these localities, which is in the northwestern corner of Archer county, will be designated as "Camp Creek." The second is in Baylor county, near the middle of its eastern boundary line, and will be designated as "Godwin Creek." The third is in the northeastern part of Baylor county, near where the old military road, constructed by General Van Dorn, crossed the Big Wichita river. This locality will be briefly designated as the "Military crossing of the Big Wichita." The strata of the two first mentioned localities occur in No. 3 of the foregoing descriptive section of the Permian, and the last named one, in No. 2.

The following is a list of all the invertebrate species which are now known to have been found in the Texas Permian, all of which are discussed on following pages. The list is presented in tabular form for the purpose of giving a synoptical view of the fauna, so far as it is at present known, and also to indicate the localities at which the respective species have been discovered, as well as their inter-association there. As to the latter condition, it is proper to state that specimens of all the species found at the locality which is indicated as the Military Crossing, were collected by myself from a single stratum, where they were found commingled in such a manner as to leave no doubt as to their having been all members of one and the same contemporaneous fauna. Specimens of the greater part of the other species were also collected by me at the localities indicated.

LIST OF SPECIES.

	Camp Creek.	Godwin Creek.	Military Crossing.
1. Goniatites baylorensis n. s.			X
2. Ptychites cumminsi n. s.			X
3. Medlicottia copei n. s.			X
4. Popanoceras walcotti n. s.			X
5. Orthoceras rushensis McChesney ?			X
6. Nautilus winslowi Meek and Worthen			X
7. N. occidentalis Swallow			X
8. N.————?			X
9. N.————?		X	
10. N.————?			X
11. N. (Endolobus)————?			X
12. Naticopsis remex White		X	X
13. N. shumardi McChesney ?		X	
14. Euomphalus subquadratus M & W.			X
15. E————?			X
16. Murchisonia————?		X	X
17. Patella————?		X	
18. Bellerophon crassus M & W.		X	X
19. B. montfortianus Norwood & Pratten		X	
20. B————?			X
21. Sedgwickia topekaensis Shumard sp		X	
22. Pleurophorus————?		X	
23. Clidophorus occidentalis Geinitz		X	
24. Yoldia subscitula Meek & Hayden		X	
25. Myalina permiana Swallow	X	X	X
26. M. aviculoides M & H		X	
27. M. perattenuata M & H	X	X	X

28. Gervillia longa Geinitz....		X	
29. Aviculopecten occidentalis Shumard........			X
30. Syringopora——————?	X	X	
31. Spirorbis——— ———?......................... ..			X
32. Cythere nebrascensis Geinitz.......................			X

SUMMARY.

Mollusca.	Cephalopoda........	11	species.
	Gastropoda.........	9	"
	Conchifera..........	9	"
Articulata,	Vermes.............	1	"
	Crustacea...........	1	"
Radiata....	Polypi..............	1	"
	Total,	32	"

By reference to the foregoing list of species, and especially to the summary at the foot of the list, it will be seen that the invertebrate collections which have hitherto been made from the Permian formation of Texas, do not represent a fauna in its usual proportions, as regards the classes and families to which the species respectively belong. This is especially true when we compare these collections with Permian faunas already known in other regions. For example, it will be seen that the Cephalopoda are in unusually large proportion, that the Brachiopoda and Polyzoa are absent, and that the Polypi are represented by only a single species. In short, it is plain that the invertebrate fauna which existed during the period in which the Texas Permian was deposited, and in the same, or in contiguous waters, is imperfectly and disproportionately represented by these collections.

Some of the causes of the imperfection and disproportion referred to, are too plainly apparent to need extended comment, and others are suggested by the lithological and stratigraphical character of the formation in which the remains are found. Besides the inevitable causes of imperfect representation of extinct faunas by their remains, a conspicuous reason for the imperfection of these collections is that the formation has yet been carefully examined in only a small part of the large region which it is known to occupy, and an exhaustive search for invertebrate fossils has yet been made at only a few of the localities which have been visited by competent collectors.

Again, there are few strata entering into the composition of the Texas Permian where it has been examined, the character of which indicates that they successively formed the bottom of waters where at least a large proportion of then existing invertebrates could not have found a congenial habitat. That is, sandy and other silicious strata, as has already been shown, prevail in this formation, while calcareous strata are comparatively rare. It is true that certain families, especially of the Mollusca, find a silicious, sandy bottom, such as the material of most of those strata doubtless formed, more congenial than a muddy or calcareous one ; but to far the greater part of all invertebrate faunas the latter kind of bottom, other conditions being favorable, is much more congenial. In short the lithological character of a formation often presents obvious reasons not only for the comparative paucity of all invertebrate fossils in its strata, but even for the absence of representatives of certain families which we have every reason to suppose existed when they were deposited, but in other, not far distant places, and in more congenial waters.

But these collections, imperfect as they are, present subjects for consideration which are of far greater interest than that which attaches to a mere addition to our knowledge of a few of the forms which constituted the fauna of any given epoch or period. Such, for example, as the relation which the fauna of one period in a given region bore to faunas which were presumably contemporaneous with it, and to those of the periods which immediately preceeded and followed it ; and the indication which these fossils give as to the geological age of the strata containing them.

Three of the Cephalopod species, the names of which are given in the foregoing list, are represented on the accompanying plate, and brief descriptions of them follow.

Ptychites cumminsi n. s. Plate I figs. 4, 5, 6, 7 and 8.

Shell compressed-subglobose, volutions deeply embracing, umbilici small ; septa numerous and complex, the suture line as represented by fig. 8.

Medlicottia copei n. s. Plate I, figs. 1, 2 and 3.

Shell thinly discoid, periphery narrow, medially grooved, umbilici small ; volutions deeply embracing ; septal suture as shown by fig. 3.

Popanoceras walcotti n. s. Plate I, figs. 9, 10 and 11.

Shell discoid ; periphery deeply embracing ; umbilici minute ; surface marked by slightly sinuous radiating lines or indefinite ridges ; septal suture as shown by fig. 11

The other species which is definitely recognized as new is a *Goniatites* whose general character is not unlike that of known Carboniferous species. The *Ptychites* and *Popanoceras* may be properly regarded as of mesozoic type, such as might be expected to occur in Triassic strata. The *Medlicottia* is the first species of the genus to be discovered on this continent, and has been usually regarded as indicating the later Carboniferous, or Permian age, of the strata containing the genus.

EXPLANATION OF PLATE I.

MEDLICOTTIA COPEI.

Fig. 1. Lateral view.
" 2. Outline showing transverse section of volutions.
" 3. Suture line.

PTYCHITES CUMMINSI.

" 4. Lateral view of a small example.
" 5. Peripheral view of the same.
" 6. Lateral view of a larger example.
" 7. View of a septum of a larger example.
" 8. Suture line of the same.

POPANOCERAS WALCOTTI.

" 9. Lateral view of a small example.
" 10. Peripheral view of the same.
" 11. Suture line.

All the figures are a little less than natural size.

It will be seen from the foregoing descriptions and notes, that of the 32 species of invertebrates which are represented in the collections from the Texas Permian, only four of them are recognized as new, all of which are cephalopods, and all belong to the Ammonoidea. The others have either been previously described and published, or their specific identity with published forms is in doubt because of their imperfection, either of the specimens in hand, or of the manner of publication of the species which they probably represent. Fifteen of these Texan species are satisfactorily recognized as having been previously published, a part of which have been by some authors referred to the Permian, but the Coal-measure age of the remainder has never been questioned. Some authors also assert that not only all of the fifteen species just mentioned, but all North American invertebrate species which have ever been referred to the Permian, are really members of the fauna which characterizes the Coal-measure period. Indeed, so generally has this view prevailed during the last twenty years, that if the four new cephalopods before mentioned were not present in the Texan

Permian Cephalopoda.

collections, no American paloæntologist who is familiar with the Coal-measure fauna, would probably have hesitated to refer them all to that period.

It is doubtless true that because so large a proportion of the invertebrate species, which have been obtained from reputed Permian strata in North America, occur also in characteristic Coal-measure strata, no satisfactory separation of them into two groups has hitherto been practicable upon the evidence of invertebrate fossils ; and stratigraphical evidence has hitherto been unsatisfactory also. The collections, however, which are represented by the foregoing list and descriptions, although consisting mainly of Carboniferous forms, contain at least two types which are so generally regarded as indicating the Mesozoic age of the strata containing them, that if they alone, and without any statement of correlated facts, had been submitted to any paleontologist, he would not have been warranted in referring them to an earlier period than the Trias, if he had followed the usually accepted standard of reference. These two forms have been described on preceding pages, under the names of *Ptychites cumminsi* and *Popanoceras walcotti* respectively ; and with the exception of the *Ammonites Parkeri*[5] of Heilprin, also from Texas, similar types have never been found associated with recognized Carboniferous species in North America.

This, however, is by no means the first, nor the most important discovery of the commingling of Mesozoic and Paleozoic types in such a manner as to indicate that they all lived contemporaneously, and were members of one and the same fauna. The remarkable discovery by Professor Waagen, in India, of[6] many molluscan species belonging to mesozoic types associated with a characteristic Carboniferous fauna is well known. It is also well known that mesozoic characters are recognizable among certain of the Carboniferous and Permian cephalopods of Russia and Armenia, as well as of certain parts of Europe.

The special interest which these Texan collections possess lies, first, in the presence of the two cephalopods of mesozoic type as members of an invertebrate fauna composed otherwise of paleozoic types ; and second, in the association of this invertebrate fauna with a vertebrate fauna composed mainly of Permian types, as de-

[5] Proc. Acad. Nat. Sci. Phila. 1884, vol. XXXVI, p. 53.

[6] See Paleontologia Indica Series XIII ; Salt Range Fossils.

termined by Professor Cope, and in the known superposition of the formation containing these faunas upon characteristic Coal-measure strata. The first point of interest relates to the interdelimitation of the Mesozoic and Paleozoic; and the second, to the assumed Permian age of the Texan formation from which the collections referred to were made.

The biological interdelimitation of the Mesozoic and Palæozoic ages in geological history has long been regarded as clearly recognizable in all parts of the world. While it was well known that a considerable number of generic forms, especially of the invertebrates, respectively occur in strata of both ages, palæontologists have generally regarded it as a fundamental fact that certain orders, families, and even genera, which possess certain characteristics of structure and form, were rigidly confined to each age respectively. That is, they believed that the types which fall into the one category all ceased to exist at the close of the Palæozoic age, and that no member of the other category began its existence before the opening of the Mesozoic age. The presence of remains belonging to either the one or the other of these categories was therefore regarded as affording unquestionable proof of the geological age of the strata containing them. Attempts were made to explain the first discoveries of the commingling of earlier and later types in one and the same stratum, by assuming that the specimens showing the earlier types of structure were derived in an already fossil condition from pre-existing strata in the process of their destruction by which the materials for new strata were produced.

However unphilosophical those views concerning the chronological restriction of certain types may appear in the light of modern biology, it is not to be denied that until within comparatively few years paleontological observations in the field seemed, as a rule, to favor them. These later discoveries, important instances of which have been referred to, show conclusively that animals belonging to both the categories which have just been indicated lived contemporaneously. It furthermore appears that some of those which have been regarded as exclusively mesozoic in character began their existence while yet Palæozoic forms were far in the ascendant; and also that many Palæozoic types survived their earlier associates and lived in association with Mesozoic faunas. As I shall discuss this subject in another publication, it need not receive further consideration here; but I offer in following paragraphs some general remarks upon the reputed North American Permian, in the course of which reference will be made to the bearing which the presence of Mesozoic types among the Texan Permian fossils has upon the question of the geological age of the strata containing them.

From time to time during the past thirty years there have been discussions among geologists as to whether there is in North America any true equivalent of the Permian formation of Europe. Some writers have been uncompromising in their advocacy of the affirmative side of this question, and others have been equally positive in asserting the negative. Much of this difference of opinion has arisen from imperfect knowledge of essential facts, and much from want of a clear definition by the respective writers as to what they have regarded as constituting equivalency in this case. Although much addition has within the past few years been made to our knowledge of facts bearing upon this question, and it is evident that clearer views upon it are now generally held than formerly prevailed, it is too much to expect that the views of all geologists should even now fully agree. The following statement of the present condition of this question, as the writer understands it, is presented that the reader may understand more clearly his views, and the reasons for the conclusions and opinions which are expressed in this article.

In Europe the Carboniferous system is understood to be divided into three great groups, namely, the Lower Carboniferous, the Coal-measures and the Permian, which are definable from one another, not only by palæontological, but by stratigraphical characteristics. In North America, the great Carboniferous system is quite as largely developed as in Europe. The Lower Carboniferous and Coal-measure groups are, upon both stratigraphical and palæontological grounds, as clearly recognizable and distinguishable from each other, in some parts of this continent, as they are in Europe, but the Permian has hitherto had no such undisputed recognition. Therefore, the question now to be considered is whether the Permian of Europe has really an equivalent anywhere in North America; and if so, how that equivalency is recognizable.

There are seven principal regions in North America within which strata occur that have been by different authors referred to the Permian. These are (1) southwestern Pennsylvania and northern West Virginia; (2) Prince Edwards Island; (3) eastern Illinois;

(4) northeastern Kansas and southeastern Nebraska; (5) South Park, Colorado; (6) isolated portions of New Mexico, Arizona, Utah and Western Colorado, and (7) northern Texas and the adjacent part of Indian Territory.

In all these cases there seems to be no room for doubt that the strata in question are not older than the Upper Coal-measures, as that formation is distinguishable in North America, but aside from their evidently high position in the Carboniferous system, their recognition as Permian has been based upon different kinds of evidence in each case. In the first and second mentioned cases it was based wholly upon plant remains; in the third, upon vertebrate remains alone; in the fourth, upon invertebrate remains; in the fifth, upon plants and insects,[7] and in the sixth, mainly upon stratigraphical position. The evidence in favor of the recognition of the strata, as constituting a separate formation in the seventh case, is presented in this article.

Two general ideas seem to have prevailed respectively in the minds of those who have considered the question of the recognition of the Permian in North America. On the one hand, the discovery on this continent of remains belonging to generic or other types of vertebrate, invertebrate, or plant life, which are respectively similar to forms found in the European Permian, have been regarded by some authors as surely indicating in each separate case the Permian age of the strata containing them, even in the absence of, or without regard to, correlated facts, whether paleontological or stratigraphical. On the other hand, it has been contended that no definite recognition of the Permian, even in the first-mentioned cases, ought to be made until after due consideration of all obtainable correlated palæontological and stratigraphical facts; and not then, unless the preponderance of all that evidence should plainly favor such recognition.

The untenableness of the position indicated in the case first stated is shown by the facts mentioned in preceeding paragraphs of the occurrence in one and the same stratum of forms which have been held to be characteristic of separate geological periods, and even of separate ages. It is conspicuously shown in the case of the Texan formation, which is specially discussed in this article, be-

[7] These insects, however, have been by Scudder referred to the Trias, although they are associated with the most characteristic Permian flora that has yet been discovered on this continent.

cause both its Coal-measure and Triassic age can be even more readily proved, in an ex parte way, by special selections from its fossils, than its Permian age. And yet the sum of all the evidence is in favor of the latter.

The following paragraph from the work of Professors Wm. M. Fontaine and I. C. White tersely states[8] the principle which ought to govern the investigator in these cases, although it was written only with reference to the Permian character of the flora which they were then investigating.

"It is good evidence that we have to deal with a more recent formation, when we find it to show a decadence of old forms, and an introduction of new ones, destined to reach their culmination at a later period. Thus if we find, in a series of rocks, plants characteristic of the Carboniferous formation, and perceive that these die out and disappear, we should not conclude from their mere presence that the age of the strata is Carboniferous, but rather that it is Permian. So also the finding of genera and species, even identical with those of the Trias or Jurassic, would not necessarily imply a Triassic or Jurassic age. If we find them to be exceedingly rare, their presence is rather indicative of a formation older than the Trias or the Jurassic. It is only by taking into consideration all the above named characters and other points which may be presented by the entire body of specimens, that we can determine the nature of the evidence offered by the life of a formation. It will not suffice to say arbitrarily that this or that feature is without value as evidence. Circumstances might reverse the normal relative weight of evidence from the several sources, and give preponderating weight to what would, if unaffected by them, have slight value."

Besides the observance of this principle, the investigator should remember the entire improbability that distinguishing types could have been simultaneously introduced in all parts of the world; and the no less evident fact that certain types in different parts of the world long survived their extinction in other parts. He should also bear in mind the now evident fact that the rate of progressive development of vertebrate, invertebrate and plant life respectively has not been uniform in all parts of the world. It therefore ought not to be expected that precisely the same associa-

[8] Permian or Upper Carb. Flora of West Virginia and S. W. Pennsylvania. Second Geol. Surv. Penn. Rep. Prog. P. P., pp. 109, 110.

tion of types would be found on this continent that occur in Europe and elsewhere.

Much difference of opinion has prevailed even among those who recognize the importance of considering all the facts which bear upon a given case of assumed equivalency. Some have believed that it should be strictly chronological as regards the whole of a given formation ; while others claim that the most we can reasonably assume in any case is approximate contemporaneity, and all that we can ever certainly know in such cases is the homotaxial relations of formations in different parts of the world respectively. The scope of this article, however, will admit of only a partial discussion of those views.

If all the time which is represented by the entire Carboniferous system in Europe is represented by the entire Carboniferous system of North America, the Permian of Europe must necessarily have a complete time equivalent somewhere on this continent If that system is everywhere incomplete at the upper limit on this continent, and the same is complete in Europe, it necessarily follows that the stratigraphical time equivalent of the European Permian is either absent or incomplete in North America. But all the known facts which bear upon this case are of such doubtful value in their application to the question of strict chronological equivalency that it seems to be unprofitable to discuss it. Therefore the only question that remains to be considered in this connection is that of homotaxy.

The question, even after being reduced to these limits, is a complex one, for it still involves the consideration of conflicting and disagreeing palæontological evidence as well as a recognition of upper and lower delimiting boundaries of the formation. There can be no good reason for doubting that there are in various parts of North America strata which are homotaxially equivalent, at least in part, with the Permian of Europe. But it is equally true that much of the reputed North American Permian cannot be satisfactorily separated from the Coal-measures, and even those which have been separated more or less satisfactorily, are found to be so intimately related to the Coal-measures as to make the lower limit indefinable.[9]

[9] In view of the last mentioned condition, several American and European writers have applied the compromising term "Permo-Carboniferous" to that undefinable upper portion of the Carboniferous system. Unfortunately, however, some American authors have of late applied the same term to the whole Carbonif-

Heretofore it has been impracticable to say whether the upper limit of the Carboniferous system in North America is complete or not. For example, none of the reputed Triassic strata, which occur in various parts of the continent, have been found in such relation to the reputed Permian as to indicate that there was continuous sedimentation from the one formation to the other ; nor have those Triassic strata been found to contain any conclusive palæontological evidence of their immediate succession to the Permian. Indeed, as regards the remains of invertebrate life, the existence of any Triassic strata in North America rests upon comparatively slight evidence ; slighter, indeed, than it might have seemed to be before the discovery of Triassic types associated with well-known Carboniferous forms.[10]

The conflicting character of a part of the evidence afforded by the reputed North American Permian as to its age has already been shown, but there is an important case of want of harmony of different portions of certain accepted paleontological evidence that deserves mention. In Professor Cope's systematic catalogue of the Permian vertebrate fauna of North America,[11] he shows that it has been discovered mainly in two limited districts, one in eastern Illinois and the other in Texas. His catalogue also shows that of the 76 species enumerated, not one, and of the 32 genera only five, are common to the two districts. He also states that "the Permian vertebrate fauna of Illinois and Texas exhibits close parallels, but not yet generic identity on this continent."[12]

On the contrary, the marine invertebrates which characterize the North American Coal-measures, a part of which usually range up into the reputed Permian, are widely distributed on this continent,

erous series ; seeming thereby to imply that the series includes an inseparable equivalent of the Permian, as well as the remainder of the system.

[10] The Triassic character of a part of the Permian fauna of Texas has been sufficiently stated, but it is also true that certain Carboniferous types occur in the Meekoceras beds of southeastern Idaho. Besides this, those beds appear to have an intimate stratigraphical relation with the characteristic Carboniferous strata beneath them. Add to these facts the further one that types similar to those which have been relied upon in referring the Idaho beds to the middle Trias, also occur in undisputed Carboniferous strata, and it seems possible that those reputed Triassic beds ought to be referred to the Permian rather than to the Trias.

[11] Trans. Am. Philos. Soc. vol. XVI, pp. 285-288.

[12] See Vol III., Book I. U. S. Geol. Surv. Terr., p 25.

and their geographical range includes both the Illinois and Texan vertebrate localities. That is, the invertebrate fauna referred to is uniform over a region in which the vertebrate fauna is diverse.

In all the vertical and geographical range of these invertebrate fossils, there has never been observed any evidence of the decadence of old forms[13] such as would be taken to indicate an approaching close to the geological period which they have especially characterized ; and it is only in the case of the Texan Permian that an introduction of new forms has been yet observed which might be regarded as forerunners of a new one.

Finally, while it is freely admitted that a considerable number of the invertebrate species which characterize the Permian of Europe have nearly related representatives on this continent, it should not be forgotten that they are as characteristic of our undisputed Coal-measures as of the reputed Permian. Even if those forms are really specifically identical on the two continents it does not necessarily prove the contemporaneity of the respective formations containing them. In fact those formations must be necessarily of a difference in age equal to the time required by the distribution of the species.

The recognition of the Permian of Texas as a separate upper group of strata belonging to the Carboniferous system is based upon both stratigraphical and palæontological evidence, and this evidence is fuller than that which has been adduced in favor of any other reputed Permian strata of North America. First, it contains invertebrate species which have been referred to the Permian in other districts to the northward, some of which are closely related to Permian species of Europe. Second, it contains the large vertebrate fauna published by Professor Cope, which he regards as characteristically Permian. Third, the Texan formation evidently constitutes an upper, apparently the uppermost, portion of the Carboniferous system. Fourth, the lithological difference between this formation as a whole and the Coal-measures beneath it

[13] It has been pointed out by some authors that certain of the brachiopods and other species which characterize the Coal-measures, have never been found in any of rhe reputed Permian strata, and it seems to have been assumed that their absence was due to a final decadence of those forms before the Permian period was reached. It seems, however, not at all unreasonable to infer that successive changes of conditions differently affected different classes of animals, in consequence of which the forms referred to were not extinguished, but only differently dispersed.

is sufficiently marked to make it conveniently distinguishable by the eye. Besides this, the mesozoic element which has been shown to exist among the invertebrates of the Permian of Texas may be properly regarded as holding an opposite relation to the Palæozoic element, and thus to suggest a balance of palæontological evidence in favor of the Permian age of that formation.[14]

The present state of our knowledge, or warranted opinion, as to the existence of the Permian formation in North America may be summed up briefly as follows :—

Although the two earlier groups of the Carboniferous system, namely, the Lower Carboniferous and Coal-measures are as clearly recognizable in the region traversed by the Mississippi river as they are in Europe, in many parts of this continent where Carboniferous strata are largely developed no distinctive recognition of either of those groups, or of the Permian, is practicable.

In those regions where the Coal-measures or their equivalent strata are recognizable, certain strata are sometimes found resting upon them which have been referred to the Permian ; but those strata are as a rule, not distinctly separable from the Coal-measures upon either stratigraphical, or palæontological ground. That is, no distinct stratigraphical plane of demarkation between the Coal-measures and the reputed Permian is observable. Besides this, many of the common Coal-measure species range up into those Permian strata, and many acknowledged Permian types, according to the European standard, occur in the unquestioned Coal-measure strata beneath them.

The upper limit of the Carboniferous system and the lower limit of the Trias, have never been clearly recognized upon this continent, and it is therefore not yet known that either of these systems are here at any point complete in that respect. But the upper limit of the Carboniferous system is known to be incomplete at most places where strata of that age occur.

Notwithstanding the mezozoic character of some of the fossils found in the reputed or true Permian strata the relationship of all these strata, both palæontologically and stratigraphically, is far more intimate with the Carboniferous than with the Trias.

14. The value of this suggestion is somewhat lessened by the known presence of the *Ammonites parkeri* of Heilprin in the underlying Texan Coal-measures, and by the presence of similar types beneath the Permian in certain parts of the old world. Still, such forms as *Ptychites cumminsi* may properly be regarded as mmediate harbingers of the Mesozoic age.

A large part of the North American strata which have been by various authors referred to the Permian have no valid claim to be either so considered, or as being separate from the upper Coal-measures. But a part of them may be reasonably assumed to be homotaxially equivalent with at least a part of the European Permian; although their delimitation from the Coal-measures may in most cases be difficult or impracticable.

The evidence upon which the Texan strata have been referred to the Permian is fuller than that which has been adduced with regard to any other North American strata, that have been so referred. That is, the evidence of both vertebrate and invertebrate fossils is in favor of such reference, and the difference in the character of the strata from those of the underlying Coal-measures, although not great, is conveniently distinguishable. Still, it is true that the Texan Permian strata bear many Coal-measure invertebrate species; and its flora is at present unknown.

ON THE MAMMALIA OBTAINED BY THE NATURALIST EXPLORING EXPEDITION TO SOUTHERN BRAZIL.

BY E. D. COPE.

THE Naturalist Exploring Expedition left New York for Southern Brazil in the year 1882, and landed at Porto Alegre in the department of Rio Grande do Sul, with the object of making collections in that province.[1] It was under direction of Herbert H. Smith, whose former service under Prof. Frederick Hartt in the Geological Survey of Brazil, had given him ample acquaintance with the people and language. Regular collections were first made at the village of Sao Joao do Monte Negro, on a tributary of the Ura-

[1] Articles descriptive of this region by Mr. H. H. Smith will be found in the AMERICAN NATURALIST, 1883, pp. 480, 707 & 1007.

guay River, in the western centre of the province, in about lat. 28° south. After a residence there of several months, Mr. Smith and party proceeded north-west to the interior province of Matto Grosso, ascending the Paraguay River to Cuyaba. From Cuyaba the party went about thirty miles to the north-eastward, to the little village of Chapada, where they remained for months. This locality was especially favorable for the objects of the expedition, being on the boundary line between the great plains to the south and the forest-covered mountains on the north, and at the heads of the drainage of the Paraguay to the south, and of the Xingu tributary of the Amazon on the north, at about lat. 15° S.

The difference in the characteristics of these localities is easily observable in the collections obtained from them. I have already published reports on the Batrachia and Reptilia from both localities,[1] and the present report embraces the Mammalia. The insects and birds are in the Museum of Natural History, Central Park, New York. Researches on the Mammalia of these regions have been already made by Hensel[2] and Von Jhring in Rio Grande do Sul, and by Natterer at Cuyaba. The collections of the last-named explorer are worthily described by Wagner of Munich, and a full report on them has been made by Von Pelzeln. ‡ of Vienna. Sixty-five species were obtained by Mr. Smith, most of them represented by many specimens, and five of the species appear to be new to science. The distribution of these as to locality will be stated at the close of the paper.

MARSUPIALIA.

1. Didelphys marsupialis azaræ Temm. (Thos.)

Two skins with skeletons from Sao Joao; three skins with skeletons from Chapada; one skin with skull from Sao Joao; two skins from Chapada, two from Sao Joao, and four without locality; also one skeleton from Chapada, two skulls from do, three skulls from Sao Joao, and two skulls and a skeleton of unknown localities.

2. Didelphys marsupialis aurita Wied. (Thomas).

One skin from uncertain locality. Although fully grown, the long dorsal hairs and the ears are perfectly black, and there are large spots above the eyes. Belly light brown.

[1] Proceedings American Philosophical Society, 1884, p. 185 ; 1887, p. 44.

[2] Memoirs of the Akad. Wissensch. Berlin 1872. ‡ Zoolog. Botan. Gesselsch. Wien, 1883.

3. PHILANDER PUSILLUS Desm.

A specimen in alcohol, and a skeleton, probably of this species, from Chapada.

The generic name Philander is used here for the opposums without marsupial pouch, without regard to other characters.

4. CHIRONECTES MEMINA Cuv.

One skin with skeleton from Chapada.

CHIROPTERA.

PHYLLOSTOMIDÆ.

5. PHYLLOSTOMA HASTATUM Pallas.

Chapada.

6. CAROLLIA BREVICAUDA Weid.

Chapada.

7. ARTIBEUS PLANIROSTRIS [1] Spix.

Chapada.

8. ARTIBEUS BILOBATUS Peters.

Neither of the two specimens from Chapada agree with the description given by Professor Peters in all respects. The edge of the lancet of the nose-leaf is not crenulate, and the border of the horseshoe is but slightly lobed. In all other respects the specimens agree with the descriptions. The degree of the lobing of the edge of the

[1] DERMANURA EVA sp. nov.

Founded on two adult males from the Island of Saint Martins, West Indies.

Dentition, I.$\frac{2}{2}$; c.$\frac{1}{1}$; pm.$\frac{2}{2}$; m.$\frac{2}{2}$. Median upper incisors emarginate ; all the inferior incisors emarginate. Lip tubercles as usual in this genus and Artibeus, those of the permaxillary region narrow and separated by vertical plicæ, and without an interior row of rounded warts as in *A. planirostris.* Inferior border of horseshoe free and not appressed, its lateral borders once undulate. Ear laid forwards reaching to middle of eye. Tragus acuminate, widest at the middle, triangular in section, the edge external. Interfemoral membrane notched to a line opposite to the middle of the tibia. Hind legs and feet, interfemoral membrane to line of knees, and proximal half of fore-arm, with a sparse silky fur. Wing membrane furred to middle of femur above and below. General color brown, reddish tinged on the limbs and head. Sides of head a pale shade, above each eye to inner side of ear, paler.

Length of head and body, m. .079 ; of interfemoral membrane to notch, .012. Length of head .032 ; of leaf of muzzle, .0125 ; of fore-arm, .059 ; of tibia, 021 ; of posterior foot, .017.

According to Dobson, this species approaches nearest to the *D. quadrivittata,* but it differs in its much superior size and in the different form of the external incisor tooth. It is as large as the *Artibeus planirostris.* Dr. R. E. Van Rijgersma.

horse-shoe may be variable; and I observe some crenation of the edge of the same in some specimens of the *Vampyrops lineatus* which is wanting in other specimens.

9. VAMPYROPS LINEATUS Geoffroy.
Chapada.

10. STURNIRA LILIUM Geoffroy.
Chapada.

EMBALLONURIDÆ.

11. MOLOSSUS RUFUS Geoffr.
One specimen from Sao Joao.

12 NYCTINOMUS BRASILIENSIS Is. Geoffr.
Four specimens from Sao Joao.

VESPERTILIONIDÆ.

13. VESPERUS ARGE sp. nov.

Dentition I. $\frac{2}{3}$; c. $\frac{1}{1}$; Pm. $\frac{1}{2}$; m. $\frac{3}{3}$. Inferior incisors trilobate, placed transversely to the mandible; superior incisors unequal, the external simple, narrow, not quite so long as either lobe of the internal, and placed close to it and to the canine. "First" (second) inferior premolar much smaller than second, and in line with the latter. Ears much shorter than the head, when laid forwards reaching a short distance in front of eye, near the apex. Helix openly notched on the external margin, which is thus turned outwards and obtusely rounded. Tragus convex, separated from helix by a very open emagination. Antitragus elongate lanceolate, with the greatest width near the middle, and with a rounded lobe at the external base. Lateral swellings of the muzzle large, covered with sparse hair. At their anterior extremity and just above the nostril is a deep fossa which is connected by a groove with the nostril, giving the appearance when closed of an oblique slit-like nostril, as in *V. platyrhinus* of Dobson. No tubercles on the soles. Interfemoral membrane inclosing all the caudal vertebræ, which terminate in a short free catilaginous apex. Wing membrane to base of hallux. Calcaneum long; postacalcaneal lobe distinct, narrow. Tibia elongate. Fur extending on the wing membranes by a narrow border only above and below, not extending on interfemoral membrane. Antebrachial membrane not reaching middle of fore-arm.

Color above dark brown tinged with reddish; below similar, the hairs with lighter brown tips. Inferior side of interfemoral membrane pale or milky, the color becoming less decided towards the margins.

Length of head and body m. 061; of tail .038; of head .020; of hind foot, 010; of third digit, .071.

One [1] from Sao Joao.

EDENTATA.

MYRMECOPHAGIDÆ.

14. MYRMECOPHAGA JUBATA Linn.

Four skins with skeletons, and three skulls, from Chapada.

15. MYRMECOPHAGA BIVITTATA Desm.

Two skins with skeletons, and two skeletons and a skull from Chapada; one fresh skin purchased at Sao Joao.

16. MYRMECOPHAGA BIVITATTA STRAMINEA sp. nov.

This species is represented by a nearly perfect skin in good preservation. Its proportions are much as in the *M. bivittata*, including the relative length of the tail. The internal claws are smaller than in the common species. The most obvious peculiarity is the color. This is a general straw-color, uninterrupted excepting by two black bands on the shoulders, and a black patch on the middle of the abdomen. The black bands commence immediately in front of the shoulders, and extend posteriorly over them, and terminate above a point about an inch posterior to the axillæ, converging very slightly, or nearly parallel. A blackish band passes from the eye, which it surrounds, to the muzzle. Claws dark horn-color.

Measurements of skin in normal proportions.

	M.
Length to base of tail (below)	.410
" of tail	.365
" from end of muzzle to eye	.055
" " " " to ear	.095
" of ear	.028
" of fore leg	.153
" of second claw (chord)	.016
" of third claw (chord)	.037
" of hind leg	.150
" of sole of hind foot (exclusive of claws)	.069
" of posterior fourth claw	.015

[1] In a cave near Chapada, Mr. Smith found skulls of species of bats of the genera Molossus, Phyllostoma, and Chiroderma.

Burmeister (Thiere Brasiliens) refers to specimens of the *M. bivittata* in which the black of the dorsal regions is very much reduced in extent.

The type specimen is not fully grown I suspect. The label has been lost, so that I do not know whether it was obtained at Sao Joao or at Chapada.

17. MYRMECOPHAGA ?SELLATA [1] Cope.

A skin from Chapada resembles almost exactly this species or sub-species, in coloration, differing only in the non-continuation of the median yellow dorsal stripe to the yellow of the rump. But unfortunately it lacks the end of the tail so that the length of this part cannot be ascertained. I therefore refer it here with doubt.

Two specimens from French Guiana are in the Museum of the Academy of Natural Sciences in this city. They are grizzled straw-color, and have no black bands or spots. The hair of the entire superior regions is black at the base. The tail, is as long as the head and body together. These animals I suppose to belong to the *M. longicaudata* of Schreber, but the tail is not twice as long as the body

[1] MYRMECOPHAGA SELLATA sp. nov.

This species is founded on a skin which I obtained from Dr. Fritzgaertner, who brought it from Honduras and displayed it in the exhibit from that country at the World's Exposition at New Orleans. It is characterized by its long tail and peculiar coloration, exhibiting characters between the *M. longicaudata* of Wagner and the *M. bivittata*. While the tail is as long as the body in the latter, it is said to be nearly double that length in the former. In the *M. sellata* it is at least equal to the head and body together, but as the extremity is wanting it may have been longer. The hairs on the extremity of the tail are very sparse.

The color is characteristic. The ground is straw-color. An oblique black band commences on the front of the upper arm and extends upwards and backwards over the shoulder, and converges rapidly towards its fellow. They do not, however, meet, but each is continuous with a large black patch which covers the back and sides on each side of a narrow median band of the light ground-color. These patches extend posteriorly above to the end of the lumbar region, and then the boundary runs obliquely forwards on each side to the groin. This leaves the thighs, rump and tail of the pale ground color, regions which are black in the *M. bivittata*. The dusky color in front of the eye is very indistinct. The feet and end of the muzzle have been unfortunately cut off from this specimen, so that their characters cannot be ascertained. The length of the body to the base of the tail is 0.400 m. ; length of tail, .515 m.

Besides the three skins above mentioned, there are two of the *M. bivittata* in the Museum of Philadelphia, one from the Magdalena River, and one from Brazil.

as Gray states, but as long as the head and body, as in the *M. sellata*, and considerably exceeding that of the *M. bivitatta.*

DASYPODIDÆ.

18. XENURUS GYMNURUS, Illiger, 1815.

Three skins, with skeletons, one from Sao Joao, and one from Chapada.

19. XENURUS HISPIDUS Burmeister.

Twelve individuals, all from Chapada: evidently abundant, and constant in its characters.

20. DASYPUS SEXCINCTUS Linn.

Two skins, five skeletons, and nine skulls, all from Chapada.

21. PRIODONTES MAXIMUS Kerr.

One individual complete, and one skull from Chapada.

22. TATUSIA PEBA Desm.

Two skins, with skeletons, from Sao Joao ; one skin with skull, four skeletons and nine separate skulls, all from Chapada.

23. TATUSIA MEGALOLEPIS sp. nov.

Movable bands, six ; transverse bands or rows on the scapular shield, counted near the border, and omitting the large posterior row, twelve. Transverse rows on the pelvic shield, counted near the border, twelve, without the anterior wide marginal row. Tail considerably shorter than body, cylindric to the end. No rudimental thumb on the forefoot. Ears one-third as long as head. Two short hairs issuing from each scute of the movable rings. Hair of inferior surfaces very sparse.

Measurements.

	M.
Length of carapace (axial)	.197
" of shield of head	.055
Width between orbits	.026
Length of ear	.025
" of tail	.166
" of fore leg	.052
" of third claw of fore foot (fourth)	.017
" " " hind foot	.012

The large size of the scales distinguishes the *Tatusia megalolepis* from the *T. peba* and the *T. hybrida* at all ages. The number of scuta in a movable band in the former is only 43, while in both the latter the number ranges from 57 to 60. It resembles the *T. hybrida* in the short tail, but differs from this species in its longer ears, which are quite as in the *T. peba*, and also in the rounded and not angulate posterior border of the head shield, with one and not two rows of scales. The skull displays some slight differences from that of the *D. peba*. One character appears to be of value. The pterygoids are produced towards the median line, so that their opposing edges are parallel and separated by a fissure only, and this fissure is continued on the middle line into the palatine bone for a distance of nearly 2 mm. In all of my numerous skulls of *T. peba*, the pterygoid borders are either divergent or are separated by a wide space, and the palatines are not notched posteriorly. The palate is flat, with the borders rounded, and not recurved.

A single specimen with skeleton from Chapada.

RODENTIA.

SCIURIDÆ.

24. Sciurus æstuans Linn.

One skin with skeleton, one with skull, and one entire skeleton, from Sao Joao.

25. Sciurus variabilis Geoff. var *Langsdorffii* Natt.

Four skins with skeletons, four skins with skulls, nine separate skins, and four separate skulls, all from Chapada.

Mr. J. A. Allen refers the *S. langsdorffii* of Natterer to this species as a color variety. All of the above seventeen skins are identical in color, showing that if it is but a variety, it is very constant in this locality. I may add that of the eleven skulls of the collection, all have but one superior premolar, and not two as given by Mr. Allen for the S. *variabilis*.

MURIDÆ.

26. Cricetus sp.

Chapada.

27. Cricetus sp.

Chapada.

28. Cricetus sp.

Chapada.

29. Cricetus sp.

Sao Joao.

[1]Report U. S. Geol. Survey Terrs. XI, p. 768.

30. Mus alexandrinus Geoffr.

Chapada. With a litter of young.

31. Mus decumanus L.

Sao Joao.

ECHINOMYIDÆ.

32. Dactylomys amblyonyx Wagner.

Three skins with skeletons, from Sao Joao.

These specimens agree with the descriptions given by Hensel and Burmeister. The dentition differs from that of the *D. typus* Geoff. as figured by Geoffroy [1] and F. Cuvier,† in having the two component V-shaped columns in both jaws united by a narrow isthmus, as is the case in the columns in Echinomys. This fusion is probably due to the age of the specimen, as it takes place on wearing in the genus Echinomys. Another character is the transverse lamina-like anterior plate of the first inferior molar (premolar), which is represented by a cylindric column in the *D. typus*, according to the authors cited. The superior molars are not nearly so close together anteriorly as is represented by St. Hilaire to be the case in the *D. typus*, and they diverge a little posteriorly.

HYSTRICIDÆ.

33. Sphingurus prehensilis Linn.

Three skins with skeletons, and one skull, from Chapada.

34. Sphingurus sericeus sp. nov.

All the inferior surfaces with the forearm and lower leg destitute of spines, but clothed with a silky hair of which the basal half is black and the terminal half silvery white. Superior surfaces to the middle of the length of the tail, spinous; the spines concealed by long silky hair except on the head, nape, and proximal half of the tail. This hair is much longer than that on the inferior surfaces, and is similarly colored, i. e., with the basal half black, and the terminal half silvery, but more inclining to gray than on the inferior surfaces. The spines are an inch and a half long, becoming shorter on the tail, the front, and the upper lip, and are rather slender, and on the nape are decurved. Those on the interorbital and suborbital regions are still more slender. The nasal, preorbital, and subcaudal regions are

[1] Geoffroy St. Hilaire, Nouv. Ann. du Museum I, 450 pl. XVIII, fig. 3; Is. Geoffr., Magaz. de Zoologie, 1840, p. 27, pl. XXVIII, figs. 1–3. † Dents des Mammifers.

covered with rather stiff hairs, the latter becoming silky towards the end of the tail.

The spines are generally black on their basal half, and sulphur yellow on their terminal half, without other color on the apex. Those of the interorbital, suborbital and prescapular regions, are white, with a black space at the middle, and the base of the spines is also white below the black on the posterior regions of the body, and on the tail. The hairs covering the basal half of the tail below are yellow ; those covering the terminal half are black. End of muzzle projecting beyond mouth, covered with minute silky hairs. Whiskers long, black.

Measurements of skin.

	M.
Total length	.665
Length from end of muzzle to vent	.395
" " " " orbit (on axis)	.020
" of fore limb	.130
" " foot on sole (total)	.045
" " claw (third)	.020
" of hind limb	.135
" " foot on sole (total)	.063
" of third hind claw	.018

Measurements of skull.

	M.
Total length on base	.073
Length to line of orbits (axial)	.022
Interorbital width	.026
Length of palate from incisors	.032
Width of palate below m. iii	.010

In the determination of this species I have had before me in the museum of the Academy of Natural Sciences, three specimens of *S. villosus* Cuv. (*S. insidiosus* Licht.), and one each of the *F. melanurus* Natt., and the *S. nychthemerus* Licht. These render it evident that the only species with which it is necessary to compare the *S. sericeus* is the *S. affinis* of Brandt, which I have not seen. That animal is described as being brown above and below, instead of silvery white, and in having the spines brown tipped. The humeral spines are exposed, which they are not in the *S. sericeus*. It is said to have a postorbital process of the malar bone. This is wanting in the *S. sericeus* (two skulls).

The *S. sericeus* was probably included by Mr. Hensel in the

S. villosus in his memoir on the Mammalia of Southern Brazil.[1] He refers to such variations of color and length of hair, as will embrace both species. Should his species not be separable from the *S. villosus*, then the *S. melanurus* and *S. nycthemerus*, must be also united with the latter.

The entire absence of all brown color from the hair and spines of this species, and their replacement by silver white and sulphur yellow, gives it a very distinct appearance.

CAVIIDÆ

35. CŒLOGENYS PACA Linn.

One skin with skeleton from Sao Joao; one skin with skeleton from Chapada, and two skulls without locality.

36. DASYPROCTA AZARÆ Licht.

Six skins with skeletons from Chapada; one skin with skeleton from Sao Joao; four skins with skulls from Chapada; one skin from Chapada without skull; one do, from Sao Joao; two skeletons without skins from Chapada, and one from Sao Joao; and eight skulls without skins from Chapada; total twenty-five individuals.

The single skins from Sao Joao have the inferior surfaces of a deeper yellow than those from Chapada, and the hair of the rump is less tinged with gray and more with yellow, than in the latter.

37. DASYPROCTA AUREA sp. nov.

This species is represented by but a single perfect skin in excellent condition, from Chapada. It is superficially most nearly related to the *D croconota* and *D prymnolopha* of Wagler, and represents them in Southern Brazil. The species is of about the size of the *D. azarae* and resembles it in general proportions. The ungues are, however, shorter, as is also the sole. In color it is peculiar. The hairs are uniform orange yellow on all parts of the body, paler at the base. There is no crest of long hair on the nape as in *D. prymnolopha*, but the hair of the rump is elongate, and rather paler in color than on other parts of the body. The top of the head is a little darker than the back, having a rufous tinge. The anterior faces of the feet are similar to the top of the head. The belly is a little paler than the back, but not so pale as the rump. Soles and claws yellowish horn color. The ears are rather sparsely haired. The tail is very short, as in the *D. azarae*.

[1] Memoirs of the Akademie der Wissenschaften of Berlin, 1872, p. 56.

In the following measurements some allowance must be made for stretching of the skin.

Measurements of skin.

	M.
Total length	.660
Length of tail	.010
" from end of muzzle to orbit	.067
" " " " to ear	.113
" " " " to axilla	.273
" of fore leg	.142
" " foot below	.032
" of hind leg	.165
" " foot below	.103

This species seems to be nearer to the *D. croconota* than to the *D prymnolopha.* Unfortunately I can find no skeleton or skull pertaining to the type, so that I can not describe their characters. It is much larger than the former species, exceeding it by more than six inches. Its uniform coloration is also entirely peculiar in the genus, for the hairs are not annulated. The feet are relatively much shorter than in the *D. croconota;* for according to Waterhouse, with a total length of 17 in. 9 lines, the feet of the latter measure (minus the nails) 3 in. 5 lines which is identical with the length of the foot in *D. aurea,* with a total of twenty-four inches. The head is the *D. croconota* measures 3 in. 11 lines. The relationships of the *D. rarea* appear to be with the *D. azaræ.*

38. Hydrochœrus capybara Erxl.

Four skeletons, one with a skin and a separate skull, all from Sao Joao.

39. Cavia aperea Erxl.

Four skins, three with skeletons, from Sao Joao.

LEPORIDÆ.

40. Lepus brasiliensis Linn.

Two skins with skeletons; three skins with skulls; six separate skins, and four separate skulls; all from Chapada.

CARNIVORA.

CANIDÆ.

41. Canis cancrivorus Desmarest.

Three skins with skeletons; one skeleton without skin, and one skin without skeleton, all from Chapada.

42. CANIS VETULUS Lund.

One skin with skeleton, and one separate skull, from Chapada.

43. CANIS ENTRERIANUS, Burmeister, Reise durch die La Plata Staten 1865, II, p. 400.

Two skins with skeletons, and one skin with skull, all from Sao Joao, Rio Grande do Sul.

I am not as certain of the identification of this species as I would wish, and find it easier to determine what it is not than what it is. It differs from the preceding two species as follows :

C. cancrivorus ; Mandibular angle robust, truncate; posttympanic process adherent to bulla ; larger ; sectorial teeth relatively larger.

C. vetulus; mandibular angle slender, acute; posttympanic process adherant to bulla; smaller; sectorial teeth relatively small.

C. entrerianus; mandibular angle slender; acute; posttympanic process well posterior to bulla, but connected at base; larger; sectorial teeth relatively large.

This supposed *C entrerianus* agrees closely in general characters with the *C. griseus*, Gray, described by Burmeister [1] excepting in the superior size. It agrees in dimensions with the *C. azarae Cuv.* but differs from both that species and the *C magellanicus* Gray, in the possession of but one inferior premolar tooth with posterior cutting lobe instead of two. It also differs from both these species, and agrees with the *C. griseus* in the wide separation of the premaxillary and frontal bones. The general color is reddish, the hair on the anterior regions above, yellow near the tips, and brown at the tips, the brown becoming blackish on the posterior regions and the tail. Limbs light clean rufous; soles reddish brown. Belly and neck white, a gray band crossing just in front of the breast. Chin black except at tip, which is white. Upper surface of ears (which are large) bright rufous. The animal is at least as large as the red fox. The coloration differs from that of *C. griseus* only in not showing the two white spots on the throat as described by Burmeister.

MUSTELIDÆ.

44. GALICTIS VITTATA Schreb.

Three skins with skeletons from Sao Joao.

[1] Erlaüterungen zur Naturgeschichte Brasiliens, 1856, p. 48.

45. Galera barbara Linn.

Five skins with skeletons from Chapada.

46. Lutra platensis Burmeister.

A skin and skeleton from Sao Joao ; do. from Chapada ; do without locality.

A comparison of the skulls of this species with two of *Lutra canadensis* in my collection, and three in that of the Academy of Natural Sciences, show the following differences. The palate is not so much produced posterior to the molar teeth : the superior tubercular molar has smaller anteroposterior diameters, especially at the interior extremity; and there is no preglenoid crest. The length of the skull is 103 mm., and the total length of the same individual is 1200 mm.

PROCYONIDÆ.

47. Procyon cancrivorus Cuvier.

Black-footed variety, Sclater, Proceedings Zool. Soc., London, 1875, p. 421.

One skin with skeleton of a male, and a separate skull ; both from Sao Joao.

The skin is that of an adult male in excellent condition. The hair is dense and woolly on the body, but is very sparse on the anterosuperior faces of the feet. The tail is fusiform and bushy. The fundamental color is brownish-yellow above, but the hairs on the middle region of the back have long black extremities. The color below is light brownish yellow. The feet are all black up to the midde of the tibia and forearm. The tail is black, crossed by five annuli of yellowish brown.

For comparison with the skulls of this species I have eight of the *P. lotor* and two of the *P. hernandezii.* Of the former, one is from New York, and one from Pennsylvania ; of the latter, one is from S. W. New Mexico, and one from Western Oregon. The characters of the *P. cancrivorus* are easily observable ; while those of the two other species are also visible. I compare them in the following table :

I. Canines less compressed ; metaconid of P. m. I. often present.

Postdental part of palate wider than long ; malar bone weak ; front narrow, width equal diameter of orbit ; each nasal bone obliquely truncated ; larger.

P. cancrivorus.

Postdental part of palate as wide as long ; malar bone very robust ; front wide, flat, exceeding diameter of orbit ; each nasal bone truncate with produced outer angle. *P. hernandezii.*

Postdental part of palate longer than wide ; malar bone robust ; front narrow, convex, width equal that of orbit; each nasal bone deeply emarginate distally.......*P. lotor.*

II. Canines much compressed ; metaconid of P. m. I. always wanting.

Muzzle shorter ; palate angularly elevated posteriorly ; last inferior molar wider, heel median ; larger...*P. nasicus.*

Muzzle longer ; palate nearly flat posteriorly ; last inferior molar narrower, the heel internal ; smaller.......*P. nasua.*

In the two specimens of *Procyon cancrivorus* before me the metaconid of the p. m. I. is well developed. In the *P. lotor* it is distinct in four out of eight skulls, and is represented by a mere trace in the other four. In a single *P. hernandezii* a trace only is visible. The form of the free extremity of the nasal bone is not constant in these species, and that of the last inferior molar will bear further examination.

The question is raised by Dr. P. L. Sclater, as above cited, as to whether the southern black-footed raccoon is specifically identical or distinct from the rufous-footed form from Surinam and Central America. In the lack of specimens of the latter region I cannot give a definite answer to this question.

In the skull of the *P. hernandezii*, above described, the *processus pyramidalis* of the palate has on its external face, a deep groove, bordered above and below by an alate crest, which are wanting in the *P. lotor*. The malar bone is also produced downwards at its inferior border next the maxillary, and the postorbital processes of the frontal and malar bones are both more distinct than in the *P. lotor*. Whether these are individual characters or not I cannot now determine.

48. Procyon nasua Linn. *Nasua rufa* Desm. Allen.

Three skins, with skeletons, all from Sao Joao.

49. Procyon rufus Desmarest.

Twenty skins, three with skeletons, and one with a skull ; seventeen separate skulls and eleven skeletons, all from Chapada.

The skins of the Coatis from the two localities, differ constantly and essentially, so that there appears to me to be two species, or, perhaps, subspecies. The most important difference is in the shape of the naked part of the nose. In the *P. nasua* from Sao Joao, in each of the three specimens, this region is not longer than wide above, and is wider than deep below, being separated by a broad band of hair from the lip border. In the *P. rufus* this region is constantly at least twice as long as wide above, and much deeper than wide below, with an angular outline which approaches near to the lip border. In the *P. nasua*, the white on the upper lips is wide and conspicuous, and the cheeks and top of head are of a light gray or pale brown. The top of the nose is light except at the end, and the median head stripe when present is of a darker color than the top of the head. In the *P. rufus* the white line on the upper lip is very narrow or wanting, and the head is generally blackish gray, the color of the vertex continued on the middle line to the black of the top of the nose. In the *P. nasua* the general color is light brown or gray ; below light yellowish brown. Less than half the leg is black. In the *P. rufus* the back is dark rufous, the hairs generally shortly, sometimes deeply, black tipped : belly and throat bright rufus, except the white chin. More than half the legs black.

The colors of these specimens are as constant as the different character of the naked nasal surfaces, and the resulting appearance is that of two species. The specimens of the *P. nasua* appear larger and more robust than those of the *P. rufus.* I cannot detect any difference in the skulls and teeth; there being no osseous character corresponding to the different proportions of the external nasal organs in the two species.

I find the characters pointed out by J. A. Allen[1] to distinguish the two Brazilian species from the Mexican, to hold good.

CERCOLEPTIDAE

50. CERCOLEPTES CAUDIVOLVULUS Pallas.
A skull from Chapada.

FELIDÆ.

51. UNCIA ONCA Linn.
One skin with skeleton, and three skulls, from Chapada.

52. UNCIA CONCOLOR Linn.
One skull from Chapada.

[1] Bulletin of the U. S. Geolog. Survey of the Terrs, 1879, vol. v, p. 161.

53. Felis pardalis Linn.

One skin from Chapada.

54. Felis geoffroyi D'Orbigny.

One skin with skeleton from Chapada, and a skin with skeleton from Sao Joao.

55. Felis jaguarondi Lacep.

One skin with skeleton from Chapada, and a skull from the same locality.

56. Felis braccata sp. nov.

Size of *F. jaguarondi*. Claws very small, white. Tail to end of vertebræ extending one inch beyond extended posterior limbs. Fur of irregular lengths, mingled everywhere with numerous long hairs. Color above brown, the hairs on the middle of the back, and on top of head and muzzle, with several black sections, which give a mixed black and brown hue to those regions. Upper portion of limbs of the same color, interrupted by black cross-bands, two on the fore leg and three on the hind, the former extending on the inner face as well. Distal half of all the legs black, without brown intermixture. Ears of moderate size with an apical angle a little less than right; the anterior half black, the posterior half gray. Inferior surface anteriorly furnished with long hairs of a buff color, which with short hairs of the same color near the anterior margin, show from above, giving a narrow brown border. Hair of the muzzle terminating in a straight transverse line which extends between the posterior parts of the nostrils. Lip whiskers long, buff with black bases. Some slender superciliary vibrissæ. A buff spot below each nostril, and a similar one above the anterior part of each eye. Cheeks yellowish brown, hairs black-varied.

Chin very pale buff. This color deepens posteriorly, soon passing into the yellowish brown of the lower surfaces. Numerous white hairs are scattered on the thorax and abdomen, and numerous deep brown spots form transverse series, which sometimes become bands, mark the same regions. Three cross-rows of brown spots appear on the throat, the most anterior consisting of two small lateral, and a large median spot, crossing below the ears. The spots become more indistinct on the sides, and are wanting on the inferior surface of the tail. The latter is colored like the back above, and is black at the tip.

Measurements of the relaxed skin.

	M.
Length from end of muzzle to vent	.467
" of tail from vent to end of vertebræ	.230
" of ear above	.017
Width between bases of ears	.052
Length from anterior base of ear to end muzzle	.052
" of fore leg	.195
" of fourth anterior claw	.006
" of hind limb (approximate)	.195
" " " from vent	.220
" of second posterior claw	.005

This cat is evidently more nearly allied to the *F. jaguarondi* than to any other known species, and I need only point out the characters in which it appears to me to be distinct. The *F. jaguarondi* is evidently subject to considerable variation, but none of its forms approach sufficiently near to the *F. braccata* as to lead one to believe in the identity of the two. I have before me the skin of the *F. jaguarondi* above referred to from Chapada.

In what might be called structural differences I note the following. The feet of the *F. braccata* are smaller than those of the *F. jaguarondi*, and the toes are of more equal length. The claws are very much smaller. Both the internal and external toes are relatively considerably shorter on both limbs in the *F. jaguarondi* than in *F. braccata*. The fourth anterior and second posterior claws of the former species measure 6 and 5 *mm.* respectively; in the latter they measure 11 and 13 *mm.* respectively. The tail is rather shorter in the *F. braccata*, being less than the length of the body from the axilla to the vent, and only an inch in excess of the posterior legs extended posteriorly. The tail in the *F. jaguarondi* equals the body, and extends two inches beyond the limbs. This character may prove to be unimportant. Finally the ears in *F. jaguarondi* are broadly rounded; in *F. braccata* they are so prominently angular, as to present an apex rather less than a right angle. The fur of the muzzle has a truncate border, while in the *F. jaguarondi* the border presents an acute angle forwards, as it follows the superior outline of the nares above.

The differences in color are as follows:

The upper surfaces of the ears are like the top of the head in *F. jaguarondi;* in *F. braccata* they are of two colors in strong contrast, and both different from that of the head. In *F. jaguarondi* the inferior surfaces are like the superior ; in *F. braccata* they are totally different, resembling various spotted cats. The legs are colored on the upper surface like the back in *F. jaguarondi*, and are black below; in *F. braccata* they are cross banded proximately, and the distal halves are totally black.

The aggregate of characters indicates the specific difference of the *F. braccata* from the *F. jaguarondi*. The only approach to any of the peculiar characters of the *F. braccata* in descriptions of the *F. jaguarondi*, which I can find, is in that by Mr. Alston in the Fauna Centrali-Americana, who states that there are transverse bars on the *inside* of the legs.

It is to be much regretted that the label belonging to this specimen has been lost. I do not know therefore whether it was obtained in the province of Rio Grande do Sul, or in Matto Grosso.

DIPLARTHRA.

TAPIRIDÆ.

57. TAPIRUS AMERICANUS Briss.

One skin with skeleton from Chapada.

HIPPOPOTAMIDÆ.

58. DICOTYLES LABIATUS Cuv.

One skin with skeleton from Chapada; six skins from Chapada; one skin from Sao Joao; two skulls from Chapada.

One of the skins from Chapada presents certain peculiarities. It is not larger than the *D. tajassu*, and the bristles are longer and denser along the back, and especially on the rump, than in the other skins. The dirty white or yellowish part of the hairs is replaced by red-orange, giving the animal a fiery tint when the bristles are erected. It was labelled "red-pig" by Mr. Smith. Unfortunately its skull was not preserved. It does not appear to me to represent anything but a slight variety; perhaps it is a young male. In all the characters of the feet, muzzle, etc., it agrees with the *D. labiatus.*

59. DICOTYLES TAJASSU Linn.

Two skins with skulls from Chapada ; two separate skins from do.; three skeletons from do.; thirteen skulls, do.; one skull from Sao Joao.

On comparing the sixteen skulls from Southern Brazil with five skulls in my collection, and one in the Museum of Princeton College, from Texas, I find such constant and important difference as to satisfy me that the two forms cannot be regarded as specifically identical. Their differences may be compared as follows :

D. tajassu. Malar crest terminating above infraorbital foramen ; nasal bones rounded in cross-section ; first superior premolar (fourth of old works) tritubercular or rounded in outline, premolariform ; molars not wrinkled.

D. angulatus sp. nov. Malar crest continued forwards to base of canine alveolus ; nasal bones pinched or angulate on the middle line ; first superior premolar quadritubercular, with intermediate tubercles, and quadrate in outline, molariform ; molars wrinkled.

The characters cited are constant, although the amount of angulation of the nasal bones in the *D. angulatus* is subject to some variation. Another character, generally constant, is the form of the fossa above the diastema. In *D. tajassu* it is a narrow groove ; in *D. angulatus* it is a wide fossa. On comparing two Texan skins with five from Brazil, I notice but one distinctive character. The naked spot on the rump is very much larger on the former, and it is followed by a large patch of brown hairs, forming a distinct spot. In the *D. tajassu* the brown hairs exist, but in smaller numbers, and they are completely covered by the black hairs which are mixed with them. The feet have been cut off from my Texan skins, and those of other specimens are in skeleton, so that I cannot compare the hoofs. The Texan skulls average larger in dimensions than those from Southern Brazil.

The characters of the first premolar, and of the dentition generally, are well represented by Professor Baird, but the prolongation of the malar angle and the roof-shaped nasal bones are not very clearly expressed in the outline figures he has given. [1] His specimens came from the Rio Grande. Mine are, one from the Guadalupe R., two from the Llano R., and two from a tributary of the Red River.

The character of the first premolar in the *D. angulatus* approximates it to the *D. nasutus* Leidy.

CERVIDÆ.

60. CARIACUS CAMPESTRIS F. Cuv.

One skin with skeleton ; three skins, and three skulls ; all from Chapada.

[1] U. S. Mexican Boundary Survey, Pl. xxvii.

61. Coassus rufus F. Cuv.

One skin with skeleton : one skin with skull ; two skulls with skin of head, and six separate skulls, all from Chapada.

62. Coassus simplicicornis Illiger.

One skin with skeleton ; one skin with skull ; three skins and three skulls, all from Chapada.

QUADRUMANA.

CEBIDAE.

63. Mycetes seniculus Linn.

Very abundant at Sao Joao do Monte Negro. Varying in color from bright rusty red, to brownish black with dark rusty crown. No specimens from Chapada.

64. Mycetes belzebul Linn.

Three specimens from Chapada Matto Grosso. The skull of this species does not differ from that of the last. The hair differs, especially on the head. It is procumbent and radiates in all directions from a point on the middle line posterior to the ears. It points directly forwards on the crown and front to the base of the nose, and anterior eyebrows, when it is met by hair directed upwards and backwards, forming a low tranverse elevation bordering the front, much as described by Slack in the *M. niger*. In the *M. seniculus*, the hair of the crown is erect and woolly from front to rear.

65. Cebus cirrhifer. G. St. Hilaire.

One adult (female) from Sao Joao.

66. Cebus elegans G. St. Hilaire.

Abundant at Chapada. In the males there is generally a low sagittal crest, the glabella is swollen, and the frontal profile is convex. In the females there is no sagittal crest, the glabella is less swollen and the front is less convex. In the specimen above referred to, the *C. cirrhifer*, the characters of the skull are like those of the female *C. elegans*, but the front is flatter in profile.

SYNOPSIS.

The species obtained by the Naturalist expedition are distributed as follows, as to numbers and localities :

	Total.	Sao Joao.	Chapada.
Marsupialia....................	4	1	4
Chiroptera......	9	3	6

Rodentia....	17	9	10
Edentata....	9	3	9
Carnivora....................	16	6	12
Diplarthra....................	6	2	6
Quadrumana..................	4	2	2
	65	26	49

In the following lists the species of Sao Joao and Chapada are compared :

SAO JOAO.	CHAPADA.
MARSUPIALIA.	
Didelphys marsupialis azaræ.	*Didelphys marsupialis azaræ.*
" " *auritus*	
	Philander pusillus.
	Chironectes memina.
EDENTATA.	
	Myrmecophaga jubata.
Myrmecophaga bivittata.	" *bivittata.*
	" *? sellata.*
Xenurus gymnurus.	*Xenurus gymnurus.*
	" *hispidus.*
	Dasypus sexcinctus.
	Priodontes maximus.
Tatusia peba.	*Tatusia peba.*
	" *megalolepis.*
RODENTIA.	
Sciurus æstuans.	*Sciurus variabilis.*
Cricetus sp.	*Cricetus* sp.
	Cricetus sp.
	Cricetus sp.
Dactylomys amblyonyx.	
Sphingurus sericeus.	*Sphingurus prehensilis.*
Cœlogenys paca.	*Cœlogenys paca.*
Dasyprocta azaræ.	*Dasyprocta azaræ.*
	" *aurea.*
Hydrochœrus capybara.	
Cavia aperea.	
	Lepus brasiliensis.
CHIROPTERA.	
	Phyllostoma hastatum.
	Carollia brevicauda.
	Artibeus planirostris.
	" *bilobatus.*
	Wampyrops lineatus.
	Sturnira lilium.

Desmodus rufus.	
Nyctinomus brasiliensis.	
Vesperus arge.	
CARNIVORA.	
Canis entrerianus.	*Canis cancrivorus.*
	" *vetulus.*
Galictis vittata.	*Galera barbara.*
Lutra platensis.	*Lutra platensis.*
Procyon cancrivorus.	
" *nasua.*	*Procyon rufus.*
	Cercoleptes caudivolvulus.
	Uncia onca.
	" *concolor.*
	Felis pardalis.
Felis geoffroyi.	" *geoffroyi.*
	" *jaguarondi.*
	" *braccata.*
DIPLARTHRA.	
	Tapirus americanus.
Dicotyles labiatus.	*Dicotyles labiatus.*
" *tajassu.*	" *tajassu.*
	Cariacus campestris.
	Coassus rufus.
	" *simplicicornis.*
QUADRUMANA.	
Cebus cirrhifer.	*Cebus elegans.*
Mycetes seniculus.	*Mycetes belzebul.*

From the preceding lists, it appears that but ten species were procured at both localities. Of the thirty-one genera obtained at Chapada sixteen were found at Sao Joao. Of the twenty-three genera found at Sao Joao, sixteen were obtained at Chapada. Of especial peculiarity of the Sao Joao collection may be mentioned the absence of the water opposum, the tayra, the six banded and giant armadillos, and of all the leaf-nosed bats. Also the absence of most of the cats, including the jaguar; also the absence of the deer. The Chapada collection lacks the crab-eating raccoon, and the gray coati; the capybara and the wild guinea-pig ; and the bats of the families Emballonuridæ and Vespertilionidæ.

EDITORS' TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

At the last meeting of the Society of Charities and Corrections the Rev. Oscar C. McCulloch, of Indianapolis, read a paper on the Tribe of Ishmael, in which he detailed the result of his studies on the pauper families of Indianapolis. The story he tells is a sad one. It is the history of generation after generation of paupers and criminals, of people sunk so low as not to have the slightest aspiration for a better life, who obey Scriptural injunctions only in that they are fruitful and multiply their vicious kind. Five generations of thirty families are traced, and of all the individuals whose records are worked out, but one ever emerged into a respectable life. This Tribe of Ishmael is but a repetition of the Jukes family, but it brings again to prominence a problem with which society has to deal. What shall be done to check the growth of these and similar parasites? They are sunk to a depth where no church can reach them; the so-called charity which gives to beggars and which patronizes the halt and maimed but encourages them in their present life; our present laws having no terrors for them, for imprisonment means but a winter of warmth, comfort and idleness. Were pauperism and beggary the only sins of these people then existence might be endured, but in the case of both the Jukes family and this tribe of Ishmael—and the same is true of all other similar families—every species of crime from murder down has been perpetrated by its members.

What can society do to protect itself against these pests? is a question which must be answered. Growth of cities means a disproportionate increase of this undesirable class. An answer seems difficult; in fact, we can only see one direction from which relief can come. The teaching of evolution must be recognized and incorporated in our laws. Evolution teaches that variation, the influence of environment, and adaptability to changed conditions are important factors in organic life, but it also teaches that these are fixed and perpetuated by heredity. It is this aspect of evolution that seems to point to the answer. The children of these people inherit scarcely a good trait, but are heirs to all that is vicious and criminal in their parents. They are begotten in criminality, nurtured in vice, and their maturity is crime. Our good people should refrain from indiscriminate alms giving, for this is offering a premium for a continuance of present conditions, and our laws should recognize the existence of heredity and make provision whereby the reproduction of this inherited vice could be checked. Such laws may seem harsh, but consider for a moment the saving to the country had the notorious Margaret, the mother of the Jukes family, been imprisoned so that none of her illegitimate children could have come into the world. Such a step would have been deemed cruel, but in the light of what we now know of the criminality of her descendants, society would have been justified in such extreme measures. The record of her children is but a continuous account of murder, highway robbery, burglary and prostitution, while the cost of prosecuting these criminals mounts up into the hundreds of thousands of dollars.

RECENT LITERATURE.

THOMAS' CATALOGUE OF MARSUPIALIA AND MONOTREMATA.[1]—This publication is very timely, as it places in the hands of students the means of becoming acquainted with the characters of the species of the important orders named, at a time when it is important that they should have the knowledge. The Marsupialia are arranged in six families, of which three are referred to the Diprotodontia, and three to the Polyprotodontia. The species number as follows :

Diprotodontia.		*Polyprotodontia.*	
Macropodidæ,	56	Peramelidæ,	14
Phalangeridæ,	34	Dasyuridæ,	26
Phascolomyidæ,	3	Didelphidæ,	24
Totals.	93	Totals.	64=157

The systematic treatment is conservative, and in the main satisfactory. Tarsipes seems, however, to deserve family recognition. In the matter of species the novel proposition is maintained that the larger South American opossums are only variations of the species with which we are familiar in this country. *Didelphys cancrivora*, *aurita*, *azaræ*, and *albiventris* become synonymous of *D. marsupialis* L. (=*D. virginiana* Kerr).

[1] Catalogue of the Marsupialia and Monotremata in the Collection of the British Museum. By Oldfield Thomas, 1888, pp. 401 ; xxviii plates.

We have fault to find with the lettering and other signs affixed to the paragraphs of the analytical keys of the various divisions. Were it not for the indenting and correct ranging of these paragraphs, their relations to each other could be only discovered by a considerable study of the signs affixed, and then many students, we suspect, would be hopelessly confused. The same system or *unsystem* has been adopted by Mr. Dobson in his catalogue of Chiroptera. It is to be sincerely hoped that in future the taxonomic keys may be arranged on the usual plan, such as for instance is employed by Mr. Boulenger in his catalogues of the Batrachia and Reptilia.

The twenty-eight plates are a welcome aid to the study, but the dental cusps are often poorly represented.

THE CLASSIFICATION OF THE CRINOIDEA appears now to have reached sound and rational basis as is clearly set forth in a recent important contribution[1] to Crinoid morphology by Messrs. Charles Wachmuth and Frank Springer. Although the subject is approached chiefly from a palæontological standpoint, morphological deductions derived from the latest researches among living crinoids have been duly considered. The systematic arrangement of the Crinoidea as indicated is of not less supreme interest to the palæontologist than to the biologist ; and the classification as now proposed appears to be practically in agreement with the views of Dr. P. Herbert Carpenter, the distinguished English authority on recent crinoids. The necessity of a radical change in the existing classification centers around the discovery of the ventral structure in *Taxocrinus*. It is now clearly demonstrated that in this genus, and doubtless in the Ichthyocrinidæ generally, the mouth is open, and surrounded by five conspicuous oral plates, as in the recent genera *Rhizocrinus*, *Bathycrinus*, *Hyocrinus* and *Holopus ;* thus differing in structure very materially from other palæozoic crinoids, which have the mouth closed. In the latter group, as is now conclusively shown, the orals are the hitherto denominated "central" and four "proximate" plates. The plan upon which modern crinoids are constructed is therefore one of high antiquity, dating back geologically to the Lower Silurian.

The Crinoidea are thus divisible into

1. Camarata.

2. Inadunata, comprising the branches Larviformia and Fistulata.

3. Articulata, including Ichthyocrinidæ and possibly *Uintacrinus* and *Thaumatocrinus*.

4. Canaliculata, including most of the mesozoic and recent crinoids.—*C. R. K.*

[1] Discovery of the ventral structure of *Taxocrinus* and *Haplocrinus*, and consequent modifications in the classification of the Crinoidea.—By Charles Wachsmuth and Frank Springer. Proceedings of the Academy Natural Sciences. Philadelphia, Nov. 27, 1888.

Fritsch and Kafka's Crustacea of the Bohemian Cretaceous.*—This elaborate folio memoir of 54 pages is richly illustrated by ten plates printed in colors and 72 woodcuts, giving both views of the actual specimens and what appear to be excellent restorations of some of the more interesting forms.

Beginning with the cirripedia of the Bohemian chalk, remarks are made on the species, most of which have been previously described by the authors, but the new details and excellent figures add much to our previous knowledge. The same may be said of the Ostracoda which are illustrated by 20 figures in the text. The richest material consisted of the remains of Decapoda, especially the Macrura, and this is the most valuable and interesting portion of the work. Some of the new material in this order belongs to the Palinuridæ. Our knowledge of the extinct Mesosoic family Glyphæidæ, so well developed in Belgium by Winckler, is farther extended by the full accounts of the remains of *Glyphaea bohemica* Fr., the figures including a restoration. Of the family, Astacomorpha *Enoploclytia leachii* Mantell is fully restored, with dorsal and side views, and the text contains a very detailed description. The same may be said of *Schlüteria tetracheles* Fr., and of the species of Hoploparia, Paraclatia, and Stenocheles. Further information of the Cretaceous specimens of Callianassa is given with a restoration, while new facts and figures concerning the Dromiacea, Oxystomata and other Brachyura complete the work, which as a whole is a most valuable contribution to our knowledge of extinct Crustacea.—*P*.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL[1]

Africa, The Western Sahara.—As Spain has recently annexed the African coast between Morocco and Cape Blanco, with an indefinite extension inland, the geography and ethnography of these regions is naturally prominent in Spanish geographical papers. Sres. Coello, Cervera, Quiroga, and Costa have recently explored this region, especially that part known as the Adrar Temar which is a raised oasis or meseta containing an area equal to a sixth of that of Spain. The mesa terminates in a point towards the south and is crossed here and there by ranges of hills, which have a slighter slope in its

[1] Edited by W. N. Lockington, Philadelphia, Pa.

eastern than in its western portion. In the centre opens the principal valley, that of Atar, which runs from north-west to south-east, and is the most thickly-populated part of the oasis. The greatest height of these hills is not more than 125 metres and most are much lower. The shifting sand-dunes which surround the whole of the oasis have penetrated between the two principal ranges of hills until they reach the walls of the towns of Uadan and Xingueti. The hills of Adar contain pines (*P. maritimus*) and several other kinds of trees, with spiny shrubs and herbage which grows even among the sand. Gazelles and other antelopes, foxes, hares, porcupines, etc., are among the wild animals. The natives have herds of oxen and buffaloes and flocks of sheep and goats; they cultivate wheat, barley, millet, sorgum, maize, cucumbers, etc., and tobacco; but have no olives, figs, or oranges. Their principal article of food is the date. Everywhere in the Sahara there is water beneath the surface, often at a slight depth. The oasis is salubrious; and the temperature varies from 4 to 40 degrees, centigrade. The inhabitants of Adrar are Berbers, and some preserve the type tolerably pure, though as a whole they are mixed with Arab and Negro. They are divided into four castes, sacerdotal, warrior, plebeian, and slaves; the noble or warrior class being the owners of the soil. The civil and religious head of this people is a hereditary sovereign, but the real power in each tribe is in the hands of an assembly of notables. A hundred slaves form the bodyguard of the king, who resides in Atar. Most of the natives belong to the mussulman sect of the Dyilani, whose religious head or Great Makkaddem resides at Uadan.

Xingueti, the most populous town of the oasis, contains from 3 to 4,000 souls; Atar 2,000 to 2,500; Uyeft about 1,500, while Uadan, which in the XVI. century was the capital, has greatly decayed. There is another Adrar, the Adrar Sutuf, about which less is known. The district next the coast and between the two Adrars is known as Tiris, and its inhabitants are shepherds and guides of caravans. In this country there are some curious rocks that are wider at the top than at the bottom, looking like basaltic monuments. At some points the basalt is formed into great arcades like those of an aqueduct. The districts called Skarna and Semmur form the drainage area of the Seguia-el-Hamra, which may be called a river though it has no perennial flow. Yet the Seguia is never entirely dry and there must be springs at certain points; it has many affluents, and the whole basin is humid and very productive. The indolent inhabitants are more given to the chase than to cultivation.

The most powerful tribes are those of the Erguibat, who reside in the upper part of the river. This tribe sends caravans in all directions, some having as many as a thousand camels guarded by two to three hundred armed men. The small commercial town of Tenduf belongs to the tribes of the Tadyacant.

THE OASIS OF FIGUIG.—France has intended to annex the oasis of Figuig, which is situated near Algeria, south of the mountains of Maiz and Beni-Smir. This territory is in Morocco and pays a small tribute to the Sultan, but is practically independent. The people are freebooters and their excursions have given the French government the pretext for claiming damages against the Sultan of Morocco. The last governor of Figuig was a fanatic Musselman and stirred up against the infidel rulers of Algeria all the Arabs under his jurisdiction. Three employes of the Algerian government were taken prisoners, and the French, after occupying with their forces the railroad fom Saida to Ain Sefra, have procured the dismissal of the governor of Figuig.

GEOGRAPHICAL NEWS.—The Philippine Islands, although probably the most valuable of Spain's remaining possessions, and although their productions are exceedingly rich and varied, have not hitherto attracted emigrants from the mother country. It is now proposed to choose for colonization the Island of Paragua, not more than a thousandth part of which is at present occupied by settlers, the remainder being the exclusive property of the State. The forest riches of Paragua are immense, the species including some that are not known in the rest of the archipelago. Among these is *Fragosa peregrina*.

Without the province of Algeria or the protectorate of Tunis, the French "colonies" or possessions, scattered over the four quarters of the world, contain an area of more than two millions of square kilometres, and a population of rather more than twenty-two millions, without including that of the Congo and Gaboon territory. The colony of Senegal contains about 805,000 square kilometres and that north of the Congo at least 600,000.

GEOLOGY AND PALÆONTOLOGY.

THE VERTEBRATE FAUNA OF THE EQUUS BEDS.—While the Equus Beds are found at various localities in North America, the greater number of characteristic species of Vertebrata have been obtained in three regions. First, the Oregon Desert; second the Country of the Nueces, S. W. Texas; third the Valley of Mexico. I give lists of the species found at these and their localities.

Recent species are indicated by a *

1. The species found in the Oregon Desert are the following:

MAMMALIA.

Holomeniscus vitakerianus Cope.
" *hesternus* Leidy.

Eschatius longirostris Cope.
" *conidens* Cope.
Equus major Dekay.
" *occidentalis* Leidy.
" *excelsus* Leidy.
Elephas primigenius Blum.
Canis latrans Say*.
Lutra ?piscinaria Leidy.
Castor fiber L.*
Arvicola sp.
*Thomomys talpoides** Licht.
" *?clusius** Coues.
Mylodon sodalis Cope.

AVES.

Podiceps occidentalis Lawr.
" *californicus.**
*Podilymbus podiceps.**
Graculus macropus Cope.
Anser hypsibatus Cope.
" *canadensis* L. *
" *albifrons gambeli.**
" near *nigricans* Lawr.*
Cygnus paloregonus Cope.
*Fulica americana.**
And numerous other species.

PISCES.

Leucus altarcus. Cope.
Myloleucus gibbarcus Cope.
Cliola angustarca Cope.
Catostomus labiatus Ayres.*
" *batrachops* Cope.

II. From S. W. Texas we have the following species.[1]
Equus barcenæi Cope.
" *fraternus* Leidy.
" *excelsus* Leidy.
" *occidentalis* Leidy.
" *crenidens* Cope.
Elephas primigenius Blum.
Canis sp.
Glyptodon petaliferus Cope.
Cistudo marnochii Cope.

III. From the Valley of Mexico the following have been recorded.[2]

[1] See American Naturalist, 1885, p. 1208.
[2] Proceeds. Amer. Philos. Society, 1884, p. 1.

Bos latifrons Harl.
Eschatius conidens Cope.
Holomeniscus sp. minor.
" *hesternus* Leidy.
" sp ? *californicus* Leidy.
Platygonus ?compressus Lec.
Equus barcenaei Cope.
" *excelsus* Leidy.
" *tau* Owen.
" *crenidens* Cope.
Elephas primigenius Blum.
Dibelodon shepardi Leidy.
Canis sp.
Ursus sp.
Glyptodon ? petaliferus Cope.
Mylodon sp.

IV. The following species were derived from a locality in Whitman Co., Tacoma (or Washington).

Mylodon sp.
*Taxidea americana** (*T. sulcata* Cope.)
Equus sp.
Holomeniscus sp.
Holomeniscus sp.

ALCES BREVITRABALIS, sp. nov.

This deer is represented by the basal part of the antler of three large and one small specimens. They agree with those of the genus Alces in the absence of a brow-antler, and the flattening of the beam preparatory to a palmation. The palmate part of the horn is lost from all the specimens. It was probably not nearly so extensive as in *Alces machlis* since its base is not wider than that of the bez-antler. The beam is short, and becomes rapidly much compressed in a plane transverse to the axis of the skull (judging by the obliquity of the base), which is also the plane in which the equally compressed bezantler is given off, in the external direction. The surface is not very rough, nor are the tubercles of which the burr consists, very large. A few nutritious grooves are well-marked. The external edge of the beam becomes truncated towards the base, and the section of the latter is a spherical triangle, transversely placed, with the external apex more or less obtuse.

Measurements of No. 1.

		M.
Diameters at base of beam	anteroposterior	.043
	transverse	.058
Length to base of bezantler		.100
No. 2.		
Long diameter of bezantler at base		.045

In No. 2 a tuberosity on the external face of the beam a short distance above the base, represents the brow-antler.

As compared with the year-old moose of which a figure is given by Prof. Baird (Rept. U. S. Pacific R. R. Exped. IX, p. 632), these horns differ in the relatively shorter and more compressed beam, with the less expansion of the portion immediately distad to the bez-antler.

The specimens of this species are all from Whitman County, Tacoma (Washington), and were obtained by Dr. J. L. Wortman.

ALCES SEMIPALMATUS sp. nov.

This species of elk is known to me from a basal portion of a horn of a larger individual, and the corresponding part of a smaller one. The larger specimen is considerably smaller than the adult of the *A. brevitrabalis*, representing a species of about the size of the black-tailed deer (*C. macrotis*), while the latter is as large as the *Cervus canadensis*. It differs from the *A. brevitrabalis* in the relatively and absolutely longer beam, and the relatively greater expansion at the base of the bezantler. The general characters are otherwise much as in that species. The beam is compressed, with the external face truncate, and the bezantler directed outwards in the plane of the beam. The burr is very prominent, consisting of a rim of confluent tubercles. The beam is smooth on the sides, but has several tubercles on the external border. Unfortunately the beam is so split that its transverse diameter can be only surmised, from the curves of its surface.

Measurements.

		M.
Diameters at base of beam	anteroposterior	.015 to .020
	transverse	.030 to .035
Length of beam to base of bezantler		.120
Long diameter of bezantler at base		.035

Besides the greater length of the beam, its expansion near the base of the bezantler and away from it, is greater than in the larger species above described, and the concavity of the surface is wider.

From Whitman Co., Tacoma, Dr. G. M. Sternberg, U. S. A.

CARIACUS ENSIFER, sp. nov.

This deer is represented by the beams of the horns of two individuals of probably different ages. In one of them a considerable part of the beam is preserved, so that a good idea of its characters may be obtained. It differs from both of the other species described in the presence of a short brow-antler, which originates exactly at the base of the beam, and is directed horizontally. It is depressed and not very long, and is accompanied by a twin process at its base, with which it is united by a horizontal lamina or palmation. The beam is, like that of the species already described, compressed, with a flattening of one edge, that immediately above the brow-antler. A similar flattening characterizes the base of the external edge, which is not wider than the internal base, the reverse of what is seen in the *Alces brevitrabalis*. The beam soon becomes compressed, especially on the antero-external edge (above the brow-antler), and in the specimen where it is best preserved, it is quite acute. In neither specimen is there any indication of a bezantler. The longer specimen may be possibly young, but its surface is strongly keeled and furrowed. The burr consists of acute edges connecting sharp points. The other specimen is smoother and rather more robust. It shows no indication of the expansion of the species referred to Alces, which it would do were it proportioned as in the *A. brevitrabalis*.

Measurements. No. 1.

		M.
Diameters at base of beam	anteroposterior	.022
	transverse	.035
Estimated length of brow-antler above		.040
Diameters beam .090 M. from burr	anteroposterior	.007
	transverse	.025

From Whitman Co., Tacoma, Mr. C. H. Sternberg.

This species is referred to Cariacus, although the position and direction of the brow-antler are different from those of any known species of the genera. I suppose it to be one of the Telemetarcapi solely from its resemblance to the Alces here described.

Several species have been found in localities not far removed from those mentioned, and in beds possibly of the same geological age. As it is not yet possible to determine with accuracy the ages of these fossils, I only refer to them. Such are an Aphelops from the valley of Toluca, Mexico ; and *Mastodon americanus* and *M. serridens* from S. W. Texas.

The close parallelism between the faunæ at the three localities is seen in the probable and ascertained identity of several species in the lists of each. The following species have been found in the two regions most remote from each other, the valley of Mexico and the Oregon Desert.

Eschatius conidens Cope.
Holomeniscus hesternus Leidy.
Equus excelsus Leidy.
Elephas primigenius Blum.

Of these, the *Equus excelsus*, and *Elephas primigenius* have been found in S. W. Texas. These species, with the *Equus barcenæi*, *E. crenidens*, and probably the *Glyptodon petaliferus* are common to the last named locality and the valley of Mexico.

The horizon to which these beds should be referred was held by King to be the Upper Pliocene. I have coincided with this opinion on palæontologic grounds, since the fauna presents a much greater diversity from that now inhabiting North America than that of the Plistocene beds of Europe exhibit when compared with the existing

Vertebrata of that country and Asia. Four families have disappeared since that epoch, viz.: The Glyptodontidæ, Megatheriidæ, Elephantidæ and Eschatiidæ. The genus Holomeniscus has passed away. The disproportion of extinct forms increases as we go south. Thus in the Oregon beds we find that out of twenty-six determined species, ten are still living. With further examination this list will be probably increased. At the Texan and Mexican localities no recent species have been yet determined. As we enter the South American extension of the same fauna, the number of extinct species and genera greatly increases, although some recent species have been found associated with them in the Pampean Fauna.

I have found Indian implements in considerable numbers in such close proximity to the fossils of the Oregon Desert, as to lead to the strong suspicion that they are contemporary with the latter. This opinion has been, according to Mr. G. K. Gilbert, reduced to certainty by the finding of such implements in place in the Equus beds in Nevada or California. The age of the Equus beds is placed by Mr. Gilbert as Plistocene (Quaternary.)

The Neighborhood of Seville.—The city of Seville is situated in the alluvial plain of the Guadalquivir, which every few years, at the height of the winter rains, rises sufficiently high to flood the streets. On both sides of these alluvial flats is a pliocene area, rising into the clayey hills ; this is succeeded by a belt of miocene. To the southeast of the river, between it and the sea, are secondary rocks, among which the Nummulitic and Jurassic have been recognized. Between the folds of these rocks are intercalated series of more or less metamorphosed rocks, which were regarded by Sr. Macpherson as Triassic, but which Sr. Calderon, from the discovery of fossils still remaining in them, has proved to be altered Nummulitic or Jurassic strata, according to their position. On the opposite side of the river there exists a Triassic area, but the greater part of the formations are either Palæozoic or eruptive. Granites, gneiss, syenite, diorite, diabase, and porphyry cover extensive areas, there are patches of Carboniferous strata, and a considerable extent of Cambrian.

At Peñaflar, a few miles above Seville, the mountains (Sierra Morena) come near to the river, and in the hollows are deposits of gold-bearing clay, which is supposed to be derived from the diorite and diabase above, though it is mingled with material from the archaic limestone and mica-schists. A section at this spot shows the limestone interrupted by two broad bands of diorite, also with lines of phosphorites, a thin vein of magnetic iron, and two bands of mica-schists. Near the Guadalquivir there is a great fault, which brings the Miocene suddenly to the surface. The upper portion of the Miocene is conglomerate, the lower molasse. Two wide bands of amphibolite intersect the Miocene. On the south of the Guadalquivir a second fault, affecting only the Miocene, occurs.—*W. N. Lockington.*

An Attempt to Compute Geological Epochs.—The precession of equinoxes and the periodical change on the eccentricity of the terrestrial orbit are reflected on the geological series of strata, and are the key to the calculation of the duration of epochs.

The precession causes the winter and summer to be alternately longer and shorter. In the semiperiod when winter is longer than summer, the distinction between inland and coast climate becomes more prominent. The currents of the atmosphere become stronger, and in consequence of that, the ocean currents increase in strength, and that again reacts upon the climate. The periodical change of the climate produced by the precession is not great, but it is sufficient to imprint itself in the alternation of beds, and in the formation of beach-lines, terraces, series of moraines, etc. To each period of precession corresponds one alternation of strata.

The eccentricity of the Earth's orbit is periodically changeable. Its mean value rises and falls for a period of about 1½ millions of years, with 16 oscillations. Such a rise and fall I term a cycle, and each cycle is, in the calculated curve, composed of 16 arcs.

The tidal wave, which is the most powerful agent in altering the sidereal day and in lengthening it, rises and falls in some measure with the eccentricity. It so exceeds the other forces that act in altering the length of the day, that the day steadily becomes lengthened, on the average, more quickly in the middle of the cycles, when the mean value of the eccentricity is greatest, and more slowly at the limit between them, when the eccentricity is the least; and in respect of the respective arcs with increasing speed during falling eccentricity.

The interior of the globe is plastic, owing to great pressure. The surface or "crust" opposes the greatest resistance to change of form. But according as the sidereal day becomes lengthened, and the equatorial regions of the earth increase in weight; a steadily increasing strain acts outward towards higher latitudes, and the strain increases until the resistance is overcome. We must also bear in mind that forces too slight to produce a sudden change in a solid body, may still produce a change of form when they act through long periods. Therefore the lengthening of the sidereal day acts not only on the seas, but also on the form of the solid globe. The earth approaches steadily more and more to the spheriform, but the solid crust is more sluggish in its movement than the seas, which immediately accommodate themselves to the altered time of rotation. As the motive force of these movements of seas and solid earth is periodically changeable, according to the eccentricity of the earth's orbit; these movements take place also, periodically quicker and slower. And as the seas always accommodate themselves to the forces before the dry land does, it is likely that the

Eccentricity of the earth's orbit,

calculated according to Stockwell's formula by R. W. Mc. Farland (Amer. Journ. of Science, ser. 3 vol. 20. New Haven 1880).

beach-lines come to oscillate up and down once, for each rise and fall of the eccentricity of the earth's orbit. That is the case in respect of both the respective arcs of the curve and of the cycles. On such a cycle "the mean level of the sea" rises and falls once in 16 oscillations.

The sidereal day has (cfr. Damine) become several hours longer. It is therefore probable that there must have accumulated such a strain in the mass of earth, that a slight increase of strain would be sufficient to cause changes of form at the weakest points. It is also likely that those partial changes in the solid mass of the earth must occur, especially at times of great eccentricity, or some time after such an occurrence, when the motive force increases quickest.

The change in the tidal-wave, caused by the variation of the eccentricity, is presumed to be sufficiently great to explain the displacement of the beach-lines. A few metres of vertical displacement of the beach-line is sufficient to produce in the deep basins, an alteration of many metres of thick marine and fresh water beds. And as regards the changes in the solid body of the Earth, we must recollect that the series of beds is not complete at any single spot. In other words the oscillations were not general to such an extent that they were contemporaneous everywhere. Only by partial changes of form sometimes here, sometimes there, always at the weakest point in each age, has the solid earth approached to the spheriform. To each arc of the curve there corresponds, therefore, only a partial and not a general change in the form of the solid earth. And the oscillation of the beach-line, corresponding to the arc, can, therefore, not be pointed out everywhere, but only in the basins when the forces at that time exerted their effect. In this way we can obtain a perfect profile only by combining layers of all the Tertiary basins. Neither were the changes of the solid earth everywhere equal in extent, but were greatest at the weakest points of its surface, so that quite extensive local upheavals may be caused by slight changes in the length of the sidereal day.

That is the case as regards the individual oscillations, but even the great trangressions of the sea, of which one occurs in each cycle, need not be owing to any great rise of the sea level; as great flat lands may be covered and drained by a relatively small vertical displacement of the beach-line. But these great changes in the distribution of land and sea were undoubtedly sufficiently great to produce considerable changes of climate. Extensive seas in higher latitudes cause their climate to be mild, and vice versa.

If we now compare, keeping these principles in view, the curve of the eccentricity with the geological series of beds, we find an agreement indicating that the hypotheses are correct. The two cycles of the calculated curve, correspond to two geological cycles. Each of the cycles has 16 arcs that correspond to 16 slight oscillations of the beach-lines or 16 geological stages. In each of these stages there are as many alternations of strata as there are precessions in the corresponding arc, and the mean sea level rises with the mean eccentricity in the middle of the cycles, and falls at the limit between them, and hand in hand with the mean sea level, rises and falls also, the temperature in the higher latitudes.

The doctrine here discussed agrees with Lyell's great principle. Slow changes in the length of the winter and summer and in the force of the tidal-wave, produce periodical changes of climate, and displacements of the beach-lines. The earth changes its form slowly and imperceptibly. The changes take place so slowly that the effects, first after expiration of many thousands of years, begin to appear distinctly. There are two astronomical periods which are the causes of the great and radical changes, of which geology leaves to us testimonies from remote ages, and which will still continue in the future, for millions of years to produce similar changes in the geography of the globe, its climate and its animal and vegetable life.—*A. Blytt in Christinia Videnkabs Selskabs Forhandlingar, 1889, No. 1.*

THE WESTERN SAHARA.—According to the data brought together by Sr. C. G. Toni, in the *L'Esplorazione Commerciale*, from the explorations of Spanish and German travelers, the western coast of Africa consists of a Cretaceous mass which is continued from the Cretaceous nucleus of Morocco and terminates at Cape Blanco. In immediate contact with the Cretaceous band of the coast and immediately above it, exists a thick deposit of desert sands, which covers all the subjacent formations. Beneath this sand through a large portion of its extent, rocks of the Devonian period are believed to extend and crop out in a few points. The hills of the oasis of Adrar Temar contain trachyte and have some peaks of granite and basalt. These hills also contain quartz, marble and various siliceous and ferrigenous rocks.

In the "Neues Jahrbuch für Mineralogie, Geologie und Paleontologie, Jahrgang, 1888, I Band; drittes Heft," Dr. Ferd. Roemer describes and figures a new genus of Echinodermata from Texas, to which he gives the name of "Macraster," and calls the only species *Macraster texanus*. This fossil has long been familiar to the writer in his stratigraphic investigations in Texas, and it makes a well defined horizon near the very top of the immense thickness of lower marine Cretaceous in Texas, and does not occur, as Dr. Roemer infers from the specimens which accompanied it to Germany, with the *Exogyra texana* fauna, a statement which has been verified by Mr. Geo. Stolly, the collector. This fact is important because of the tendency upon the part of European palæontologists to underestimate the value of the stratigraphic differentiation of the Texas Cretaceous. —*R. T. Hill.*

CÆNOZOIC.—Teeth of *Elephas antiquus* found at Rinconada, Cantillana and other places in the province of Seville Spain, together with vertebræ of the same species, are to be found in the museum at the University at the last named place, which museum also contains the mandibles of *Elephas armeniacus* found at Almudovar del Rio near Cordoba.

GEOLOGICAL NEWS.—GENERAL.—Herr Schlüter in two papers entitled "Ueber die regulären Echinodermata der Kreide Nord Americas," and "Ueber Inoceramus und Cephalopoden der Texanischen Kreide, (Niederrhein. Gesselschaft at Bonn, March, 1887), describes *Salenia mexicana*, from Chihuahua, Mexico, and *Inoceramus subquadratus*, *Turrillites irrideus*, and *T. varians* from Austin, Texas. The validity of the three species last mentioned is exceedingly doubtful, as the descriptions give no data sufficient to differentiate them from species already described by Roemer and Shumard. He also asserts that the Austin Cretaceous is equivalent to that of Ems, Germany, a rather indefinite statement since within the corporate limits of Austin is found nearly the whole range of the comprehensive Texas Cretaceous under conditions which could hardly be duplicated.—*R. T. Hill.*

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Messrs. Adams and Lawson [2] of the Canadian Geological Survey have been examining the rocks associated with the apatite in the Canadian apatite mines, to determine whether or not there is present a rock similar to the scapolite-diorite occurring in the Norwegian apatite region. They find that in some instances the Canadian apatite veins occur in a rock, composed essentially of orthoclase and biotite, with or without augite. i.e, either mica-syenite or augite-mica-syenite. None of the thin sections of the rocks associated with the apatite resemble in the least those of the Norwegian rock. At other regions in the Canadian Laurentian, however, associated with limestones and amphibolites, specimens were collected which are found to bear a strong likeness to the scapolite-rock from Norway. A specimen from near Arnprior on the River Ottawa, is described as a granular aggregate of augite, hornblende, scapolite, epidote, enstatite, pyrrhotite and rutile. The hornblende appears in some cases to be primary and in others to be secondary. The scapolite is in large colorless grains, many of which show polysynthetic twinning lamellæ, which may be due to the remains of the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Can. Rec. of Science, 1888, p. 185.

original plagioclase from which the scapolite was derived. Inclusions of dust and fluid cavities are present in the scapolite in large quantities and microlites are developed along its cleavage planes. The rutile occurs in grains closely associated with the scapolite. In several instances these grains appear to be made up of lamellæ, in which, however, there is no alternation of extinction as in the case of polysynthetic twins. The authors call the rock a scapolite-diorite. A rock from McDougall, Parry Sound District, contains a basic pagioclase in addition to the minerals mentioned above, and has been called plagioclase-scapolite-diorite. Schistose rocks with the composition of the last mentioned diorite, have had their schististy produced in them by pressure, as is evident from the shattered condition of the plagioclase constituent. The scapolite in these rocks bear no marks of a secondary origin from plagioclase. Augite is lacking, but biotite and quartz are observed in addition to the minerals found in the diorites.—The dolerites [1] of Londorf, Hessec, embrace coarse and fine grained varieties as well as glassy phases. The former consists of plagioclase, a titaniferous augite, olivine, a little enstatite, magnetites, apatite and titanic iron. The olivine is a pure hyalosiderite, elongated in the direction of the *c* axis, and intergrown with plates of titanic iron in such a way that these are perpendicular both to the cleavage planes and to the long axes of the olivine crystals. Amygadaloidal cavities contain the rock forming minerals together with little crystals of hornblende, and tridymite and masses of hyalite. To account for the existence here of well developed crystals of the minerals occurring in the body of the rock, Streng supposes the bubble of gas which gave rise to the cavity to have moved along through the partly solidified magma, shoving out of its way the liquid portions and leaving the crystals free. Other substances are supposed to be due to the alteration of the glass which was left attached to the crystals. The hornblende is regarded as having been deposited from the hot solutions, which would naturally circulate through the amygdaloidal cavities. The sublimation theory proposed to explain the existence of druse minerals in cavities of eruptive rocks he dismisses as unsubstantiated by facts. Upon the surface of the glassy dolerite is a crust of altered material with the characters of palagonite.—Lœwinson-Lessing [2] has embraced in a very readable article the views which are gradually becoming prevalent among petrographers in reference to the origin of diabases, gabbros and diorites. After briefly calling attention to the acknowledged differences between the structure of intrusive and effusive rocks, and emphasizing the peculiar features of the diabase structure, the author declares that this is the structure of an effusive rock rather than of an intrusive one. The association of diabases with fossil-bearing tuffs and their gradation into augite-porphyrites leads him to regard them as effusive under water, with the augite-porphy-

[1] Streng : Neues Jahrb. f. Min., etc. 1888. II. p. 181.

[2] Bull. Soc. Bélg. d. Géol. II. 1888, p. 82.

rites as their equivalent terrestrial effusives. The gabbros he acknowledges to be intrusive, and would regard as the intrusive equivalents of the diabases. In recapitulating his views the author divides the diabasic rocks into (1) intrusives (gabbros, granitoid-diabases), and (2) effusives, (*a*) terrestrial (augite-porphyrites and melaphyres), and (*b*) sub-marine (ophite-diabases). The diorites he would separate into those which are merely altered phases of diabase (including the epidiorites and the proterobases), and the primary diorites, which owe their hornblendic constituents to the presence of water vapor in the magma from which they solidified. Since hornblende is found only in those portions of rocks which cooled in the intratellurial period, *i. e.*, under such pressure as would prevent the escape of water, the diorites are to be looked upon as characteristic plutonic rocks.—The kersantite [1] dyke rocks from south-western East Thuringia contain numerous inclusions of granite which have been more or or less affected by the enclosing rock. The quartz of the granite has been enlarged by the addition of new material, and has yielded tridymite as a product of its alteration. It contains numerous glass inclusions as the result of the fusion of original mica inclusions. Mica, augite and a new crystallization of feldspar have originated from the feldspar of the granitic rock. The original mica has changed into spinel and augite. Garnet, sillimanite, rutile, and apatite, which were among the original constituents of the granite can no longer be detected in the inclusion. The groundmass in which the new minerals lie consists of a micro-felsitic aggregate of quartz and feldspar, in which are numerous concentric and radial spherulites, and a well-marked fluidal structure. Inclusions of a mica schist, and of a cordierite bearing andalusite contact rock are also found in the same kersantite.—Mr. Cross [2] communicates some brief descriptions of a few of the eruptive rocks occurring in Custer Co., Colorado. The first rock described is a garnetiferous rhyolite with a eutaxitic structure. It is remarkable for its simple composition which is as follows:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	
75.20	12.96	.37	.27	.03	.29	.12	8.38	2.02	.58	tr.	=100.22.

A sanidine-oligoclase-trachyte possesses the peculiarity of a secondary porous structure due probably to the alteration of inclusions. Its biotite has yielded augite on its corroded edges. In a syenite occurring in narrow dykes are irregularly-shaped pieces of biotite, with their greatest development in the direction of their *c* axes. Peridotite and an olivine-augite-diorite are also described. The former contains brown hornblende and hypersthene in about equal proportions.—The same writer [3] announces the discovery of a second occurrence of phonolite in the United States. The specimen examin-

[1] R. Pohlmann: Neues Jahrb. f. Min., etc. 1888. II. p. 87.
[2] Proc. Col. Scient. Soc. 1887. p. 228.
[3] Proc. Col. Scient. Soc. 1887. p. 167.

ed was not found in place. It was picked up on the Eastern slope of the Hayden divide, between Florissant and Manitou, Colorado. The rock consists of about 25 per cent. of nepheline, of granular sanidine, prismatic particles of a deep green hornblende, and little colorless grains of a mineral supposed to be augite.—After an examination of the specimen of altered diabase from Quinnesec, Mich., Cathrein [1] concludes that the rutile, which Williams [2] thought to be secondary after ilmenite contains no titanium, and can, therefore, not have given rise to the rutile by alteration.—A porphyritic hornblende—andesite from Dewéboyun in Turkey in Asia, is described by Lœwinson-Lessing[3] as composed by large crystals of hornblende and labradorite in a groundmass consisting of plagioclase microlites in a glassy base.—Karl Schneider [4] has observed the alteration of sphene into calcite and perofskite in a phonolite from Bohemia.

MINERALOGICAL NEWS.—*New Minerals, Sperrylite*[5] is the first compound of platinum that has been found as a mineral. It occurs in the Vermillion mine, in Algoma, Ontario, in a layer of loose material on the contact between a vein of gold-bearing quartz and the enclosing rock, and in pockets in the decomposed ore. In both cases it is associated with copper and iron pyrites. The sperrylite is found in small lustrous grains, which are fragments of crystals on which Mr. Penfield has discovered cubic, dodecahedral, octahedral, and pyritoid faces. The color of the fragments is tin-white and their powder black. Their hardnesss is between 6 and 7. Although their specific gravity is 10.602 the grains have a tendency to float upon the surface of water. Analysis yielded :

As	Sb	Pt	Rh	Pd	Fe	SnO_2
40.98	0.50	52.57	.72	tr.	.07	4.62

corresponding to $PtAs_2$, after allowing for the cassiterite present as an impurity. The artificial compound made by passing vapor of arsenic over red hot platinum possesses many of the properties of the natural substance, the most characteristic of which is instant fusion upon contact with red hot platinum, with the evolution of almost odorless fumes of arsenic, and the production of porous excrescences of the color of platinum. The composition of the mineral and its crystallization relegate it to the pyrite group.—Attention has already been called to the new mineral [6] Beryllonite. A full description of its occurrence and properties has recently been given by Messrs. E. S. Dana and Wells.[7] The mineral is found at the

[1] Neues Jahrb. f. Min., etc. 1888. II. p. 151.
[2] Amer. Naturalist. Feb. 1888. p. 168.
[3] Bull. Soc. Bèlg. d. Géol. 1887. I. p. 110.
[4] Neues Jahrb. f. Min., 1889, I. p. 99.
[5] Amer. Jour. Sci., Jan. 1889, p. 71.
[6] Amer. Naturalist, Nov. 1888, p, 1023.
[7] Amer. Jour. Sci., Jan., 1889, p, 23.

base of the McKean mountain near Stoneham, Maine, in the destritus of what is supposed to be a granitic vein in mica schist. In addition to the facts announced in the former notice it may be added that the mineral is orthorhombic with $a : b : c = .5724 : 1 : .5490$. It has four cleavages parallel respectively to $0\,P$, $\infty\,\bar{P}\bar{\infty}$, $\infty\,\breve{P}3$ and $\infty\,\breve{P}\breve{\infty}$ in the order of their perfection. Twins parallel to $\infty\,P$ are not rare. It is colorless or yellow and transparent. The plane of its optical axes is $\infty\,\breve{P}\breve{\infty}$. Its double refraction in negative and $2\,H_a = 72^\circ\,47'$ for yellow light. The mineral is remarkable for the presence in it of cavities elongated parallel to the c axis. These sometimes contain two movable bubbles, and are so numerous as to produce an apparent columnar structure in the mineral.—*Dahlite* from Bamle, Norway, is described by Brögger and Bäckström[1] as a new mineral occurring as a thin yellow crust on massive apatite. This crust is composed of little fibres arranged perpendicular to its surface, which is smooth and lustrous. The mineral is translucent, is optically negative, has a hardness of about 5 and a specific gravity of 3.053. It is a hydrous double phosphate and carbonate of calcium ($4\,Ca_3\,(PO_4)_2 + 2\,Ca\,CO_3 + H_2O$) It gave on analysis :

P_2O_5	CO_2	CaO	FeO	Na_2O	K_2O	H_2O
38.44	6.29	53.00	.79	.89	.11	1.37

Awaruite[2] is the first nickel-iron compound described that is not of meteoric origin. It occurs in small plates and granules in the sand of George River, in the western part of South Island, New Zealand. Its composition is :

Ni	Co	Fe	S	Si
67.63	.70	31.02	.22	.43

The mother rock of the mineral is a serpentine that has originated from an olivine rock by alteration.— Darapsky[3] adds *Naposite* to the list of iron sulphates from Atacama, Chili. It is found in radially fibrous, glistening, brittle, dark-red crystals containing 24.72 per cent. of SO_3, 30 per cent. of Fe_2O_3, and 16.43 per cent. of H^2O, thus corresponding to the formula Fe (FeO_3 SG 43, + 10 H_2O It is decomposed by water and by acids.—*Mazapilite*. Dr. König[3] announces the discovery of a new arsenide of calcium and iron from Zacatecas, Mexico. It occurs in dark red and black, probably orthorhombic crystals, with a hardness of 7 and a specific gravity of 3.567.

Miscellaneous.—Gonnard[4] describes natural corrosion figures in *Barite* from the Puy-de-Dôme, that consist of little depressions

[1] Aefv. Vet.—Akad. Förhandl, 1888, d. 493. Ref. Am. Jour. Sci. Jan. '89, p. 77.

[2] Vom Rath: Ref. Neues Jahrb. f. Min., etc., 1889, I. p. 23.

[3] Boletin d. l. Soc. Nac. Min., Santiago de Chile, Ref. Neues Jahrb, f. Min, 1889, I p. 33.

[4] Bull. Soc. Fr. d. Min., 1888, XI., p. 269.

with an orthorhombic or a monoclinic symmetry. Those of the latter kind are triangular in shape and are supposed to owe their abnormal symmetry to twinning.—Mr. Cross[1] has noticed striations in the cubic faces of *galena* from the Minnie Moore mine, Bellevue, Idaho, which he believes to be due to twinning lamellæ produced by the slipping of alternate bands of the mineral along gliding planes, as a consequence of pressure, The twinning planes lie in the zone between ∞O ∞ and ∞O—New methods for the detection of tin, caesium, and rubidium under the microscope are suggested by Streng[2] The detection of tin depends upon the fact that KCe and Sn Ce yield a double salt, which crystallizes in little tabular orthorhombic crystals, which upon the addition of nitric acid pass over into octahedroas modified by icositetrahedrons. Caesium and rubidium chlorides with stannous chloride in hyrochloride acid solutions give crystals of the same shape as those of potassium and stannous chlorides, but in the case of caessium these are brightly polarizing, while in the case of rubidium they are monoclinic. The author also calls attention to the fact that all hydrofluoric acid sold as pure, even when carefully made from cryolite, contains silica and cannot be used for the detection of this substance in small quantities.—Calcium carbonate readily decomposes solutions of aluminium salts in the cold, with precipitation of gelatinous aluminium hydroxide, which, in the presence of coloring matters absorbs these and becomes stained. Under the same conditions dolomite produces no change in the solutions unless it remains in contact with them for a long time. A knowledge of these facts induces Lemberg[3] to propose a method of distinguishing between calcite and dolomite in thin sections of rocks. The solution which he proposes for use is made by dissolving four parts of dry aluminium chloride in sixty parts of water and adding to it six parts of *haematoxylin campechianum*,

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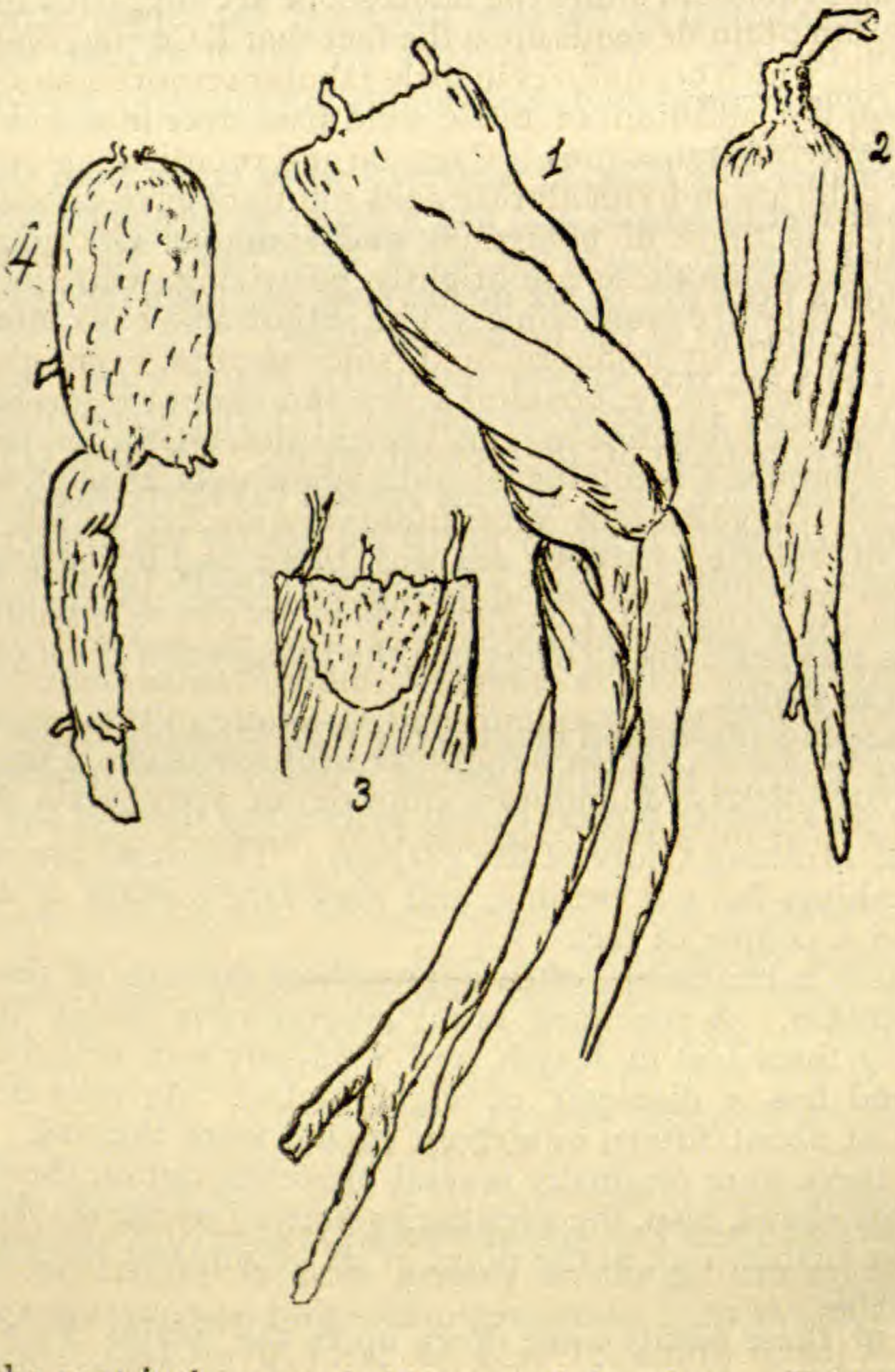
BOTANY.[4]

Two Big-rooted Plants of the Plains.—Now and then some of the plants of the plains present odd characteristics not observed in some of the eastern regions. Two species native of the open plains at an altitude of from 2,000 feet above the sea to the base of the Rocky Mountains are remarkable for their enormous roots. One

1 Proc. Col. Scient. Soc. 1887, p. 171.
2 Neues Jahrb. f. Min., etc., 1888, II., p. 142.
3 Zeits. d. deuts. geol. Gesell. XL., 1888, p. 357.
4 Edited by Chas. E. Bessey, Lincoln, Nebraska.

of these is the Wild Pumpkin (*Cucurbitale perennis* Gray), which produces a trailing stem, bearing triangular, woolly pubescent leaves, whose blades are six to eight inches in length. The fruits are about the size of an orange, and are perfectly spherical in shape. When ripe they are yellow with some greenish longitudinal markings. Internally they are exceedingly fibrous, and contain a great number of seeds (about 200) which are about one-third of an inch in length



But the root is the remarkable part of the plant. Two specimens were brought to my laboratory last fall, figures of which are given herewith. The largest (Fig. 1) measured when first dug nearly seven feet in length, and at the top or crown had a diameter of fully eleven inches. The crown is curiously hollowed out, as shown in Fig. 3, the cavity being fully six inches in depth. The inside of the cavity is covered with a healthy cortex, and there is no sign of decay about it. Around the margin of the cavity are the remains of several stems, showing that in this portion the buds for the annual running stems occur. At about two feet from the crown the root bends abruptly and sends out a couple of branches. When in the ground the part below the bend was vertical, while that above was inclined. The root grew upon a hillside and its upper portion was nearly if not quite perpendicular to the surface of the ground. The bend was probably occasioned by the slow sliding of the upper strata of the soil down the hill. The branches are much smaller where they emerge from the main root, and enlarge considerably within the first six or eight inches.

The smaller root (Fig. 2) measured when taken from the ground nearly four feet in length, and had a diameter of about eight inches. It is regular in form, and is not much branched. Its crown is extended into a neck five or six inches long, and upon the upper part of this are the remains of the branching stems.

Both roots are very fibrous internally, almost woody in fact, but they contain also an enormous amount of stored up nourishment for the rapid development of the annual stems. The first (1) weighed eighty pounds when fresh, and the second (2) thirty-three. But this store of nourishment is amply protected against the hungry gophers, moles, mice, rabbits, squirrels and larger animals, for it is intensely bitter. In the struggle for existence those only have remained whose bitterness was sufficient to overcome the hunger and thirst of the animals of the plains.

The second big-rooted plant is the Wild Morning Glory (*Ipomœa leptophylla* Torr), a beautiful plant of a bushy habit, bearing numerous large pink-purple flowers closely resembling those of the common cultivated Morning Glory of the gardens. The stems are numerous and branching, but not twining, and they rarely attain a height of more than a couple of feet.

The root is enormous, often approaching the size of that of the Wild Pumpkin. A specimen in my laboratory is shown in Fig. 4. It is nearly three feet in length, and evidently was originally much larger, and has a diameter of eight inches. As may be seen, it branches at about fifteen or sixteen inches from the top. On the one side there were originally several branches, but on the other but one. This shows, also, the peculiarity noticed above of the smaller size of the branch root at the point of its origin, and its subsequent enlargement.

Both of these plants come down upon the plains to about the 100th meridian. In northern Nebraska at Long Pine, I have seen the Wild Morning Glory ten or twelve miles east of that meridian. The wild pumpkins are abundant in Lincoln County (south of the Platte River), not more than fifteen or eighteen miles west of the line mentioned.—*Charles E. Bessey.*

Herbarium Notes.—An Alphabetical Arrangement.—In arranging an herbarium one's first thought would be to arrange it according to some recognized natural system of which it would then constitute a practical application. Yet,as herbara are intended much more for use in the identification of species than for instruction in systematic botany or for embodiment of ephemeral classifications, alphabetical arrangements based on assumed convenience are probably the prevailing ones. These alphabetical arrangements may be either of species in a genus or of genera in certain large groups, as the Fungi, the composite or the Grasses; but they are all based on the idea of convenience of reference.

As to the alphabetical arrangement of genera. Without considering the question whether a natural arrangement, even if slightly less convenient, would not be preferable, I believe that such an arrangement can be shown to be equally convenient. In the first place the largest families of Fungi, for example, as the Icaceæ, Uredineæ, or Sphæriaceæ; are by no means as large as A, C, S, or P of an alphabetical arrangement. The larger groups like S and P are exceedingly inconvenient unless subdivided; and surely it is of more value to the student to know the subdivisions of the Sphæriaceæ than of S, unless he is preparing himself to be a Register of Deeds. The convenience of an alphabetical arrangement arises from the familiarity of the alphabet, yet the names of the natural sub-divisions of plants should be scarccly less familiar to the botanist. Then, too, allied genera are often wanted at the same time; genera of the same initial letter probably never. Plants are generally studied in small groups; and nothing could be more inconvenient to the student of a tribe than to find six genera in six distinct groups, each of which must be carefully searched, nor more convenient than to have them together, perhaps even placed in the very order in which he wishes to study them.

Somewhat more can be said in favor of an alphabetical arrangement of species in a genus. Such an arrangement is not needed to any appreciable extent, however, except in very large genera. Yet in such genera as Carex, for example, a natural arrangement is equally convenient, without regarding the fact that it is infinitely more instructive. Almost any one who has spent much time in the matter can put a Carex into the proper group, the species within the group is the difficulty; and it is much more convenient to have all the species of a group together than to be forced to search through five or six letters. But in genera of Fungi, as Cercospora, where there is no very good natural arrangement, it might be said, is better than one based on the host, such as is usually given in the books, because neither is particularly instructive and the first is the handier. Yet, as herbarium specimens are consulted for the most part in connection with a manual, an arrangement following it would certainly be perfectly convenient. And, perhaps, it would not trouble the student over much to remember that Cercospora viticola is on the grape and therefore, goes in the section "in Di cotyledonis lignosis," while he could gain very little from the reflection that its specific name begins with "J."

THE ALGÆ FUNGI AND LICHENS.—Many who no longer hold the idea of the autonomy of the groups Fungi, Algæ, and Lichens, nevertheless persist in keeping them separate in the herbarium. This, too, is done on the plea of convenience, as they are usually studied by different students. Letting alone the question of whether it would not be better for the mycologist to think more about Algæ, I believe that an herbarium where all plants are arranged according to a natural system without regard to anything else is perfectly convenient for reference, as long as the families are clearly indicated on the cases. If this is so, the natural arrangement is clearly preferable. For these are not mere questions of convenience. In the case of a classification, if mere convenience of placing specimens in their proper genera and species were all that was to be considered, perhaps no system would be superior to the celebrated one of Linnæus But this is one of the last things which we demand of a classification. The function of a classification is to teach us the relations, the ancestry and thus a part, it may be, of the history of plants. So with an herbarium. Its object should be no more to furnish authentic specimens for the determination of single species than the higher one of teaching us the relations of these species by bringing together their names.—*Roscoe Pound.*

SACCARDO'S GREAT WORK ON FUNGI.—Although Saccardo's Sylloge Fungorum has been noticed in the NATURALIST from time to time upon the appearance of the volumes, it may be of service to our readers to indicate more fully the scope of the great work. The intention of the author (Professor P. A. Saccardo of the University of Padua) is to publish in one work the descriptions of all the Fungi now known in all parts of the world. Such an undertaking involves as all will admit, an immense amount of labor, and he must have been a bold man indeed who willingly entered upon it. As a matter of course such a work, intended for the whole world, could be written in Latin only.

The first volume appeared in 1882, the second in 1883, the third in 1884, the fourth in 1886. In the latter year A. N. Berlese and P. Volgins brought out a supplementary volume to volumes I to IV, in which additions and corrections were made. The fifth volume appeared in 1887, and the sixth and seventh in 1888. The eighth and concluding volume may be looked for some time during the present year. The total number of pages thus far printed is 6898, and doubtless the final volume will bring the number up to 7700.

The system adopted by Saccardo may be learned from the following synopsis:

ORDER PYRENOMYCETEÆ Fr. Em. De Nat.

Family 1. *Perisporiceæ* Fr.
" 2. *Sphaeriaceæ* Fr.
" 3. *Hypocreaceæ* De Nat.
" 4. *Dothideaceæ* Nits. et Fkl.
" 5. *Microthyriaceæ* Sacc.
" 6. *Lophiostomaceæ* Sacc.
" 7. *Hysteriaceæ* Corda.

ORDER SPHŒROPSIDEÆ Lev. reform.

Family 1. *Sphæroideæ* Sacc.
" 2. *Nectroideæ* Sacc.
" 3. *Leptostromaceæ* Sacc.
" 4. *Excipulaceæ* Sacc.

ORDER MELANCONIEÆ Berk.

Including six "Sections" which are designated Hyalosporeæ, Scaloce-allantosporeæ, Phœosporæ, Didymosporeæ, Phragmosporeæ

ORDER HYPHOMYCETEÆ Martins.

Family 1. *Mucedineæ* Link emend.
" 2. *Dematieæ* Fr.
" 3. *Stilbeæ* Fr.
" 4. *Tubercularieæ* Ehrenb. emend.

ORDER HYMENOMYCETEÆ Fr.

Family 1. *Agaricineæ* Fr.
" 2. *Polyporeæ* Fr.
" 3. *Hydneæ* Fr.
" 4. *Theleporeæ* Pers.
" 5. *Clavarieæ* Corda.
" 6. *Tremellineæ* Fr.

ORDER GASTEROMYCETEÆ Wild.

Family 1. *Phalloideæ* Fr.
" 2. *Nidularieceæ* Fr.
" 3. *Lycoperdaceæ* Ehreub.
" 4. *Hymenogastraceæ* Vttt.

ORDER PHYCOMYCETEÆ DeBary.

Family 1. *Mucoraceæ* DeBary.
" 2. *Peronosporaceæ* DeBary.
" 3. *Saprolegniaceæ* DeBary.
" 4. *Entomophthoraceæ* Fowakow.
" 5. *Chytridiaceæ* D. By eb. Worou.
" 6. *Protomycetaceæ* DeBary.

COHORT MYXOMYCETEÆ Wallr.

Subcohort I. **Myxomyceteae** (Grauinæ)

ORDER PROTODERMIALLŒ Rost.

Family 1. *Protodermiaceæ* Rost.

ORDER CALCAREÆ Rost.

Family 1. *Cienkowskiaceæ* Rost.
" 2. *Physaioceæ* Rost.
" 3. *Didymiaceæ* Rost.
" 4. *Spumariaceæ* Rost.

ORDER AMAUROCHETEÆ Rost.

Family 1. *Echinosteliaceæ* Rost.
" 2. *Stemonitaceæ* Bel.
" 3. *Raciborskiaceæ* Bel.

" 4. *Amaurochaetaceæ* Rost.
" 5. *Brefeldiaceæ* Rost.
" 6. *Enerthenemaceæ* Rost.

ORDER ANEMEÆ Rost.

Family 1. *Liceaceæ* Rost.
" 2. *Clathroptychiaceæ* Rost.

ORDER HETERODERMEÆ Rost.

Family 1. *Cribrariaceæ* Rost.

ORDER COLUMELLIFERÆ Rost.

Family 1. *Riticalariaceæ* Rost.

ORDER CALONEMEÆ Rost.

Family 1. *Perichaenaceæ* Rost.
" 2. *Arcpriaceæ* Rost.
" 3. *Trichiaciæ* Rost.

Appendix. ORDER SOROPHOREÆ Zoph.

Family 1. *Guttubineæ* Zoph.
" 2. *Dictyosteliaceæ* Rost.

Sub Cohort II. **Monadineae** Cienk.

ORDER MONADINEÆ AZOOSPOREÆ Zopf.

Family 1. *Vampyrelleæ* Zopf.
" 2. *Burrsullineæ* Zopf.
" 3. *Monocystaceæ* Zopf.

ORDER MONODINEÆ ZOOSPOREÆ Zopf.

Family 1. *Pseudosporeæ* Zopf.
" 2. *Gymnococcaceæ* Zopf.
" 3. *Plasmodiodiophordæ* Zopf.

ORDER USTILAGINEÆ Tul.

Artificially divided into "Amerosporeæ" "Didymosporeæ" and "Dictyosporeæ."

ORDER UREDINEÆ Brongn.

Artificially divided into "Amerosporeæ" "Didymosporeæ" and "Dictyosporeæ."

The final volume will contain the Discomyceteæ, Tuberaceæ and Satrigomyceteæ, and the whole work will then be one which every student of the Fungi will need to have. The descriptions, while often mere translations or copies of the originals, are in the case of the species of certain groups entirely re-written. The total cost of the whole work will be about one hundred dollars.—*Charles E. Bessey*.

ZOOLOGY.

TWO REMARKABLE RADIATES.—In the *Aarsberetning* of the Bergen Museum for 1887 (but recently issued), Dr. D. C. Danielssen describes two interesting forms obtained by the dredge in the recent Norse North Atlantic Expedition. When collected they were regarded as sea anemones allied to Halcampa an l Cerianthus, but anatomical investigation shows them to differ from all Cœlenterates in just that feature which has been regarded as diagnostic of the group, while on the other hand they have many points in common with the actinians. For them Dr. Danielssen has made the Tribe Aegireæ which he defines as "Actinida, with a perfect body cavity (Cœlom) and a developed digestive apparatus consisting of œsophagus, stomach and anus." The two genus are called Fenja and Aegir, names derived from Scandinavian mythology. In general terms they may be described as sea anemones whose so-called stomach (Actinostom of Agassiz) has extended down to the base thus partially (Aegir) or completely (Fenja) separating the digestive from the mesenterical spaces, while in both an anus is developed in the base. In both the cœlome thus formed is divided by twelve perfect septa, but in Aegir these spaces communicate by twelve slender fissures with the rectal area of the digestive tract. In Fenja there are twelve genital pores around the anus, outside the rectum; in Aegir the genitalia are more like those of ordinary sea anemones. Both forms are hermaphrodites.

As will be seen these forms which in every other respect are true sea anemones differ from all cœlenterates in the distinction between digestive and cœlomic cavities. On the other hand they differ from the true Cœlomata in the fact that each cœlomatic space extends the length of the body. While interesting, in a general way, as indicating a possible development of the cœloma of higher animals from the mesenterical space of an actinian, we cannot regard them as being links in the line connecting the Cœlenterata with segmented animals, according to the theories of Balfour and Sedgwick, for that demands the conversion of the cœlenterate mouth into mouth and anus, while the anus of Aegireae is clearly not derived in this way, but is rather a perforation through the base of attachment of the ordinary sea anemone. Occasionally such "anal pores" occur in the Cerianthidæ. An extensive account illustrated by over twenty plates is promised at an early date.

THE EYES OF TRILOBITES.—Mr. J. M. Clarke gives an account of the eyes of the trilobite *Phacops rana* in the *Journal of Morphology*, Vol. II., 1888. He divides the trilobites into two groups, Holochroal and Schizochroal, according as the *external* surface of the cornea is faceted or not. The Phacopidæ belong to the latter group, and their eyes are to be regarded as aggregate rather than compound. The corneal lenses were hollow or filled with some substance different from the cornea. Nothing like a crystalline cone has been preserved. Until maturity the number of eyes in an optical organ increases by the addition of new lenses at the ends of the diagonal rows, and these new lenses are apparently formed by a thinning of the integument. (The reporter would remark that there seems to be a difference in the way in which, according to Mr

Clarke's observations, the visual area is increased in the trilobites and that shown by Mr. Watase's unpublished observations on the eyes of Limulus.) After maturity, although the trilobite may continue to increase in size, senility begins and with it there is a decrease in the number of optical elements.

In a concluding note Mr. Clarke calls attention to the fact that in the Leptostracan genus Mesothyra of the Portage (Devonian) group "the eye consists of a single deep pit at the summit of the optic node."

THE SEXES OF MYXINE.—Dr. Fridtjof Nansen (Bergens Museum's *Aarsberetning*, 1887) states that in his studies of the nervous system of Myxine he was struck by the fact that it semed as if females only came under review. He therefore investigated the subject, and after reviewing the more prominent papers and detailing his own investigations states his conclusions that "Myxine is generally or always (?), in its young state, a male; whilst at a more advanced stage it becomes transformed into a female." The genital organs are female in front and male behind. Nansen has investigated the spermatogenesis but his results are widely at variance with those of Cunningham. He has also tried, but in vain, to obtain the embryology of this form. Myxine is extremely abundant at Bergen, but dredging in the harbor at all seasons of the year has failed to produce a single ovum. He has tried to breed them in confinement but though gravid females were kept in wooden cages for half a year they obstinately refused to lay their eggs. From his studies of ovaries he concluded that eggs were deposited at all seasons of the year, and he adds to our knowledge of specimens of the eggs of Myxine by recording one dredged in 1857 by Dr. Danielssen and his son near Molde. Nansen does not seem to be familiar with a paper by Putman on Myxine and Bdellostoma in the *Proceedings* of the Boston Society of Natural History some years ago.

ZOOLOGICAL NEWS.—PROTOZOA.—Mr. Beddard, in his earthworm studies, has recently met (Proc. Zool. Soc., London, 1888, p. 355) a gregarine in the body cavity of a New Zealand Perichæta which is remarkable among gregarines in forming a nucleated cyst.

Dr. L. Plate (*Zool. Jahrbuch*, III., 1888) describes under the name Acinetoides a new infusorian, of which two species were found at Naples, which seems to connect the Acinetæ and Ciliata. It bears a clubbed suctorial thread for taking food, which is shorter and stiffer than those in the true Acinete ; and it possesses besides longitudinal rows of cilia on the ventral surface. Acinetoides forms colonies and has been seen to divide transversely.

CŒLENTERATA.—Gireg describes and figures as new (Bergens Museum's *Aarsberetning* for 1887) *Rhizoxenia alba* and *Sympodium margaritaceum* from the Norwegian coast.

EMBRYOLOGY.[1]

The Structure of the Human Spermatozoon.—Any new light which is thrown upon the structure of the sexual elements by the aid of more refined methods of research, will be welcomed in view of the possible bearings which such information may have upon questions of inheritance. That variations in the structure of the male elements do occur as abnormalities seems to be established by the researches of E. M. Nelson [2], who finds that not only do they vary in the number of heads, but also in the number of tails and even as to the number of the nuclei; forms were also met with which were joined together in pairs by a band. Those familiar with Selenka's work on the Opossum will recall in this connection the singular fact recorded by that embryologist as to the double nature of the fresh spermatozoa of *Didelphys virginiana*.

The most interesting facts, however, which Mr. Nelson records as the result of his studies, with the aid of the new apochromatic objectives of Zeiss, relate to the details of structure of the human male element.

The head, which has always been figured as a simple, somewhat flattened pyriform body, according to this last observer, is rather complex when studied by the aid of better appliances. It is rather obovate in outline from the broad side, but when viewed edgewise it is seen to be curved upon itself, so that it bears a resemblance to an oblong meniscus lens.

Furthermore, this observer gives names to its parts. The anterior portion containing the nucleus, he calls the *spore*, and at its extreme anterior pole it bears an excessively minute *filament* as he names it, which is hardly as long as the spore itself. He suggests that this is a sort of feeler or tentacle by means of which the spermatozoon finds its way into the pore in the ovum which serves for the micropyle.

The flattened and curved flagellum-bearing spore is joined to or rests in what Nelson calls the *cup* which corresponds to the swollen basal part of the head as usually figured.

Then succeeds a delicate cycle of processes just around the base of the cup where the latter joins what Nelson calls the *stem*, which answers to the "middle piece" of authors. This delicate cycle of bluntly rounded processes he calls the *calyx*.

Next follows the *stem* or "middle piece" which at its posterior extremity is slightly swollen. This swollen posterior extremity of the stem and the anterior end of the tail there occurs a constriction which has been previously noticed by Nelson, and to which he gives

[1] Edited by Prof. John A. Ryder, University of Pennsylvania, Philadelphia.

[2] On the human spermatozoon, Journ. Quekett Microscop. Club. Ser. II, Vol. III, No. 23. Jan., 1889, pp. 310-314.

the appropriate name of *joint.* It seems, in fact, as if such were its nature, as a very short refringent and dark band of substance here joins the stem and tail together. This band is so much narrower than the stem or tail that it appears as if there were a deep notch on either side of the tail portion of the spermatozoon at this point.

Immediately behind the joint, the flagelliform tail is continued as that tapering organ[1] familiar to all histologists since the time of Leeuwenhoek.

The structure of the spermatozoon is therefore more complex than is usually supposed, and the following eight parts may be distinguished, beginning at the anterior extremity :

Filament, spore, cup, calyx, stem, joint, tail.

The following measurements are given :

Head (spore and cup) long	$\frac{1}{4250}$	in.	5.9 μ
" " broad	$\frac{1}{7500}$	"	3.4 μ
Stem long	$\frac{1}{5700}$	"	4.4 μ
Tail from joint to tip	$\frac{1}{500}$	"	.05 *mm.*
Total, head, stem and tail	$\frac{1}{425}$	"	.06 *mm.*

From what has preceded it is clear that there is great capacity for variation. Further, it is probable that this high degree of complexity signifies that a very considerable part of the spermatozoon is of secondary importance, or is rather only accessory to the act of fertilization or the formation of an öosperm. The already remarkable results of those investigators who have occupied themselves with the study of the phenomena of fertilization, must undoubtedly be modified when the subject is viewed from the basis of a renewed study of the structure and function of the spermatozoon at all phases of the process of its union with the ovum. May it not be that some important parts of the process of union have escaped observation in virtue of the optical difficulties which are involved ? The consequences of fertilization as the result of union with abnormal spermatozoa is also worthy of consideration, not only from a purely scientific standpoint, but also on account of the possible light it might throw upon possible abnormalities so provoked, which eventuate in disease and deformity. Truly, to those who are familiar with the great number of forms assumed by the male element throughout the animal kingdom, and the very diverse conditions under which fertilization occurs, it seems as if Du Bois Reymond's reproach—*Ignorabimus*—may here remain true.

[1] It may possibly be of advantage to use the word *organula* here instead of organ, following a suggestion of Möbius. Functionally differentiated multicellular aggregates in multicellular forms or metazoa are in this sense organs, while for functionally differentiated portions of unicellular organisms or for such differentiated portions of the unicellular germ-elements of metazoa the diminutive—*organula*—is appropriate.

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

MOUND AND OTHER EXPLORATIONS BY MR. WARREN K. MOOREHEAD.—On the high wooded hills bordering the Little Miami River in central Greene County are a number of mounds. One is the large mound on the farm of Mr. J. B. Lucas, three miles west of Xenia. Up to June, 1885, this mound had never been thoroughly explored. It was about twenty feet in height with a slightly flattened summit, perhaps seven feet across, and sixty feet in diameter at the base. Four good sized trees grew out of the sides, one of which was an oak perhaps ninety years old.

This mound was opened in June, 1885. A shaft was sunk, from the summit downwards, twelve feet, but nothing of interest found. We began a trench on the outer edge of the east side, and carried it to the center ; then extended the trench from the summit down until these two met. Completing this work, we caved in the sides, and threw back the earth taken out, thus restoring the mound nearly to its former shape.

The trench from the outer edge of the mound to the center was about twenty-five feet in length. For the first ten feet of this distance the earth was fine clay, not mixed with ashes. At twelve feet from the outer circumference was a bed of ashes and charcoal, perhaps two feet in thickness, and sticks of the half-charred wood three feet long and quite well preserved were taken out. These had been laid with regularity and were probably covered with earth before the fire had consumed them. At sixteen feet a thin irregular stratum of ordinary river sand was found, three or four inches in thickness.

Immediately following this sand layer, and extending upwards possibly three feet, was a mass of hard, burned clay. When this was reached we stopped work in the trench and went to the shaft above. We had not thrown out a foot of earth until we came to a mass of charcoal and ashes. This occurred without intermission for two feet or more when we came upon a layer of pure clay, nearly two feet in thickness. Immediately below this was the thin stratum of sand, and under this sand, resting on the "altar" of burnt clay, were five skeletons much decomposed. Of these, the teeth and small fragments of the skull and short sections of the femur and tibia were all that could be preserved. The skeletons were buried side by side ; the heads to the south. At the feet were fragments of a clay urn, peculiarly shaped. It had been broken into seven or eight pieces, but could be easily restored. It was of the "basket-moulded" pattern, having plain marks of the basket reeds

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

on the surface—a pattern rare in Ohio. Save a few perforated bear teeth and three rough spear-heads, no other relics were found. The excavation from both summit and base were carried through the burnt clay to the original level below. The clay contained fragments of calcined bones evidently of animals such as the deer, bear, and raccoon.

The opposite side of the mound (the west side) has since been opened by parties living near, but nothing found.

TWO INDIAN CEMETERIES NEAR ROMNEY, HAMPSHIRE COUNTY, W. VA.—Eight miles up the south fork of the Potomac River from Romney, W. Va., is an island owned by Mr. I. Pancake, and on this island once stood a large Indian village. A flood some two years ago cut a channel through the island and exposed to view the skeletons of many human beings, as well as relics and objects of aboriginal manufacture. Recent newspaper reports attracted Mr. Moorehead's attention, and he visited the spot for the purpose of investigation.

With a force of several Irishmen, work was commenced the morning of January 16 '89 A large part of the island was carefully dug over and the earth examined to a depth of four feet. It was found that over one-half of the bodies originally interred had been washed out by the flood ; those that remained were scarcely two feet below the surface, consequently when the island was cultivated the bones would be much disturbed. Only five skeletons could be taken out entire, those at a depth of three feet. With two of them were buried several triangular arrow-heads, a clay pot, whole, (not decorated) and fragmentary bones of deer, ground hog, and turtle. With the others nothing was found. On the surface of this island we picked up many beads, arrow-heads, broken pottery, split bones, carved bones, unfinished celts, etc. The space occupied by the evidences of Indian occupation was about 150x200 yards. The most interesting find met with during the excavation of these graves was the discovery of a large ash pit, about six by seven feet, five feet in depth. In this there were many deer bones, broken pottery, ashes, charcoal, etc. There was no order observed, the accumulation seemed to result from a hearth or wigwam. The only object found in the pit was a long sharp bone awl, a fine specimen. A part of a skeleton (said by some to be Ox, by others Bison) was taken from the bottom of this pit. The bones showed action of fire, and many of them were broken into fragments.

Two days were spent in examining another village site, on the north sideof the river twelve miles below. This was smaller than the one above mentioned, but as it had been little disturbed we found more skeletons, etc. This site does not exceed 200x450 feet. In a space of 60x100 feet we took out fifteen skeletons in a fairly good state of preservation. All were buried singly and extended, save four. These four were heaped together ; the skull of one was missing, the arms of another gone, and the leg of a third absent.

Four others had nothing whatever placed in their graves. Two of the remaining seven had broken pottery and a few arrow-heads with them. The others were buried nearly with their heads to the South. With the first were 62 bone beads and from their curved position plainly showed they had originally been on a string. The second had a neat little urn with handles, and containing a carved mussel shell, placed by his head. This pot was seven inches high, four inches in diameter, and was decorated with spiral lines. The third personage had nearly 300 glass beads between the ulna and radius. A small iron tomahawk near his hand showed furthermore that he had known the "long-knives."

The fourth Indian had a copper plate (Lake Superior copper) over his head, four and a half inches long, two inches wide ; perforated near one end. Beneath his head were twenty-four broken quartz fragments about the size of an egg.

The fifth individual has a small copper earring, a tip to an arrow made of copper, and three large glass beads. The skulls of three of these five were taken out nearly whole. The average depth of the interment of these bodies did not exceed two and a half feet.

The owner of the land presented the writer with a copper plate and a stone tomahawk (greenstone) from the same spot. He claimed that after a heavy rain twelve circular spots about ten feet in diamather could be plainly seen in the field, that these spots had a reddish color, and were arranged in two rows. He further said that he thought them burnt spots of ground where the wigwams stood. That the field had been cultivated only a few years which accounted for the spot being still discernable. The bodies found by myself were *all under these spots*. *No skeletons* were exhumed in ground *not included* in these reddish circular places.

After the work here was completed, a mound on one of the high hills overlooking the valley was examined. Its dimensions were 35 x 45 feet diameter and six feet high. It was one mile north of Romney. The material was half stone, half earth. Seven men were all day in digging it through ; the whole structure was removed. Nothing was found save one decayed skeleton. This skeleton had five large mica plates placed where his breast had once been, a copper bead has served as an earring, a slate ornament as a breast-plate, and five black serrated arrow-heads as weapons. The mica was 7x10 inches in size. The ornament 5x2, with two perforations.

SCIENTIFIC NEWS.

—The Geological Society was organized at Ithaca, New York, on December 29, 1888. The original fellows number one hundred and nine. The admission fee is $10.

—The trustees of the Australian Museum, Sydney, have recently decided to continue the publication of the rich collection of drawings and MSS. left by the late Alexander Scott, and since acquired by them, and the work of revising and editing this material has been entrusted to his daughter, Mrs. E. Forde, and Mr. A. Sidney Olliff.

—The Marine Biological Laboratory has just issued its circulars for the coming summer's session. Dr. C. O. Whitman will be the director. He will be assisted in the Investigator's Department by Drs. Howard Ayers and E. G. Gardiner, and in the Student's Department by Drs. J. S. Kingsley and J. P. McMurrich and Prof. J. Ellis Humphrey.

The laboratory is located at Wood's Holl, Mass., near the laboratories of the United States Fish Commission. The building consists of two stories: the lower, for the use of students receiving instruction, the upper, exclusively for investigators. The laboratory has aquaria supplied with running sea-water, boats, collecting apparatus, and dredges; it will also be supplied with reagents, glassware, and a limited number of microtomes and microscopes. The library will be provided, not only with the ordinary text-books and works of reference, but also with the more important journals of zoology and botany, many of them in complete series. The Laboratory for Investigators will be open from June 3 to August 31. It will be fully equipped with aquaria, glassware, reagents, etc., but microscopes and microtomes will not be provided. In this department there are eight private rooms for the use of investigators not requiring instruction, who are invited to carry on their researches at the laboratory. Those who require supervision in their work, or, being already prepared to begin original work, desire special suggestions and criticism, or extended instruction in technique, will occupy tables in the general laboratory for investigators, and will pay for its privileges a fee of fifty dollars. The Laboratory for Students will be opened on Wednesday, July 10, for regular courses of seven weeks in Marine Zoology and Microscopical Technique. Botany will be taught for the present season during August. Opportunities will be given for collecting and preparing material for use in the class room and for special lines of study. The fee for workers in this department is twenty-five dollars, payable in advance. The number of students will be limited to twenty-five, and preference will be given to teachers or others already qualified. By permission of the Director, students may begin their individual work as early as June 15, without extra charge, but the regular courses of instruction will not begin before July 10.

Applications should be addressed to Miss A. D. Phillips, *Secretary*, 23 Marlboro St., Boston, Mass.

—An important series of lectures on Evolution is being delivered in the Second Unitarian Church of Brooklyn (Dr. Chadwick's), under the auspices of the Brooklyn Ethical Association. The lectures are delivered on alternate Sunday evenings, beginning on Oct. 14 and ending May 26. They are issued in pamphlet form and may be obtained from Dr. Lewis G. James, President, No. 55 Liberty St., New York.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON.—Annual meeting, and election of officers for 1889, *January* 12, 1889.—The following officers were elected :

President—Lester F. Ward.

Vice-Presidents—C. V. Riley, R. Rathbun, C. H. Merriam, Frank Baker.

Recording Secretary—J. B. Smith.

Corresponding Secretary—F. A. Lucas.

Treasurer—F. H. Knowlton.

Members of Council—Geo. Vasey, J H. Bean, R. E. C. Stearns, C. D. Walcott, F. W. True.

January 26.—The following communications were read : Dr. Cooper Curtice, Notes on the Sheep Tick, *Melophagus ovinus* Linn.; Dr. Geo. Vasey, New Species of North American *Gramineæ* of the Last Twelve Years ; Mr. Th. Holm, Contributions to the Morphology of the Genus *Carex ;* Dr. C. Hart Merriam, A New Species of Pika (*Lagomys*).

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND.—*January* 12, 1889.—Mr. Wm. T. Davis read the following notes in regard to the appearance of shad along our shores :

"It has been the custom among those engaged in shad fishing in the bay to preserve a record of their first catch, which sometimes merely consists in chalking the date on the beams in the houses where they keep their nets and live, so as to lose no time at the turning of the tide. In one of these houses I copied the following dates, posted on the rafters overhead, as already described :

"April 3, 1873; March 30, 1874; March 28, 1878; March 30, 1879; April 4, 1880 ; April 5, 1881 ; April 4, 1883 ; April 9, 1884, 49 fish taken ; April 11, 1885, 1 fish taken ; April 11, 1886 ; April 9, 1887, 36 fish taken ; April 11, 1888, 29 fish taken.

"Mr. Wm. H. Wardell, who lives at Bay Ridge, Long Island, but who fishes from the Staten Island shore, has given me the following record of his first captures :

"April 3, 1878 ; March 29, 1879 ; March 28, 1880; April 9, 1881; April 5, 1882 ; April 5, 1883 ; April 1, 1884 ; April 3, 1885 ; April 5, 1886 ; April 7, 1887 ; April 11, 1888.

"One of the signs of the Indians' calendar was the blossoming of the 'shad bush' (*Amelanchier*), which occurs about the middle of April, and it will be seen from the above dates to be an excellent guide, for it is not until its flowers appear that the fish come in numbers."

Mr. Chas. W. Leng presented the following memorandum : "In the Proceedings of April 14, 1888, a correction must be made in regard to the pupation of water beetles, the fact being that they pupate not under water, but in soil. Mr. Davis has this year raised the larvæ of *Hydrophilus triangularis* and supplied a part of the larvæ with soil under water and others simply with soil. The first lot refused to pupate, while many of the second lot formed pupæ in the ground."

The Indiana Academy of Science held its annual meeting in the Court-House at Indianapolis Dec. 25, 26, and 27. The following papers were read : Geographical Distribution of Umbellifers, J. M. Coulter ; A Study of the Sub-epidermal Rusts of Grasses and Sedges, H. L. Bolley ; The Future of Systematic Botany, J. M. Coulter ; Raphides in Fruit of *Monstera deliciosa*, W. S. Windle ; The Spines of Cactacæ, Walter H. Evans ; Strengthening Cells and Resin Ducts in *Coniferæ* (by abstract), S. Coulter ; The Epidermal Scales of Tillandsia, H. Seaton ; Peculiarities of the Indiana Flora, J. M. Coulter ; An Objection to the Contraction Hypothesis as Accounting for Mountains, F. B. Taylor ; The Old Channel of Niagara River, J. T. Scovell ; The "Collett Glacial River," J. L. Campbell ; A Sketch of the Geology of Arkansas, J. C. Branner ; Evidences of Shallow Water Deposition of Silurian Rocks, Chas W. Hargitt ; Meanderings of the Arkansas River Below Little Rock, J. C. Branner ; Occurrence of *Ancistrodon contortrix* in Dearborn County, Ind., C. W. Hargitt ; Some Strange Cases of Color Variation in Animals, C. W. Hargitt ; Amœba : a Query, S. Coulter ; On a Striped Spermophile Mammal New to Indiana, A. W. Butler ; Explorations of the United States Fish Commission in Virginia and North Carolina, D. S. Jordan ; Analogy between River Faunæ and Island Faunæ, D. S. Jordan ; Outline of Work in Physiological Psychology, W. J. Bryan ; The Ancestry of the Blind Fishes, D. S. Jordan ; A New Kind of Phosphorescent Organs in Porichthys, Fred. C. Test ; Notes on Indiana Reptiles, A. W. Butler ; On the Skull of the Larva of *Amphiuma means*, On the Hyobranchial Apparatus of *Amblystoma microstomum*, Further on the Habits of Some Amblystomas, O. P. Hay ; Contributions to the Knowledge of the Genus *Branchipus*, O. P. and W. P. Hay ; The Occurrence in Indiana of the Wood Ibis (*Tantalus loculator*), B. W. Evermann ; The Relation of Systematic Zoology to Museum Administration, D. S. Jordan ; Observations on the Destruction of Birds by Storms on Lake Michigan, A. W. Butler ; Additions to the Fish-Fauna of Vigo County, Indiana, B. W. Evermann ; Some Notes on the Natural History of Guaymas, Mexico, O. P. Jenkins and B. W. Evermann. The Presidential address, "Religion and Continuity," was delivered Christmas night by Dr. D. P. D. John. The following officers were elected for the following year : President, John C. Branner ; Vice-Presidents, T. C. Mendenhall, Oliver P. Hay, John L. Campbell ; Secretary, Amos W. Butler ; Treasurer, Oliver P. Jenkins. The Field-meeting will be held at Greensburg, Ind., in May.

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THE MIMETIC ORIGIN AND DEVELOPMENT OF BIRD LANGUAGE.

BY SAMUEL N. RHOADS.

WHATELY, Archbishop of Dublin, remarked a half-century since,—"man is not the only animal that can make use of language to express what is passing in his mind and can understand, more or less, what is so expressed by another;" a remark which echoes with the increasing emphasis of another fifty years, the pious poet's couplet—

> "I shall not ask Jean Jacques Rousseau
> Whether birds confabulate or no."

Darwin thinks "the sounds uttered by birds offer in several respects the nearest analogy to language: for all the members of the same species utter the same instinctive cries expressive of their emotions, and all the kinds that have the power of singing, exert this power instinctively, but the actual song is learned from their parents or foster-parents."

The longer this subject is critically considered, the more are we convinced that the communication of ideas by means of sound and gesture (language) is instinctive and common to all animals;—that it is a genetically transmitted faculty, quite independent, in its earliest manifestations, of experiential or empiric knowledge, and that laws, governing the development of any one language, have an equal application to all the rest. It is quite generally conceded that the present status of human language is the result of slow developement or evolution from the innate, inarticulate and exclamatory utterances of our human progenitors.

We see apt illustration of this in the gesticulations and cries of the newly born of man, bird or beast; which cries, originating in the primal idea of want, are its natural, spontaneous expression, and, in consonance with the other faculties, develop through early life to maturity, furnishing, in the momentary individual life, a brief, actual epitome of the genesis of language through successive generations in the infinite past. Therefore in so far as he may have "no knowledge but a cry" man may account himself not only a little lower than the angels, but quite as low as the creatures over whom he has dominion. Thus far language is an instinct common to all, and, in nature, identical among all animals; a conclusion necessitating in us the sort of humility which nowadays leavens all progressive inquiry.

Of language, in its original and primitive exercise, such a view is tenable, but in its wider acceptation, as Horne Tooke remarks,—"language is an art, the developement of which is consonant with that of the mental faculties," and it is reasonable to infer that while articulate language (speech) is peculiar to man, distinctly separating him, as Cuvier states, from other animals, "it is not the mere power of articulation that distinguishes man from the other animals, for as every one knows, parrots can talk, but it is his larger power of connecting definite sounds with definite ideas."[1]

It follows therefore, that the language of birds differs not in kind from that of man, though far removed therefrom in degree of perfection as an art. Allowing for the difference in mental capacity, betwixt man and the lower animals, the comparative attainments among men in the linguistic art exhibit disparities no greater than may daily be observed of birds *inter se.* As the singing of a thrush to the chatter of sparrows, so the solo

[1] Descent of Man. Vol. I., P. 53.

of a Patti to the hurly-burly of an Italian marketplace; or (extending parallels to tribal characters) if we compare the Fuegian or Caffiric tongues with those of more enlightened races, the contrast, however startling, finds its equivalent in a comparison between oscine and non-oscine orders of birds.

Between the higher and lower oscines there exists the same gradation of vocal attainments as exhibited by the dialects of nations speaking a language derived from the same parent tongue, and Bechstein, pushing the analogy further, instances how slight geographic differences of song among members of the same species inhabiting widely separated districts, may be appositely compared to "provincial dialects" among speaking peoples.

The inference of Darwin, "that an instinctive tendency to acquire an art is not a peculiarity confined to man" receives daily confirmation in the life history of all the creatures. It is apparent not only in the language of birds, but also in the construction of their nests and in their methods of discovering and storing food.

The ratiocinative processes which distinguish artificial from natural or innate actions are unmistakably apparent in the musical performances of our higher oscine birds.

Among the North American Turdidæ are several species which habitually retire to more secluded portions of their forest haunt to rehearse, in critical undertone, difficult bars and passages of the favorite song, and it is demonstrably true that the older and more experienced of these vocalists surpass the younger by reason of their longer practice.

In this respect bird-language has developed into a fine art analogous to the attainment made in bird-architecture, as exampled by the play-houses of the Bower Bird and two American wrens,[1] and in the ornate embellishment of their nests by the Trochilidæ and Vireonidæ.

Barrington, in his paper on the "Songs of Birds"[2] has well remarked that "that there is no better method of investigating

[1] *Troglodytes aedon & Cistothorus palustris.*

[2] Trans. Phil. Soc. 1776.

the human faculties than by a comparison with those of (other) animals," and *vice versa* the same will hold in an inquiry like the one now before us. In the evolution of language as in everything else, we may recognize the all-pervading unity of plan and purpose, the "one law, one element and one far-off divine event to which," not man alone, but "the whole creation moves." This granted, the wealth of all past philological research is at our disposal and by so much are we warned of quicksand hypotheses and set upon a theory of some endurance.

Perhaps the theory most generally accepted as accounting for the origin of human language, is the onomatopoetic or mimetic, coupled with that elaborated by Wedgewood,—the interjectional or exclamatory theory. Wedgewood's theory has more to do with the original and instinctive sounds which form the primitive utterances of the speaking animal, while the mimetic accounts for the subsequent development of language into an art. Leaving all discussion of the tenability of these in their application to human language, let us apply them to birds.

The most cursory study of the songs of our feathered favorites must lead every inquirer to believe them the result of imitation, and a more critical examination would demonstrate that not only does this apply to the transmission of song from one generation to another, but it may be held to account for the origin and development of all bird-language in the past.

Consonant with our proposition, we find among the least specialized of avian forms that language is limited to half audible hissing or choking sounds or even to life-long silence,—an attempt merely, with sure-attendant failure. In such, language has been doomed to perpetual infancy; development in this direction has done nothing, has nought to do with it; it is not this noise or that noise, but *a* noise they are trying to make. The primal death-birth of speech is the result. Except as a proof that language, out of the chaos of silence, had a beginning so dumbly weak and abortive, we here have nothing to do with it either. Next come such as have found a tongue; an unruly, screaming or croaking member, 'tis true, yet a tangible something for us to hear and heed; its products tangible too, for there is some attempt at combination and modulation there for discriminating ears. And so, from Pygopodes ascending, we start with promises, attempt and failure to climb the vocal scale through Longipennes upward. I will classify a few of the better known species illustrating the mimetic development of bird language into three,—1. Mimics of sounds in animate nature exclusive of other bird-notes: 2. Mimics of sounds in inanimate nature: 3. Mimics of song and human language. In the first class are many, probably a majority, whose notes in greater or less degree are intentionally imitative of those of other birds, and, for sake of illustration, are not so significant as those which (unlike the Mocking-bird, Catbird and Carolina Wren etc.) are not intentional, but seemingly unconscious mimics of animate sounds produced in their immediate environment. The Mocking-bird, Catbird, Shrike and Jay are studied and artistic imitators of their feathered associates, indicating the perfection to which bird-language has developed as an art, but if we would seek examples of the primary, instinctive exercise of the mimetic faculty, the notes of the Prairie, Bluewing, and Yellow warbler, the Grasshopper warbler of Europe, the Yellow-wing and Savannah sparrow together with most of those of the Ardeidæ, Anatidæ, Rallidæ and of some of the better known Strigidæ and Falconidæ, afford a better illustration. The resemblance of the notes of many smaller birds to those of insects of contemporary habitat is very noticeable in the songs of the five first mentioned in the above list.

Each of these sings so like a grasshopper haunting its respective locality as to deceive the unpracticed ear, causing the careless observer to overlook them entirely.

Among the lower orders, this ornithic mimicry, owing to the less complicated and exclamatory nature of their language, is more easily studied. To receive forcible proof of this, let the reader adventure on an April evening's tramp along our river marshes. To most, the novelty of such an experience would lend just the necessary stimulus to imagination and when, after having every sense of musical concord outraged by the vast callithumpian chorus, there should come, as there surely will, an echo of tenfold emphasis from overhead, eliciting now here, now there, the wierd password till all is hushed along the shore, —then, methinks, in sounds not sweet he could detect a direful harmony.

But the Qua bird's is as one among the many voices of the night which nearly concerns us. Of perhaps four species of frog which in the spring make such localities nightly jubilant, two, more especially, are as well "taken off," vocally speaking, by the Bittern and Green heron as they are in the more literal sense of the phrase. To the third it seems fair to assign the origin of all quacking and its corresponding modifications among the Anatidæ, while the fourth makes a sound so like the notes of a Sora Rail as to put one in doubt which is the best mimic. Turning over the pages of Nuttall's "Ornithology" at this moment, the following, relating to the morning cries of the yellow-breasted Rail seems opportune. "As soon as awake, they call out in an abrupt and cackling cry, 'kreck, 'krek, 'krek, 'krek, 'kuk 'k'kh, which note, apparently from the young was answered by the parent in a lower, soothing tone. The whole of these uncouth and gutteral notes have no bad resemblance to the croaking of the tree-frog, as to sound."

To the student of shadows of things gone by, nocturnal sounds and scenes are a fitting environment. How to-day's dark guess gathers increasing light by this backward look into the infinite night of myriad yesterdays, where lie, in silent readiness, the unspoken but not unspeakable secrets of the past!

In considering the second class of bird-mimics,—viz., those which imitate sounds in inanimate nature, we approach nearer the question of the origin as distinguished from that of the development of their language. Aristotle goes to the root of the matter when he queries regarding the European Bittern's note, —"why do those which are called Bomugi, and which are fabulously reported to be bulls consecrated to some deity, usually dwell among marshes which are situate near rivers? Is not such a sound produced when rivers inundate marshes or marshes overflow their boundaries and are either roughly checked in their impetuous course by the sea and thence send forth a rushing sound? Similar sounds are produced in caverns underground into which currents of water rush and dispel the air through small apertures."[1] According to both the Mosiac and Darwinian genesis we are to believe that this elemental turmoil and river rushing was a primal thing and precedent of reptilian life just as reptilian life preceded avian life; therefore the whole family "Bomugi" may have had their music second-hand, through batrachian ante-cessors, from wind and wave and chafed shore. If this be true of Bomugus, it is true of all, however shrouded now by the intricate processes of their evolution from such crude, unmusical beginnings to the higher minstrelsy of the present.

At risk of the imputation of having a too fertile imagination, I will separate the second class of sound mimics into two divisions,—viz: 1. Mimics of water sounds; 2. Mimics of wind sounds. The long and short-billed Marsh Wrens and the Winter Wren sing songs so in harmony with their aquatic surroundings that you must be attentive to separate them from the rippling, bubbling sounds of moving water which they affect, the songs of the former being as characteristic of a marsh-receding tide as the other is in its unison with the prattle of woodland rivulets. The same may be observed of the Dipper, Kingfisher, Aquatic Thrush, Blue-yellow-back Warbler, Sea-side Finch, Swamp Sparrow and others of like predilections. Many years ago, when the subject began to claim my attention, I call to mind having nearly decided that the Swallows all sang improvisations of a single theme, the rapid clattering of their own mandibles. But on a later occasion, it having struck my fancy that I detected in the joyous little flight-song of a White-bellied Swallow coursing near by, a likeness to the dripping sound of water, I waited till its repetition and then asked my companion, a wide awake negro boy, if he heard "that bird"? "Why," said he, "was that a bird? I thought it was

[1] Aristotle, Problem II., 35.

rainin'." A showery April day had sufficed to complete the illusion.

For a long while, too, the shrieks and hootings of sundry owls continually suggested an unnameable likeness to other sounds in nature, but save that impossible original in the north window casements, none other presented itself to mind.

Then in hypothetic despair I bethought me of an empty porter bottle which once hoo-hooed and shrieked, to the wind responsive, from a nigh fence panel, till a wrathful storm made end of it.

With twofold thanks that the bottle was empty, I now am wont to picture how, ages ago, the mute, inarticulate Scops sat taking music lessons in his porter-bottle house, and how in piny solitudes remote, great Bubo tuned those bass-viol monotones of his in full accord.

The mourning Dove is typical of a family whose voices are in symphonious keeping, with the sighing cedars and moaning pines of their choice. The same correspondence is noticeable in species which, like the Grouse, Vulture, Swan and other aquatic kinds are mute or nearly silent.

In contrast with the silent Vulture, content with silent victims, the nearly related Eagles and Hawks are a screaming, noisy set of birds which seem to have adopted for their own a quintessence of the dying utterances of their victims merely because of carnal policy and from no delight in language in itself considered.

However, the further consideration of this, more properly belongs to the last division of mimics, *i.e.* those which intentionally imitate the sounds produced by their contemporaries.

It were best, ere passing on, to allude to a few others of those birds whose notes resemble the sounds produced by the action of wind. The Broad-wing Hawk's love-notes are like the sound of high-whistling winds or the shrill creaking of interfering tree limbs, or may be imagined by another to be the exaggerated shrieking of a stricken hare or field-mouse. Possibly, yes, probably, all of these may have had combined influence.

The same previously noted of Doves, may apply to the "pewee" of the Flycatcher, the "yank yank" of Nuthatches, the scolding of our Vireos, parts of the song of many higher oscines, (Turdidæ and Icteridæ), and all songs of the more essentially whistling birds, or at least, such part of it as they have not acquired from the whistling Batrachia. Whistling, and its fife-like modulations was likely among the smaller thick-billed families, to be the natural outcome of the imitative faculty, limited in quality and variety by the peculiar structure of their mandibles, but the appearance of tenuiostral forms enabled the more specialized vocalists to produce those more flexible, flute-like songs, which characterize them.

The third class division of mimics will include birds unmistakably imitators of their contemporaries in song,—mockers in the strict sense, and indebted to furred and feathered originals for the greater part. All in this class have a score of their own, a thread of original prose melody, lavishly embellished by poetic quotations from their favorite authors. By way of distinguishing these from the rest let us compare the Mocking-bird and Song-Sparrow. Each are songsters *par excellence* in their separate classes; each boast of a varied repertory, yet in the last, these variations are merely varietal combinations of the "sui, sibi, se or sésé" solus of ancestral Melospiza, and (*inter se*) differ only by numerical sequence of the syllables in a "four foot iambic," or by a change of accent or the addition of a final syllable, convert iambus to trochee and wind up with anapest flourish; whereas Mimus, multiplying his own wild originality by a hundred borrowed roots endlessly declines and conjugates, or with Pentecostal inspiration speaks all languages in one. From "yon trim Shakspeare on the tree," we pass again by exquisite minor gradations of the feathered genius, to sweet sparrow-rhymes and rhymesters many. Past Brown Thrush, Cat-Bird and White-eyed Vireo, by whom a sort of five minute rule has been set up in which each borrowed phrase is given impartial hearing, according to calendar, as if it were; —so on, by way of the Baltimore Oriole, Carolina Wren and others, which are not chronically mockers, but hold that talent in heroic reserve for after-dinner speeches, we reach the notes of such as quickened the highly sensitive ear of a Nuttall or Burroughs by some vague likeness in them to other note of bird or beast,—chance utterances remotely suggestive of a first attempt at exercising the latent talent for mimicry.

But so nearly do these nice discriminations bring us to the mysterious borderland where fact and fiction intermingle, it were well to pause and confess our fallibility.

In his "Birds in the Bush," Mr. Torrey aptly remarks of a turn or grace-note, in the song of *Dendroeca virens*, which he was tempted to number among "the latest" of philological discoveries, that "perhaps after the lapse of ten-thousand years, more or less, the whole tribe of Black throated Greens will have adopted it, and then when some ornithologist chances to fall in with an old-fashioned specimen who still clings to the plain song as we commonly hear it, he will fancy that to be the very latest modern improvement and proceed forwith to enlighten the scientific world with a description of the novelty."

Beyond what has been said of this native genius in feathers, I may not in present limits so enlarge as to notice that interesting subject, the influence of domestication and human training upon the language of birds, save to note that every experiment made with a view to solve the problem of its origin and development justifies the belief that bird language, as now existent, is, like human language, "the result of some operation of the imitative principle, quickened in all probability by circumstances which we are able to a certain extent to reconstruct, and aided at first very largely, but always in lessening measure, by the language of sign and gesture. [1]

The joke of Prof. Schleicher, "If a pig were ever to say to me, 'I am a pig,' it would, *ipso facto*, cease to be a pig," while controverting the ultra Darwinian theory by its reference to the impassable language barrier, twixt man and the rest of the animal kingdom, nevertheless assumes a serious and questionable significance if the names of certain birds were substituted for the pigs.' Independently of the question of man's descent,

[1] See Philology; Appleton's Ency., New Ed.

however, the result of Darwin's life-long study of psychical and physical evolution receives wonderful confirmation in the family resemblance of notes peculiar to species whose genealogies, according to the development hypothesis, are tracable to the same ancestry. The Icteridæ form a group, the genera of which emphatically demonstrates this.

In the song of the Bobolink, a well known representative, he who runs may read a sure word of prophecy, proclaiming to the ear in its every emphasis, the same scientific facts as does his anatomy to the eye.

Who, that hears him say, in lusty May-song, " I'm a finch, I'm a finch, Icterus, Icterus, Quiscalus, Molothrus, Sturnella, one and all; as you'll see if you look at me, chee! Agelæus et cetera, all linked in me, a bobolink, bobolink, as you can see!"—dare contradict a word of it on biological grounds?

Not less confirmatory of this and of the theory of the mimitic origin of bird notes is the evidence given by species of widely separted generic characters which frequent the same sort of habitat and are subject during life to the same environing influences.

Some of these, as the Robin, Scarlet Tanager, Rose-breast Grosbeak and Baltimore Oriole, have song-notes in common, while the Woodcock, Night-Hawk and Snipe, have nearly the same squeaking call-note when associated together at night as frequently happens, thus indicating that their inspiration was derived from like natural sources, and that, in harmony with their limited vocal needs, it has remained content with squeaking. But, strange to relate, the members of this same trio have each made an attempt at something higher, and, (which is stranger than all) with nearly identical results. In the Goatsucker it is a hollow, booming sound, produced by its sudden downward descent during flight; in the Snipe and Woodcock it results from a whirring of wings during a slowly ascending and descending spiral flight. Such is the commonly accepted belief of observers of these manœuvres, and, if correct, they illustrate how, in the retarded organic development of any faculty, nature supplements it by mechanical ingenuity.

May we not in conclusion, fittingly adopt the words of a modern seer, with him agreeing that "between two opposing tendencies, one urging to variation, the other to permanence, (for nature herself is half radical, half conservative) the language of birds has grown from rude beginnings to its present beautiful diversity, and whoever lives a century of milleniums hence, will listen to music such as we in this day can only dream of. Inappreciably but ceaselessly the work goes on. Here and there is born a master singer, a feathered genius, and every generation makes it own addition to the glorious inheritance!"

A MONTH IN THE EASTERN PHILLIPINES.

BY J. B. STEERE.

WE spent the last days of March, 1888, at Cebu, in packing our collections from the Central islands. We were fortunate in finding an American vessel in port, sailing to Boston, and nearly loaded with sugar and manila hemp, and shipped home several cases of bird skins and other valuable and perishable collections by her, while the bulkier part, corals and sea shells, were left to be forwarded in the same way at a later date. We then took passage on the little Spanish steamer "Gravina," for Catbalogan on the island of Samar, the most eastern of the archipelago. The weather was of the ordinary Philippine kind, calm and with smooth seas. We left Cebu about noon, passed by the northern end of Bojol, and were then in sight of the mountains of Leite, and we spent the evening in coasting up the west shore of that island. The next morning when we waked up we were lying at anchor in front of the town of Catbalogan. We were started out of our berths a little sooner than common by an outcry among the Spanish passengers, and a call for the "Naturalistas Americanos." Hurrying into one of the passage ways, I found a Spanish military officer standing in a tragic attitude, with his sword thrust through a poor little centipede, which he had pinned to the floor.

The harbor of Catbalogan is formed by several small islands but is not considered safe in storms from the northwest. The town is on low ground near the sea, and has about ten thousand inhabitants, and shows the usual church and parish house with a governor'sand other officer's residences, for it is the capital of a province ; in addition to the usual streets of Indian houses supported on posts in the ordinary way. The town had an unmistakable appearance of age and unthrift, though the little square in front of the church was decorated with triumphal arches and flowers, for we had brought a new governor with us, the same who had so courageously attacked the centipede in the morning.

The island of Samar is some one hundred and twenty miles long, by thirty or forty broad, and is said to have two hundred thousand inhabitants. Its native name is *Ibabao,* which means *up above*, and we were certain before we had left it that it was well named. It is very mountainous and steep so that a great part of it is uncultivable. The exports are chiefly of manila hemp which is sent to Cebu or Manila for shipment.

The captain of the steamer landed us and our goods on the beach and steamed away, and we were left again to find a home among strangers. There was no hotel, as is usual in such towns, and the people were too busy with the new governor to care for us, and it looked for some time as if we might go hungry and without shelter unless we took refuge in the *tribunal*, the court-house, jail and common assembly room of the Indian population, but after noon we found an empty house and making a bargain with the owner, and hiring a young Indian for cook, we moved in that night. Our house was out on the borders of the town near the hills. It had a room large enough to hold our hammocks, and another back one open on all sides, serving for a kitchen, dining-room and a place in which to skin birds. The hills covered with second growth were just behind us and we could see unmistakable patches of virgin forest on the mountain sides, two or three miles farther back and we concluded to make the place our headquarters for the month we had devoted to this part of the island. The next morning I dressed and started to the governor's residence, to present our passports and other papers, but the rest of the party, anxious to see what could be found in this new field, were in the hills before my arrival, and the reports of their heavy guns were rolling down upon the town as if it was besieged. A squad of Indian soldiers were hurried out after them, and made out to capture one of the party, and march him in, just after I had shown our papers, when he was released without ceremony.

The birds, in the jungle of second growth near town, were, many of them, the same we had found in other parts of the group, but the first day's hunt proved that we had reached a new and distinct location.

A number of birds, including the large Philippine crow, the yellow oriole, the black, and bald headed starlings, the white collared kingfisher, one or two sun birds, the fruit-thrushes, and the little scarlet breasted parrots, and many others, are such common residents about the Indian towns, and especially in the coco groves, and are so rarely found in the virgin forest, that we learned to expect them everywhere we went. Their distribution may have depended in part upon the habit the natives have of capturing these birds and carrying them from place to place. Since the islands have been inhabited there can be no doubt that man has been the chief agent of distribution, and of much greater importance than storms, floating timber, etc., all taken together.

We had,at a step, passed from the region where the dry season was at its height in Negros, Cebu, and Bojol, to where the rainy season was beginning. The mountains behind were much of the time enveloped in dark mists and thunder clouds and one or two showers had already reached down to the town. The steep hills between us and the true forest were wet and slippery, and we found our best means of reaching the hunting grounds was to employ native boatmen to pilot us up the little tidal river in their canoes to the foot of the mountains. The authorities seem to have become discouraged in trying to make roads in such a country, and though a bridge had been built over the river, the road after running along the beach for two miles, had been abandoned, and all the commerce of the place is carried in boats and on men's backs. The mountains were heavily timbered and very steep. Several mountain streams formed the river, these flowing along narrow ravines, running for some distance over flat-ledges of rock and then breaking over perpendicular precipices in waterfalls into deep pools below. We found the beds of these shallow streams our best paths, and adopting the native *alpargate*, a canvas sandal with hemp sole, we spent our time in following their beds, shooting from the overhanging trees, and the mountain sides above. It was still dry at the town, though it rained nearly every day in the mountains, but usually in the afternoon, and everything was dripping with moisture. We seemed to be in the rain clouds themselves. The land leeches were swarming and very troublesome, even making their way through the meshes of our stockings. But with all our discouragements we were rapidly adding species new to our collection, and new to science. Among these were a new squirrel, a new broad-bill of the genus *Sarcophanops*, first described from Basilian, two new woodpeckers, and another fruit-thrush, and a little crow, these two latter staying in the mountains and not interfering with their relatives about the town below. A great horn-bill proved to be distinct from its allies in Mindanao and Luzon.

A division of the party took a native boat, and pushed down to the south into the strait of San Juanico, between Samar and Leite, and stopped for ten days at the village of Babatgnon, on the latter island. The fauna appeared to be identical with that from Samar as might be expected, the strait being in many places not over a mile or two in width and this frequently narrowed by small islands.

Toward the latter part of our stay, the rains came farther and farther down the mountain side, and storms became frequent at the town itself, and so continuous in the mountains as to hinder us considerably in our work. Reptiles were abundant, crocodiles were found in the river we used as a highway, and our Indian boatmen would devoutly cross themselves and say their prayers before wading into the deeper places. Nearly every day we started the large plant-eating lizard, called *ibit*, from the bushes on the sides of the river, and they frequently made directly across the stream in front of us, not swimming in the water, but moving rapidly over the surface, apparently chiefly by strokes of the broad flattened tail and of the hind feet, the head and fore part of the body being elevated high in the air. This is much nearer the position of birds in swimming than that of most reptiles. Perhaps some of the fossil reptilia moved in this way. We encountered two or three cobra de capellos in our hunting. One of them, an immense fellow, lay coiled behind a big rock with its head raised and neck flattened in the traditional style. The *Naturalista Americano*, was within fair biting distance of him as he turned the corner of the rock, and was so frightened that he allowed the snake to drop down and glide out of sight. He did not do much collecting the rest of that day, but spent most of his time in looking out for snakes. There is no doubt but that the cobra, hearing the noise, was looking out for food, but finding the game too big to swallow, got out of the way without striking. One of the under officers at Catbalogan had a large python which he had kept for a number of years in a cage. The snake was about fifteen feet long, and as thick as a man's thigh. He was fed once a month, and his appetite demanded a good sized dog at a meal. As the time for his dinner arrived, he became active, gliding about the cage with head raised and when the trap door was lifted and the dog dropped in it was seized before it touched the bottom, and a coil being thrown about it, it was crushed to death before it had time to howl. After his meal the snake lay for weeks in so deep a sleep that I could not waken him by punching him with my cane. One could run over such a snake in the jungle and hardly know it. A large number of deaths undoubtedly occur in the Philippines from poisonous serpents and pythons, but from the apathy of the people but little attention is paid to it. If a person is killed in this way it is his *suerte* or fortune, just as it is of the gains or loses on a cock fight. Remedies for snake poison abound as in other countries. One old Indian who had been to Manila and had dabbled in drugs, assured us that if he could reach the person bitten before he was quite dead he could save him by applying muriatic acid. The flying lizard, *Draco,* found here differed from those we had collected in other parts, in its larger size, and in having the under surface of the membranes bright red in color.

At the end of the month devoted to Samar and Leite, we found a little brig, built in the Philippines, and commanded by a Spaniard, loaded with manila hemp and bound for Manila. Making a bargain with the captain to land us on the island of Masbate, which lay very close to his route, we hurriedly gathered our collections and luggage together, and embarked.

ON THE DEVELOPMENT OF CALIFORNIA FOOD FISHES.

C. H. EIGENMANN.

FROM a biological standpoint the Surf Perches are the most interesting of the California fishes. The species inhabiting the shores of California are probably all well known, and the later stages of their larval development have been well treated by Agassiz, Blake and Ryder. Dr. Charles Girard was able to examine younger stages than the other writers, but he did not contribute much to our knowledge of them. Until now the ripe eggs and embryos of these fishes have not been seen. During the past two months, December and January, I have been enabled to examine many individuals of almost all the species found in San Diego Bay. In most of them I have found embryos or ripe eggs. *Micrometrus aggregatus,* on account of its abundance, the ease with which it can be caught, and the fact that different individuals of the same date have young in widely different stages of development, has proved to be the most interesting of the species. An account of it will serve for all the others. As is well known, the egg-bearing lamellæ are broad sheets which are suspended from the roof of the ovary; there are usually three of these sheets in each half of the ovary. The eggs are very small (.2 mm.) as compared with the eggs of other fishes: they protrude from the lamellæ much as other fish ova do and they seem to be surrounded by a more transparent area. I have seen the eggs of several species but for lack of proper facilities to study the material collected a more detailed description cannot be given at present. The eggs of *Micrometrus aggregatus* have the yolk collected in spherical masses, and there seems to be no oil globule, while the eggs of *Ditrema jacksoni* have from one to three oil globules. Whether the eggs are fertilized before they are freed from the lamellæ, I cannot state at present; long before hatching, the eggs are found lying in the folds of the ovary. The eye is much less conspicuous than in other fish embryos, and the hypertrophied hind gut is developed before hatching. In larvæ in which the mouth was apparently not yet formed, the vent was open and the vigorous peristaltic action which was confined to the hind gut began at the vent and traveled forward; this would seem to make it probable that food is taken in through the vent in the earliest stages of the larval existence. A structure whose significance has not yet been determined is found in larvæ less than half an inch long. It consists of a spirally twisted, opaque white substance lying free in the hind gut; it terminates posteriorly in a knob; its anterior connection has not been traced. During the peristaltic movement mentioned, this spiral moves freely, and in several instances it was entirely withdrawn from the hind gut, the knob at its posterior extremity seeming to form a partial plug at the anterior end of the posterior intestine.

The first indications of the peculiar prolongations of the vertical fins was noticed in larvæ an inch long; all the fins were well developed and the interradial membranes projected as short, broad flaps beyond the tips of the rays.

The Herring, *Clupea mirabilis*, enters the bay of San Diego in great numbers during December and January. The eggs are very adhesive when first deposited, but half an hour after deposition they lose their stickiness and remain free when loosened. The yolk is collected in spherical masses. The protoplasm is yellow, and the formation of the germinal disk can readily be watched. Strands of the protoplasm can be seen extending from it into the yolk. The first cleavage furrow is formed about two hours after fertilization, and the first cleavage occupies about forty-five minutes. The furrow travels slowly towards the base of the germinal disk, which it reaches in about twenty-eight minutes; at this stage the two newly formed cells seem well separated. As soon as the furrow has reached the base of the disk it begins to retreat, leaving but a line to separate the two cells. When the furrow has entirely retreated, the division of the two cells is not very plain, and the second furrow is immediately formed. The division of the disk into four cells is more rapid than its division into two. The further development very much resembles that of the shad as it is described by Ryder; it is, however, much slower. The blastopore closes about thirty hours after segmentation. The heart is formed near the close of the second day. Kupfer's vesicle appears about fifty hours after fertilization. On the sixth day one shell was found, but the escaped fish could not be seen. Other embroyos continued to be active in the shell five days longer, when they died.

The Smelt of California, *Atherinopsis californiensis*, is one of the most abundant of the food fishes. It enters San Diego bay in December to spawn. The eggs are large and transparent, and, during the earlier stages of development the oil is distributed in a number of globules, while in a later stage but a single oil globule is present. Each egg is provided with about ten long filaments which differ somewhat from those of Fundulus. The base of each filament is enlarged, disk-shaped and apparently hollow, and the substance of the zona seems to enter it. The filaments are uniformly distributed over the surface of the egg, and in the ovary they are coiled around the egg in one direction only.

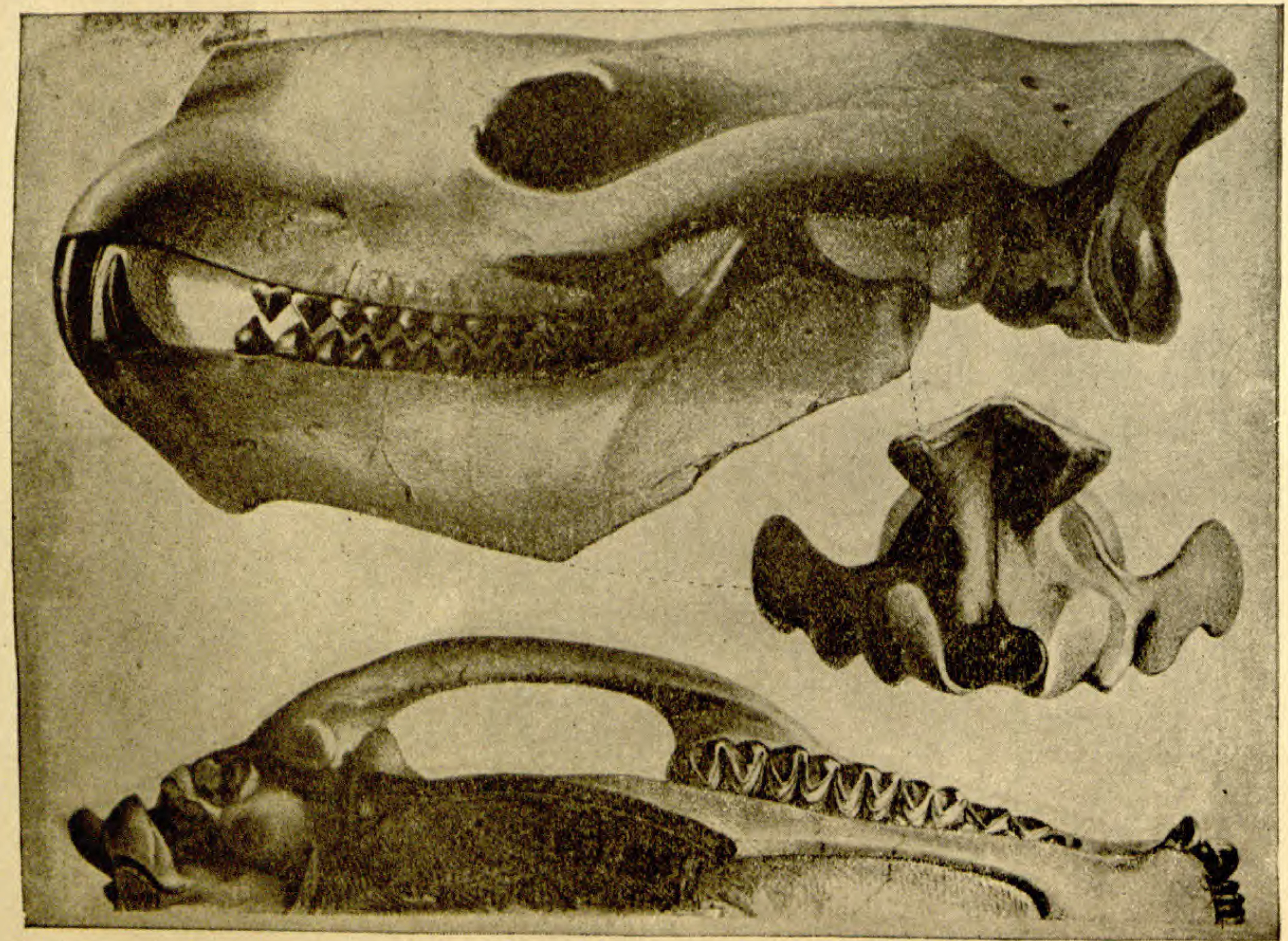
The eggs were artificially fertilized ; after three hours twenty-five minutes, the first cleavage was completed. Twenty minutes afterwards four cells had been formed. The time of the development of the other phases may be best tabulated :

16 cells	4 h. 45 min.	after fertilization.
32 cells	5 h. 10 min.	" "
First horizontal furrow	6 h.	" "
Beginning of blastula stage	28 h.	" "

At this stage the free nuclei are very abundant and cover about half the yolk. They are much larger and more numerous just at the edge of the blastula. The blastula stage lasts less than half an hour; the embryonic shield is first seen forty-one hours after fertilization. Two and a half days after fertilization the optic vesicles appear. The blastopore closes after about eighty hours. Kupfer's vesicle and the myotomes appear on the fourth day, the heart on the seventh day; on the twelfth the embryos move vigorously; on the sixteeth day pigment spots appear on the top of the head and along the median line of the back. The water space which at first was inconsiderable has greatly increased. The embroyos were at this time near hatching, but, unfortunately died.

Some larvæ of this species procured afterwards show the following pigment spots : A series along the median line of the back from the occiput to the caudal fold ; a spot above the posterior portion of each eye ; one medially above the front of the eye ; a small one at the nares. A series of spots along the median line of the sides ; numerous spots over the air-bladder and upon the abdomen. Later a series is formed along the base of the anal fold. Yellowish dots are found between the black pigment spots of the back and sides. These larvæ have a continuous fin fold from the abdominal region of the back around the tail to the vent ; a smaller fold in front of the vent. The embryonic rays are most numerous and best developed at the tail. The caudal shows heterocercal tendencies.

PLATE III.



Agriochoerus guyotianus Cope.

THE ARTIODACTYLA.

BY E. D. COPE.

(Continued from page 1095, Vol. XXII., 1888.)

IN passing from the lower to the higher Artiodactyla we encounter a succession of modifications of the skeleton which give the suborder a higher specialization than any other among mammals. These may be considered under three heads: First, the consolidation of the bones of the carpus and tarsus; second, the development of a tongue and groove of the humero-cubital and metapodio-phalangeal articulations; and third, increased complexity of the intervertebral articulations.

Of consolidation of the bones of the feet we have first, the coössification of the larger two elements of the distal row of the carpus and tarsus; viz.; the trapezoides and magnum in the former, and the meso- and ectocuneiform in the latter. This commences in the Oreodontidæ (Scott) and continues throughout the succeeding families. The next modification of this kind is the coössification of the cuboid bone with the navicular. This commences with the Tragulidæ, and continues throughout the remaining families. The fusion of the metapodials into cannon bones first appears in geological time in the Tragulidae, as does also the fusion of the ulna and radius (in Hypertragulus), and also in the contemporary Poëbrotheriidæ. The reduction in the number of the digits progresses with varying correlation with the other changes, from five in Oreodon to two in Camelus and Bos. As already explained, similar reductions took place in the Eocene members of the suborder, Anoplotherium having the digits 3-3, and Xiphodon 2-2.

The mechanical cause of these coössifications must be regarded as strains incurred in the act of rapid locomotion. Where not sufficient to produce actual flexure, strain is met by resistance and increased nutrition of the tissue, resulting in a strengthening of material at the point of resistance. With such coössifications comes increased mechanical effectiveness. Kowalevsky has shown that with the reduction of the number of the digits, the metapodials of those which remain, have increased in transverse diameter, so as to articulate with two distal elements of the carpus and tarsus each,

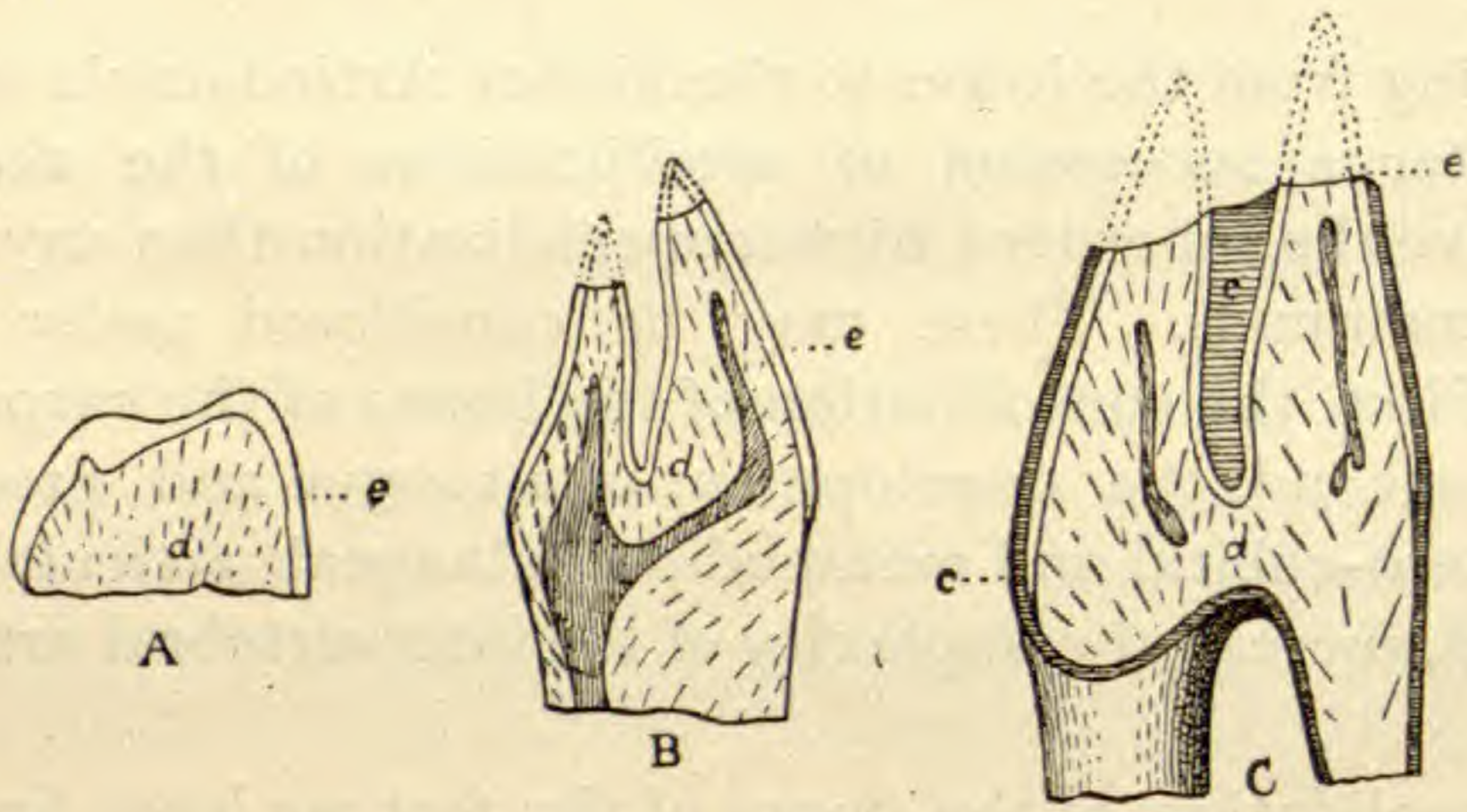


Fig. 7. Transverse sections of molars of Artiodactyla, showing successive complications of structure. A. *Sus erymanthius* ; B. *Ovis amaltheus* ; C. *Bos taurus* ; from Gaudry, Enchainements. Letters: *c*, cementum ; *e*, enamel ; *d*, dentine.

instead of with but one, as in the primitive types, as Anoplotherium, Hyopotamus and Hippopotamus. (Fig. 8.) He shows that where this expansion of the metapodials did not

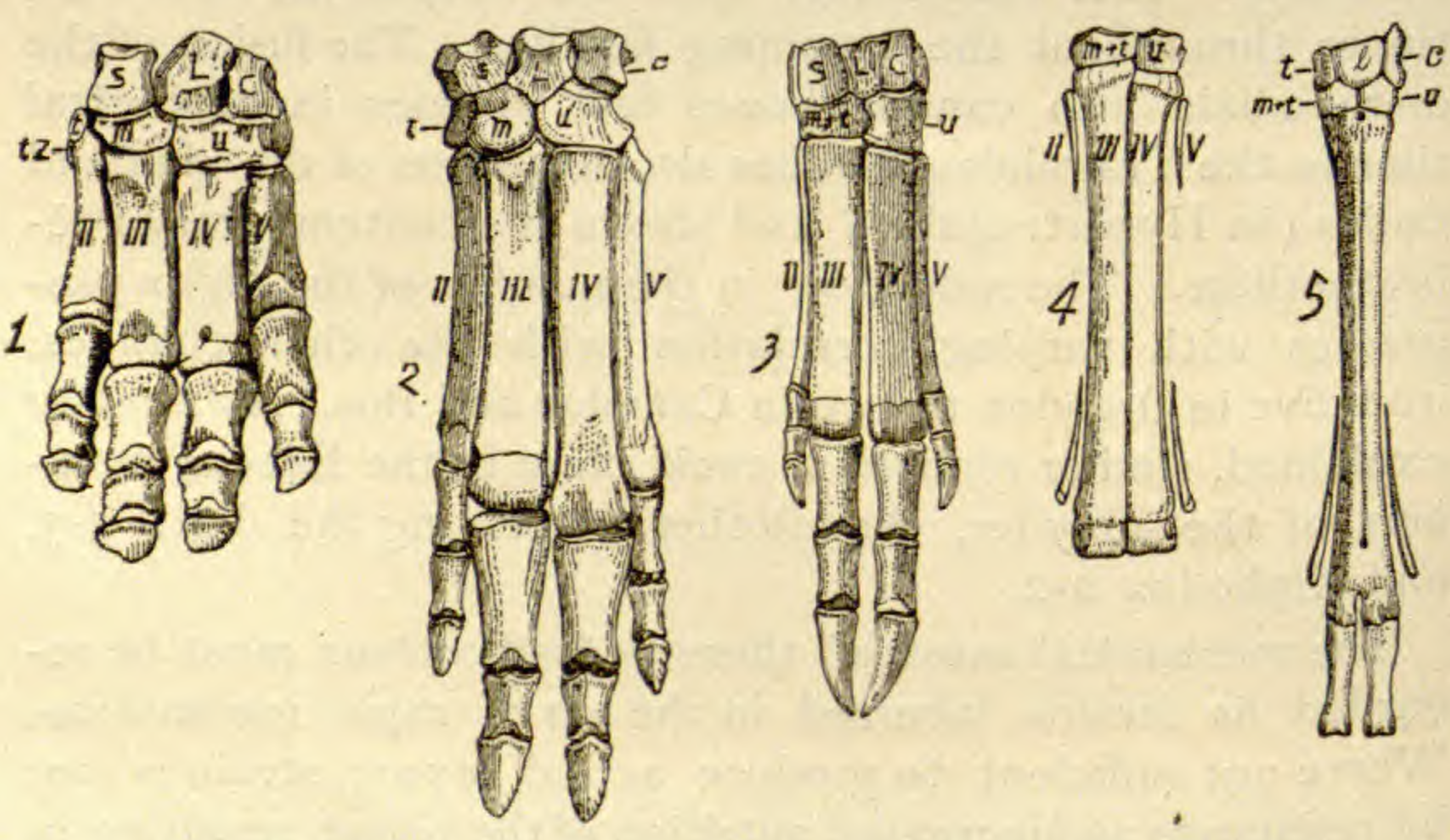


Fig. 8. Fore feet of: 1. Hippopotamus; 2. Hyopotamus ; 3. Dorcatherium ; 4. Gelocus ; 5. Cervus. From Kowalevsky. *S*, scaphoid; *l*, lunar; *c*, cuneiform; *tz*, traperium; *t*, trapezoides; *m*, magnum; *u*, unciform.

take place, the type became extinct, as in Elotherium. He supposes that the extinction of such types was due to the feebleness of the latter construction, which precluded the attainment of any considerable speed on the part of its possessor. The types in which this expansion took place persisted, and became the ancestors of the existing forms. As an example, see Procamelus. (Fig. 10.)

The specialization of the elbow joint first becomes pronounced in the Artiodactyla in the Tragulidae. This consists in the development of the external part of the condyles of the humerus into a roller of contracted diameters, and separated from the remaining part of the condyles by a keel, or tongue. The roller and tongue work into a corresponding plane and groove of the head of the radius, forming an interlocking joint of great strength. The strength of the union between the radius and the ulna is increased by the development of a keel on the inferior side of the head of the former, which fits a groove on the upper side of the latter. Both of these structures can be traced from their beginnings in the Artiodactyla. (Plate V.)

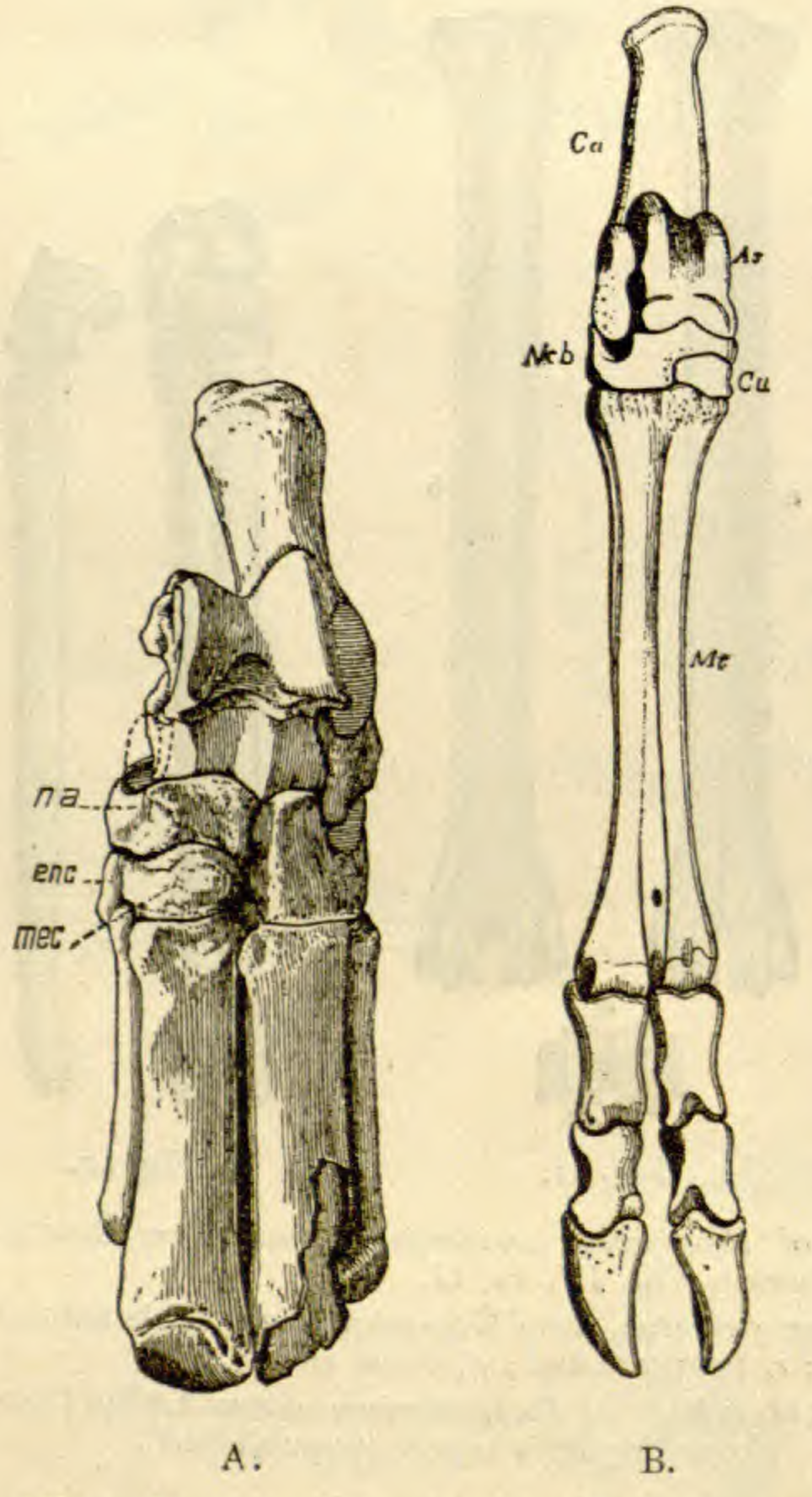


Fig. 9. Pes of Artiodactyla. A. *Merycochoerus montanus* Cope, two-fifths natural size. B. *Bos taurus*. L. one-fourth natural size.

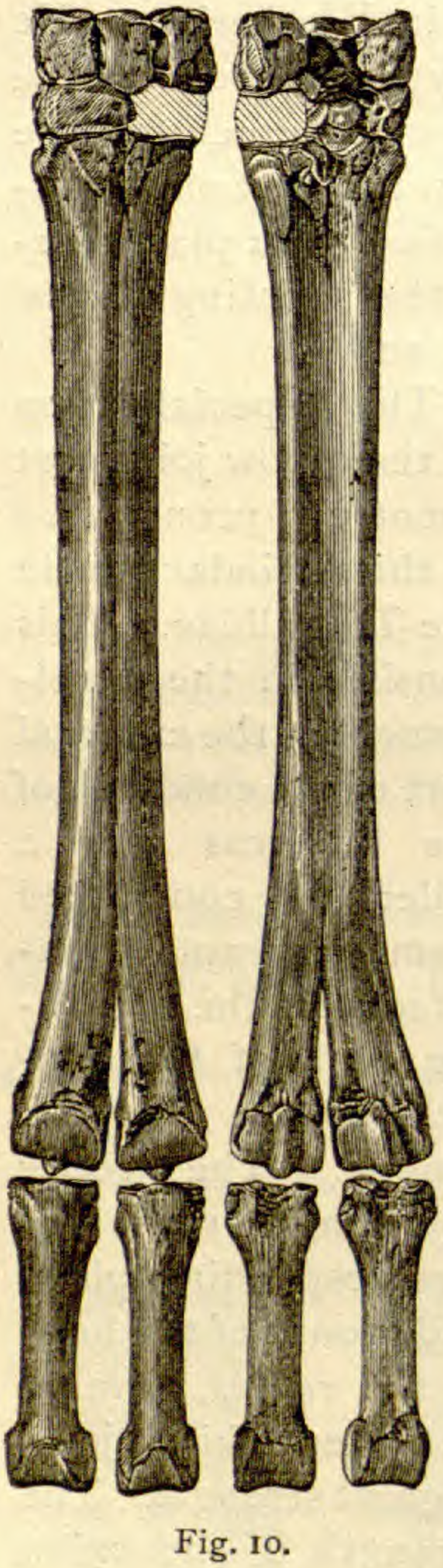


Fig. 10.

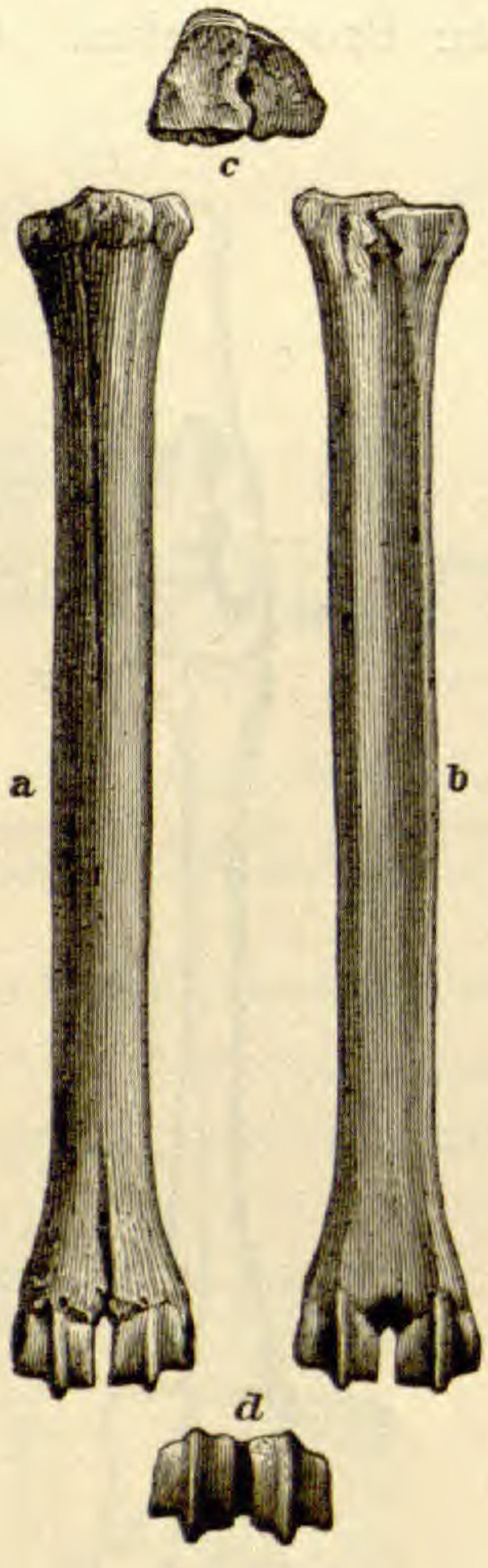


Fig. 11.

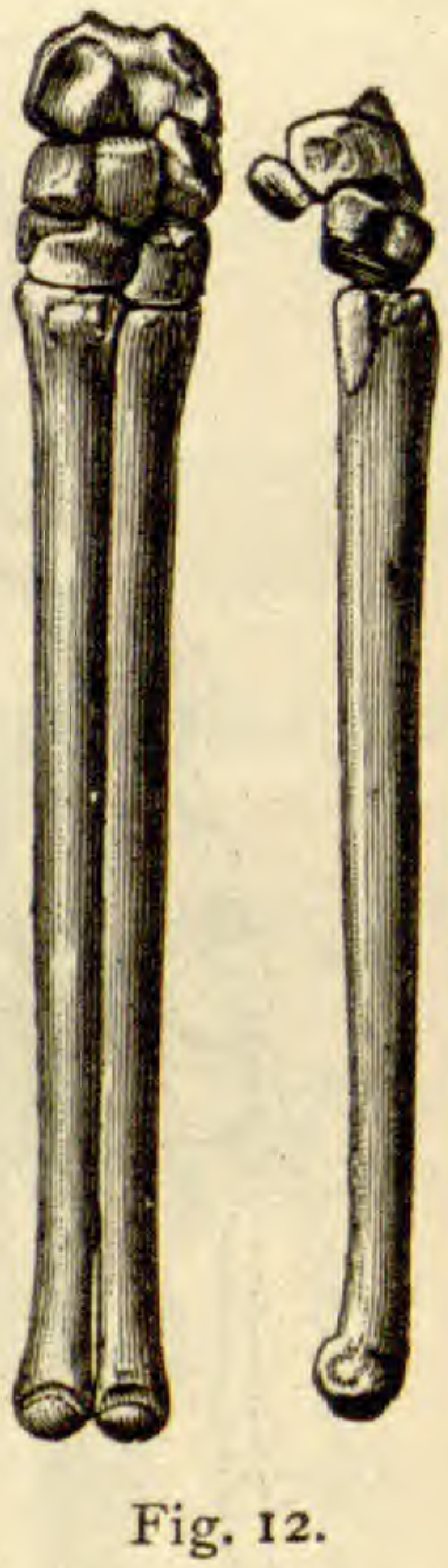


Fig. 12.

Fig. 10.--Part of anterior foot of *Procamelus occidentalis* from New Mexico. From Report of of Capt. G. M. Wheeler, Vol. IV, Pt. II.

Fig. 11.—Metacarpals of *Cosoryx furcatus* from Nebraska, two thirds natural size ; *a*, anterior face; *b*, posterior ; *c*, proximal end ; *d*, distal end.

Fig. 12.—Left forefoot with part of radius of *Poebrotherium vilsoni* Leidy, from Colorado, three-fifths natural size. From Hayden's report (unpublished).

The trochlear keel or crest,[1] as the tongue of the humerus may be called, is first represented by a convexity of the roller, precisely as in the unguiculate

[1] The trochlear crest of the Artiodactyla is not homologous with the inter-trochlear crest of the Anthropomorpha.

PLATE IV.

Vertebræ of 1, Antilocapra; 2, Dicotyles; 3, Capra.

mammals. (Plate IV. figs. A, D, Hyæna, Eucrotaphus.) With the compression of the external part of the condyle, the external slope becomes steeper and is at length nearly vertical (Ibid, fig. E, Cervus). The mechanical cause of this trochlear crest is the use of a single fore leg to support the body in rapid locomotion. As had been remarked by H. Allen, a modern Artiodactyle in rapid motion lights on one forefoot, which strikes the earth immediately on or even beyond a point below the middle of the body (fig. 13). This throws the impact principally on the external side of the humeral condyles, with the result stated. A similar cause produces a similiar result in the development of the tongue and groove articulation between the metapodials and first phalanges. In lighting on a didactyle foot, the toes are naturally spread, the result being to throw both the first phalanges away from the median line, or axis of impact, in divergent directions. The result of this impact is to produce on each metapodial condyle as in the case of the humerus, an external roller of smaller diameter than the rest of the condyle (fig. 11), and separated from it by an abrupt crest. In both humerus and metapodial bones these crests are accentuated by a pinching process during flexion and extension. This is produced by the longitudinal torsion which results in all limbs in motion from the arrest of the outward rotation of the foot by the earth, on alighting. The

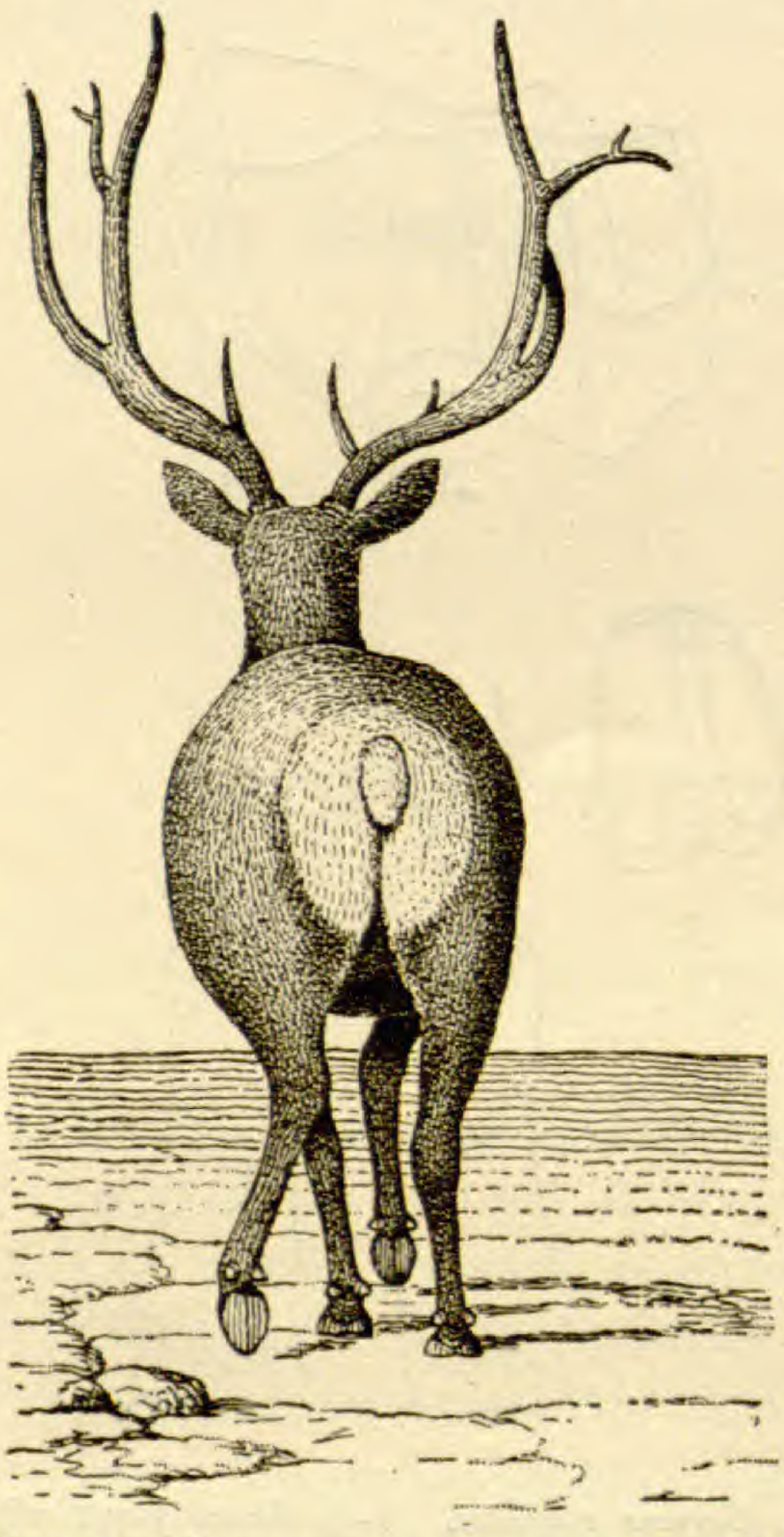


FIG. 13—*Cervus canadensis* in motion, from behind. From the Muybridge photographs.

pinching of a keel by its groove takes place at all points in the length of the former reached by the opposite sides of the extremities of the latter during flexion and extension (fig. 14). This keel becomes acute and prominent in the Boöidea, and extends to the anterior face of the condyle fig. 11, *Cosoryx furcatus*). This development has been apparently especially due to the presence of two sesamoid bones, embedded in the flexor tendons, one on each side of the middle line of the posterior side of the metapodial condyle. The fissure between these bones has permitted the moulding of the surface into a keel to fit it. That this has been the case is further indicated by the fact that a single median trochlear surface exists at the distal extremity of the first phalange in all mammals. But a single flexor tendon crosses

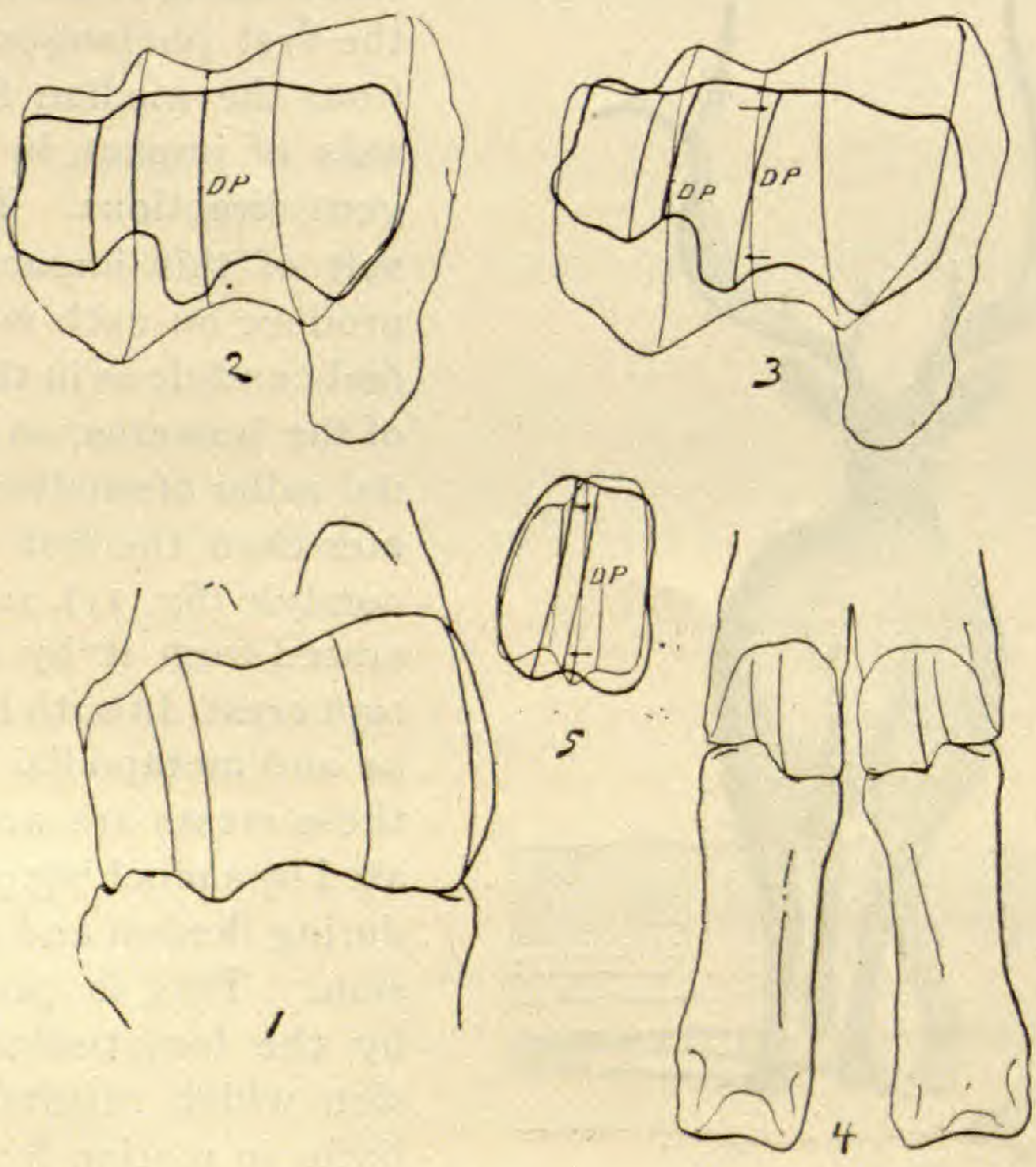


FIG. 14—Tongue and groove joints in *Cervus elaphus*. 1–3, elbow joint with trochlear keel and groove. 1–2, in place; 3, radius dislocated by external torsion. 4–5, metatarso-phalangeal articulation; 4, in place; 5, dislocated by torsion of phalange; *D P*, the dead or fixed point.

this articulation, and it contains but one sesamoid bone, to which the trochlear surface is moulded in a concave surface, as in the case of the patella and the rotular groove of the femur (figs. 8, 9B, 9, 10, 14).

The increased complexity of the intervertebral articulations,[1] is seen in the modifications in the shapes of the zygapophyses.[2] In reptiles the mutual articulating surfaces of these processes are horizontal and flat. In the lower Mammalia they are slightly oblique. In many Carnivora the obliquity is strongly marked, and a similar form is seen in the lower

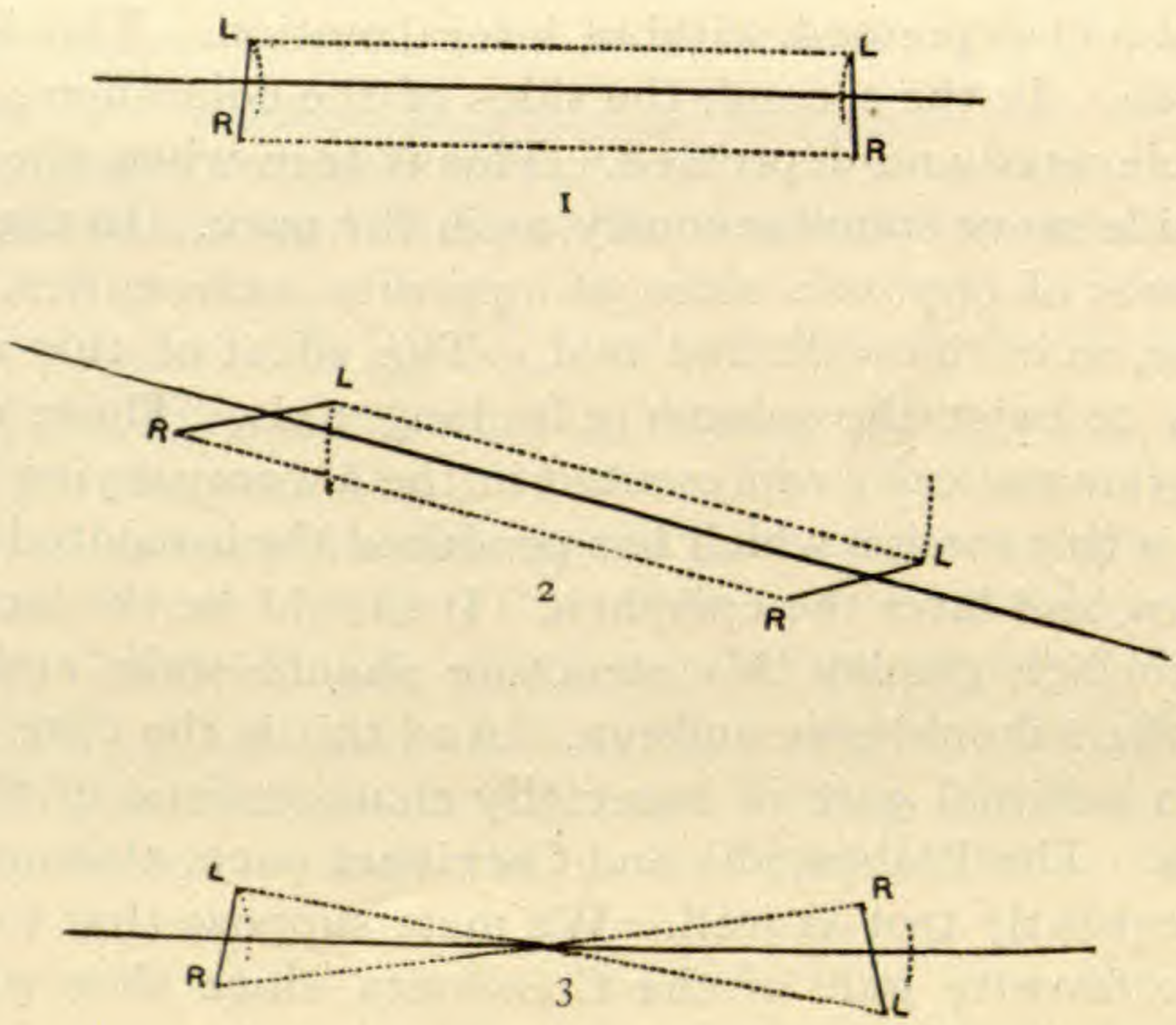


FIG. 15—Diagrams representing movements of the vertebral column in locomotion. 1. The pace; 2. the run; 3. the trot.

Diplarthra. As we ascend the scale of the latter, the prezygapophyses become involute and embrace the postzygapophyses above, as well as externally below (Plate IV., fig. 1, Antilocapra). This superior part of the prezygapophyses develops, and reaches the basis of the neural spine, with which it forms an articulation. The base of the spine expands

[1] For a tabular exhibit of these, see Proceedings Amer. Ass. Adv. Science, 1883; Origin of the Fittest, 1885.

[2] On torsion in locomotion. See art. Perissodactyla, NATURALIST, 1888, 988, 1073.

above this articulation, forming a second process above the postzygapophysis, the episphen. This occurs in the Suoidea and the Boöidea (Plate IV., figs. 2 and 3, Dicotyles and Capra).

The mechanical explanation of the origin of this structure is probably found in the nature of the movement of that part of the vertebral column which is between the limbs during progression; and especially of the more flexible region (lumbar) which is posterior to the ribs. All the gaits of quadrupeds may be reduced to three types, and their varieties. In the first, the extremities of the column are alternately elevated and depressed, without lateral motion. This is seen in the run. In the second, the sides of the column are alternately elevated and depressed. This is seen when the limbs of one side move simultaneously, as in the pace. In the third type, limbs of opposite sides of opposite extremities, move together, as in the walk and trot. The effect of this movement is to twist the column in its long axis. These effects are diagrammatically represented in the accompanying figure 15. It is this torsion which has produced the involuted zygapophyses, and later the episphen. It should be the fact that animals which display this structure should walk and trot, while others should pace and run. And this is the case. The trot as a habitual gait is especially characteristic of the Diplarthra. The Proboscidia and Carnivora pace, although the dogs frequently trot as well. We must suppose that the trot was the favorite gait of the Creodonta, since they possess the involuted zygapophyses.

The only genus certainly referable to the DICHODONTIDÆ, is the Dichodon Owen, from the upper Eocene of England. In this form we have the earliest quadriselenodont molars, the intermediate fifth crescent having disappeared The first superior premolar is like a true molar, while the first inferior is trilobate (Kowalevsky; molariform, Owen). The other premolars are very elongate and compressed, resembling those of Xiphodon. This resemblance is heightened by the incisiform shape of the canines, and the uninterrupted dental series. In the same beds occur limb and foot bones which probably belong to Dichodon (Schlosser) which are didactyle, but in which the fusion of the trapezoides and magnum in the tarsus, has not yet taken place. The metapodials then rest on a single carpal or tarsal bone each, instead of on two, as in modern didactyle genera, representing the inadaptive type of Kowalevsky. *Dichodon cuspidatus* is about the size of a fallow-deer. Smaller species have been found in Germany. The genus is probably represented in North America by Stibarus Cope, of the White River bed. I have associated provisionally with the Dichodontidæ two North American genera, Agriochoerus Leidy (Plate III.), and Coloreodon Cope (fig. 5). These genera differ from Dichodon in having the first premolars in both jaws molariform or nearly so, and in having the other ones much less compressed, except the fourth inferior, which is caniniform, as in Oreodon. There are four premolars and little or no diastema in Agriochoerus, and three premolars and a long diastema in Coloredon. The former possesses six species, which are equally divided between the White River and John Day beds, and the latter, two species from the John Day Miocene. Their feet are unknown.

The remaining families of the Cameloidea are the Poëbrotheriidæ, Protolabididæ, Camelidæ and Eschatiidæ. I have already described their characters in the pages of the NATURALIST.[1] I will only add to that account the interesting discovery made by Profs. Scott and Osborn, of a third genus of Poëbrotheriidae which they call Leptotragulus. It differs from Poëbrotherium and Gomphotherium, in the separate condition of the ulna and radius.[2] It is from the highest Eocene beds of Utah (Brown's Park, or Uinta system), and thus stands in ancestral relation to Poëbrotherium.

The Cameloid phylum presents a noteworthy peculiarity. The Poëbrotheriidæ have acute trihedral ungual phalanges like those of most other Artiodactyla. In the Camelidæ, including the extinct genus Procamelus, the ungual phalanges are short and obtuse, and apparently undergoing atrophy. This form is associated with the presence of a cushion of connective tissue on the inferior side of the phalanges, which

[1] 1886, p. 611: The Phylogeny of the Camelidæ.

[2] My knowledge of this genus is entirely derived from the unpublished mss. of Profs. Scott and Osborn.

supports the weight of the animal, thus removing it from the ungues. This cushion has relieved the metapodials from impacts and torsion, a fact which I have regarded as explaining the absence of the trochlear keel from the extremity and front of those elements in the Camelidæ. We must then suppose that the development of the elastic foot-pad of the camels began in the Miocene period before this character appears, and caused a divergence from the Booid line in the foot structure. This divergence probably took place before the development of the third stomach, and the addition of water compartments in the paunch may be supposed to have commenced at about the same time.

Existing Camelidæ pace, yet they have more or less distinct episphenal processes to the vertebræ. These are distinctly visible in Procamelus. We must suppose that their ancestors, as the Poëbrotheriidæ, were trotters, and that the habit has been changed in later periods.

With the TRAGULIDÆ we commence the great, mostly modern division of the Boöidea, or Ruminantia. As already related, most of the characteristic peculiarities of the specialized Artiodactyla commence with this family. The trochlear cylinder and crest of the humerus appear here for the first time, for the Suoid and Cameloid series never develop more than traces of either. The naviculocuboid bone is characteristic. How variable the conditions of the other bones of the limbs are in the Tragulidæ may be gathered from the accompanying table. A few species of two genera, Dorcatherium and Tragulus, still exist in the warm parts of Africa and Asia. These agree with the Camelidæ in the absence of the third stomach, the other three being present.

I. Both metatarsals and metacarpals distinct; molars brachyodont (Hypertragulinæ).

a. Lateral toes behind.

Anterior internal cresent of inferior molars represented by a conical cusp. .... *Lophiomeryx* Pom.

Interior cresents of inferior molars developed................ *Dorcatherium* Kaup.

aa. No lateral toes behind.

Diastemata in both jaws................................... *Hypertragulus* Cope.

II. Metatarsals forming a cannon bone; metacarpals distinct; molars brachyodont (Gelocinæ).

a. Lateral digits of the manus, none of the pes.

Superior premolars with a small internal tubercle.............. *Leptomeryx* Leidy.

aa. No lateral digits.

Four lower premolars.. *Gelocus* Aym.

Three lower premolars.. *Bachitherium* Filhol.

III. A metatarsal cannon bone; metacarpals forming a cannon bone; molars brachyodont (Tragulinæ).

a. Lateral digits well developed.

Premolars entirely simple.. *Tragulus* Briss.

aa. Lateral digits weak.

Four inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum......................... *Amphitragulus* Pomel.

Three inferior premolars, the posterior with branch ridges; superior premolar 3 with strong cingulum, elongate.................. *Prodremotherium* Filhol.

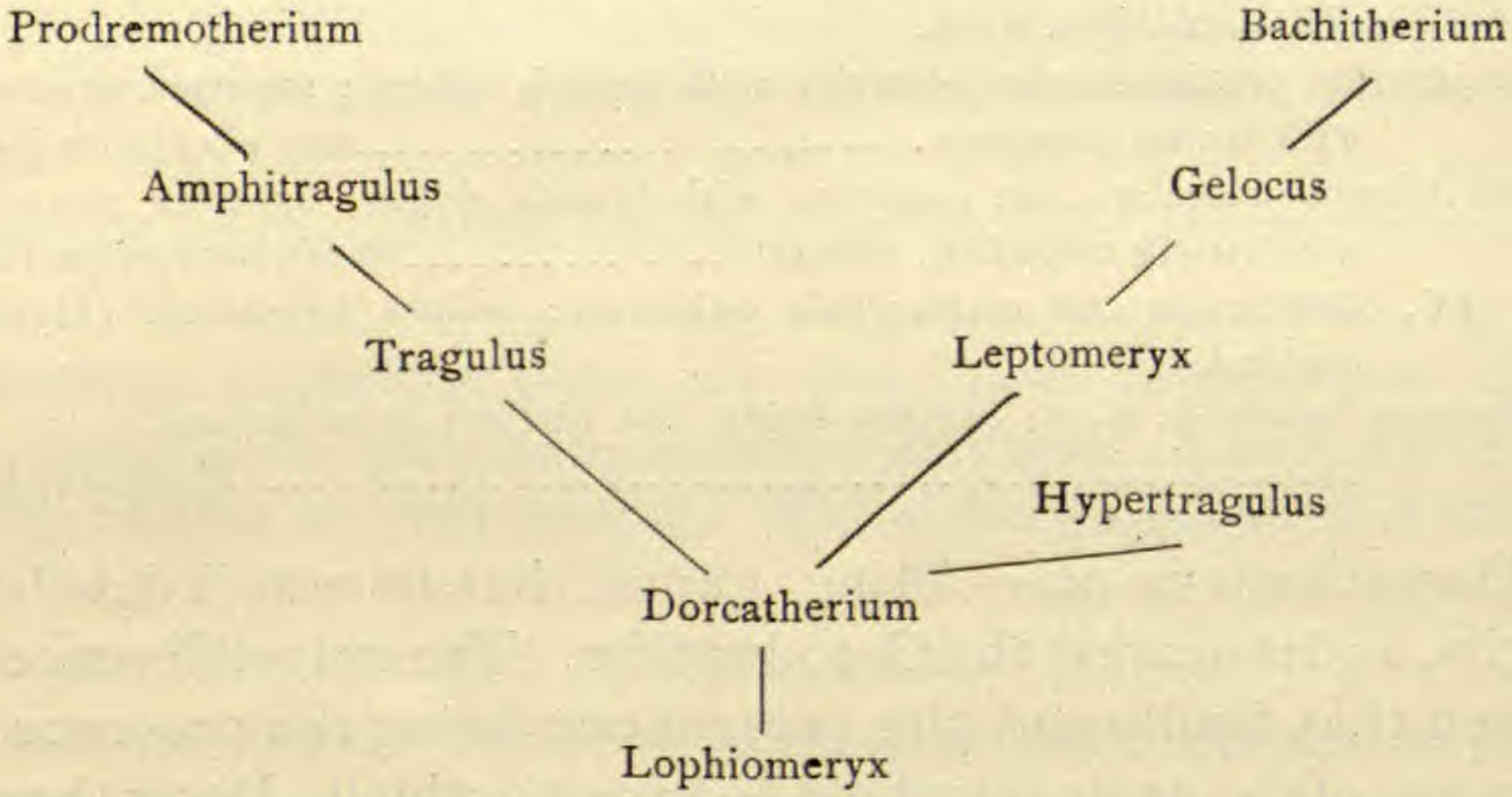
IV. Metatarsals and metacarpals unknown; molars hypsodont (Hypisodontinæ).

A diastema behind p. m. 2: canines below not distinct from incisors.
.... *Hypisodus* Cope.

Dorcatherium, an existing genus, has four well developed digits, and is nearest the Oreodontidæ. The only difference between that family and the present one being the presence and absence of the naviculocuboid bone respectively, Dorcatherium must be placed on the Traguloid side of the line. Probably extinct genera will be found which will connect this genus more intimately with the Oreodontidæ, for the slight complication of the premolars of extinct genera of the latter, testify to earlier members with simpler ones.

Lophiomeryx and Hypertragulus must be associated with Dorcatherium on account of the lack of cannon bone. Lophiomeryx has an inferior type of inferior true molar, and like Dorcatherium has four toes on all the feet. Hypertragulus displays greater specialization in the absence of lateral digits from the posterior feet. The ulna is also coössified with the radius, and there is a naviculocuboid bone. The premolar teeth are nevertheless very simple, and are separated by diastemata in both jaws. It must be regarded as a modified descendant of Dorcatherium on one side of the main line of descent. (Plate VI.)

In the next group the metatarsals have united while the metacarpals remain separate. This is the case in Leptomeryx of the American Oligocene. In Tragulus the premolars are much simpler than those of the other genera of Section III, and simpler than those of Leptomeryx, so that these two forms must have been derived from an ancestor which combined the simplicity of both forms. For this we must again recur to Dorcatherium, and I therefore insert this genus at the base of the following diagram. With its entirely prismatic molars Hypisodus has one element of superiority, but the number of its superior premolars is unknown.



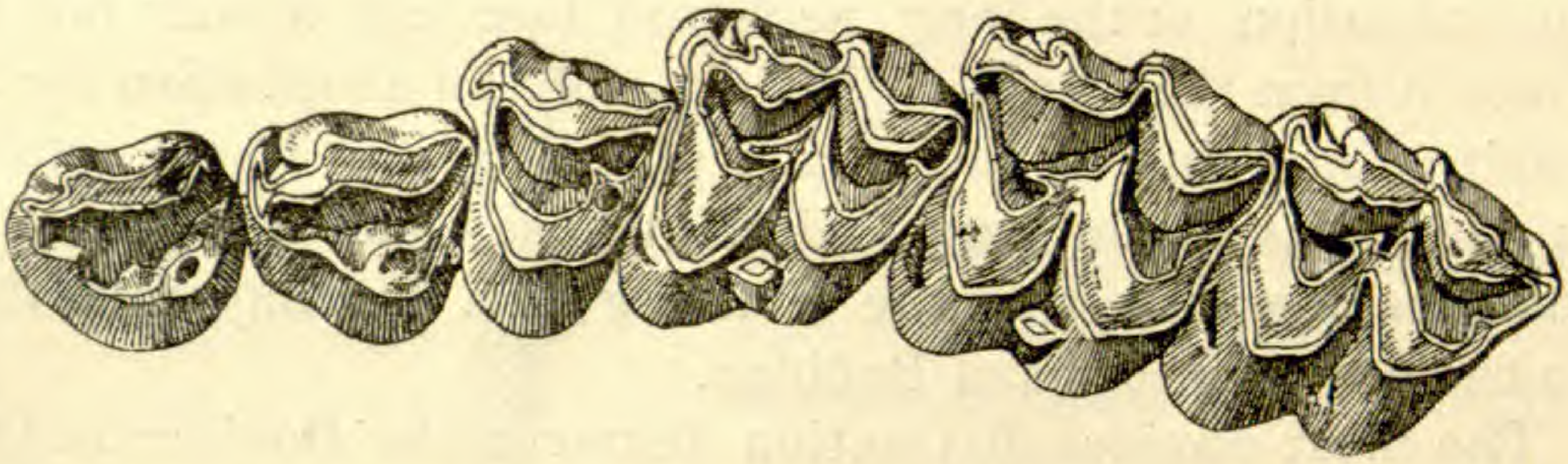
Two species of this family are very abundant in the Cænozoic beds of North America. These are the *Leptomeryx evansi* Leidy of the White River series, and the *Hypertragulus calcaratus* Cope of the same, and of the John Day Miocene series. Either species was of the size of a spaniel, and had delicately formed limbs. The *H. calcaratus* had large eyes, and a compressed muzzle. Larger species are found in Canadian beds. The least species of the family belongs also to the White River Beds. This is the *Hypisodus minimus* Cope, whose size does not exceed that of a gray-squirrel. Like the Leptomeryx, it does not extend upwards into the John Day beds.

The remaining families of the Boöidea agree in possessing the following characters.

The second and generally the third superior premolar teeth possess an internal crest as well as the fourth fig. 16). The inferior premolar teeth have oblique transverse crests. The keel of the distal extremity of the metapodial bones extends to the front of the condyle (fig. 11). The lateral metapodials are represented by their extremities only, the middle

PLATE V.

Elbow joints of A, Hyæna; B, Simia; C, Rhinolophus; D, Eucrotaphus; E, Cervus.



(FIG. 16.) *Blastomeryx borealis*, Cope, superior molars natural size. From Ticholeptus bed of Montana. Original.

portion having disappeared (fig. 8–5). The median pair are united into a cannon bone. There are no superior incisors. The odontoid process of the axis vertebra is trough-shaped. The stomach is divided into four parts.

The lowest family of the series is that of the Moschidæ. In its hard parts it differs from the Bovidæ in the simplicity of the anterior third superior premolar, which is without the internal crescent found in the other Boöidea. In this respect it is intermediate between that division and the Cameloidea, where the first premolar only possesses the internal crescent. But two genera of Moschidæ are known, Dremotherium from the Lower Miocene of France, and the living Moschus. Both lack horns and have well developed canine teeth. The origin of this group is clearly from the Tragulidæ, and the genus of that family which approaches nearest to it is Amphitragulus, which indeed only differs from it in dentition in the imperfection of the internal crest of the second superior premolar. In turn, Dremotherium must be regarded as ancestral to Palæomeryx, the most primitive genus of the Bovidæ.

The Giraffidæ differ (see table of families) in the mode of attachment of the horns. These are originally separate from the skull, but become attached to it like the epiphyses on the extremities of the bones of the skeleton. Their dental characters are like those of the Cervidæ and the lower Bovidæ, the molars being short crowned or brachyodont. It may be that the condition of the horns in Giraffa represents the mode of origin of the horns of the Bovidæ,[1] and that the genus is simply to be reckoned a primitive type in that family. The

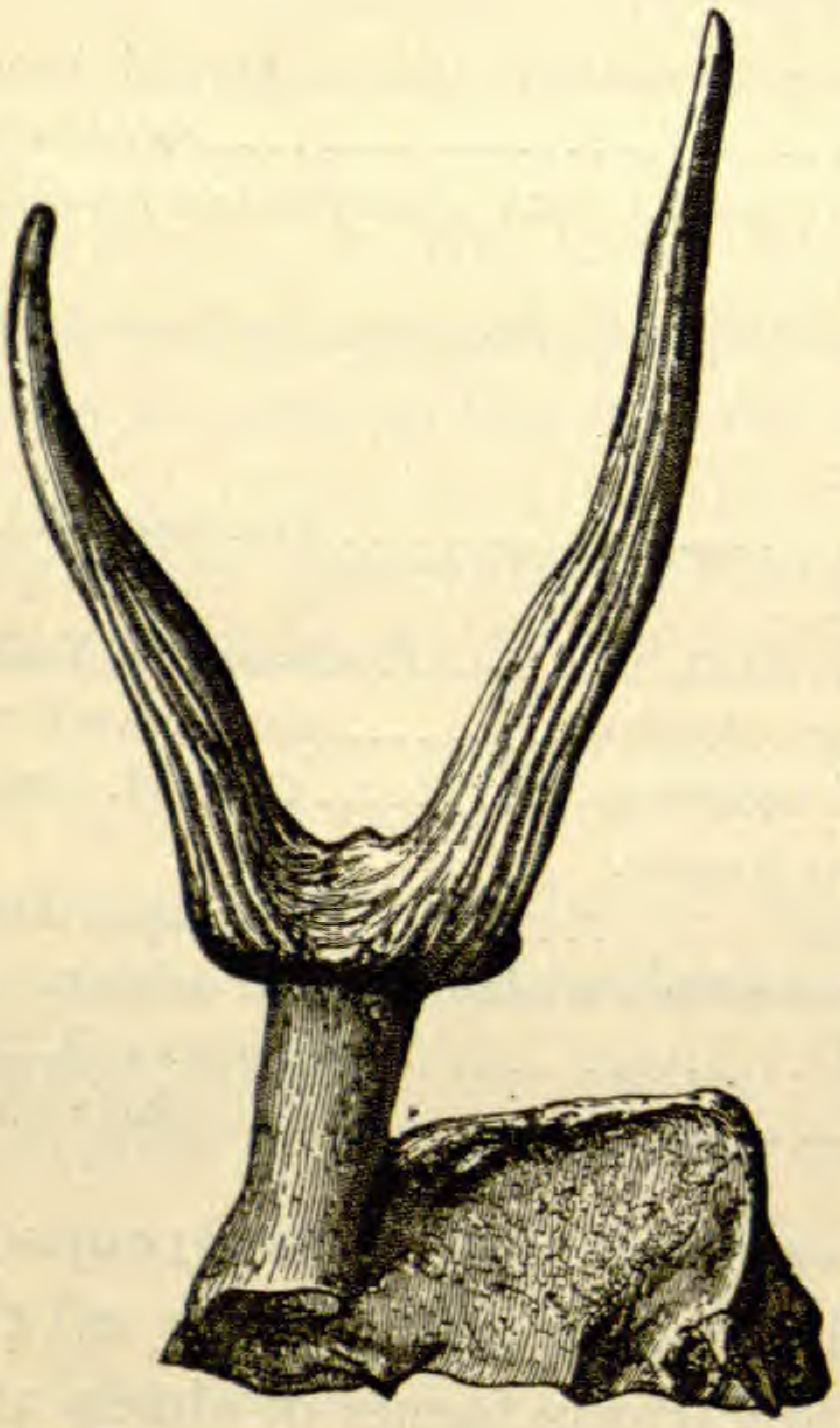
[1] In the sheep the horns begin as bodies separate from the skull.

specialization of the long neck and fore legs would not exclude it from that family. It is merely an adaptation for the habit of browsing on the foliage of tall trees. In the extinct species of its single genus, Giraffa, these characters are found in a less degree than in the existing one, forming transitions to the ordinary forms of Boöidea.

The most obvious distinction between the Bovidæ and the Cervidæ is in the differing character of the bony processes of the skull, used for offense and defense. But where horns are wanting, as is the case with some genera, these distinctions fall to the ground. The horn-type of the Bovidæ is more primitive than that of the Cervidæ, since the horny process is permanent in the former, and is shed and reproduced annually in the latter. The dental type is, however, never so specialized in the deer as is the case with the highest genera of Bovidæ, remaining always distinctly rooted, while in Bos and some other genera of the latter they become prismatic. But the lower genera of Bovidæ do not differ from Cervidæ in this respect.

In accordance with these facts the bovine ruminants appear a little before the cervine, though authors generally refer the earliest genera to the latter division. Such are the genera Dicrocerus and Cosoryx,[1] which appear in the latest Miocene beds. Dicrocerus only differs from Palæomeryx in the possession of horns, which resemble those of deer, but which were, according to Schlosser, never shed, a fact which compels its location in the Bovidæ. In Cosoryx the horns have the same character in this respect, but the teeth are antelopine, or prismatic. It is clearly to be placed in the Bovidæ with Antilocapra (the prong horn,) and it is closely allied to Dicrocerus. Here we see that the point of origin of the two families was from a common ancestor, and that this ancestor was, as has been already expressed by Schlosser, the genus Palæomeryx. Nearly related to this point of departure are the Sivatherium, Bramatherium, and Hydaspidotherium. As they did not shed their horns, they cannot be referred to the Cervidæ. In their covering with the integument, Cosoryx probably possessed a character of Giraffa, which is a primitive

[1] Leidy, Cope ; Procervulus Gaudry.



(FIG. 17.) *Dicrocerus furcatus*, posterior part of skull, one-fourth natural size. Miocene, France. From Gaudry.

stage of the essential character of the horns of the Bovidæ. Perhaps the retention of the primitive dermal character of this investment, instead of its metamorphosis into horn, might be regarded as a basis for a distinct family, the Cosorycidæ. But it is highly improbable that this covering remained in Sivatherium and Bramatherium, whose horns were apparently perfectly naked. It is not evident how all these animals can be retained as distinct from the Bovidæ, and I therefore place them in two subfamilies of that family. The Cosorycinæ, which will include Cosoryx and Blastomeryx, are characterized by the sheath of the horns being dermal ; the Sivatheriinæ by the absence of any sheath whatever. The synopsis of genera will then be as follows :

I. No horns in the male.

Molars brachyodont.................................... *Palæomeryx*[1] Von Meyer.

II. Horns covered with skin (Cosorycinæ).

Teeth brachyodont ; no frontal excrescence.................. *Blastomeryx* Cope.

Teeth prismatic ; no frontal excrescence........................ *Cosoryx* Leidy.

III. Horns naked (Sivatheriinæ).

Teeth brachyodont ; two pairs of horns, all separate..... *Sivatherium* Cautl. Falc.

Teeth brachyodont ; two pairs of horns ; those of the anterior pair from a common base.................................... *Bramatherium* Cautl. Falc.

Teeth brachyodont ; one pair of horns, from distinct bases....... *Dicrocerus* Lart.

IV. Horns covered with a horny sheath ; teeth hypsodont (Bovinæ).

α. No internal column of true molars.

β. No lateral ungues. (Nasal bones normal ; postzygapophyses single).

Horn-sheath furcate .... *Antilocapra* Ord.

Horn-sheath simple.. *Nanotragus* Sund.

[1] Should *P. eminens*, type of Palæomeryx, have possessed horns, as suspected by Schlosser, the generic name must take the place of Dicrocerus below, and be replaced by one of the various names which apply to hornless species.

ββ. Lateral ungues present.

γ. Nasal bones separated from maxillary and lachrymal bones.

Horns simple, one pair .... *Sæga* Gray.

γγ. Nasal bones more or less in contact with lachrymal or maxillary bones.

δ. Lumbar postzygapophyses single. (Numerous species not examined)

ε. Inferior premolars three.

Horns one pair .... *Antidorcas* Gray.

εε. Inferior premolars four.

Horns two pair .... *Tetracerus* H. Smith.

Horns one pair; last inferior molar with four columns .... *Neotragus*[1] Gray.

Horns one pair; last inferior molar with five columns .... *Ovis*[2] H. Smith.

δδ. Lumbar postzygapophyses double.

Horns one pair; inf. mol. 3 with five columns .... *Capra* Linn.

αα. One or more superior true molars with a median internal column.

Lumbar postzygapophyses single .... *Ægocerus* H. Sm.

Lumbar postzygapophyses double .... *Bos*.[4] Linn.

A great number of names have been given to groups of species of the Bovinæ, especially within the limits of the genus Ovis of H. Smith. Here the various forms of sheep and antelopes have been distinguished as genera, and named accordingly. So far as concerns the skeleton, further subdivisions than those indicated in the above table do not appear to exist, and none have been pointed out. The divisions proposed appear to be rather those of one extensive genus. The modifications of the skull have reference to the position of the horns. These are processes of the frontal bones, and are placed at points from above the eye to the posterior angle of the facial plane of the skull. In the latter case this angle approaches very near to the supraoccipital crest or inion, and the parietal bone is reduced to an exceedingly narrow band between the frontal and occipital bones (Rütimeyer).[5] Forms with anterior horns and well developed parietal bones are *Ovis gazella* and *Tetracerus quadricornis*; while the *Ovis gnu*

[1] *N. saltianus* type. This character is derived from authority to which I cannot now refer. I have not seen it.

[2] Includes the following supposed genera: Antilope, Gazella, Cervicapra, Oreotragus, Cephalophus, Strepsicerus, Damalis, Alcelaphus, Nemorrhædus, Rapicapra, Caloblepas, Haplocerus, Ovis, and Anoa.

[3] Includes the following supposed genera: Eleotragus, Ægocerus, Oryx, Addax and Portax.

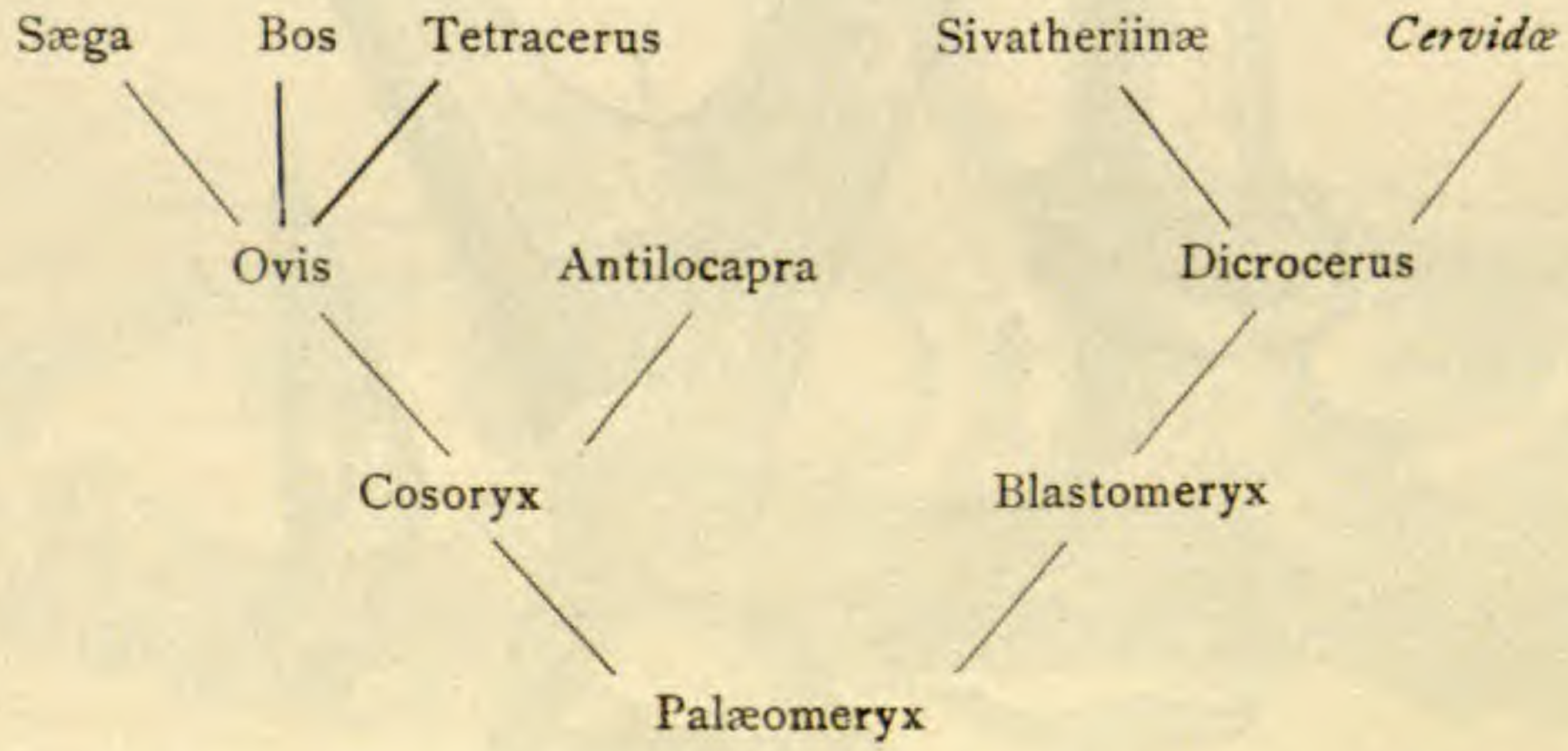
[4] In *Bos americanus* the postzygapophyses are single except on the last lumbar.

[5] Die Rinder der Tertiär-Epoche; Abh. Schwieiz. Pal. Gess., v, 1878.

displays the parietal extremely reduced, and become chiefly lateral in position. As regards the forms of the horns themselves, they present no important differences, but are angular and revolute in the section Ovis, and cylindric in the division Antilope. In the latter they vary in direction from straight to spiral or curved in different directions. Within the genus Ovis the end of the muzzle is naked or hairy, the latter in the typical forms and in those inhabiting northern and alpine localities generally. Those species that inhabit grassy or desert plains have the end of the nose naked.

Within the genus Bos modifications are observed parallel to those in the genus Ovis. The frontal bones with the horn processes are produced more and more posteriorly until the parietal bones are reduced to a narrow band across the posterior part of the skull. The bisons have the horns most anterior; then follow the buffalos, and the extreme is reached in the true oxen, of which the domesticated animal is the type.

The following table will give an idea of the phylogeny of the Bovidæ.



The hornless Palæomeryx has given origin to the horned Boöidea; on the one hand to the brachyodont (Blastomeryx, etc.), and on the other to the hypsodonts (Cosoryx, etc.). A cornification of the integument in a fork horned Cosoryx produced Antilocapra, while the same process in a simple-horned Cosoryx, produced Ovis. The development of this type has undergone the three principal modifications indicated by the three genera which succeed upwards. In Sæga an extraordinary development of the muzzle takes place, which causes a change in the relations of the nasal bones. In Tetracerus another pair of horns is developed in front of the usual pair. Bos developes complications of the molar teeth in both jaws.

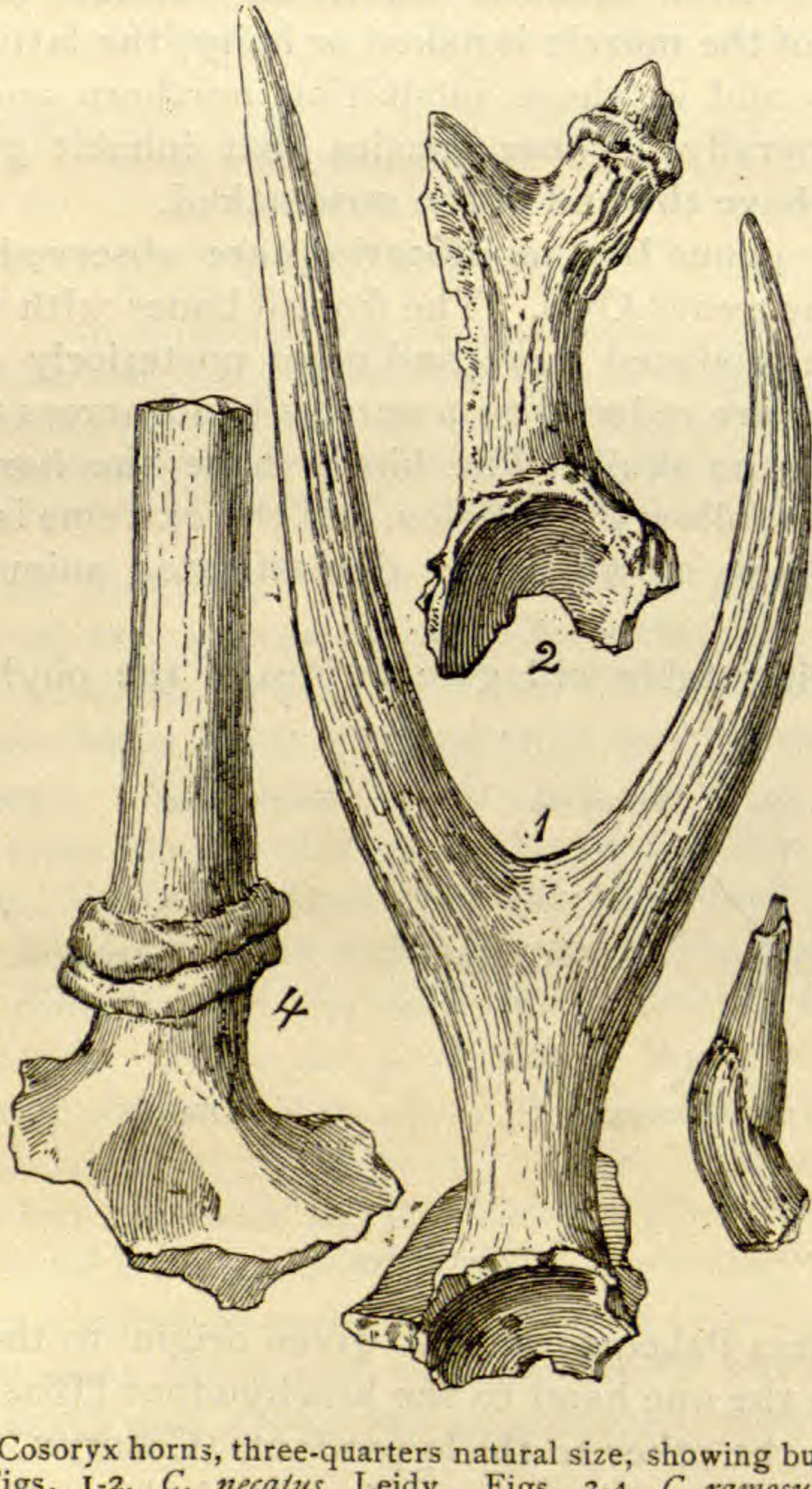


FIG. 18.—Cosoryx horns, three-quarters natural size, showing burrs and repaired fracture. Figs. 1-2, *C. necatus* Leidy. Figs. 3-4, *C ramosus* Cope. From the Loup Fork Miocene of New Mexico. From Report U. S. G. G. Surv. w. of 100 meridian.

On the brachyodont side the development of the dermal covering of the horns of Blastomeryx is arrested, and naked horned types follow. In the Sivatheriine group no further change follows except complication of the horns. In the Cervine group, on the contrary, the habit of shedding them becomes fixed, and a new family has its origin.

No species certainly referable to Palæomeryx or Dicrocerus have been as yet found in North America, but they may be detected at any time. Numerous species have been found in Europe. Cosoryx is abundant in North America, six species being known (fig. 18, *C. necatus and C. ramosus*). They vary in size from that of a gazelle to that of a

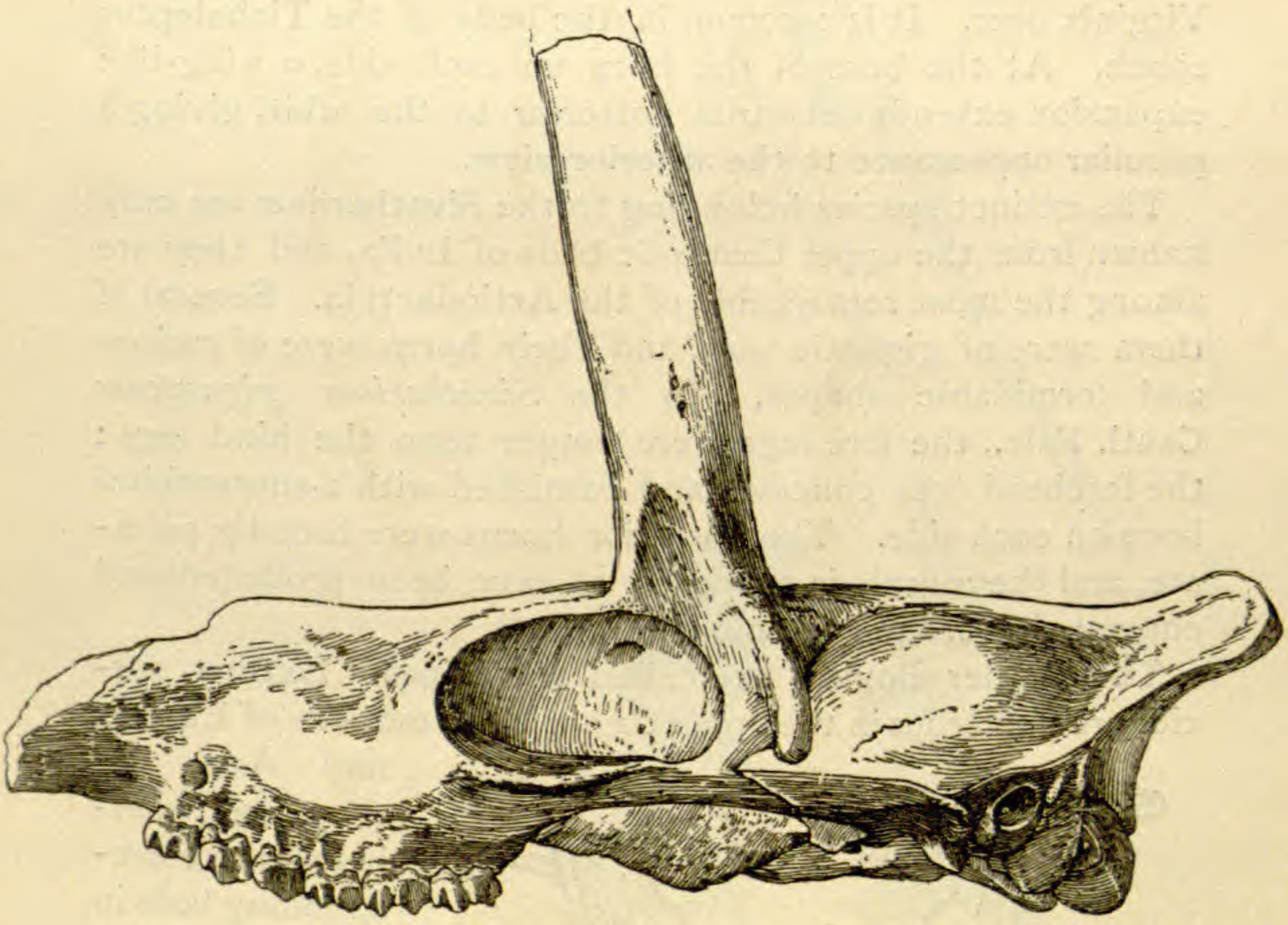


FIG. 19—*Blastomeryx borealis* Cope, one-sixth nat. size. From Ticholeptus bed of Montana; original.

fallow-deer. Although they did not shed their horns, some individuals developed a burr near the base of the beam, and burrs are found on the branches followed by broken down bone (Figs. 18, 2). In other cases broken points of antlers have become reattached, showing the presence of an integument to retain them. I have suggested that the development of the burr was due to the stripping or laceration of this integument to and at the base of the beam, producing an engorgement of the vessels and deposit of calcic phosphate; and that the stripping of the horns when complete resulted in their death and subsequent sloughing, thus originating the periodical shedding of the horns characteristic of the deer. This periodicity would depend on the periodicity of the season of reproduction, when the horns are especially used in conflicts between the males (Fig. 17).

Two species of Blastomeryx are known, a smaller, and a larger (*B. borealis*, Fig. 19), which was about the size of the Virginia deer. It is common in the beds of the Ticholeptus epoch. At the base of the horn on each side, a wing-like expansion extends outwards posterior to the orbit, giving a peculiar appearance to the anterior view.

The extinct species belonging to the Sivatheriinæ are only known from the upper Cænozoic beds of India, and they are among the most remarkable of the Artiodactyla. Several of them were of gigantic size, and their horns were of curious and formidable shapes. In the *Sivatherium giganteum* Cautl. Falc., the fore legs were longer than the hind legs; the forehead was concave, and furnished with a supraorbital horn on each side. The posterior horns were broadly palmate, and the muzzle is supposed to have been produced and convex above, as in the moose (Fig. 20).

The smaller Bovidæ are called Antelopes. Extinct species are numerous in the upper Cænozoic formations of Europe and Asia, but they are wanting from corresponding beds in North America. The European species are related only subgenerically to those now existing in central and south Africa. All sorts of grada-

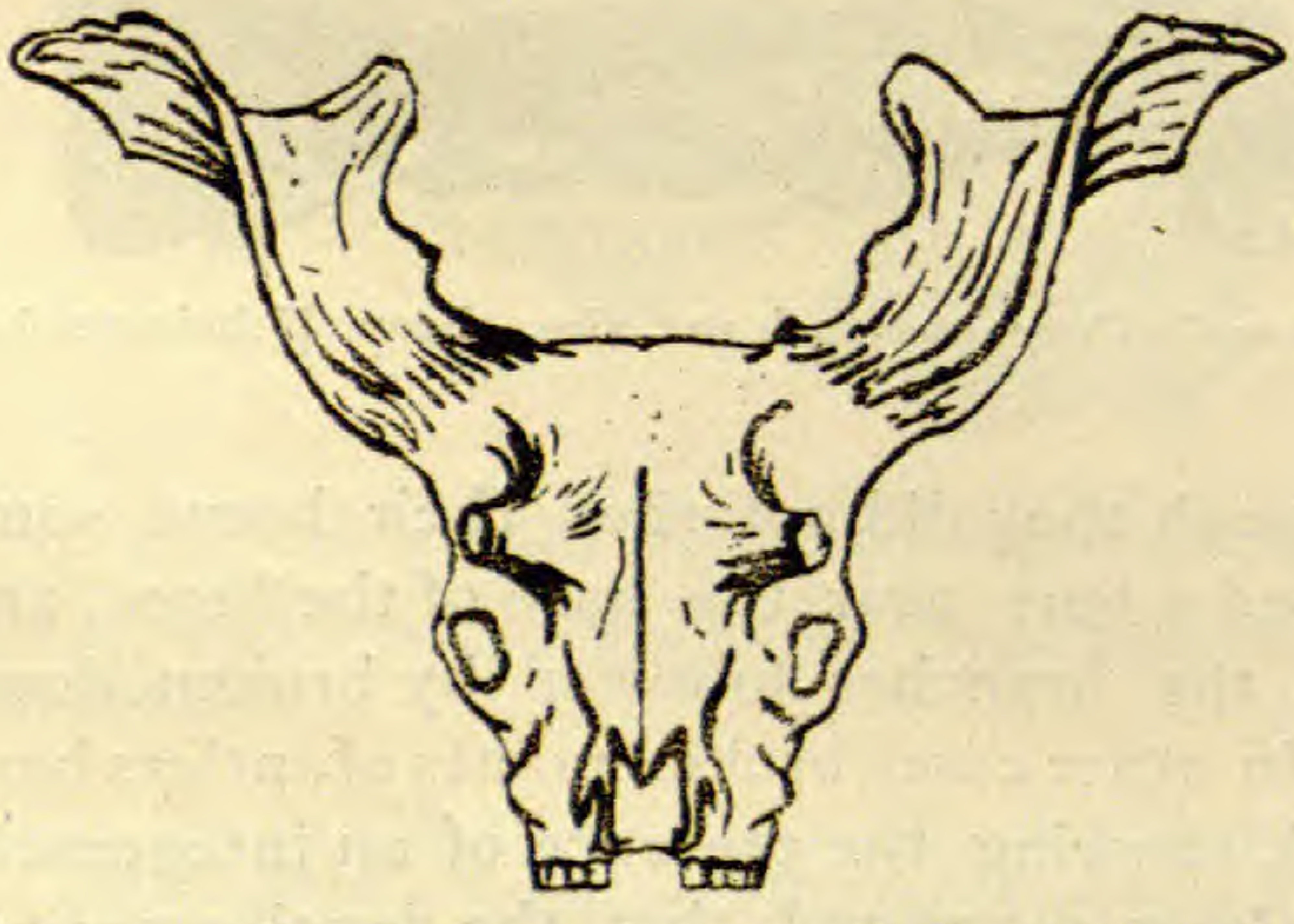
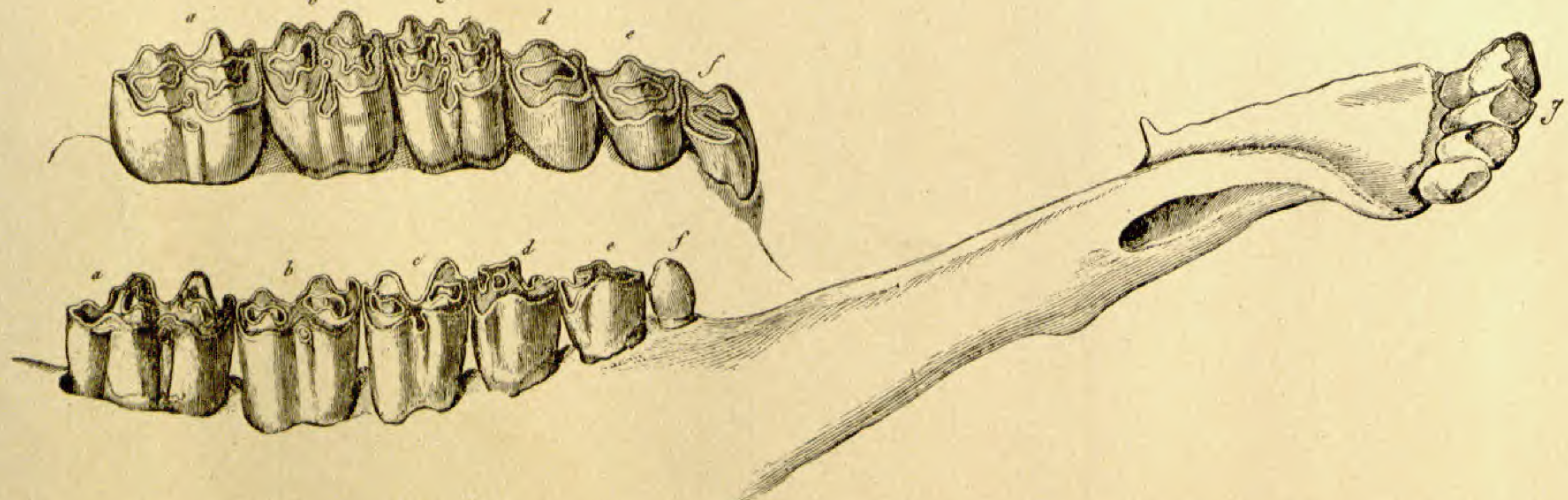


FIG. 20—*Sivatherium giganteum* C. F. cranium from front, much reduced. From Falconer. Miocene, India.

PLATE VII.



Bos taurus (from Cuvier.)

tions leading to the true genus Bos are found, especially in India, where many species of large size and various development of horns have been found. It appears that Bos is a polyphyletic genus, the divisions known as Bison, Bubalus and Bos, having arisen from as many types of Antelopes, which resemble them in the positions of the horns. In North America the division Bison only has been found, and this in Plistocene beds. Such are the species *Bos alleni* Marsh, and *B. latifrons* of Harlan. The latter species was of large size, the horn-cores of some specimens being as thick as a man's leg. It is evident that the line of the Boöidea was not continuous in North America, but that its later representatives were derived from the old world.

The following series may approximate a correct representation of the phylogeny of the genus Bos, expressed in genera.

Bos Ovis (sens. lat.) Cosoryx Palæomeryx	Bovidæ.
Dremotherium	Moschidæ.
Amphitragulus Gelocus Leptomeryx Dorcatherium	Tragulidæ.
*	
Anthracotherium Cebochœrus	Anthracotheriidæ.
*	
Pantolestes	Pantolestidæ.

Of the Cervidæ or the Boöidea which shed their horns, the genus Cervus is one of the earliest with which we are acquainted. Undoubted species of the genus occur in the Pliocene, and Upper Miocene species are also referred to it. As species from the Lower Pliocene (*C. matheroni* Gerv.) are referred to Capreolus, those of the Miocene may not be true Cervi. Their structure is not sufficiently known to determine this point. The arrangement of the genera is as follows. The three primary divisions were established by Brooke.

I Lateral metapodials complete only distally, and supporting dewclaws (Telemetcarpi).

a. Nasal passages posteriorly two, separated by vomer (Cariaci).

Horns simple spikes.. *Coassus* Gray.
Horns more or less furcate.................................. *Cariacus* Gray.
Horns palmate.. *Rangifer* H. Smith.

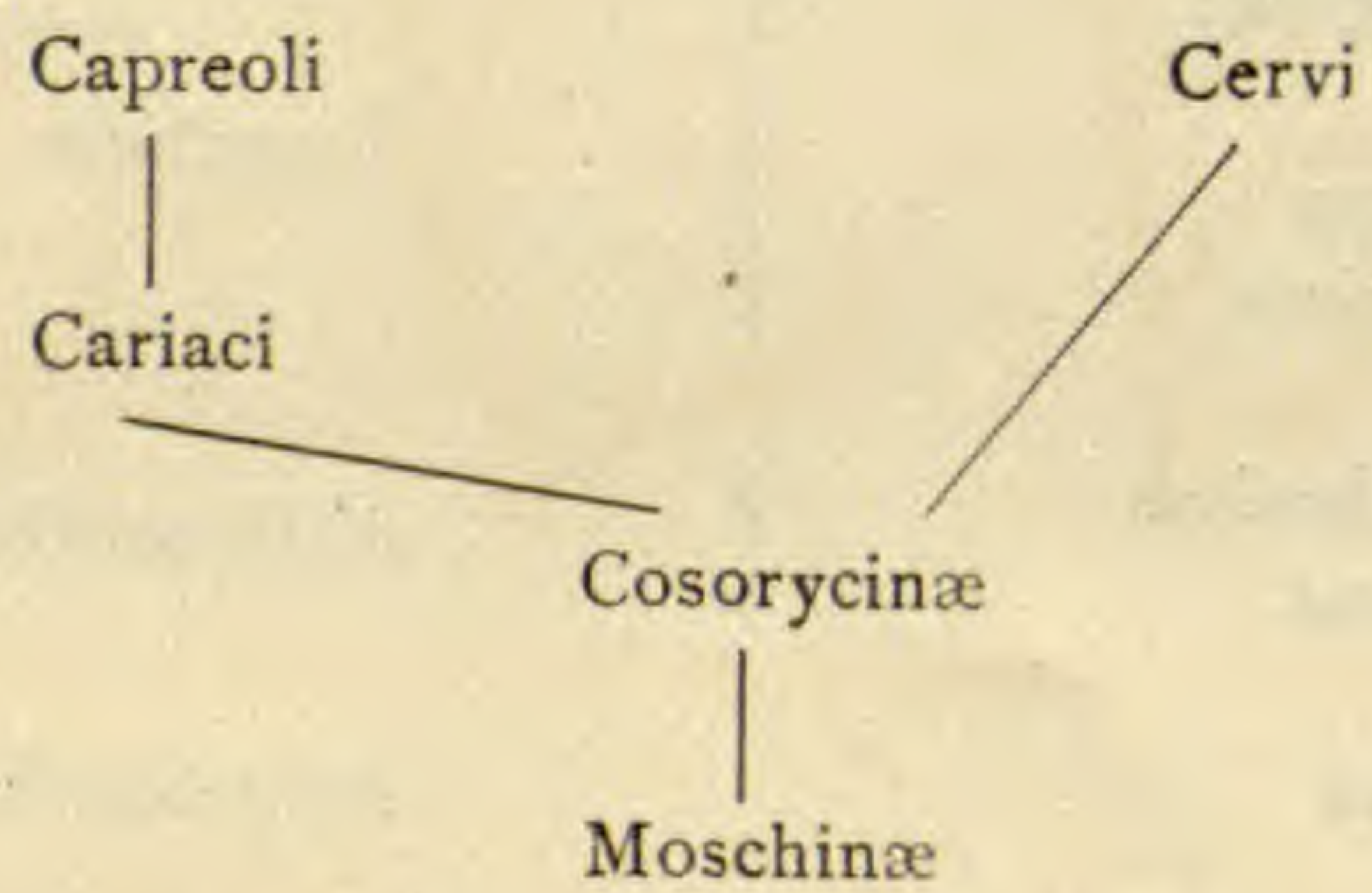
aa. Nasal passage posteriorly one, not divided (Capreoli).

No horns... *Hydropotes* Swinh.
Horns furcate; no postantler............................... *Capreolus* Gray.
Horns palmate; no postantler............................... *Alces* H. Smith.
Horns palmate; a postantler................................ *Cervalces* Scott.

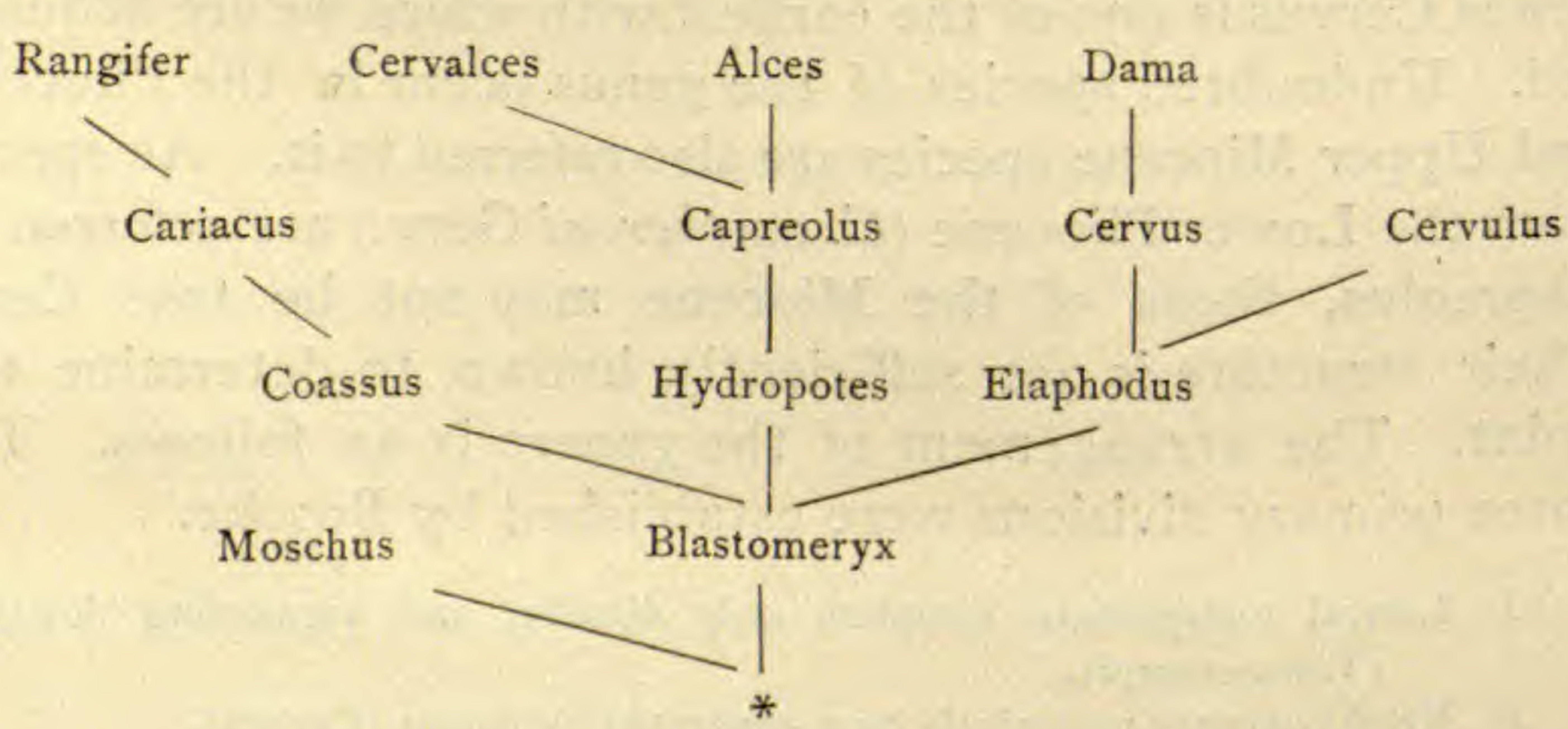
II. Lateral metapodials represented by proximal splints only; nasal passage not divided (Plesiometacarpi). (Cervi).

Frontal cutaneous glands; horns furcate.................... *Cervulus* Blv.
No frontal glands; horns simple............................ *Elaphodus* M. Edw
No frontal glands; horns furcate........................... *Cervus* Linn.
No frontal glands; horns palmate........................... *Dama* H. Smith.
Horns furcate; brow antler greatly exceeding beam, (Gill)... *Elaphurus* M. Edw.

The phylogeny of these genera cannot be fully known until the skeletons of the extinct genera and species have been obtained. It is, however, certain that the short series of genera included in each of the three divisions (II *a* and *aa*, III) are genetic series; and also that division I is ancestral to both II and III, although perhaps by an extinct genus differing in some respects from Moschus. These relations can be thus expressed:



or thus:



Each of the genetic series commences with a genus with no or with very simple horns. The next genus or stage presents branched horns, sometimes of great complexity. The last term in each is the palmate horn, where a greater or less number of the tines unite to form a plate. These series, as is well known, correspond with the history of the growth of the horns in successive years of the life of each species.(Fig. 21.)

None of the genera of this family are extinct except Cervalces Scott.

The true Cervidæ form a family of very recent origin, and only distinguished at the period when forms like Cosoryx and Dicrocerus began to shed their horns. Dicrocerus is repre-

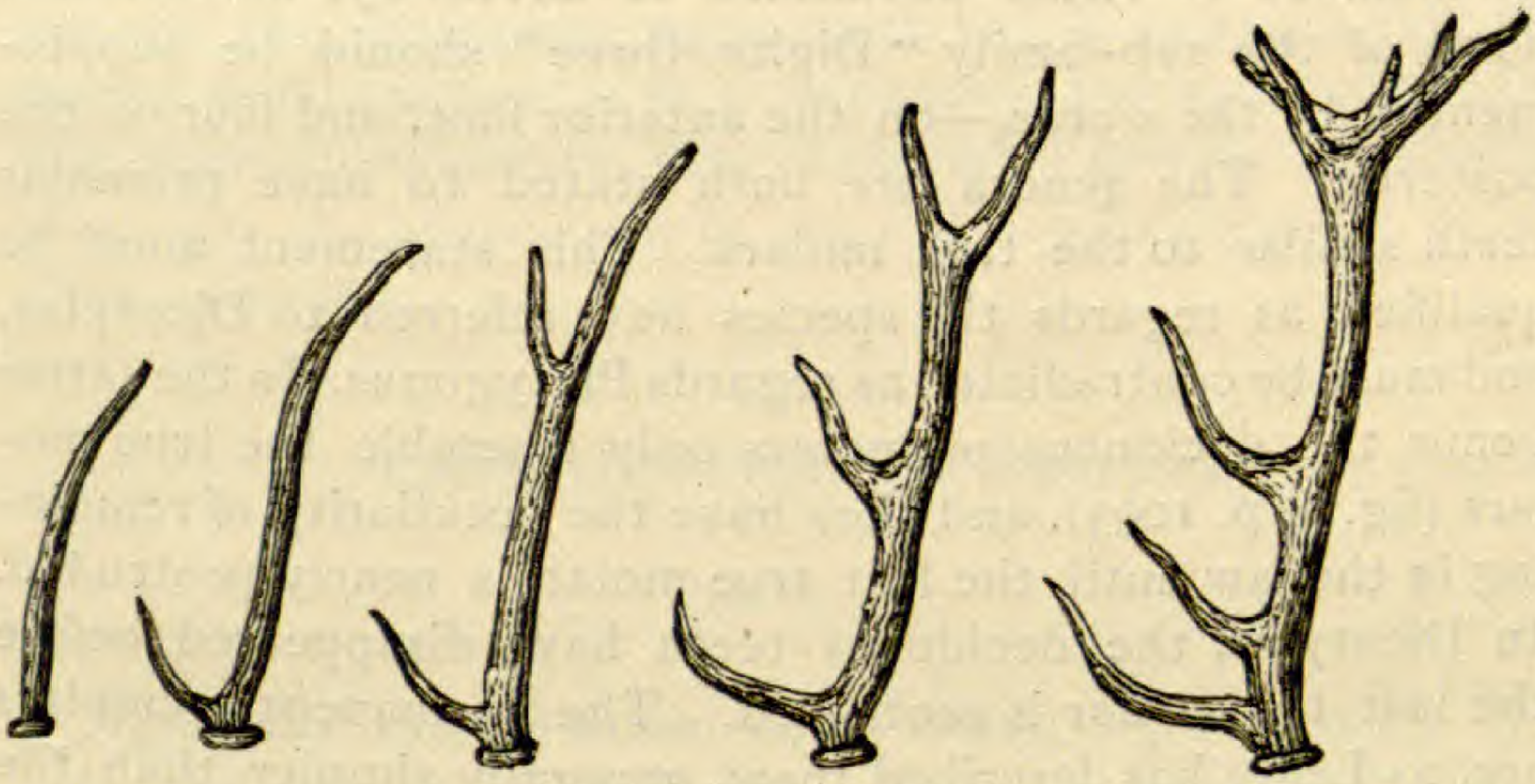


FIG. 21. Horns of *Cervus elaphus* from the second to the sixth years inclusive. From Cuvier.

sented by several species in the middle Miocene of Europe, and their horns are mostly bifurcate as in the third year's horn of a true deer. In the middle Miocene and part of the Pliocene the horns have three antlers as in the fourth year of Cervus, and as is permanent in the genus or section Rusa of tropical Asia.

The many branched horns appear in the Pliocene and Plistocene in Europe, in numerous species. In America extinct Cervidæ are more abundant than Bovidæ. Several species occur in the Pliocene beds of Buenos Ayres, and of Washington. The latter are related to the Moose (*Alces brevitrabalis* Cope) and American deer, (*Cariacus ensifer* Cope.) A very remarkable species occurs in the Plistocene beds of the eastern region, the *Cervalces americanus* Harlan. Its affinities are with the Moose, with which it agrees nearly in size; but it differs in possessing a posterior branch to the horn, which forms a broad, curved plate extending outwards above and behind the orbit, which resembles somewhat a hearing trumpet.

ADDENDUM.

In the first part of this article in the NATURALIST for December, 1888, p. 1088, I have given the characters of the sub-family, Dicotylinæ, of the family Hippopotamidæ, and of the two included genera, Dicotyles and Platygonus. Some amendment of these definitions is necessary, as follows: That of the sub-family "Digits three" should be supplemented by the words,—on the anterior foot, and four on the posterior. The genera are both stated to have premolar teeth similar to the true molars. This statement must be qualified as regards the species now referred to Dicotyles, and must be contradicted as regards Platygonus. In the latter genus the deciduous premolars only resemble the true molars (fig. 6, p. 1093), and they have the peculiarity of remaining in the jaw until the last true molar is nearly protruded. In Dicotyles, the deciduous teeth have disappeared before the last true molar is protruded. The permanent premolars are, as Leidy has described them, generally simpler than the true molars, consisting of two external, and one internal tubercle.

But the species differ so much in the characters of their premolars that they can be referred to three subdivisions, which may be at some future time regarded as genera. These are as follows:

I. Premolars all different from molars (*Notophorus* Gray); *D. tajassus*.

II. Last premolar only, like the molars (*Dicotyles* Cuv.); *D. labiatus* Cuv.; *D. serus* Cope; *D. angulatus* Cope.[1]

III. Second premolar (from front) like true molars (*Mylohyus* Cope); *D. nasutus* Leidy.

It is uncertain whether the complex premolar of *D. nasutus*

[1] AMERICAN NATURALIST, Feb. 1889.

is the penultimate or the last premolar. If it is the last, the genus Mylohyus will be distinguished by the presence of only two premolars.

An examination of the crania of *Dicotyles tajassus* in the U. S. National Museum from Costa Rica, shows that they display characters intermediate between the Brazilian typical form, and the *D. angulatus* of Texas. The last premolar teeth are sometimes premolariform, and less frequently approach the molariform structure. The facial angle is continued to the position of the canine aveolus, and the ridge of the maxillary bone is only separated from its border by a groove, not a fossa. The nasal bones are not tectiform. In general the characters agree with the *D. tajassus*, but the lateral facial angle is as in *D. angulatus*, and occasionally the last premolar resembles that of the same species. It appears then that the latter must be regarded as a subspecies rather than a species.

EXPLANATION OF PLATES.

PLATE III.

Agriochœr s guyotianus Cope, skull, natural size ; from side, and one-half from below. From the John Day Bed of Oregon. Original from unpublished plate in Report of U.S. Geol. Survey Terrs.

PLATE IV.

The elbow joint of Mammalia, separated, and seen from above and posteriorly. A, *Crocuta maculata*. B, *Simia nigra*. C, *Rhinolophus* sp. D, *Eucrotaphus pacificus*. E, *Cervus elaphus*. All four-fifths natural size.

PLATE V.

Vertebræ of Artiodactyla, two-thirds natural size. Fig. 1 *Antilocapra americana;* 2, *Dicotyles angulatus;* 3, *Capra hircus*. *Prz* prezygapoplysis ; *Poz* postzygapoplysis; E.S. Episphen.

PLATE VI.

Hypertragulus calcaratus Cope, skull, natural size ; from the lower Miocene. Fig. 1, lower jaw from above, of specimen from White River bed of Colorado. Fig. 2, skull from John Day series of Oregon ; *a*, side, *b*, from above, *c*, from below.

PLATE VII.

Bos taurus, dentition, two-thirds natural size ; from Cuvier.

EDITOR'S TABLE.

EDITORS E. D. COPE, AND J. S. KINGSLEY.

The position of the Post-Darwinians is clearly set forth in an abstract of a lecture delivered by Prof. E. Ray Lankester, at the London Institution, which appears in *Nature* of February, 28th. Prof. Lankester declares that the error of Lamarck (and consequently of the Neolamarckians,) consists in the assumption that acquired characters can be inherited. He says, " Congenital variation is an admitted and demonstrable fact ; transmission of congenital variations is also an admitted and demonstrable fact. Change of structure acquired during life—as stated by Lamarck—is also a fact, though very limited. But the transmission of these latter changes to offspring is not proved experimentally ; all experiment tends to prove that they cannot be transmitted." Two inferences may be derived from these statements. First ; the author of them does not believe that the so-called congenital variations can be or have been acquired ; second ; that he has no hypothesis to offer in explanation of the origin of congenital variations . These positions exclude another inference which nevertheless may be derived from other propositions embraced in the abstract of the lecture. He says, with Lamarck, that " change of structure acquired during life is also a fact," and also that " all plants and animals produce offspring which resemble their parents on the whole." But in spite of these statements we are to believe that if a plant or animal acquires a useful addition to or mortification of its structure during life, this is the particular variation which will *not* be transmitted. Since the modifications acquired by use during life are necessarily useful, it seems that according to the Post-Darwinians, the only way of acquiring useful variations known to us, is excluded from the process of Organic evolution. To say the least of it, the doctrine of probabilities is severely taxed by such a position as this.

But we say further, with Professor Cunningham, that were this hypothesis true, there should have been no evolution. If acquisition during life-time, is to render a character non transmissible, the continued growth of a single character by accretions during successive generations through geological ages could not and ought not to occur. Each generation should begin where its ancestors began in the matter of useful characters, or those acquired by use, so that there could be no accumulation or development of such characters. The influence of the environment, as well as that of the energies of the living being, would be incompetent to develop more in a given generation than that generation could acquire in its single life-time. How then can evolution account for the law so beautifully disdisplayed by paleontology, of the gradual modification of parts through long geological ages, towards given ideals of mechanical perfection? How can we account for the gradual perfecting of the articulations of the internal and external skeletons of forms which possess them? Not only is no explanation offered the Post-Darwinian school, but such progress is under their hypothesis, impossible. It is an explanation of *obscurus per obscurius.* But we are still of the opinion, in spite of Weissman's theory to the contrary, that so long as the germ plasma is subject to nutrition, it is subject to influences occurring during the adult life of an animal, and it would be an exception to all the other tissues were it not so.—*E. D. C.*

A graceful tribute to the memory of Priestly, was recently paid by the first Unitarian Church of Philadelphia. A tablet surmounted by a bust was placed on the interior wall of the church, and services in honor of the philospher, in which several scientific men took part, were held at the time of the unveiling. Priestly was not only one of the fathers of modern chemistry; it was also as a philosopher and theologian, and as one of the founders of the first Unitarian Church of Philadelphia, that he was honored on this occasion. Though this act of appreciation has come too late for him to enjoy, it will encourage others to contribute their share to the progress of mankind.

RECENT LITERATURE.

LANG'S COMPARATIVE ANATOMY.[1]—This is the beginning of an entirely new edition of Schmidt's Comparative Anatomy, and so far as one may judge from a single part, it is to be ranked among the best of the recent text books. On every page there is a freshness both in treatment and illustration which is pleasing, while the text reads almost like a story. There is one noticeable feature in the work; it is logical in its arrangement. Thus we have as an introduction a couple of pages of an account of the cell followed by twenty on the Protozoa; next the student is introduced to the egg and spermatozoan, cell complexes and tissues, a few words concerning the Metazoa, and with this preparation we are lead to the Cœlenterates and thence to the higher forms. Several features, which though not exactly new, we do not recall in any text book, are introduced into the classification, and are usually to be regarded as improvements. Thus the division of the Cnidaria (—Cœlenterata *s. str*) into Hydozoa, Scyphozoa and Ctenophora and the limitation of the first two of these by the character of the œsophagus (ento, or ectodermal) is a valuable feature, though it disarranges our preexisting ideas and transfers the Craspedota from the Hydrozoa to the neighborhood of the sea anemones and corals. So too the separation of the Plathelmintha from the Vermes is *certainly* to be warranted on morphological grounds. The present part of the work considers only the Protozoa, Cœlenterata, Plathelmintha, and Vermes, but if

[1] Lehrbuch du vergleichenden Anatomie, von Dr. Arnold Lang. Erste abtheilung, June, 1888, pp. 290.

the succeeding parts treat the other groups as well, the whole will certainly prove a success.

BIRDS OF IOWA.—In the proceedings of the Davenport Academy Natural Sciences for 1888, there appears a catalogue of the birds of Iowa, with notes.[1] It is published only as a preliminary list and so escapes most of the criticism that might be offered, were it simply presented as a complete summary of extended observations.

Although it is offered only as *preliminary*, yet it is the most complete and reliable list that has so far appeared. It shows the authors to be familiar with the habits and habitats of all the common birds of the state and also that they have a good knowledge of many that are rare.

The authors enumerate 255 species as coming under their personal observation. Among this number are many species which have not been heretofore recorded as having been observed in Iowa, although from their known geographical distribution it was naturally supposed that they were to be found here. The maximum number of species *probably* found in the state including summer and winter visitors and Sea-birds migrating north by way of the Mississippi river,—is not much above 350.

Taking into account the fact that the collections and observations, upon which this list is based, were made chiefly in the vicinities of Charles City, Des Moines, and Iowa City, all situated in the interior of the state, and thus not affording a good opportunity for the study of many of the water birds, the work shows itself to be the result of much time and study.

For the reason just stated the list is most deficient in water birds. It is especially complete in Passerine species, when we consider the number of summer and winter, as well as Western visitors this order affords.

That the comparative completeness of the list may be readily seen the following list is appended. The first column gives the number of species which are probably to be found in the state as compiled from the known geographical distribution. The second column contains the number given in the catalogue of Messrs. Keyes and Williams.

Pygopodes	10	4
Longipennes	22	5
Steganopodes	7	2
Anseres	43	26

[1] A preliminary circulated catalogue of the birds of Iowa, by Charles R. Keyes and H. S. Williams M.D. Prof. Davenport Acad. Nat. Sci. Vol. V.

Herodiones	13	8
Paludicolæ	11	8
Limicolæ	37	21
Gallinæ	6	5
Columbæ	2	2
Raptores	34	25
Psittaci	1	1
Coccyges	3	3
Pici	10	7
Macrochires	4	4
Passeres	153	136

The work is especially valuable for the following things:

Dates of arrival and departure of summer residents.

Dates of arrival and time of stay of migratory birds breeding farther North.

Dates of arrival and departure of winter visitors.

Breeding season and nesting habits.

F. M. Fultz, Burlington, Ia.

RECENT BOOKS AND PAMPHLETS.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.

THE STATE OF MICHOACAN.—Michoacan is one of the richest and most fertile of the states of Mexico, rich in woods, in mines, and in capacity of cultivation. Along with part of Guanajuato, it formed the ancient kingdom of Mechocean. Its extent is 55,693 sq. kilometres, its population about 800,000. The entire state is mountainous, and a considerable portion is occupied by lakes, among the principal of which is that of Patgcucero. The coast line is 163 kilometres long and contains the ports of SanTelmo, Bucerico and Marauta. Among the principal peaks of the state are Tarcitaro (3,860 m.), Patambon (3,750 m.), Quinceo (3,324), Tarimangacho (3,104), Zirate(3,340), and San Andres (3,282).

BOLIVIA.—According to an interesting article in the last issue of the Spanish Geographical Society, the area of Upper Peru, now known as Bolivia, is 2,115,329 kilometres, or rather more than four times that of Spain. Its population, according to a census taken in some departments, and calculations made in others, is only 1,182,270, a figure considerably below previous calculations. The engineer Minchi gives the altitude of La Paz as 3,641 m., that of Lake Titicaca at 3,824 m., and that of the peak of the Illimani as 6,488 m. This height agrees well with the average given by other surveyors. Sorata is thirty or forty metres higher. Among other elevated peaks are Chachacomani (6,203), Hauina (6,184), Murudata, (5,120) Sunchulli (5,546), and Tres Cruces (5,504). All of these as well as Sorata and Illimani are in the department of La Paz. In that of Oraro are Sajama (6,546), Parinacocha (6,376), Pomerape (6,260), Azanagues (5,136) and Guanani (3,968). In Pobors are the peaks of Charague (5,603), Potosi (5,830), Nuevo Mando (5,949), Lipez (5,982), Taguegua (5,704), Guadalupe (5,754), Esmeraca (5,406), Tazna (5,105), and Ubina (5,203), and in Cochabamba that of Tunare (4,726). The most elevated inhabited places are: Tolapalca (4,290), Potosi (4,166), in its highest part, Catamarca (4,141), and Oruro (3,792). The great tableland between the two ranges of the Andes has an average elevation of 3,800 metres.

The mountainous part of Bolivia may be divided into four regions: (1.) that between the sea and the high plateau, poor in vegetation but rich in minerals and salts; (2.) the plateau itself, also poor in its flora, but rich in mines of every class; (3.) the region of the valleys formed by the lateral chains of the interior of Royal Andes, the chains which unite the two main ranges, and the buttresses of the interior range—this is a most fertile country with exuberant vegetation; and (4.) the eastern plains, a land of virgin woods and wilds.

Among the valleys of the third region may be mentioned those of Beni, Santa Cruz, and Cinti, the last famous for its wines. The *yungas* are deep valleys, whose temperature never descends below 21° and rises to 45 C.

In the E. and N. are the great flats of Beni, Santa Cruz, Chiquisaca, and Tarija. The river Beni and its tributaries inundate these flats in the flood season, leaving large lagoons, and giving rise to insalubrious conditions. More to the E. the Paraguay also inundates the flats of Manzo and Gran Chaco, forming the Tarayas lakes. Between the Paraguay and Pilcomayo are great salt lakes, the most notable of which is Izozo. Some sierras arise in the eastern part, on the confines of Brazil, the most easterly that of San Simon.

The greater part of the rivers of Bolivia are affluents of the Amazons or the La Plata, and are navigable. Only one river, the Loce, reaches the Pacific, all others are lost in the Atacama desert.

About a third of the population is white, the rest for the most part Indian or Mestizo. Among the higher classes of the whites, French customs prevail, but the Chulos or Mestizos still wear the dresses they wore when they were Spanish subjects.

Europe.—Geological Work in Spain.—The two first volumes of the Commission of the Geological map of Spain treat of the geology and mineralogy of the province of Huelva, and will be followed by two other volumes treating of the petrography of the same province. The same Commmission has also published the fourteenth volume of its bulletin, which is almost exclusively occupied by a description of the lower cretaceous formation of, by Sr. L. Mallado, forming part of a Palæontological Synopsis of Spain, which commenced with the ninth issue of the same bulletin. The general geological map of Spain, consisting of thirteen sheets, is also almost complete. The Commission of Mining Statistics has also published a map of the peninsula showing the areas conceded in each province for the exploitation of various minerals. The Hydrographical Commission has not only published the plans of various parts of the Mediterranean coast, but is at work upon those of the Philippines.

Engineering Works in Europe.—Among engineering works of geographical importance now being carried on in Europe, are the canal across Schleswig from the North Sea to the Baltic, commenced in June, 1887, and likely to be finished next year; and the construction of a railway from Belgrade to Salonica. In Italy a project is on foot to convert Rome into a sea-port by forming a canal from the south-east part of the city to the coast. As the Tiber, at the highest point of the canal, is but twelve metres above the level of the sea, the project does not involve any very great difficulty.

A new port for the city of Bilboa is also projected. Belgium is commencing a series of fortifications upon the river Meuse to protect the territory in case of a new Franco-German war.

Sardinia.—From the fourteenth to the sixteenth century, during the time that Sardinia belonged to Aragon, the official language of the island was that of Catalonia, but this was superseded by the Castilian tongue after the union of Aragon and Castile. Nevertheless the Catalan language is still spoken at the northern end of the island, where, at the foot of Nurra, the Catalan Sr. Toda, found himself perfectly understood. In Alguer, an ancient walled city of 12000 inhabitants, the names of the streets are Catalan as are also the speech of the populace and the songs of the children. Since the Peace of Utrecht in 1720, the Castilian tongue has given way to the Italian, yet even within its capital, Cagliari, the Spanish tongue is still used in the nunnery of Santa Clara.

THE MOUNTAIN RANGES OF SPAIN.—The highest peaks of the Pyrenees, according to the recently issued, "*Reseña Geographica y Estadistica de España*, are Nethon, 3404 metres; Pico de Posets, or Landana, 3,367 m.; Maladetta or Montes Malditos, 3,354 m.; and Tres Sorores or Mont Perdu, 3,351 m.

The northern range of the Iberian peninsula is by D. J. Bisco considered as composed of two sections, the one east, the other west, of the northern end of the Iberian range, which is that which forms the western border of the Ebro valley, and which prolongs itself southward sufficiently to form a base from which rise the ranges running east and west between the various rivers of Castille and Andalucia. The highest peaks of the Vasco-Cantabrian or eastern portion of the northern cordillera are: Peña de Cerreda, 2678 m.; Peña Vieja, 2639 m.; Peña Prieta, 2520 m.; and Contes 2373. The two highest peaks of the western or Galicio-Asturian part of the northern range are: Espiguete 2453 m.; and Peña-Ubina, 2300. The Iberian, or north and south system, the highest portion of which is known as the Mountains of Burgos, has no peaks comparable to those of the Pyrenees, its three highest summits being Moncayo 2315 m,; San Lorenzo, 2303 m.; and the Picos de Ebibron, which rise to 2246 metres. The city of Burgos stands at a height of 856 metres.

The ranges which run westward from the Iberian are the Central, between the basins of the Duero and Tajo (Tagus); the Toledo Mountains, between the Tajo and the Guardiana, the Sierra Morena, and the Sierra Nevada. The highest summits of the Central system are: Plaza del Moro Almansor 2,650 metres; Calvitero 2,401 m.; Peñalara 2,400 m.; and Hierro 2,383. The city of Avila stands at a height of 1,126 metres, Segovia at 1,000, and the Observatory of Madrid is 655 metres above sea level. None of the Toledo Mountains attain great elevations, the loftiest being Corocho de Rocigalgo 1,448 metres and Vicente 1,429 m. Still more insignificant is the elevation of the Sierra Morena, which rising but slightly above the plains of Castile, may be regarded as little more than a huge step from those plains, to the valley of the

Guadalquiver. The highest points are, Estrella 1,299 m., and Rebollera 1,160 m.

South of the Guadalquiver, the Penibetic system culminating in the Sierra Nevada, though less continuous and extensive than the Pyrenees, attains in some points elevations second only to the Alps. The two loftiest peaks, Mulhacen 3,481 m., and Veleta 3,470 m., are both near Granada. Next in height come the Cerro de la Alcazaba 3,314 m., and the Cerro de la Caldera 3,289 metres.

AFRICA.—THE MUNI QUESTION.—According to a paper read by Sr. F. Coello, before the Geographical Society of Madrid, (Jan 9, 1889) the rights of Spain in the Gulf of Guinea date from a treaty made with Portugal in 1777, by which the island of Santa Catalina and the Spanish colony of Sacramento (in Brazil) were ceded to Portugal in exchange for the islands *Fernâo do Poo* and *Anno Bon*, together with the right to treat with the natives in all the neighboring coasts, from Cape *Formozo* at the mouth of the Niger, to Cape *Lopo Gonçalves*, or Lopez, S. of the *Gabâo*. (The Portuguese orthography is here given). Portugal had the right to dispose of these coasts, not only from having discovered them, but from having occupied the Cameroons, the Gaboon (where some relics of the Portuguese dominion have been found), and some points in the interior. In 1778 this treaty was ratified, and a Spanish expedition took possession of Fernando Po and Anno Bon. In 1827 the English occupied the former island, but afterwards surrendered it, and proposed to purchase it for 1,500,000 francs. This proposal was refused, and in 1843 an expedition took possession of both the above islands and of Corisco. The king of Corisco and of the Vengas tribes, who inhabit the neighboring coasts and the banks of the Muni, also acknowledged the sovereignity of Spain. No nation but France has disputed the rights of Spain upon the Muni, nor did France dispute them until many years later. In June, 1843, the French took possession of a blockhouse at the mouth of the Gaboon, the site of the present Libreville, but all annexations since made by France have been to the southward. Various treaties, letters of nationality, etc., have since bound the natives of various parts of this territory to Spain.

The first claim of France dates from May, 1860, and proceeded from the governor of the Gaboon. In 1883 the French openly claimed the territory, not only as far as the river Campo, (the northern boundary of the Spanish possessions) but even to and beyond the Cameroons. The Germans, who later on commenced to treat with the natives of this part of the coast, recognized in 1885 the rights of Spain as far north as the river Campi. In various expeditions under Dr. Ossario, Ivadier, and the governor Sr. Montes de Oca, the basins of the Campo, Benoto or Eyo, and Muni, were explored, and as many as 370 chiefs recognized the rule of Spain. The territory thus embraced covers about 50,000 sq. kilometres, and if the strip is carried inwards between the same degrees of latitude to the Ubangi, parallel to the French possessions, would contain at least 180.000 k. It is, moreover, a fertile and thoroughly well-watered country, well-wooded and capable of great production.

THE CITY OF WAZAN.—It is extraordinary and almost unexampled, says Don T. de Cuevas, in a recent issue of the *Boletin of the Madrid Geographical Society*, to meet among the most remote folds of the Masamoda mountains a city of at least 11,500 inhabitants, a centre of mercantile activity and of traffic among semi-independent kabyles, the seat of a religious power that at the commencement of this century made the monarchs of the Magreb tremble on their throne, and the residence of Xarifes who descend from kings and even from a higher stock, since in their veins runs the blood of Mohammed. Uazzan has various orthographies, the French know it as Ouezzan, the English as Wazan.

When at the destruction of Baurce, 979-84 A.D. the Edrisite power was overthrown, part of the Edrisites took refuge in the Uad Droa, and established themselves in Axyen, a town of Arjona, at the beginning of the XVI. century, a little after the Xerifes Saadies had acquired the throne of Morocco. From Axyen, the emir Muley Abdallah changed his residence to Wazan. The consent of this Xerif is necessary in order to make the election of the Sultan legal.

GEOGRAPHICAL NOTES.—The Hungarian, M. Dechy has ascended Elbourz and has reconnoitred the glaciers which surround that peak ; and M. Trillo has explored the right bank of the Volga and has discovered the ruins of an ancient city, in which, from the marbles, aqueducts, and Arab, Persian, and Tartar coins met with, a high civilization must have existed.

Two small sections of railway have at last been opened in Persia, one from Teheran to Xahzade-Abdulazin, the other from the coast of the Caspian to Amal, the capital of the province of Mazanderan. A line uniting the Persian gulf and the Caspian sea is also spoken of.

The Germans accuse the English of delaying the rectification of the bounderies between the possessions of the two countries in the Niger region, until they had made sure of their claims over the Upper and Central Binue by means of treaties with the native chiefs. France and England dispute the protectorate of the Egba territory, situated to the north of Porto Novo and Lagos. The English claim that the natural route to Abeokuta, the Egba capital, is by the river Ogun, which disembogues at Lagos, while the French claim that it can be reached as readily by the French river Addopero. The truth is that the Frenchman M. Viard has got ahead of the English in treating with the Egba king.

The expenses of the Congo Free State during 1887, have amounted to 1,891,190 francs, spent in political and judicial administration, transport and mails, constructions, geographical explorations, etc. The receipts are not given, but they must be small, since at present ivory is the only article of commerce.

The treaty by which the Sultan of Zanzibar conceded the greater part of the coast of Zanguebar to Germany, came into force the 15th of August last, but the rebellion of the natives of Pangani has spread along the coast and makes German domination difficult. It is said that at the present time the Germans have abandoned the only two points they had occupied viz: Bagamoyo and Dar-es Salam.

Turkey has sought to reclaim the port of Zeila, in the gulf of Aden, asserting that it was yielded to Egypt on condition of an increased tribute; but England asserts that the said port is in the Egyptian dominion. In the meantime Zeila remains in the hands of England.

Among the boundary disputes which are common in America, there has now risen one which is also a question of money. Rich gold fields have apparently been discovered in Dutch Guiana, between the rivers Lava and Papanaom; but the French call to mind that both these rivers are affluents of the Marouine, which forms the boundary between the two colonies, and therefore doubt the right of the Dutch to the territory.

According to a provisional treaty concluded between Bolivia and the Argentine Republic, the boundary between the two countries follows the parellel of 22° S. from the Paraguay to the Pilcomayo, thus leaving the two coasts of the navigable part of the latter river in the possession of the last named country.

Last March the French took possession of the Society islands, it is said, at the invitation of the inhabitants, but some of the natives of the island Raiatea attacked a French detachment. England has taken possession of the Fanning islands, south of the Sandwich group. England has also acquired the island of Rarotonga, which is advantageously placed between Panama and Australia, and which France considered as a natural connection between Tahiti and New Caledonia.

Germany has declared the neighboring Tonga group, which England intended to take possession of, to be neutral in accordance with the agreement signed by both powers April 6, 1886.

GEOLOGY AND PALÆONTOLOGY.

CREDNER ON PALÆOHATTERIA. The seventh part of Dr. H. Credner's account of the Stegocephali and Saurians found in the "Plauens'ch Grounds," near Dresden, is devoted to the above-named interesting genus of Reptilia. A single species is embraced in the genus, *P. longicaudata* Credner. This animal was of about the size of the *Sphenodon punctatum* of New Zealand, and presents so many points of affinity, that Dr. Credner places it in the same order, the Rhynchocephalia, and even in the same family, the Sphenodontidæ.

An examination of Professor Credner's description and the figures with which it is abundantly illustrated, shows that its describer has not overrated the importance to biology of its discovery. But its nearest ally is not, as Professor Credner supposes, the *Sphenodon punctatum* of New Zealand, but the fossil *Stereosternum tumidum* from the probable carboniferous formation of Brazil. It differs widely from Sphenodon in the character of the pelvis, agreeing in this with Stereosternum, and with the Pelycosauria. It differs from the Pelycosauria in its two postorbital cranial arches, and in its single-headed ribs, agreeing in the latter point with both Stereosternum and Sphenodon; and probably in the former point also, but the character of the cranial arches in Stereosternum remains unknown. It agrees also with the Brazilian genus in the characters of the tarsus, and differs more from the Pelycosauria and less from the Sphenodon. The humerus is also like that of Stereosternum.

The conclusion is that Palæohatteria is one of the Proganosauria, and that it is probably a member of the family of the Stereosternidæ. The division Proganosauria differs from the Rhynchocephalia by the structure of the pelvis.

Since the above was written, a review of Professor Credner's paper, by Dr. G. Baur, appeared in the February number of the *Americau Journal of Science and Arts.* His conclusions are similar to those reached by myself.—E. D. COPE.

BROGNIART AND DÖDERLEIN ON XENACANTHINA. Thanks to these authors we are now well acquainted with the structure of this important type of palæozoic fish. M. Brogniart[1] has described the structure of the skeleton, and Professor Döderlein[2] gives us that of the skull. The former bases his observations on numerous specimens from Commentry, and the latter on material from the coal formation of Alsace. He shows that it is nearly allied to Didymodus from the North American Permian, and represents the same ancestral type of fishes. The cranial structure is that of an Opistharthrous shark; that of the lateral fins is of a Dipnoan type; while the characters of the median fins are those of a primitive Teleostome, as seen in some Crossopterygia. There is a well developed hyomandibular; and the toothed spine, long known as a separate body, and first identified by Kner, is articulated with the posterior median part of the cranium. The pectoral fin is unsymmetrically bipinnate, and the ventrals are unipinnate. They arise from a lateral cartilage, and terminate in a simple, elongate, fringed plate, which is the position of the male organ of the sharks. The vertebral centra are unossified, but intercentra and mesial spines are present, the former supporting short ribs. The dorsal fin is especially interesting, as displaying one of the primitive stages of development of this organ. It is distinguished by the enormous size of its basiosts, which, as in Lepidosiren, are articulated with the axinosts. The fin radii also articulate with the baseosts, thus differing from the Lepidosirenidæ, and agreeing with Phoneropleuron. And all these support with the neural spines, confirming the view which I have taken of the original relation of the fins to the vertebral column.

Dr. Döderlein agrees very nearly with the position assigned this division (the Ichthyotomi) by the present writer, except that he thinks that it should be separated from the Elasmo-

[1] Etudes sur le Terrain Houillier de Commentry, par C. Brogniart et E. Sauvage.

[2] Zoologischer Anzeiger, 1889, March 4th.

branchii and maintained as a distinct class like the Dipnoi. He employs Lütken's name, Xenacthini for it, but this must be clearly retained for the subdivision of the Ichthyotomi to which Xenacanthus properly belongs. If for instance, it should be discovered that Acanthodes belongs to the Ichthyotomi, (AMERICAN NATURALIST, 1887, p. 1016) the Xenacanthini and Acanthodini would be two of its primary divisions.

It is to be regretted that M. Brongniart was not better acquainted with the work done in America on this group, as he would have been thus spared the necessity of making some new names.—E. D. COPE.

CROLL ON MISCONCEPTIONS REGARDING THE EVIDENCE OF FORMER GLACIAL PERIODS. In a paper read before the Geological Society of London, January 23, 1889, Dr. James Croll made the following statement:—

The imperfection of the geological record is greater than is usually believed. Not only are the records of ancient glacial conditions imperfect, but this follows from the principles of geology. The evidence of glaciation is to be found chiefly on *land-surfaces*, and the ancient land-surfaces have not, as a rule, been preserved. Practically, the several formations consist of old sea-bottoms, formed out of material derived from the degradation of old land-surfaces. The exceptions are trifling, such as the underlayer of coal-seams and dirt-beds, like those of Portland. The transformation of an old land-surface into a sea-bottom will probably obliterate every trace of glaciation; even the stones would be deprived of their ice-markings; the preservation of boulder-clay, as such, would be exceptional. The absence of large, erratic blocks, in the stratified beds, may indicate a period of extreme glaciation, or one absolutely free from ice. The more complete the glaciation the less probability of the ice-sheet containing any blocks, since the rocks would be covered up. Because there are no large boulders in the strata of Greenland or Spitzbergen, Nordenskiold maintains that there were no glacial conditions there down to the termination of the Miocene period. The author maintained that glaciation is the normal condition of polar regions, and if these at any time were free from ice, it could only arise from exceptional circumstances, such as a peculiar distribution of land and water. It was extremely improbable that such a state of things could have prevailed during the whole of the long period from the Silurian to the close of the Tertiary.

A million years hence, it would be difficult to find any trace of what we now call the glacial epoch; though if the stratified rocks of the earth's crust consisted of old land-surfaces, instead of old sea-bottoms, traces of many glacial periods might be detected. The present land-surface will be entirely destroyed, in order to form the future sea-bottom. It is only those objects which lie in existing sea-bottoms which will remain as monuments of the post-tertiary glacial epoch. It is then probable that the geologist of the future will find in the rocks formed out of the non-existing sea-bottom more evidence of a glacial epoch during post-tertiary times than we now do of one, say, during the Miocene, Eocene, or Permian period. Palæntology can afford but little reliable information as to the existence of former glacial periods.

THE VERTEBRATA OF THE SWIFT CURRENT RIVER, II. In the NATURALIST for 1885, p. 163, the writer gave a brief account of the vertebrata of the above locality obtained by the Geological Survey of the Dominion of Canada. Explorations set on foot by the Director of the Survey, Dr. A. R. C. Selwyn, during the year 1888, resulted in the obtaining of a number of additional species, some of which are of considerable interest. In describing these, I will enumerate those already known from that locality. The specimens are generally in a fragmentary condition, owing to the conglomeritic nature of the deposit. The new material was obtained by Mr. T. C. Weston, of the Survey. The total number of species is seventeen.

PISCES.

Amia sp., numerous vertebræ.

REPTILIA.

Trionyx sp., Ann. Report, G. N. H. Survey, Canada, 1885, c. p., 79.

Stylemys sp. loc. cit.

MAMMALIA.

Rodentia.

Palæolagus turgidus Cope, loc. cit.

Bunotheria.

Hemiopsaldon grandis Cope, loc. cit., and American Naturalist, 1885, p. 163.

Ancylopoda.

Chalicotherium bilobatum sp. nov.

Founded on a mandibular symphysis and part of the left ramus of an adult animal, which contains the alveoli of the anterior four molars, and part of that of the fifth. All the premolars are two-rooted, showing that they are but three in number. Canines and incisors wanting, the anterior alveolar margin thin and little prominent, and bilobed, with a median emargination. Symphysis coössified, with an angulate inferior margin, posteriorly with a fossa on each side of the median line, sloping regularly upwards to the alveolar margin, and concave above behind the margin. Minute traces of alveoli of a canine and two incisors on each side, which were probably present in the fœtus. Length of symphysis above, 120 mm.; depth posteriorly, 48 mm. Length of symphysis in front of p. m. iii. Length of premolar series, 75 mm. Length of m. i., 40 mm.

Although this is the first announcement of the discovery of the genus Chalicotherium in America, it is not the first discovery. Professor Scott showed me a series of superior molars from the Loup Fork formation of Kansas, from the Agassiz Museum, which he identified as belonging to this genus. The present species is of larger size than the Kansas form, and is apparently equal to the *C. goldfussii* of the Upper Miocene of Europe. The occurrence of this form in the Lower Miocene (White River), as well as the Upper Miocene (Loup Fork), of this country, is a noteworthy fact, but is parallel to its history in Europe. Described from the upper Miocene by Kaup, it was afterwards found in the middle Miocene (*C. grande*) by Lartet, and in the Upper Eocene (*C. modicum*), by Gaudry.

The remarkable character of this genus, as discovered by Filhol, has been already mentioned in the NATURALIST.[1] It has little relation to the family of Perissodactyla, to which it has given the name, and which it so resembles in molar dentition. It must form a family by itself, and the genera with which it has been associated must form a family to which the name Lambdotheriidæ may be applied. The anterior ungual phalanges of Chalicotherium are of prehensile character and not ungulate, but rather unguiculate. The phalanges resemble those of the Edentata, but the carpus and tarsus are, according to Filhol, diplarthrous in structure, while the Edentata are taxeopodous. We have in the Chalicotheriidæ the antithesis of the Condylarthra. While the latter is ungulate with an unguiculate carpus and tarsus, the former is unguiculate with an ungulate (diplarthrous) carpus and tarsus. Thus

[1] Osborn on Chalicotherium, 1888, p. 728.

the Chalicotheriidæ must be referred to a distinct order of unguiculate Mammalia, which I propose to call the Ancylopoda, with the above definition. Two genera belong to the single family, the Chalicotheriidæ; viz., Chalicotherium Kaup, and Ancylotherium Gaudry. In the former, the phalanges are distinct; in the latter the first and second are coössified (Lydekker). Marsh has not yet shown how his genus Moropus differs from Ancylotherium. The species described by Marsh under this name are from the Loup Fork bed of Kansas.

Perissodactyla.

Haplacodon augustigenis, Cope, gen. nov. *Menodus angustigenis*, Cope, Annual Report, G. N. H. Survey, Canada, 1885. C, p. 81.

Char. gen. Additional specimens of the species described, as above cited, show that it cannot be referred to the genus Menodus, but that it belongs to the family Lambdotheriidæ (Chalicotheriidæ *olim*) as at present defined. It differs from all the genera of the Menodontidæ in the presence of but a single internal cusp of the first (posterior) superior premolar, a fact which renders it highly probable that the premolars which precede it in the maxillary bone, were similarly constituted. It differs from all other genera of Lambdotheriidæ and also from Diplacodon, to which it is allied, in the presence of but two inferior incisors on each side. It is not certain whether it possesses horns or not.

Menodus sp. Cope, Ann. Report, l. c. p. 83.

This species is allied to the *M. giganteus* Leidy, but whether identical or not can not be yet ascertained.

Anchitherium westoni sp. nov.

This species is represented by a single superior molar, and two inferior molars, the latter in place in a part of the mandible. The teeth are smaller than those of the *A. bairdii*, from which they also differ in their greater transverse as compared with their anteroposterior diameters. The intermediate tubercle of the posterior crosscrest is more distinct than that of the anterior, and the posterior intermediate cingular cusp, so prominent in the *A. bairdii*, is here wanting. The posterior cingulum continues round the internal base of the posterior internal cusp. Diameters of superior molar; transverse, 13.5 mm.; anteroposterior, 10 mm. Diameters of inferior molar; transverse, 8 mm.; anteroposterior, 10.5 mm. This species, interesting for its primitive character in the absence of the posterior cingular cusp, is dedicated to Mr. T. C. Weston, the explorer of the region from which these fossils were obtained.

Aceratherium mite Cope, l. c.

Aceratherium pumilum Cope, l. c.

Artiodactyla.

Hypertragulus transversus sp. nov.

Indicated by two superior molar teeth of old individuals. They are of nearly twice the linear dimensions of the only known species, *H. calcaratus* Cope. The external cusps are subconical, and the external rib which separates them in Leptomeryx is wanting here. Anterior cingular cusp small. The anterior bone of the posterior internal crescent enters the notch between the external cusps but does not fuse with either of them. Slight cingula on the anterior and posterior sides of the internal lobes which do not pass round their internal sides. No external cingulum. Diameters, anteroposterior, 12 mm.; transverse (at base) 15 mm. Crown very brachyodont.

Leptomeryx esulcatus sp. nov.

A single superior molar indicates this species, which is of about the dimensions of the *L. evansii*. It differs distinctly from this Tragulid, in the greater convexity of the external face of the external cusps, and the absence of the sulci which define an external median rib of that surface in the *L. evansii*. The rib which bounds the external faces of the cusps from each other is present. Anterior external cingular cusp small, continuous with anterior cingulum. No internal nor external cingulum. Diameters of crown; anteroposterior, 6.5 mm., transverse, 7.5 mm.

Leptomeryx mammifer Cope, Report, G. N. H. Survey, Canada, 1885, C p. 84.

Four superior molars add to the characters already derived from mandibular teeth as above cited. The median and anterior external cingular cusps are large and obtusely subconical. The anterior external cusp has a very strong median external rib, while the posterior has a very weak one. The anterior horns of the internal crescents are much produced; the posterior but little. The cingula are slight, and are not continued round the internal base. Diameters of superior molar; anteroposterior, 11 mm.; transverse, 11.5 mm.

Leptomeryx semicinctus sp. nov.

A large species possessing twice the linear dimensions of the *L. evansii* in the superior molar teeth, is represented by three of the teeth designated. In these the external crescents are more compressed and less conical than the two species above described, resembling more nearly those of the *L. evansii.* The posterior has a weak vertical rib; the anterior a strong one. The external cingular cusps are thoroughly fused with the external crescents, forming their anterior horns. The anterior horns of the internal crescents are a little more produced than the posterior. No external or posterior cingulum; a much interrupted anterior cingulum, which is continued round the internal base of the anterior crescent, which is further continued on the anterior side of the internal base of the posterior crescent. Enamel finely wrinkled. Diameters; anteroposterior 14 mm.; transverse, at base, 15 mm.

Oreodontidæ, an inferior first premolar.

Elotherium mortoni Leidy; l. c.

Remarks.

The continued scarcity of Oreodontidæ is matter of surprise. Their place is supplied so far, by an increased number of Tragulidæ (four species). The presence of a genus of Lambdotheriidæ, Haplacodon, increases the impression of antiquity of the fauna produced by the presence of a Creodont (Hemipsalodon.)

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Interbedded with the Tertiary schists of the western Cordilleras in Peru and Bolivia, are andesites, which are divided by Rudolph[2] into a western area of pyroxene-andesites, an eastern area of horn blende-andesites and a middle area of a variety intermediate between these two. The structure of each class varies from those types in which there is a devitrified glassy groundmass, to those in which the groundmass is microcrystalline. The plagioclase is andesin that has suffered alteration in the center because of the more basic character of this portion. The pyroxene-andesites contain augite twinned parallel to $P\bar{\infty}$, and also an orthorombic pyroxene with a cleavage parallel to $\infty P\breve{\infty}$ and a parting parallel to OP. Both augites have in some cases undergone alteration into bastite. By an increase in the amount of hornblende the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Miner. u. Petrog. Mitth. ix. p. 269.

pyroxene variety passes over into the typical hornblende-andesite through stages in which hornblende and pyroxene are both present, the amount of the one increasing with diminution in the amount of the other. The hornblende is often surrounded by an opacitic rim in which are frequently numerous little crystals of augite. Tridymite is both an original and a secondary constituent in all varieties of the andesites, with the exception of the dacites in the extreme eastern portion of the area studied, where the silica is in the form of opal and porphyritic quartzes. The biotite present in many specimens contains apatite and rutile inclusions regularly arranged, the former with their long axes perpendicular and parallel to the *c* axis of the mica, and the latter cutting each other at angles of 60°. The author describes the course of a silicification process which has taken place in some of the rocks, and also the eutaxitic structure noted in many of them.—Of the Andes mountains in Colombia four distinct ranges are recognized, viz: the Western, Central, Eastern and Coast Cordilleras. The structure and the rocks of the Central and Eastern ranges have recently been studied by Hettner and Linck.[1] In the former granite, gneiss, crystalline schists, diabase, dacites, andesites and clay slates occur. The crystalline schists and the slates are regarded as Archaean. In the Eastern range none of the younger rocks were found, except a tuff composed of andesite material. Among the older rocks found in this area may be mentioned a quartzite and a felsophyre.—In a beautifully illustrated paper on the rocks between the Province of Minas Garaes and São Paulo, in Brazil, Machado[2] describes the gneisses and the sedimentary rocks of the region, nepheline-syenite, quartz-augite-diorite and olivine-diabase. The last mentioned rock occurs in dykeform and presents no unusual features. The diorite forms a stock in the gneiss. It contains in addition to its essential constituents also hypersthene and scapolite. The most interesting portion of the paper is that devoted to the nepheline-syenites. These are pre-Devonian and form the plateau of Poços de Caldas. Three types are distinguished —a coarsely granular, a fine grained and a dense and porphyritic type. They all contain the same components, viz: orthoclase, nepheline, aegerine, biotite, sodalite and cancrinite (as a decomposition product of nepheline), and grade over into one another. Wollastonite, lovenite and epidote also occur in some specimens as accessory constituents. Darker fine

[1] Zeits. d. deutsch. geol. Gesell. XL. 1888. p. 205.

[2] Miner. n. Perog. Mitth. IX. p. 318.

grained varieties of the rock often appear as if included in lighter colored coarser grained kinds, the color of the two rocks depending upon the percentages of augite in them. The dense varietiesoften show a fluidal structure in the arrangement of little microlites of augite, and sometimes possess these in dendritic groups. Rutile is noted as an alteration product of sphene, and several unknown minerals are briefly described.—In an English summary at the end of his book[1] Reusch gives a description of the remarkable geological region of Norway where eruptive, sedimentary, vein and dyke rocks have had developed in them by the action of great pressure, a schistisity which was attended by chemical change in the original constituents of he rock masses. Through processes carefully described the author shows that granite may originate from clastic rocks and afterwards be intruded as an eruptive into other eruptive and clastic rocks in the form of dykes. Gneiss veins are said to be common in the region, and schistose gabbro, diabases and other basic rocks occur in great quantity. The book contains three colored maps and two hundred-and-five wood-cuts of geological sections and sketches of thin section of rocks. From his observations, Reusch draws some important conclusions which will probably explain many of the difficulties met with in solving the problems of the origin of crystalline schists.—A hornblende-peridotite[2] from a hill at the south foot of Kilimandjaro in E. Africa is an allotriomorphic granular aggregate of grass-green hornblende, salmon colored hypersthene and colorless olivine. The hornblende and olivine include rows of opaque rod-like bodies. The hypersthene is pleochroic as follows: a = salmon-red; b = pale yellow; c = sea-green. Pleonast and magnetite are among the other constituents.—A few small isolated patches of a green rock occurring just north of Aberdaron in North Wales, and colored as serpentine on the survey maps of Wales are regarded by Elsden[3] as serpentinized diabases. Unaltered diabases, hornblende-gabbros, and porphyrites from the same region are also briefly described by the author.—Mr. Wethered[4] has discovered well outlined quartz crystals in the insoluble residues of the Carboniferous limestones at Clifton, England, that have resulted by the enlargement of fragmental quartz grains by the deposition of silica derived from organic sources.—In the

[1] Bommeloen og Karmoen med. omgivelser geologisk beskrevne. Kristiania. 1888.

[2] Hatch: Geol. Magazine, May, 1888. p. 257.

[3] Geol. Magazine, 1888. p. 303

[4] Quart. Jour. Geol. Soc. May, 1888. p. 186.

course of a paper on the Huronian rocks from Sudbury, Canada, Bonney[1] describes altered feldspar fragments in a conglomerate, that have given rise to flakes of mica and interlocking grains of quartz. He points out that the same change on a larger scale might produce a gneiss—a result which has already been indicated by Van Hise.[2]—A rock composed entirely of a mosaic of hornblende and biotite is mentioned by Horton[3] as having been collected at Dosky Sound, New Zealand.—Jade has been found by Von Fellenberg[4] on the contact between limestone and serpentine on the Pizzo Lunghino, near the Maloja Pass in the Alps.

MINERALOGICAL NEWS.—In a Bulletin of the New York State Museum[5] F. L. Nason describes some fine crystals of brown *tourmaline* from Newcomb, Essex Co., N. Y. of *pyroxene* from Ticonderoga in the same county, and of some *calcites* collected by the late Prof. E. Emmons at Rossie, St. Lawrence Co. The brown *tourmalines* occur in Laurentian limestone, and present in general the features of the well-known Gouverneur mineral. They are associated with graphite, apatite, sphene, wernerite, quartz, zircon, muscovite, albite, tremolite, pyroxene and pyrite. Some of the crystals are of large size and others are so flawless as to have yielded fine gem material. A characteristic grouping is that in which a number of parallel growths are terminated at one end by a form common to the entire group, while at the other end each individual has an independent termination. Some of the *sphenes* exhale a feted odor when struck, and many of them include rutile needles with a distinct crystalline form. *Dipyr* crystals of large size are glassy or transparent and enclose crystals of sphene and opaque acicular inclusions arranged with their long axis parallel to the *c* axis of the dipyr. The *calcite* crystals from Rossie are remarkable for the fact that they are all twins. The most common twinning plane is $^{\circ}$P. Twins parallel to ∞ P are also quite frequent. Often trillings occur in which two of the crystals are twinned according to one law, and are twinned with reference to the third crystal in accordance with the second law. One set of rhombohedral faces is smooth and glistening while the second set is rough. The pyroxenes are from a vein

[1] ib. Feb. 1888. p. 32.

[2] Amer. Jour. Sci. xxxi. p. 453. AMERICAN NATURALIST, Aug. 1886. p. 723.

[3] Quart. Jour. Geol. Soc. Nov. 1888. p. 745.

[4] Neues Jahrbk für Min., etc., 1889. I. p. 103.

[5] No. 4. Aug. 1888. Albany.

of calcite in gneiss, which vein has been worked for graphite. These pyroxenes are sometimes eighteen inches in length and thirty-six inches in circumference, and exhibit a parting parallel to oP. The pyroxenes are thought to be older than the calcite but younger than the quartz with which they are associated.—Interesting parallel growths of *andalusite* and *sillimanite* are described and figured by Lacroix[1] from Ceylon and from a metamorphic rock from Morlaix, Finistère, France. In the former instance the two minerals are intergrown with their *c* axes parallel, and in addition two other series of sillimanite crystals cross the principal one at angles of 90° and 45°. The same author finds that *bamlite*, *monrolite*, *bucholzite*, *xenolite* and *wörthite* are either merely peculiar forms of sillimanite or impure varieties of this mineral.—Two *barium feldspars* from the manganese mines of Söjgrufran, Grythyttan, Sweden have been analyzed by Igleström.[2] The first is a red mineral and the second is white and transparent. Both are insoluble in acids. Their analyses yielded:

	SiO_2	Al_2O_3	FeO	MnO	BaO	MgO	CaO	Na_2O	K_2O
Red feldspar	61.90	15.80	5.00		9.58		1.30	.40	6.02
White feldspar	54.15	29.60			1.26		1.52	1.00	12.47

According to Des Cloizeaux the white mineral has the optical properties of albite.—The same mineralogist records the analysis of a clear straw yellow *pyrrhoarsenite*[3] from the same mine. Its composition corresponds to the formula 10 (Ca. Mg. Mn.)$_3$ $(AsO_4)_2$ + Ca_2 Sb_2O_7, and is:

AO_2O_5	Sb_2O_5	CaO	Mno	MgO
53.23	6.54	20.21	10.82	9.20

Gonnard[4] mentions the rare mineral *torbernite* as occurring in quartz veins cutting granite in the neighborhood of Charbonnières les Varennes, Puy-de-Dôme, France. Here are found also fine pseudomorphs of quartz after calcite, the formation of which is explained as having taken place in three stages. 1), by the coating of the calcite crystals by silica; 2), by solution of the calcite, and 3), the filling of the molds left with silicious material mixed with a little clay. Druses of smoky quartz crystals found in the same veins are thought to owe their color to bituminous matter which floated on the surface of the siliceous waters that yielded the quartz and colored those last formed (the druse crystals).

[1] Bull d. l. Soc. Franç. d. Min. 1888. XI. p. 150.

[2] Ib. XI. p. 26.

[3] Neues Jahrb. f. Min., etc. 1889. I. p. 48.

[4] Bul. d. l. Soc. Franç. d. Min. 1888. xi. p. 265.

Rare Minerals.—The interesting zeolite *beaumontite* which has heretofore been known only at Baltimore has lately been discovered by Schmidt[1] in the vacuoles of a pitchstone from Sweden (Mien See.) The mineral has the same habit as the Baltimore crystals. Its double refraction is weak and its optical angle large. The plane of its optical axes is normal to $\infty \mathrm{P}\grave{\infty}$ and parallel to the edge which this plane makes with oP. Schmidt can see no reason for regarding the mineral as anything more than a variety of heulandite.—Mr. Hanks[2] has given us an account of the occurrence of the rare mineral *Hanksite* from the vicinity of Borax Lake, San Bernardino Co., Cal. The best crystals have been obtained from a stratum of clay and sand underlying a two foot thick surface-layer of salt and thenardite, and from a second stratum of the same materials at seventy feet below the surface. These crystals are bounded by the planes oP, ∞ P, P, and 2P. When the basal plane is largely developed the crystals become hexagonal plates or columns. They vary in size from half an inch or less to three inches in diameter. Hanksite is known to occur also in the borax fields of Death Valley, Inyo Co., Cal., and at several localities in Nevada.—Recent investigations on the *bertrandite* from a pegmatite vein at Pisek, Bohemia, yield Scharizer[3] results differing slightly from those of Bertrand and Des Cloizeaux, who thought the mineral orthorhombic. Scharizer's measurements show it to be monoclinic with $B=90^\circ\ 28'\ 34''$ and $a: b: c=1.7793: 1: 1.07505$.

NEW BOOKS.—In the "FIRST REPORT OF PROGRESS OF THE GEOLOGICAL AND MINERALOGICAL SURVEY OF TEXAS,"[4] State Geologist Dumble gives a resumè of the rocks and minerals of economic importance existing within the boundaries of the State. Natural gas, petroleum, salt and coal are known to occur in large quantity within the boundaries of Texas, but the limits of the formations containing them have not yet been carefully mapped.—"A COURSE OF MINERALOGY FOR YOUNG PEOPLE,"[5] is a little pamphlet of sixteen pages which accompanies a collection of twenty-five common minerals. It is intended to aid young people in the determination of the most common minerals by teaching them to observe for themselves their most prominent characteristics. The

[1] Zeits. f. Kryst. xv. p. 573.

[2] Amer. Jour. Sci. 1889. Jan. p. 63.

[3] Zeits. f. Kryst. xiv. p. 17.

[4] Austin. State Printing Office. 1889.

[5] By G. Guttenberg, Erie, Pa.

book and the collection comprise the first portion of a course in mineralogy which has been arranged for the use of the Agassiz associations throughout the country. The price of the pamphlet and the twenty-five minerals which it describes is one dollar.—The principal formal and optical characteristics of the more important rock-forming minerals have been arranged by Rosenbusch[1] in sets of tables covering about twenty-five pages. The tables are of great convenience to students who are far enough advanced in the study of petrography to understand the significance of the terms used in them.

BOTANY.[2]

NOTES ON NEBRASKA LICHENS.—Our knowledge of the Lichen Flora of Nebraska is as yet very meager being confined principally to the work of Hayden and Hall during the Government Geological Surveys. Our knowledge, such as it is however, shows that our Lichen Flora has many interesting as well as instructive characteristics. There is a general dearth of the large eastern forms throughout the greater part of the state. There are, however, along the Missouri river and its tributaries, many forms that are found in the eastern states. The Flora of this region serves as a connecting link between the timber forms of the East and the prairie forms of the West. The prairie region has an abundance of earth forms such as Endocarpon, and many Buellias and Biatoras.

Many semi-mountain and mountain forms occur in the western and northwestern parts of the state. Beginning with the eastern border of the state and going west a gradual transition from timber forms to earth forms, is observable ; and from these to the forms usually found in higher altitudes as Umbilicaria, Omphalaria, and similar forms.—*T. A. Williams.*

AS TO THE CITATION OF AUTHORITIES.—That the effects of individual eccentricity when given room for free development are always striking, is well shown by the diversity of methods used by botanists in giving authorities for scientific names. In the good old days when but one name, that of the author of the combination, was cited, there was, at least, uniformity and hence some certainty. But the later method

[1] Hülfstabellen zur Mikroskopischen Mineralbestimmung in Gesteinen. Stuttgart. 1888.

[2] This department edited by Dr. C. E. Bessey, Lincoln, Neb.

of citing the author of the specific name and especially the introduction of the parenthesis has resulted in a confusion which is certainly "enough to throw a strong man into blue convulsions." The advantage of the old method is its simplicity. The common objection to it is that it does not give any credit to the author of the specific name. But credit and glory are not the objects in citing authorities; surely it is not the only office of the parenthesis to serve as a sarcophagus in preserving the names of botanists who might otherwise be forgotten. The true purpose is accuracy in determining the species meant. Plants are continually being described under names already occupied, and unless the name of the author is given it is impossible to know what species is meant. Now if one of two plants bearing the same name is put in another genus how, unless the authority is cited, is one to know whether it is a new species or one of the original two, and if so which? On this account it is a great convenience to have the name of the author of the specific name given also. There are several ways of doing this. Some cite the author of the specific name even after the genus has been changed, as if he were the author of the combination, *e. g.* "Hypoxylon colliculosum Schw"—Rav. Fung. Am. No. 742. (for H. colliculosum (Schw.) Nits.) No worse method could be thought of. According to this Sphæria colliculosa Schw and Hypoxylon colliculosum Schw" are evidently two distinct things and some investigation is of course necessary to establish their unity. Schweinitz did not make the combination Hypoxylon colliculosum, and to cite him for it is confusing and absurd. A slightly better method is to give the name of the author of the specific name in a parenthesis omiting that of the author of the combination, *e. g.* "Puccinia phragmitis (Schum.) Winter Pilze 179. This should be P. phragmitis (Schum.) Körnicke. But many, misled by the omission of a name after the parenthesis, have written P. phragmitis (Schum.) Wint., and then P. phragmitis Wint. while on the other hand we find P. phragmitis Körn. In a large genus of intricate synonymy like Puccinia how is one without investigation to know that all these are the same? Another very peculiar method has recently broken out which it is to be hoped will not get abroad; that is, to put the name of the author of the combination in a parenthesis after that of the author of the specific name thus: "Hicoria alba L. (Britt.). Bull. of Washb. Coll. Vol. II, No. 9. This of course if it gains any foothold will give rise to all manner of false citations.

There are only two methods which can be used without making endless trouble and confusion. If but one authority is to be cited, give the author of the combination. Consider accuracy and convenience rather than glory and justice so-called. If two are to be given, place the name of the author of the specific name in a parenthesis, and that of the author of the combination following, and outside. If, in this case, it seem strange to cite a botanist as an authority for a name he did not know, still it is in many cases the best way. For example, in the case of Lactarius plumbeus Fr.; if this is written L. plumbeus (Bull.) Fr., one knows that it is Agaricus plumbeus Bull. not A. plumbeus Schaeff, nor Mycena plumbea Fr. Again, Uropyxis petalostemonis De Ton. scarcely seems familiar. But any one can recognize in U. petalostemonis (Farl.) D. Ton., Puccinia petalostemonis Farlow. It may also be objected to this method, that in many cases it merely perpetuates worn out synonymy. But it is the only one which causes no confusion and indicates exactly the species meant. —*Roscoe Pound.*

A Question Regarding the Application of the Law of Priority.—The strict application of the law of priority to botanical nomenclature, raises several interesting questions. One of them is whether a specific name of the same etymology and meaning with its generic name should be retained. There seems no good reason why it should not, as long as they are not identical. Indeed botanists are doing this in the names of many Phanerogams, *e. g.* Echinocystis echinata (Muhl) and Larix laricina (D. R.). The author of these combinations gives Specularia speculum D. C., as a precedent, and Arctostaphylos uva ursi (L) is almost another. Among the Fungi there is Fomes fomentarius. There are two Fungi which offer excellent opportunities for doing the same, namely; Ramularia didyma Ung. and Cylindrium septatum Bon. Saccardo gives these as Didymaria ungeri corda and Septocylindrium bonordenii Sacc. But strictly according to the law of priority they should be Didymaria didyma (Ung.) and Septocylindrium septatum (Bon.) However strange these combinations appear, it would seem better as the great majority of specific names are arbitrary and without particular application, to apply the law of priority uniformly, than to make an exception for so slight a cause.—*Roscoe Pound.*

Of Generic and Specific Names too Nearly Alike.—Saccardo (in a note in Syl. Fung. V. p. 474) in commenting upon Winter's change of Cercospora pulvinulata Sacc. & Wint. to C. missouriensis Wint. on account of C. pulvinulus C. & E. reproaches him with admitting Nitzchia and Nitschkia. Saccardo changes the latter to Cœlosphæria on account of its similarity to the former—a genus of Algæ. This led me to investigate some of the names which Saccardo himself admits. He allows without hesitation Libertella Desm. and Libertiella Speg and Roum ; Licea Schrad., and Lisea Sacc. ; Dichaena Fr. and Dichlaena D. and M. : Pleospora Rabh. and Phleospora Wallr. ; Entoloma Fr. and Entyloma D. B. ; Riessia Fres. and Reessia Fisch. and Eriosphaera Reich. and Eriosphæria Sacc. Whether or not these are too nearly alike depends upon the taste and pronunciation of those who use them. To one using the English pronunciation, Licea and Lisea are indistinguishable. Besides these he admits many which are very much alike, but more defensible, as Arthrobotryum and Arthrobotrys, Urospora and Urosporium. He retains Antennaria Lk. in spite of Antennaria Gærtn., and even gives under the genus Marasmius the sections Collybia and Mycena, although there are the genera Collybia and Mycena in the same family.

As regards specific names : he necessarily admits many which are very similar as pulvinula and pulvinulata, flavus and flavidus, etc. In a large genus, new specific names are rather hard to get and one ought not to be too sensitive. But are not the following too nearly alike : Puccinia penstem onum, Lev. and P. pentstemonis Pk ; P. schileana Speg. and P. scheliana Thuem; P. scleroteoides Mont. and P. sclerotioidea Cooke ? The following in Vols. III. and IV. are certainly indefensible : Phoma pini C. and Hark. and P. pini Sacc.; Phyllosticta viticola Thuem and P. viticola Sacc. and Speg. Zygodesmus ochraceus Corda and Z. ochraceus Sacc., Cladotrichum fuscum Poeuss and C. fuscum (Grev) Sacc.; Cercospora fumosa Pewz. and C. fumosa Speg. These and some others in the two volumes mentioned have been corrected, but in such out of the way places that very few would notice them. Those in Vol. III. are corrected in a note at the close of the index ; those in Vol IV. in a similar note mixed in with corrections of typographical errors. For this reason I have given them. The following from Vols. V. and VI. have not, as far as I can find, been corrected : Polystictus stereoides Fr., and P. stereoides Berk., Fomes calignosus Ces., and F. calignosus Berk., Clavaria cervina B. & C., and C. cervina Sm., Polystictus cinerescens Schw. and P. cinerescens Lev., Stereum concolor Jungh., and S. concolor Berk., Clavaria coronata Schw. and C. coronata Zipp., Cyphella ravenelii B. & C. and C. ravenelii Sacc. This last he substitutes for C. fulva B. & C. to avoid C. fulva B. and Br. But the worst of all is in the genus Polyporus where there is, No. 303, Polyporus armeniacus Berk. Engl. Flor. V. 147. and also No. 215, P. armeniacus Berk. Hook. Journ. 197.—*Roscoe Pound.*

SOME EXPERIMENT STATION BOTANY.—A dozen or so of the bulletins issued by the Agricultural Experiment Stations contain matter more or less botanical in nature. From these the following notes have been rather summarily made.

In Dakota the growth of planted trees during the two years 1886 and 7 was watched and noted.—In Missouri forty "varieties" of grasses were grown and their deportment noted under certain local conditions.—In Kansas the observations upon grasses and clovers extending through fourteen years have been summarized and recorded in Bulletin No.2.—In Florida, the grasses have been grown and watched in like manner.—In Indiana, Professor J. C. Arthur (in Bulletin 15) describes popularly, but accurately, the structure of the potato tuber. The treatment of the subject is admirable and aside from its horticultural value the paper is of value and interest to botanists.—In Minnesota the Bulletin for July, contained a popular account of the organs of fertilization in plants with especial reference to the artificial pollination of cultivated plants.—The August bulletin of the Iowa station contained an interesting paper on corn tassels and silks, and a popular discussion of grasses and other forage plants. Mr. Crozier's notes upon the wild grasses of Northwestern Iowa are valuable, although some of the English names used by him are misleading and confusing. "Blue Stem" for *Agropyrum glaucum* and "Buffalo Grass" for *Bouteloua oligostachya* ought not to be tolerated.—In Texas, Bulletin 3 is devoted to popular notes on native and introduced grasses and other forage plants.—Bulletin 4, of the Minnesota station, devotes sixteen pages to "Fungi which kill insects," by Otto Lugger. The paper is a well written summary derived from various sources, with observations by Mr. Lugger, and is illustrated by nine cuts two of which are original.—The November bulletin, from the Iowa station, includes a short paper by C. P. Gillette on Chinch-bug Diseases (*Empusa* sp. and *Micrococcus insectorum*) and "Some Injurious Fungi" by Mr. Crozier. The latter are Apple Blight, (*Micrococcus amylovorus* Burrill.) Potato Rot (*Phytophthora infestans* DeBary,) Grape Rot (*Læstadia bidwillii* Sacc) and Ergot, (*Claviceps purpurea* Tul.) Mr. Craig contributes some notes on Promising Grasses of Montana, and Idaho, based upon personal observations made during a hasty trip taken at the suggestion of the Governing Board of the station.—In New Jersey, Mr. Hulst reprints at length from Worthington Smith's account in "Diseases of Field and Garden Crops," of Club-Root (*Plasmodiophora brassicæ* Wor.) Some personal observations are added.—Professor Kellerman makes a preliminary Report on Sorghum Blight (*Bacillus sorghi* Burrill) in the December bulletin of the Kansas station.—Otto Lugger in the January Bulletin of the Minnesota station, publishes a paper on "Frosted and Rusted Wheat," apparently being for the most part a compilation from various sources.—The Spotting of Peaches and Cucumbers is treated by Professor Arthur in the January Bulletin from the Indiana station. The disease on peaches is caused by *Cladosporium carpophilum* Thuem, and that on Cucumbers by *Cladosporium cucumerinum* E. & A. Figures are given of various stages of the fungi.

BACTERIOLOGY.[1]

THE BACTERIA OF SNOW.[2]—In many countries, during several months, snow forms the natural covering of the earth. Waste materials of all sorts, which collect in houses, etc., in many villages and small cities are thrown out directly upon the earth, and in the winter the snow takes the place of the earth in receiving and absorbing contaminating matters. In the spring, the water from the melting snow makes its way into the earth, carrying with it various impurities, some of which may be pathogenic. Whether any change takes place in them during the long time the snow lies upon the earth or whether they enter the earth unchanged, is a question of much importance.

According to the author of this paper, at the time of his writing, there was little or no literature concerning the bacteriology of snow. A number of investigators too, had worked on ice, but no where could he find any reports of examinations of snow. It remained uncertain whether its long stay on the earth changes the number or the character of the bacteria contained in it.

In the bacteriological examination of snow, it is obviously of first importance to secure it pure and free from accidental impurities, as it is often found, for example, on a large clear expanse. As it was evident that there would probably be a difference between snow which had lain long on the earth and freshly-fallen snow, the author made investigations of both kinds. Of fresh snow, some was caught, while falling, during

[1] This Department is edited by Prof. Wm. T. Sedgwick, of the Mass. Institute of Technology, Boston, Mass., to whom brief communications, books for review, etc., should be sent.

[2] "Ueber den Bakteriengehalt des Schnees," von Th. Janowski. *Centralblatt für Bakteriologie* IV, 547.

a snow storm, in a sterilized tube. The snow so taken was melted in a water bath at 30° C. and .5 C.C. of this melted snow mixed with nutrient-gelatin. From this, plates were prepared in the usual way. Other samples of the same snow were also planted, and an average of these showed pretty well how many bacteria were ordinarily contained in such snow.

To insure as exact results as possible, two samples of snow were always taken from different places, and as free from contaminating matters as possible.

From fresh, falling snow, the following results were obtained:—

Feb, 2, 1888. Average temperature, — 7.2°. C.
In the first sample 34 bacteria to 1 c.c. of melted snow.
In the second, 38.
Feb., 21, 1888. Average temperature — 11.1°C
In the first portion, 203.
In the second, 384.
Feb., 28, 1888. Average temperature — 12.2
In the first portion, 140.
In the second, 165.

Although these figures differ widely they nevertheless teach us something of the bacteriology of snow, and do not show wider differences than different examinations of ice, made by Fränkel, Prudden and others. A part of the bacteria found in snow are contained in the vapor when it crystallizes. Another, and the larger part, are filtered from the air by the cottony snow-flakes in falling. Consequently, the number of bacteria in the air must be much diminished, after a snow fall, and a true cleansing of the atmosphere appears to be accomplished, such as takes place during a rain. It is also clear that the cottony or wooly structure of the snow-crystal aids in producing this effect, in no small degree. Large differences sometimes noticed in like portions, might be due to the fact that during a snow storm, the snow may sometimes become mixed with impurities gathered from buildings in the vicinity, etc.

In studying snow which has been lying for some time Janowski took samples from the upper layers of snow which had fallen several days before, and which had since lain exposed to the air. In considering the results, it is important to know the range of temperature to which the snow was exposed. This was learned from the official weather reports at Kiew, where his investigations were made.

By means of a sterilized plate of glass he then removed the top of the snow, half a centimetre deep, on top of which the dust from the air rested. From the layer thus uncovered he took his samples and prepared plates as before.

Feb., 11. No snow since the morning before. Temperature during that time ranging from —8° to — 14°.

1st, in 1 c.c. snow water 2.

2nd, " " " " 4.

Feb., 15. No snow for four days. Temperature from —1 to —8°.

1st, portion 8 bacteria.

2nd, " 20 "

Feb., 24. Three days with no snow. Temperature between —11 and —21. Heavy frost.

1st portion 228 bacteria.

These figures seem to indicate that snow lying on the ground some time and exposed to low temperatures, always contains a considerable number of bacteria, and that the low temperature in winter exercises no considerable effect on the bacteria contained.

A number of different kinds of bacteria are contained in snow. Janowski found both those which liquefy gelatine, and those that do not, the former in larger numbers than the latter. He states that one point in particular interested him considerably, namely that he always found in plates from newly fallen snow, as in river water, many colonies which liquefy very rapidly while snow that has been long exposed to extreme cold contains few or none of these. He concludes that this kind, at least, is affected unfavorably by low temperature.—(*M. E. Dodd.*)

THE CHEMICAL ACTION OF CERTAIN BACTERIA.—A paper appeared in the *Journal of the Chemical Society* for August, 1888, by Robert Warington, on "The Chemical Action of some Micro-organisms." Some twenty of the organisms experimented upon were received as pure cultures from Dr. Klein, while six or seven others were isolated by the author himself. The action of these separate species was tested in four respects: 1. The hydrolysis of urea. 2. Action on milk. 3. Capacity for reducing nitrates. 4. Power of producing nitrification.

Warington finds that "the property of effecting the hydrolysis of urea is apparently but rarely met with among micro-organisms; in the present case, out of twenty-four organisms tried, only two could certainly be shown to possess it."

Of the action on milk he says: "The whole of the organisms which fail to gelatinise milk are organisms that do not liquefy gelatin. . . . On the other hand the whole of the organisms which act on milk as ferments liquefy gelatin. . . . We may venture therefore to predict that every liquefy-ing organism will be found capable of gelatinising the casein of milk."

As regards the reduction of nitrates, Warington states that out of twenty-five organisms seven were entirely without reducing power, one produced a mere trace of nitrite, and one only a very small quantity: the remaining sixteen reduced nitrates in broth, with considerable vigor. With the possible exception of one culture, the reduction to nitrites would appear to have occurred without the production of nitrogen, oxides of nitrogen, or ammonia.

The many investigations of the past few years on the relation of micro-organisms to the process of nitrification have met with little success so far as regards the isolation of a *specific* bacterium of nitrification. Warington's researches in this direction seem to have been little more fruitful than those of his predecessors. His experiments gave mostly negative results, and he concludes his paper with the observation: "An organism which nitrifies as soil nitrifies. has yet to be isolated."—(*E.O.Jordan.*)

BACTERIA, MICROBES, OR MICRO-ORGANISMS?—These terms are being used by various writers sometimes with precision but more often as synonyms. Etymologically "microbe" and "micro-organism" are equivalent terms, meaning simply "a little living thing." But "bacterium" meaning "a staff" is certainly not equivalent to the other two. An arrangement, perhaps as natural and simple as any, is to reserve the term *micro-organisms* for all forms of life which are so small that it is impracticable to study them to any great extent with the naked eye. "Micro-organisms" would then be a usefully indefinite term including many animals as well as plants, *e.g.* the protozoa, rotifers, many crustacea, indeed representatives of nearly every great group of invertebrates, diatoms, desmids, and other micro-algae, besides moulds, yeasts, bacteria, and other micro-fungi. The micro-organisms are only a general and very comprehensive group, divisible, for convenience, into two lesser groups.

These are, *1*, *the Microscopical* and 2, *the Bacterial micro-organisms.*

The *Bacterial micro-organisms* are those which are too small to be successfully studied individually and are best investigated in masses by special "cultures." They include the bacteria together with, perhaps, the yeasts and certain moulds.

The *Microscopical micro-organisms* are those which can be successfully studied by the microscope, individually, and without special "cultures." They include all animal micro-organisms, and all vegetal, excepting those just mentioned under the Bacterial division.

The term *microbe* may be left where it is now oftenest found,—in the newspapers.

The justification for such a classification as the above, is convenience, only. As a matter of fact quantitative ; estimates of the numbers of micro-organisms in any given sample of water, air, ice or snow, are of fundamental importance. At present the bacteria are estimated by cultures, and the other micro-organisms in ways entirely different.[1]

ZOOLOGY.

THE PHALANGES OF BATRACHIA SALIENTIA.—Professor Howes and Mr. Davies read a paper before the Zoological Society of London, Dec. 4, 1888, on the distribution and morphology of the supenumerary phalanges in the Anurous Batrachians. The authors described for the first time the primary mode of development of a supernumerary phalanx. They concluded that the same is in the Anura identical with the interphalangeal syndesmoses, and that the syndemoses and phalanges are derivatives of a common blastema. In its fully differentiated condition the structure in question was shown to be functional in receiving the direct thrust under the weight of the falling body in saltation; all the variations in structure being readily intelligible on that view.

The authors discussed the bearings of the facts upon classification and upon the broader question of the morphology of supernumerary phalanges in general. They showed that the facts of development indicated a probable intercalary origin of the latter from the interarticular syndesmoses; and that the numerical increase of the phalanges in the Cetacea may have been associated with the loss of ungues, somewhat similiarly to the way in which the multiplication of segments of the cartilaginous rays in the paired fins of the Batoidei would appear to have been connected with the disappearance of horny fin-rays.

The authors also showed that the Discoglossidæ alone among the Anura retained for life the undifferentiated syndemoses,

[1] "A new method for the microscopial Examination of water." See *Science*, Feb., 15, 1889.

and that this feature testified more forcibly than anything else to their low affinities. They also described a community of structure between the modified syndemoses in certain Anura and the apparatus of the knee-joint in Mammals, and urged that the facts were such as to necessitate a reconsideration of the morphological value of the latter.

EMBRYOLOGY.[1]

NEW STUDIES OF THE HUMAN EMBRYO.—M. C. Phisalix[2] gives a very complete account of a human embryo of one centimetre (two-fifths of an inch) long. The method of plastic reconstruction from a continuous series of sections is carried out for the entire embryo. The organs which receive special attention and reconstruction are the cranial nerves and nervous system, the disposition of the valves and septa of the cavities of the heart, the origin of the pancreas, and Wolffian bodies. Many points dealt with by His have been more fully elaborated or corrected by Phisalix. The reconstructions seem to have been carried out with great care and accuracy, that representing the relations of the cranial and spinal nerves from the side is very interesting; the same may be said of the reconstructions representing the alimentary canal and its appendages.

The origin of the pancreas from two distinct diverticula will be noted by specialists as a matter of interest The great length relatively of the bronchi at this stage and the acute flexure of the branchial region are very strikingly shown, while the crowding together of the branchial clefts and the diverticula from them which give rise to the thymus gland are admirably shown in their relation to adjacent parts. But as the memoir is hard to understand without the figures which accompany it, the reader is referred to the original for fuller anatomical details.

A curious fact is mentioned by the author in regard to the embryo described by him, viz., its want of perfect symmetry, though believed to be perfectly normal. The left side, especially the region of the cerebral vesicles, was found to be larger

[1]This Department is edited by JOHN A. RYDER, University of Pennsylvania, Philadelphia.

[2]*Etude d'un Embryo humain de* 10 *millimetres.* Arch. de. Zool. Expr. 2 me Ser. vi. 1888. Nos. 2 et 3. pp. 280–350, planches xiii–xviii and figs. A.–F. in text.

than the right. The author asks, is this embryonic asymmetry peculiar to man? And also, does it bear any relation to the functional predominance of the right side over the left in the adult. This memoir is a valuable one, as it supplies a thorough study of one very important stage of the human embryo, and is a very creditable continuation of the work of His and Fol in the same direction.

ON THE DEVELOPMENT AND FIRST TRACES OF THE ANTERIOR ROOTS OF THE SPINAL NERVES IN SELACHIANS.[1]—This last of Prof. Dohrn's studies forms chapter xiv. of the *Studien zur Urgeschichte des Wirbelthierkörpers*; it is most suggestive as is all of his work. The problem of the origin of the anterior or motor roots of the spinal nerves has given rise to a great deal of speculation and discussion. It has been the good fortune of Dohrn to find in embryos of *Mustelus* and *Pristiurus* 3 mill. 5.5 mill. and 10 mill. long, conditions of the development of the anterior or motor roots which are of great importance.

1. The motor roots grow out at the lower angles of the medullary tube before the appearance of the white matter of the cord as conical or more or less produced extensions of the plasma of that tube. At first these roots contain absolutely no nuclei, but are simply homogeneous pseudopod-like processes.

2. Mesodermal cells next approach and sink into these plasmic processes. These probably have something to do with the development of the primitive sheaths of the future nerve fibres.

3. These plasmatic ventral processes from the medullary tube now blend over the extent of their outer surfaces with the still undifferentiated plasma of the adjacent cells of the protovertebræ or somites. Junction of the motor portion of the nervous mechanism with the tissue still to be converted into muscle is thus found to have taken place before even the formation of true nerve fibres or of muscular fibrillæ.

4. The next step in the differentiation of the motor roots is the migration of medullary cells into the above mentioned plasmatic processes from within the walls of the medullary tube. This seems to be conclusively established by the fact that the nuclei of medullary cells were seen in process of division at or within the bases of these processes.

It seems to be thus conclusively established that of the prim-

[1]Ueber die erste Anlage und Entwickelung der motorischen Rückenmarks nerven bei den Selachiern. Mitth. aus d Zool. Stat. zu Neapel. viii. 1888. pp. 441—461. Taf. 22.

itive constitution of motor nerves, neither fibres nor sheaths form a part. Neither are axis cylinders or medullary substance developed. End-organs or terminal branching ramifications of the nerve fibres do not as yet exist, but the capacity for their development is probably inherent in the simple structures and relations above described. The relations described by Dohrn are strongly opposed to the theory of the *ab initio* continuity of nerve and muscle by impalpably fine fibres, and if fully established fatal to Hensen's doctrine. It is needless to add that, while these new results are not wholly in accord with those of Balfour, they will probably serve to complete the true doctrine of the development of the spinal and cranial nerves, the foundations of which were first laid down by that remarkable investigator.

THE MATURATION AND FERTILIZATION OF THE EGG OF PETROMYZON PLANERI.[1] A. A. Böhm in this extended memoir gives a very complete resumè of the work of his predecessors upon the early history of the eggs of the lamprey. The formation of the polar globules is described, and the peculiar manner of union of the segments of the female and male pronuclei are illustrated. It seems that the chromatin substance of the head of the spermatozoon in this process always first breaks up into about four rounded segments or *spermatomerites* as Böhm calls them, which remain for some time lying close together in a straight or curved row.

PHYSIOLOGY.[2]

INHIBITION IN MAMMALIAN HEART.—Professor McWilliam continues[3] his work on cardiac physiology by a study of the phenomena of inhibition in the mammalian heart.[4] The results are given in considerable detail, and can be discussed here very briefly only. The effects of the stimulation of the vagus nerve on the auricles and on the ventricles are in general similar, consisting

[1] *Ueber Reifung und Befruchtung des Eies von Petromyzon planeri,* Arch. f. mik. Anat., xxxii. 4 Hft. 1888. pp. 613—670. Taf. xxiv—xxv.

[2] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[3] See AMERICAN NATURALIST, Jan. 1889.

[4] *Journal of Physiology*, vol. 9., p. 345.

of a slowing of the rhythm, and a depression of both the contraction force and the conduction power of the muscle; but the functional relation of the vagus to the ventricle is not nearly so close and intimate as to the auricle. The condition and working of the auricular muscle are much more readily and more profoundly altered than are those of the ventricular muscle. Augmentation, following the depression, as has been pointed out for the cold-blooded animals, is slight and inconstant, which would seem to be in opposition to Gaskell's idea of the vagus being an anabolic nerve. Section of the vagus causes in addition to the acknowledged acceleration of beat a marked augmentation in the contraction force of both auricles and ventricles. As has been pointed out in cold-blooded animals, the author finds a local inhibitory area to exist in the mammalian heart, *i. e.*, a limited area, stimulation of which affects the ventricle in exactly the same way as stimulation of the vagus does. In the cat and dog this region overlies the auricular septum on the dorsal aspect of the auricles. The vagus fibres pass through or near it, but it evidently contains structures differing from the vagus in regard to excitability, relations to curari and certain other influences. While normally stimulation of the venous terminations or of the auricles causes an acceleration of beat, under certain abnormal conditions, *e. g.*, in a dying heart, such stimulation results in inhibition, thus indicating under such conditions a reversion to a physiological type normally obtaining in hearts of certain lower vertebrates.

MEETING OF AMERICAN PHYSIOLOGICAL SOCIETY.—The American Physiological Society held its annual meeting in Philadelphia, December 29 and 31, 1888. The laboratories of the Jefferson Medical College and the University of Pennsylvania were inspected, and laboratory methods were informally discussed. The following papers were presented:

1. E. T. Reichert.—"The Excitability of the Different Columns of the Spinal Cord."
2. E. T. Reichert.—"The Rate of Transmission of Nerve Impulses."
3. E. T. Reichert.—"A New Calorimeter."
4. J. W. Warren.—"On Sensory Reinforcements of the Knee-Jerk."
5. H. H. Donaldson.—"On the Changes in Ganglion Cells Due to Stimulation."
6. H. N. Martin.—"The Lethal Temperatures of the Cat's Heart."

7. H. N. Martin.—"The Influence of Light on the CO_2 Excretion of Frogs Deprived of their Cerebral Hemispheres."

The Council for 1888-9 consists of S. W. Mitchell, President; H. N. Martin, Secretary and Treasurer; H. P. Bowditch, J. G. Curtis, H. C. Wood.

Dr. S. Weir Mitchell placed at the disposal of the Society the sum of two hundred dollars to be offered as a prize for researches on the rate of transmission of nerve impulses in man, such researches to be completed at the end of two years.

PHYSIOLOGICAL PRIZE.—In accordance with the offer of Dr. S. Weir Mitchell to the American Physiological Society, the latter Society now formally offers to residents of North America the prize of two hundred dollars for researches bearing on "the rate of transmission of nerve impulses—afferent and efferent—and the duration of reflex and reaction time in the higher animals, especially man; also the conditions—normal and pathological—which alter such rates and times." The work must be done between Jan. 1, 1889 and Oct. 1, 1890. Further information may be obtained of Prof. H. Newell Martin, Baltimore, Maryland: Johns Hopkins University.

PROPOSED INTERNATIONAL CONGRESS OF PHYSIOLOGISTS IN 1889.—In accordance with the circular issued by the English Physiological Society, a meeting was held in Berne, Switzerland, in September, 1888, to consider the advisability of holding, during the present year, an international congress of physiologists. England, France, Germany, Italy and Switzerland were represented. It was decided to hold such a congress at Basle, beginning September 10, 1889. The subjects to be brought before the meetings include Anatomy, Histology, Physics, Chemistry, Experimental Pathology, and Pharmacology, in so far as they bear directly upon Physiology. All communications are to be as little formal and as fully demonstrative and experimental as possible. Professor Miescher and the Department of Education of the City of Basle have cordially approved the project. The committee of the English Physiological Society has been continued with executive powers to organize the Congress, and through a circular requests information concerning probable attendance, titles of intended communications, and details of apparatus required for demonstrations. American physiologists intending to be present may notify Dr. H. P. Bowditch (till July 1st), Harvard Medical School, Boston, Mass; (subsequently) care of Knautt, Nachod & Kühne, Leipzig, Germany.

MICRO-ORGANISMS AND DIGESTION.—The extensive researches which are now being carried on in regard to the relations of bacteria to disease increase our interest in any addition to our knowledge of their connection with the normal activities of the body. Drs. Harris and Tooth, of St. Bartholemew's Hospital, have undertaken a series of experiments to investigate the relations of micro-organisms to digestion, and have published a preliminary communication on the subject.[1] They find it easy to prove that proteids can be digested by pepsin independently of micro-organisms, but have not succeeded in establishing the converse proposition, namely, that micro-organisms can of themselves convert proteids into peptone. In experimenting with trypsin it was found necessary to employ antiseptics in order to make sterile experiments. With mercuric chloride, 1 to 2 per cent. neither peptone nor bacteria appeared, with carbolic acid, 1 to 2 per cent. peptone was abundant but bacteria absent; while iodine interfered neither with the digestion nor the development of bacteria. It was thus proved that the pancreatic ferment, like the gastric, can digest proteids without the aid of micro-organisms.

It was found that the formation of leucin and tyrosin is probably due at least in part to the action of bacteria, and that the formation of indol seems to be entirely dependent upon it. The results of experiments indicate that there are special indol-forming organisms, in the absence of which this substance does not appear.

These conclusions are in substantial accord with views which have been previously entertained, though hitherto they have been accepted without adequate experimental proof.—*M. A. Johnson.*

PSYCHOLOGY.

OBSERVATIONS ON PUTORIUS VISON.—On July 6, 1887, while engaged in geological work on the Cedar River, near Osage, Iowa, my attention was attracted by the peculiar actions of a Mink (*Putorius vison.*) By careful maneuvering, we were enabled to approach to within a short distance of where it was engaged, and there watch its behaviour unobserved. It was an old mother Mink engaged in fishing, for her young.

[1]Journal of Physiology, vol. 9, No. 4.

On the ripples in the center of the stream, where the water was not more than two feet in depth, was a flat Drift Bowlder rising a few inches above the surface. On this rock the mother Mink would take her position, and here watch for small fish to approach, when she would dive into the water, be gone for a moment, and then reappear on the opposite side of the rock, usually with a fish in her mouth, which she would deposit in the center of the stone, and its struggles instantly stop by a quick sharp bite back of the head, which caused immediate death. This process was repeated without intermission, except to stop for an instant to shake the water from her furry coat, until seven fish varying from four to seven inches in length, were deposited on the rock. Then, without stopping to rest, taking one of the fish in her mouth, she plunged into the stream and swam to the shore, climbed the steep bank and ran hastily to her young, in a burrow under an old stump on the bank of the stream, fifty yards away. In a moment she was seen returning, plunged into the stream and swam to the rock, took a second fish in her mouth, entered the river once more, and returned to her young as at first.

This was repeated until all the fish had been carried away. A few moments after having removed the last fish, she returned and began her work once more. This time, however, her labors were without result, so, shifting her position to another rock in the stream, a short distance away, she continued her fishing. But although more than a quarter of an hour was spent in energetic effort, her labors were without avail, and she was this time compelled to return to her young "empty handed."

After waiting for some time, we crossed the stream to examine the burrow, but before going half way, the old Mink was met returning to her fishing ground. From the bank of the stream, where egress from the water was made, to the burrow, fifty yards distant, a well beaten path had been formed by the mother Mink in her daily excursions in quest of food for her young. Not wishing to destroy the burrow (which would have been necessary) the number and condition of the young was not ascertained. How long this Mink had been engaged in fishing before our attention was attracted to her, or how long it would have been continued, had she been undisturbed, it is difficult to say. But it is true that a degree of parental love and affection, (if we may so term it,) was evinced by the mother Mink for her young, in thus so indefatigably laboring, under a scorching July sun, to procure them food, as it is but rarely witnessed.—*C. L. Webster.*

A PECULIAR HABIT OF THE BLACK BASS.—I once observed a singular race between a Black Bass (*Micropterus dolomieu,*) and a soft shelled Turtle (*Aspidonectes spinifer*) and her young. The first noticed was the old Turtle and her young swimming steadily up stream, turning neither to the right hand or to the left, (an unusual occurrence, so far as my observations extend,) and closely followed by a large Black Bass. Both the mother Turtle and her young appeared very much exhausted, and would very often come to the surface for air. The young Turtle, if not disturbed would swim close behind its mother, but the Bass, who was always hovering *over* or following a foot or so in the rear, would often make a lunge for the young one, and apparently bite it, which would cause it to instantly dart *under* its parent, and swim in this position until compelled to come to the surface to breathe. The young one finally became so exhausted and worried by the Bass, that at three different times it was observed to lay hold of the edge of its parent's shell with its mouth, and thus compel her to take it in tow. Not the slightest attention was paid to the young one by its parent.

Several times two or three Red Horse ?(*Moxostoma macrolepidotum,*) attempted to join in the chase, but was each time immediately driven away by the Bass. This performance was watched some time by me, and when the trio was last seen, the "play" was still going on.

We have at other times and in other places, observed this Turtle to be followed by Black Bass. This has also been observed by Dr. Kirtland, (Geological Survey of Ohio, Vol. IV, Zoology and Botany, P. P. 668—669.) Whether the Black Bass is a natural enemy of this species of Turtle, or what its real intention may be in so often following it, we are at present unable to say.—*C. L. Webster.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOMETRY.—Anthropology in its literal sense is Man Science. It deals with the structure, history and development of men. The complexity of man in nature gives birth to many sciences. Some of these are old and some are new.

1. This Department is edited by Thomas Wilson Esq., Smithsonian Institution, Washington, D.C.

By their aggregation or consideration there was born a new science absorbing all the others, forming a harmonious whole, the substance of which is the natural history of man, and the name, Anthropology.

Notice the complexity of the subject and when the science comes to be divided into its distinctive parts, each of which is large enough to form (and in times past some of these have formed) a science in itself and given ample scope to the student for a lifetime.

1. Antiquity of man.
2. Origin of man.
3. Man's place in nature.
4. The races of mankind.
5. Language.
6. Development of Civilization.
7. Anatomy and Physiology of man.
8. Anthropometry or the measurement of human attributes whether physical or mental.
9. Psychology and Biology.

In former times, Archæology, classic, or otherwise, assumed control over much that has now been absorbed in Anthropology. The distinction between the two sciences is at present well defined, and they are now represented by different organizations.

Folklore and numismatics are powerful aids to Anthropology, insomuch that the student of one involuntarily becomes interested in the others. I predict their final absorbtion by the larger and more comprehensive science.

Numbers 1, 2, 3 and 8 in the foregoing list are new sciences. Their names may not be new, but they have, within the past few years, outgrown their former surroundings—burst their shell, so to speak, and now have assumed a position as part of the great science of Anthropology. The novelty of the antiquity and origin of man will always render this study attractive. They will always find their students and devotees. They deal with, that which to us are the great mysteries of the universe; the Whence, the How, and possibly the Whither, of the Human Species.

But number 8 is in danger of neglect at the hands of scientists. It is not attractive. It requires the utmost precision and care. Its results must be recorded, with all their errors. These may be detected in future investigations, and thus return to torment their originator. The work consists largely of dreary wastes of figures carried out to fractions of thousands, registered in a (to us) foreign system—the metric; and whatever of interest it may have, that of comparison, either with its own race or with others, does not commence until the future. So it has come to be neglected; but its importance to a study of Anthropology, which shall be at once scientific and valuable, cannot be overestimated. To the doubter of this proposition I propound the following question: How can you determine the different races of mankind except you consider the difference of size, color, form and capacity. And how can this be done without Anthropometry?

The number of divisions into which it has been proposed, at different times, and by different scientists, to separate mankind has ranged from two to sixty. The five great divisions which we were taught as children have been broken up and the later scientists have proposed but three, to which they have given Greek names signifying the particular attributes assigned to each group, instead of the geographical terms formerly employed.

Leucochroi—represented by the Europeans.

Mesochroi—by the Mongolian and American Indian.

Melanochroi (Huxley) or Æthochroi (Dallas)—by the Negro and Australian.

The basis on which this classification has been made is as follows:

1. Statue and comparative height of different parts of the body.
2. Color of skin.
3. Color of hair and eyes.
4. Index, Cephalic.
5. Index, nasal.
6. Cross section of hair.
7. Shape of nose, and in certain cases (to be determined after death), of the pelvis.

From these facts given in figures with the necessary precision, aided by a study of his language, the scientist determines to what division of mankind the individual who is under examination belongs. But I ask how can these facts be gathered except by use of Anthropometry?

This new science of Anthropometry has grown so that what was before unthought of, and perhaps supposed to be unattainable, is now within the commonest demands. The time was when the stature and weight of the human body, the diameter and cubic capacity of the human skull, and the weight of the brain, were about all expected from Anthropometry. But an extended consideration shows that there is little in the Science of Ethnology, in the study of physical difference between the races of mankind or the individuals thereof, which Anthropometry may not aid in clearing or defining.

Think of the physical differences in the various races of mankind in the present day—take the Western Hemisphere, and beginning at the north, compare the physical differences susceptible of accurate measurement between the Eskimos, Aleuts, Innuits, the North American Indian, the Aztec, the Peruvian, the Patagonian. A moment's consideration will carry conviction that accurate measurement would go far in establishing the dividing line between these races. As to the like benefit among our present Indians, in deciding between different tribes, I offer no opinion, but in obtaining by Anthropometry their status as a race, for comparison with other races, and so fixing their relative position as an Ethnologic group, I have no doubt as to the benefit, and that the work if done would receive the approval of the scientific world. Especially is this true since the combination of the American Indian in the same grand division with the Mongolian. I know of no method, except by Anthropometry, that the comparison between these two peoples can be made with precision; or by which they can with certainty be assigned to the same grand division. This comparison cannot be made by the measurement of a few isolated cases in either continent. The measurement must be of groups of individuals sufficiently large and numerous to establish the peculiarities of the entire people.

This application of Anthropometry to the American Indian falls naturally to the scientist of the United States. None other can do it, and our national pride should say that none other be permitted to do it. If this is a proper work, and worth the doing, it should be done by us. We should here apply the Monroe doctrine of politics. If not done, it should not be because it was neglected, or forgotten; but because we decide it not to be worth the labor and expense, and in this we must justify ourselves in the eyes of the world.

I venture with diffidence the suggestion that the present tried corps of Ethnologic explorers among our Indians might add to their present field duties that of Anthropometry. The corps is already organized and the labor, trouble or expense would be but slight compared with what it would be if a new corps had to be organized. The expense would only be for instruments and tables. The men could receive instructions in the needed manipulations from competent professors before starting. With small practice they could soon master the art, and learn to measure the human body with celerity and precision, and to record the results with certainty. Of course, the collating these results would be done after their return home by others. The proper professors would afterwards determine the conclusion established by this aggregation of facts.

So important has this science of Anthropometry been considered in Europe that one of the most studious, learned and enthusiastic professors of Anthropology in the world—he who probably stood nearest its head—Paul Broca, devoted himself principally to the study and practice of Anthropometry; he developed the system which bears his name, and his fame stands principally upon his services in this branch. The Societè d'Anthropologie at Paris endorsed his system, published his instructions as its own, and now the world has almost entirely adopted it as the basis of Anthropometry. The necessity of uniformity is so apparent that each country, one after the other, has finally adopted the metric system of measurements, England, I believe the last.

This Societè established, many years ago, a permanent course of lectures upon this subject; one each week during the scholastic year. Broca was the lecturer during his lifetime. This course is still continued and is now in the hands of Broca's successor, Dr. Manouvrier. Anthropometry is thus assigned a place equal in dignity with any other of the branches of the science.

Dr. Paul Topinard is now devoting himself to a work with a duration of many years, of making a chart of all France according to the color of the hair and eyes of the inhabitants. Mr. Francis Galton of London, has been engaged for years upon the work of "Heriditary Stature." He established an Anthropometric Laboratory at the Health Exhibition in London, 1883, where each individual could be measured, weighed and tested in all his parts, the record being furnished him and a duplicate being kept for scientific use, all for 3d. 10,000 people were measured. This system has been continued during subsequent exhibitions—the Fisheries, Colonies, Inventories, &c., and the South Kensington Museum has adopted it permanently. Mr. Galton reports that demands have been made from many places throughout the world for lots of machinery. I listened with much satisfaction to his address on this subject as President of the Anthropological Section of the British Association for the Advancement of Science at Aberdeen in 1885. He then stated the problem which he sought to elucidate; given a group of men, or a single man of any certain and known stature, and ignoring every other fact, what may be the probable average height of the brothers, sons, nephews and grandchildren respectively, and what proportion of these will probably range between any two specified heights? He found the average height of man in Great Britain, at what he calls the "level of mediocrity" to be 5 feet 8¼ inches. He was able to transmute female to male heights by multiplying by 1.08, or as he says, to state it roughly, add one inch to each foot He established the ratio of height between brothers, between father and son, uncles and nephews, between grandfathers and grandchildren, and calculated the probability for the future. He proved that with all the certainty of divergence in height in individual cases, there was a law which tended to bring the whole people towards their mean level—that the progeny of tall men grow shorter and that of short men taller. And he adds the important fact derived from his study of "Hereditary Genius," that the peculiarities of mankind, say of Genius, follow the same rule. This rule seems reasonable and wise, otherwise while the children of the good people would become "very, very good," yet those of the evil people would become even worse than "horrid," and as the evil are numerical by greater, the world, but for this rule, would soon be given over entirely to evil.

The Societè d'Anthropologie at Paris has issued a full set of instructions adapted to nearly all parts of the world.

General instructions are printed with particular instructions for France, for Australia, Algeria, Peru, Senegal, Mexico, Chili, Sicily, the Red Sea, Cambodia, Central Asia, Maylasia, Madagascar, each separate, but together forming a volume of not less than a thousand pages. Travelers to any of these countries are recommended to provide themselves with these instructions and the necessary instruments, and take observations to be reported back to the Societé. The same general course has been pursued by the principal societies in Europe. I will not attempt to give even a list of the reports made in accordance with these recommendations, such would be so incomplete that it would mislead rather than inform the reader. But it may be summarized by saying that about all we know *with certainty in figures* of the physical characteristics of the various peoples of the world we know from these sources.

I give a sample of the information thus received, a resumé of the report made by Surgeon H. B. Guppy of his visit to the Solomon Islands. He operated upon 72 natives and gives the tables of measurements in every part of the body. His resumé of the physical characteristics of the average Solomon Islander is as follows: (*Anthrop. Institute*, Vol. XV, p. 281.) "Such a man would have a well proportioned physique, a good carriage and well-rounded limbs. His height would be about 5 feet, 4 inches; his chest girth between 34 and 35 inches and his weight between 125 and 130 pounds. The color of his skin would be a deep brown, corresponding with number 35 of the color-types of M. Broca. * * * The form of his skull would be Mesocephalic. The proportion of the length of the span of the extended arms to the height of the body, taking the latter as 100. would be represented by the index 106.7. The length of the upper limb would be exactly the one-third the height of the body, and the tip of his middle finger would reach down to a point about 3½ inches above the patella. The length of the lower limb would be slightly under one-half 49-100 of the height of the body, and the relations of the lengths of the upper and lower limbs to each other, would be represented by the intermembral index 68.

I grant at once that there are other branches of Anthropology in the United States which have pressing needs for study. The Indian is said to be in progress of extinction like the buffalo, and unless he can be studied soon, in his language, art and industry, it will be too late. This argument for immediate action is all powerful, and should move the United States to all possible exertion. But I submit that it applies with equal force to Anthropometry. If not now, or soon, measured in their groups of tribes, it will be too late. Extinction or mixture of blood between different tribes or with whites would be equally fatal to Anthropometry.

Some of those who have studied the subject most, believe in an identity of race between the North American Indian and the mound-builders of prehistoric times. Anthropometry would be a powerful assistant in proving the fact.

I should much like to see Anthropometry practised upon our native tribes, whether Eskimo, Innuit or Indian, now while we have such splendid opportunities, by means of numerous examples and continued tests so extended and applied to groups of sufficient numbers, as that the physical peculiarities and attributes of each race or tribe might be established upon a scientific basis with mathematical accuracy, and which would be so complete as to be accepted by all the world. For this great subject the United States possesses peculiar facilities.

These would furnish means of comparison between them and all other tribes, races and peoples, whether modern, ancient or prehistoric. I have wondered often that this most feasible and certain evidence has never been sought by the believer in identity of the North American Indian with the lost tribes of Israel.

The prehistoric race of men in Europe and America belonging to the paleolithic age—the river drift man and the cave dweller—were of much greater antiquity that the mound-builders of the United States, and the savants of Europe seem now to be of the mind that he passed, whether by land or sea is immaterial, to America, and that the Western Hemisphere is peopled from this stock. They think they can trace similarities of implement, art and industry in the present race of Eskimos. How much it would add to the solution of the question to have the physical status of each and all these tribes settled by Anthropometry.

The scientific value of anthropometry is for comparison between different individuals, or tribes, or races of people. In order to accomplish this comparison the measurement must be accurate and done by the same system among all nations. If different systems be employed, the comparison cannot be made with certainty. The tendency of the American mind to invent new systems should be here repressed and we should adopt as universal the metric system of measurement.

Ancient Mounds at Floyd, Iowa.—On the west side of the Cedar River, one half mile east from Floyd, Iowa, are located a group of three ancient mounds. These mounds, instead of being located on the highest eminence in the region, as is most usually the case, are arranged in a slightly curved line, on a high but level space, fifty feet above, and two hundred and twenty yards back from the stream, and midway between two points (from fifty to sixty rods from each) which face the river, and rise from twenty-five to fifty feet above this level space. The ground, between the mounds and the Cedar, has a rather gently sloping surface. At this point the stream makes a bend to the east, and the mounds thus occupy a position on the south side. The north side of the stream is occupied by a steep, and somewhat broken, wooded bank, which affords a limited though beautiful bit of scenery to this place.

This area, as well as the surface of the mounds themselves, was originally possessed by a heavy growth of timber, but which was cleared away more than twenty years ago and the soil kept under the plow ever since. These mounds are low and circular, and twenty feet distant from each other. The east, or largest mound, is thirty feet in diameter, and was originally two feet high (so reported by Mr. Sharkey, who first cleared, and still owns the tract) although owing to degradation by the plow now rises only one and one half feet above the surface of the ground surrounding the mound. The two remaining mounds are smaller and lower than the first one. The third mound—there may be some slight doubt expressed regarding its origin, for the reason that in the south portion of it there is imbedded a drift bowlder, weighing some seven or eight hundred pounds. This, however, may have been placed here by human hands in the long ago, or the mound may have been an intrusion upon the stone. A partial exploration of the two smaller mounds was made, but without discovering anything.

In making a thorough exploration of the larger mound, however, the remains of five human bodies were found, the bones, even those of the fingers, toes, etc., being, for the most part, in a good state of preservation. First, a saucer or bowl-shaped excavation had been made, extending down three and three-fourths feet below the surface of the ground around the mound, and the bottom of this macadamized with gravel and fragments of limestone. In the centre of this floor, five bodies were placed in a sitting posture, with the feet drawn under them, and apparently facing the north. First above the bodies was a thin layer of earth; next above this was nine inches of earth and ashes, among which was found two or three small pieces of fine-grained charcoal. Nearly all the remaining four feet of earth had been changed to a red color by the long continued action of fire.

All the material of the mound, above and around the bodies, had been made so hard that it was with great difficulty that an excavation could be made even with the best of tools. The soil around the bodies had been deeply stained by the decomposition of the flesh. The first (west) body was that of an averaged sized woman in middle life. Six inches to the east of this was the skeleton of a babe. To the north, and in close proximity to the babe, were the remains of a large, aged, individual, apparently that of a man. To the east and south of the babe were the bodies of two young, though adult persons. The bones of the woman, in their detail of structure, indicated a person of low grade, the evidence of unusual muscular development being strongly marked. The skull of this personage was a wonder to behold, it equaling, if not rivaling in some respects, in inferiority of grade, the famous "Neanderthal

PLATE VIII.

FIG. 1.

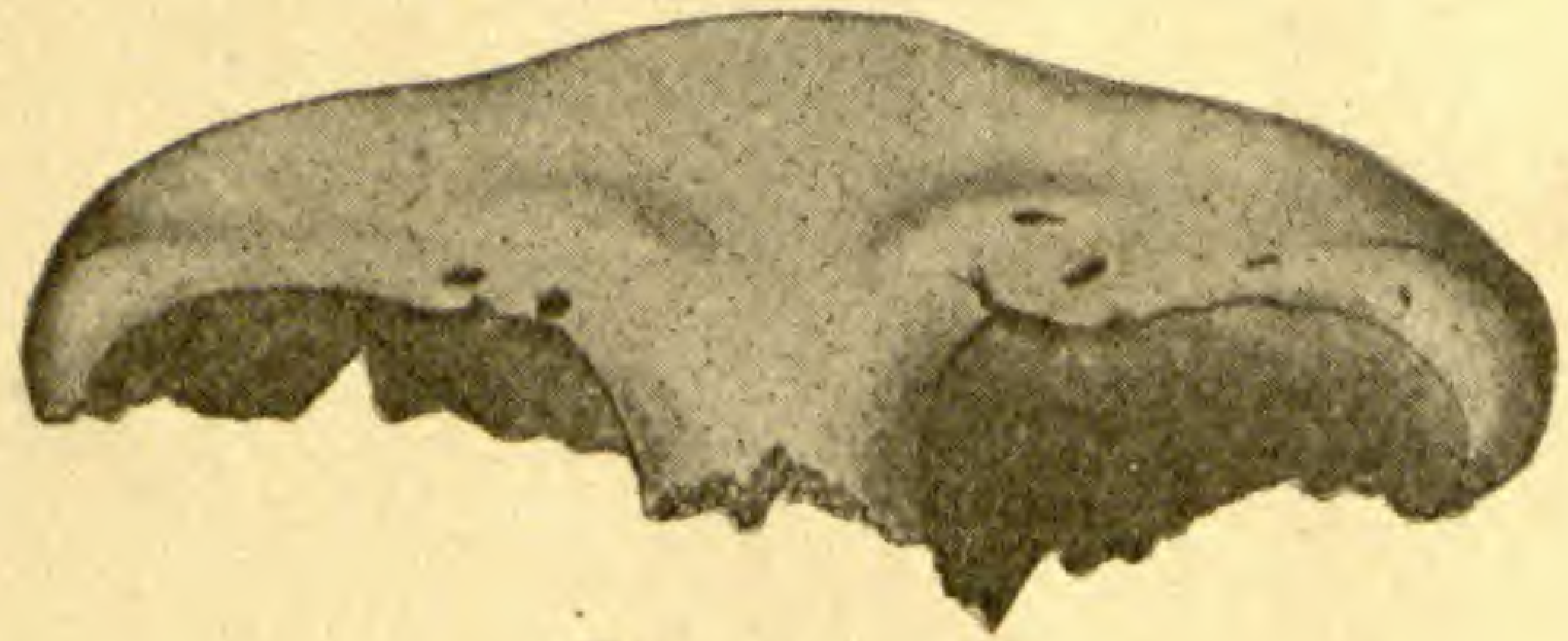

FIG. 2.

Fig. 1. A Lateral View of Skull of Mound Builder. Fig. 2. Front View of the Same. Both much reduced.

Skull." The forehead (if forehead it could be called) is very low, lower and more animal like than in the "Neanderthal" specimen. The two following cuts will illustrate this description.

This skull is quite small for an adult individual. The inner portions of the brow ridges are slightly prominent.

The distance from the lower portion of the nasal bone to the upper margin of the eye cavities is only four centimeters. A slight portion of this bone has, however, apparently been broken away.

The distance between the eye sockets at a point midway between the upper margin of the eye cavities and the lower portion of the nasal bone is two and three-fourths centimeters. Only that portion of the skull figured was found intact, the other portions being too much crushed by the weight of the earth from above to allow of a reconstruction of its parts. One of the jaws, containing well preserved teeth, was found. This was rather strong, but the teeth only moderately so. We were at first inclined to consider the strange form of this skull as due to artificial pressure while living, but a critical examination of it revealed the fact that it was normal, *i.e.*, not having been artificially deformed. The teeth of the babe were very small, and the skull thick, even for an adult person.

The next skeleton was that of a man nearly six feet in height. The crowns of all the teeth had been very much worn down, some of them even down to the bone of the jaw.

As before stated, the remaining bodies were those of young adult persons, the skull of one of which was small for a full-grown individual. No relics of any description were found with the human remains in this mound. This burial appeared to be a very ancient one, the limestone fragments in the floor of the excavation being nearly if not all decomposed.

In other mounds opened[1] on the same stream, at Charles City, six miles below, fragments of the same limestone was not infrequently found, but in no case was decomposition visible, except as a thin outer crust, although the human bones, which were usually more or less abundant, were in no case very well preserved, but on the contrary, often nearly or entirely decomposed. The fine preservation of the remains in the

[1] These mounds are thirty-one in number, an exploration of nearly all of which has been made by the writer and the results embodied in a paper soon to be published. A comparison of the method of burial practiced by the Mound Builders near Floyd, and by those of Johnson County, Iowa, (a description of which has been given by us in a paper on "Ancient Mounds in Johnson County, Iowa," and which has been in the hands of the printer for some time) will be of interest.

mound at Floyd was due to the method of burial. This being evidenced by the fact that over a small portion of one of the bodies the earth had not been so thoroughly packed, and as a consequence the bones were almost entirely decomposed away, while the other portion of the body over which the soil had been very firmly packed was well preserved. Judging from all facts gathered, it seems not improbable to suppose that this represented a family burial.

The question has been raised, "How was it that these five persons were all buried here at the same time, their bodies being still in the flesh?" As we have no reason to suppose that these ancient people possessed any means for preserving, for any length of time, in the flesh, the bodies of their dead; it seems plausible to suppose that these individuals were all swept off at about the same time by some pestilence, or else, upon the death of some dignitary of the tribe or people (perhaps represented by the remains of the old man) the other members of the family were sacrificed, similar to the custom which has prevailed among some ancient tribes or races of historic times.

On the same stream, a short distance below this mound, several other mounds occur which promise to yield interesting results, and which we purpose to explore as opportunity offers. —CLEMENT L. WEBSTER, *Charles City, Iowa.*

MICROSCOPY.[1]

THE EGGS OF PETROMYZON.[2]—1. Artificially fertilized eggs were treated with Flemming's fluid, containing a larger admixture of osmic acid than is prescribed in the original formula.

2. After 30 minutes the eggs were washed in distilled water, passed through 30% and 70% alcohol (3 hours in each), and preserved in 90%.

3. The eggs were cut in paraffine, the sections fixed to the slide with albumen, stained with safranine, and mounted in xylol balsam.

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] A. A. Böhm, *Arch. f. Mikr. Anat.*, xxxii. pp. 634-5.

CENTRAL NERVOUS SYSTEM OF LUMBRICUS.[1]—If the earthworm is to be sectioned in toto, it is necessary to remove the sand from the alimentary canal. For this purpose, place the worm in a glass cylinder partly filled with fine bits of wet filter-paper. As the paper is swallowed the sand is expelled, and at the end of about two days the alimentary tract is cleansed.

In the study of the ventral cord, Friedländer employed the following methods:

Place the worm in water, to which a little chloroform has been added, and it soon becomes stupefied in an outstretched condition. Then cut open the body-wall along the median dorsal line, and pin the edges down in a dish covered with paraffine or wax. After removing the alimentary canal, the specimen may be treated with a preservative fluid.

1. *Osmic acid* 1%. After an exposure of about half an hour, the worm is sufficiently stiffened to allow the pins to be removed, and it may then be cut into pieces of any desired length. The pieces are then left twenty-four hours in the same solution, then washed, and passed through the usual grades of alcohol. Preparatory to embedding in paraffine, the pieces are saturated with chloroform or toluol. This method is excellent for the study of the neuroglia-like elements, and is the best for the brain.

2. Preparations treated thirty minutes with osmic acid (1%) are transferred to a dilute solution of pyroligneous acid (1 part to three parts water), which reduces the osmic acid very quickly. This is followed by alcohol as before. The ganglion cells are well preserved.

3. The preparation is first treated with weak alcohol, then with stronger grades. After half an hour in 70% alcohol, it is stiff enough for removing the pins, and for cutting into small pieces. Nerve fibres are somewhat contracted by this method, and are thus more easily distinguished from the surrounding connective tissue.

4. Corrosive sublimate (aqueous sol.) and 50% alcohol in equal parts (thirty minutes) gave good preparations of the nerves and the neural tubes.

For preparations according to No. 3, the best stain is a modified form of Mayer's alcohol carmine, absolute alcohol being substituted for 80%. Sublimate preparations are successfully stained with Grenacher's hæmatoxylin. After half an hour in this staining fluid, the preparations are transferred to acidu-

[1] Benedict Friedländer, *Zeitschr. f. wiss. Zoologie*, XLVII, 1, 1888, p. 48.

lated alcohol (50%, with a little hydrochloric acid) ½ minute, then placed in alcohol containing a few drops of ammonia. Connective tissue and nerves are unstained, while ganglion cells are stained deep blue.

The last two methods of staining may be followed by picric acid, which stains the uncolored elements yellow. The process is as follows:

After the sections have been fixed to the slide with collodion and the paraffine dissolved with turpentine or zylol, the slide is placed in turpentine containing a few drops of a solution of picric acid in absolute alcohol. In a few seconds, nerve-fibres, connective tissue, and muscles are stained yellow. The slide is next to be placed in turpentine containing a few drops of alcohol, to wash away the excess of picric acid, then in pure turpentine or xylol preparatory to mounting in balsam.

ZYLOL DAMMAR.[1]—M. Martinotti advocates the use of dammar dissolved in zylol as a mounting medium, to be preferred to balsam in certain cases. He prepares his solution in the following way:

Forty grams of dammar and forty grains of zylol are mixed together in a stoppered bottle and allowed to stand for three or four days at the ordinary temperature; the solution is then filtered. The filtrate, which will amount to about 70 grams, is then evaporated in a water-bath down to about 45 grams.

The object of this concentration is to obtain a solution of the resin in the smallest quantity of zylol possible, just enough in fact to merely dissolve the resin. This concentrated solution becomes yellow, but retains its limpidity. The next step is to dilute this solution with oil of turpentine, by which means the yellowish color is made to almost disappear.

[1] *Journal Roy. Micr. Soc.*, Feb. 1888, p. 153.

ERRATUM.

Fig. 9, page 208, should read "1/7.7 natural size" in place of "natural size."

PLATE VI.

Hypertragulus calcaratus Cope. 1. (The pterygoid region injured).

THE

AMERICAN NATURALIST.

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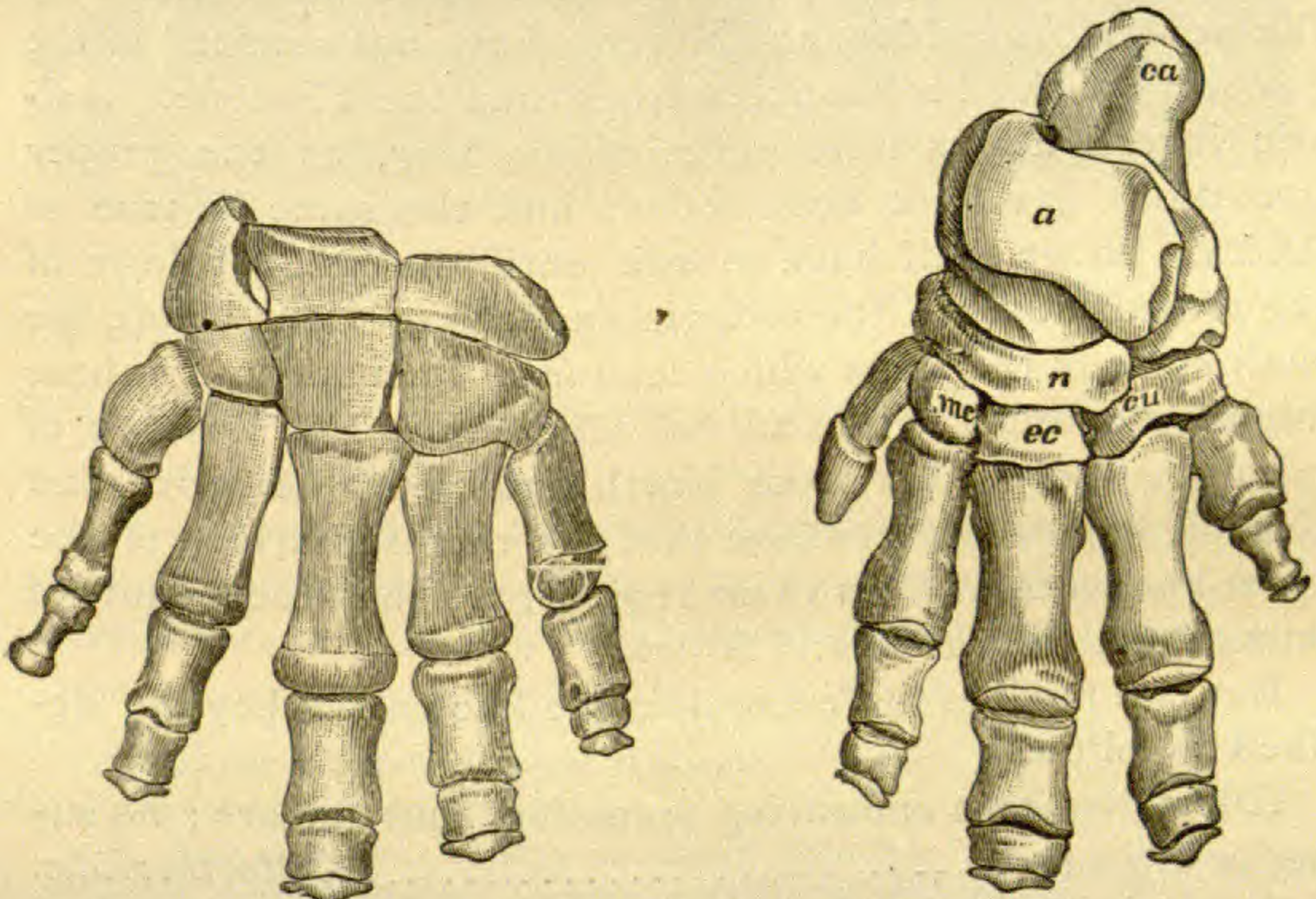
THE PROBOSCIDIA.

BY E. D. COPE.

THE Proboscidia are Ungulata in which the second row of carpal bones has not moved inwards so as to alternate with the first, and in which the second row of tarsal bones alternates with the first by the navicular extending over part of the proximal face of the cuboid. The teeth are modifications of the quadritubercular type, and canines are absent.



A B

Fig. 1. Feet of species of Elephas much reduced. A, manus of *E. africanus*. B, pes of *E. indicus*.

To these general characters are added numerous subordinate peculiarities in the known genera and species, which make them among the most remarkable of living beings. These peculiarities are the result of a long period of development. It is one of the most curious facts of paleontology that the order does not make its appearance until the middle of the Miocene system, and the greater number of forms do not appear until the upper Miocene. That it existed earlier cannot be doubted, and that it originated from some Eocene condylarthran is evident; but the intermediate forms are entirely lost to us as yet, and the phylogeny of the order is absolutely unknown. This is the more extraordinary since the earliest known genus (Dinotherium) embraces only species of colossal size, and its immediate ancestors could not have been insignificant. We may regard Phenacodus as the first form we know of earlier than Dinotherium, but what a hiatus is expressed in this statement! It is to be anticipated that the gap will be filled by discoveries in Asia, or the Southern Hemisphere. South America may be probably excluded from this prospect, since the extensive researches made there by Burmeister, Ameghino, and Moreno, have not resulted in the discovery of any Proboscidia earlier than the Pliocene. Asiatic investigations have revealed nothing, as the proper formations have not been found, and the same is true of Africa. So we shall have to wait until the paleontology of the present home of the order is exposed to view, before we shall know of the steps which lead from Phenacodus to these mighty monarchs of the animal kingdom. The absence of primitive Proboscidia from North and South America and Europe, impels us to believe that the representatives of the order known to us from those regions, are the descendants of immigrants from Asia and Africa.

But two families of Proboscidia are known. They are defined as follows:

Adult dentition embracing premolars and molars; no superior incisors.................................*Dinotheriidæ*.

Adult dentition embracing one or two true molars only; superior incisors...............................*Elephantidæ*.

The family of the Dinotheriidæ embraces one genus and four species, though a fifth species, *D. sindiense* Lyd., from India, may belong, according to Lydekker, to another genus. The *Dinotherium indicum* Falc. is known from a few teeth, which exceed in size those of the other species. The *D. giganteum* Kaup is found in several Miocene deposits of Europe. It was one of the largest of Mammalia, its femur exceeding in dimensions that of any other land mammal. The inferior incisors were robust and cylindric in form. With the symphysis of the lower jaw they are decurved so as to form a most effective instrument for the tearing up of trees by the roots, or the pulling down of their branches The temporal fossa is lateral, and the top of the head flat. The premaxillary region though toothless, is prominent, and the nasal bones do not project. There is supposed to have been a short trunk. The skull measures three feet eight inches in length. (Plate XV.)

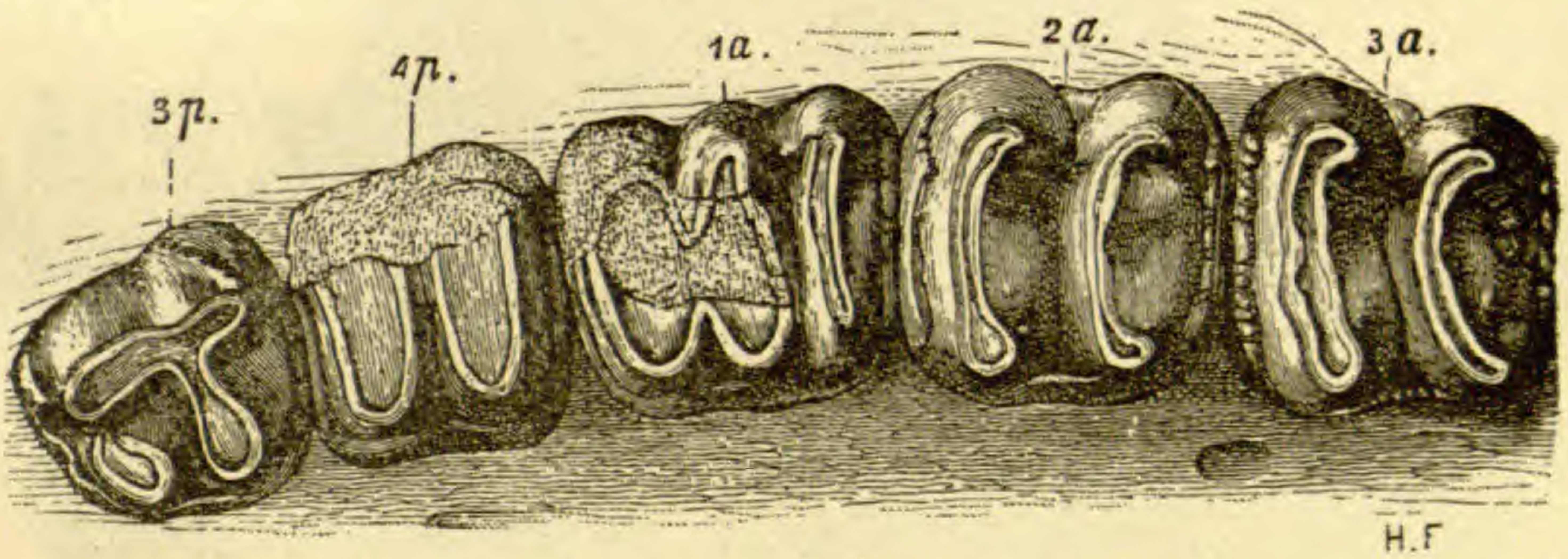


Fig. 2. *Dinotherium giganteum* Cuv. left superior molars, one fourth nat. size. From the Miocene of France. From Gaudry.

Two smaller species are known, the *D. bavaricum* from European, and *D. pentapotamiæ* from Indian Miocene beds.

In Dinotherium all the molars and premolars have two transverse crests excepting the first (posterior) premolar, and its deciduous predecessor, which have three cross-crests.

The genera of the Elephantidæ are the following :

I. Inferior incisors and premolars present.

Superior incisors with enamel-band........................ *Tetrabelodon* Cope.

II. Premolars, but normally no inferior incisors ;

Intermediate molars isomerous ; superior incisors with enamel-band.
Dibelodon Cope.

Intermediate molars isomerous superior incisors without enamel-band.
Mastodon Cuv.

Intermediate molars heteromerous; superior incisors without enamel-band.
Emmenodon Cope.[1]

III. No premolars, nor inferior incisors.

Intermediate molars heteromerous. Superior incisors without enamel-band.
Elephas Linn.

The characters assigned to the above genera are sufficient to separate them, but they have not come into general use for two reasons. One is the difficulty of verifying some of them, especially the presence of premolars, owing to the difficulty of obtaining specimens of young individuals. The other is the indisposition of naturalists to abandon the system of Falconer. As is well-known, this able paleontologist distinguished the genera by the number and depth of the transverse crests of the molar teeth, and the extent to which their interspaces are filled with cementum. This arrangement is insufficient, since it neglects the equally important characters above

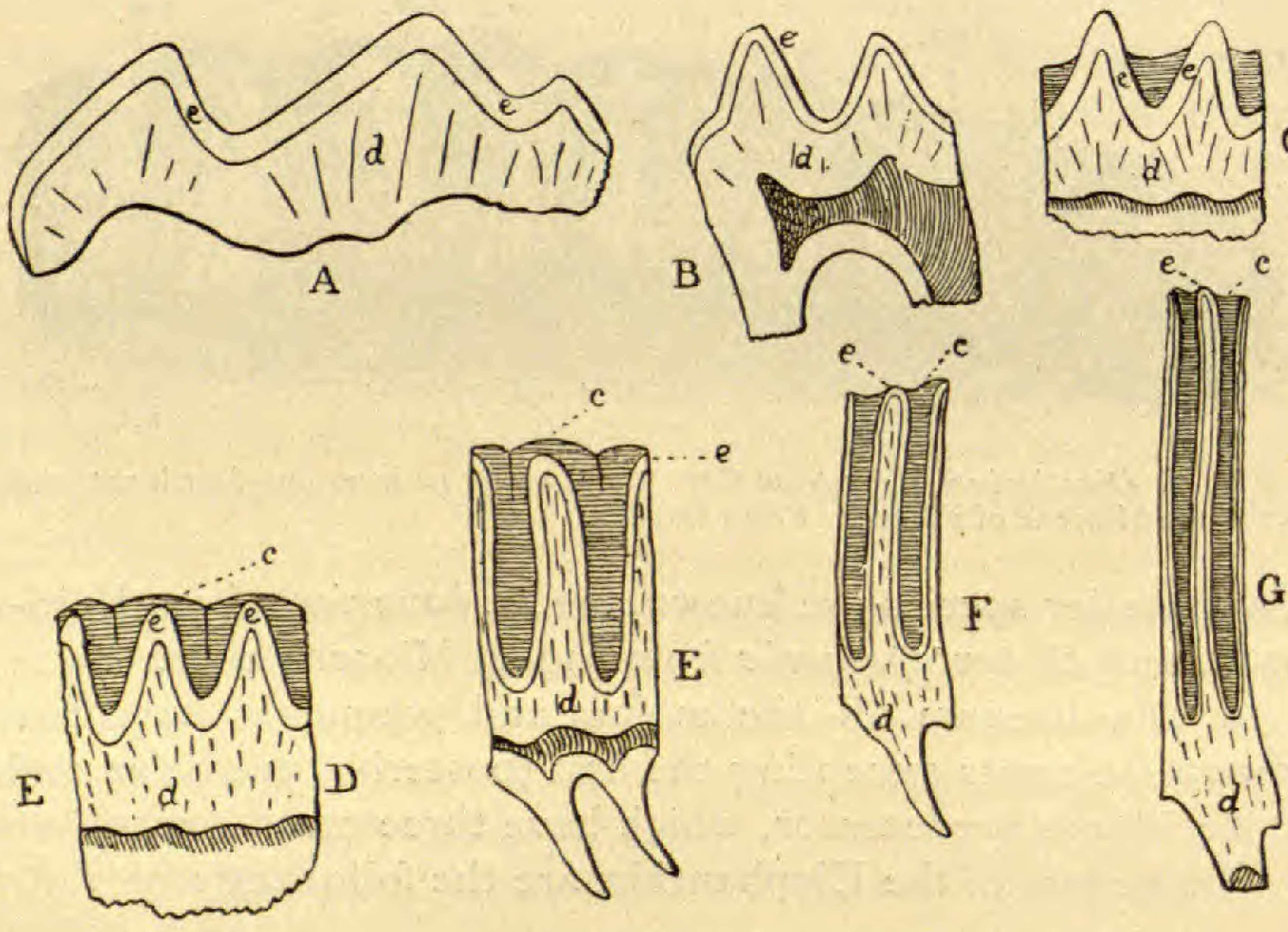


FIG. 3. Longitudinal sections of the molar teeth of Proboscidia, much reduced, from Gaudry. Letters; *c* cementum; *d* dentine; *e* enamel. A, Inferior molar of *Dinotherium giganteum* Cuv. B, superior molar of *Mastodon americanus* Cuv. C, lower molar of *Elephas ganesa* C. F. D, do. of *Elephas insignis* C. F. E, do. of *Emmenodon planifrons* C. F. F, do. of *Elephas hysudricus* C. F. G, do. of *Elephas indicus* L.

[1]Gen. nov. Type *Elephas cliftii* Falc. Cautl., *Mastodon elephantoides* Clift.

Tetrabelodon campester Cope.

mentioned ; and as observed by Lydekker[1] it fails to furnish clear definitions. He remarks, under the head of the genus Elephas, " There is no character by which the present genus can be distinguished from Mastodon ; and the division can be therefore only regarded as a matter of convenience." The characters presented in the above table are on the other hand very distinctive, and can be applied in all cases where we have the necessary information. This has not yet been obtained as regards all the species, and I have placed some of them in their respective genera provisionally. Such species are marked with an *i* when the condition of the incisors is unknown, and with a *p* when the same is true of the premolars. The species of the family described thus far, are as follows :

Tetrabelodon	*brevidens*[3] Cope sp. nov. N. America *i. p.*	
"	*turicensis* Schinz. Europe.	
"	*angustidens* Cuv. Europe.	
"	"	*palæindicus* Lyd. India.
"	"	*proavus* Cope. N. America.
"	*productus* Cope. N. America, ? Mexico.	
"	*euhypodon* Cope. N. America *p.*	
"	*pandionis* Falc. Cautl. India.	
"	*pentelici* Gaudry.[4] Europe *p.*	
"	*campester* Cope. N. America. *p.*	
"	*longirostris* Kaup. Europe.	
"	*? serridens* Cope. Texas ?Mexico ?Florida.[5] *i. p.*	
Dibelodon	*shepardi* Leidy. California, Mexico. *p.*	
"	*cordillerarum*[6] Desm. South America.	
"	*tropicus* Cope. South America and Mexico. *p.*	
"	*humboldtii* Cuv. S. America.	
Mastodon	*americanus* Cuv.[7] N. America.	
"	*borsoni* Hays. *p.* Europe.	
"	*falconeri* Lydd. India. *p.*	

[1]Catalogue of fossil Mammalia in the British Museum Pt. IV. p. 79.

[2]In compiling this list I have been greatly aided by the Memoirs of Lydekker in the Palæontologia Indica, and in the Catalogue of the British Museum.

[3]*M. proavus* Cope 1884 not 1873.

[4] According to Lydekker no premolars have been seen in this species.

[5] *M. ?floridanus* Leidy.

[6]*M. andium* Cuv. According to the recent researches of Burmeister, this species does not possess mandibular tusks. (Sitzungsb. Kön. Preuss. Akad. Wiss. Berlin 1888 p. 717.) Hence the specimens from Mexico with such tusks reported by Falconer, must be assigned elsewhere.

[7]This species is said by Lydekker not to possess premolars. Leidy Report U. S. Geol. Surv. Terrs. Pl., figures a tooth as a premolar, and similar specimens are not uncommon.

Mastodon *mirificus* Leidy. N. America. *i. p.*
" *sivalensis*[1] Cautley. India. *p.*
" *arvernensis* C. & J. Europe.
" *?punjabiensis* Lydd. India. *p.*
" *latidens* Clift. India.
Emmenodon elephantoides[2] Clift. India to Japan.
" *planifrons* Falc. Cautl. India.
Elephas bombifrons Falc. Cautl. India, ? China.
" *ganesa* Falc. Cautl. India.
" *insignis* Falc. Cautl. India to Japan.
" *meridionalis* Nesti. Middle and S. Europe, and N. Africa.
" *hysudricus* Falc. Cautl. India.
" *antiquus* Falc. Europe ? W. Africa.
" *mnaidriensis* Leith-Adams. Malta.
" *melitensis* Falc. Malta.
" *namadicus* Falc. Cautl. India to Japan.
" *primigenius columbi* Falc. W. N. America, Mexico.
" " *primigenius* Blum. N. Hemisphere.
" " *americanus* DeKay. E. N. America.

To these we must add the two existing species, *Elephas africanus* and *E. indicus*. Several species are not sufficiently known for reference to their proper genus. Such are *Mastodon perimensis* Falc.Cautl. India; *M. atticus* Wagn. S. Europe; *M. serridens* Cope, Texas; *M. cautleyi*, Lydd. India, and *M. obscurus* Leidy, N. America. In these the characters of both the incisor and premolar teeth are unknown. In some

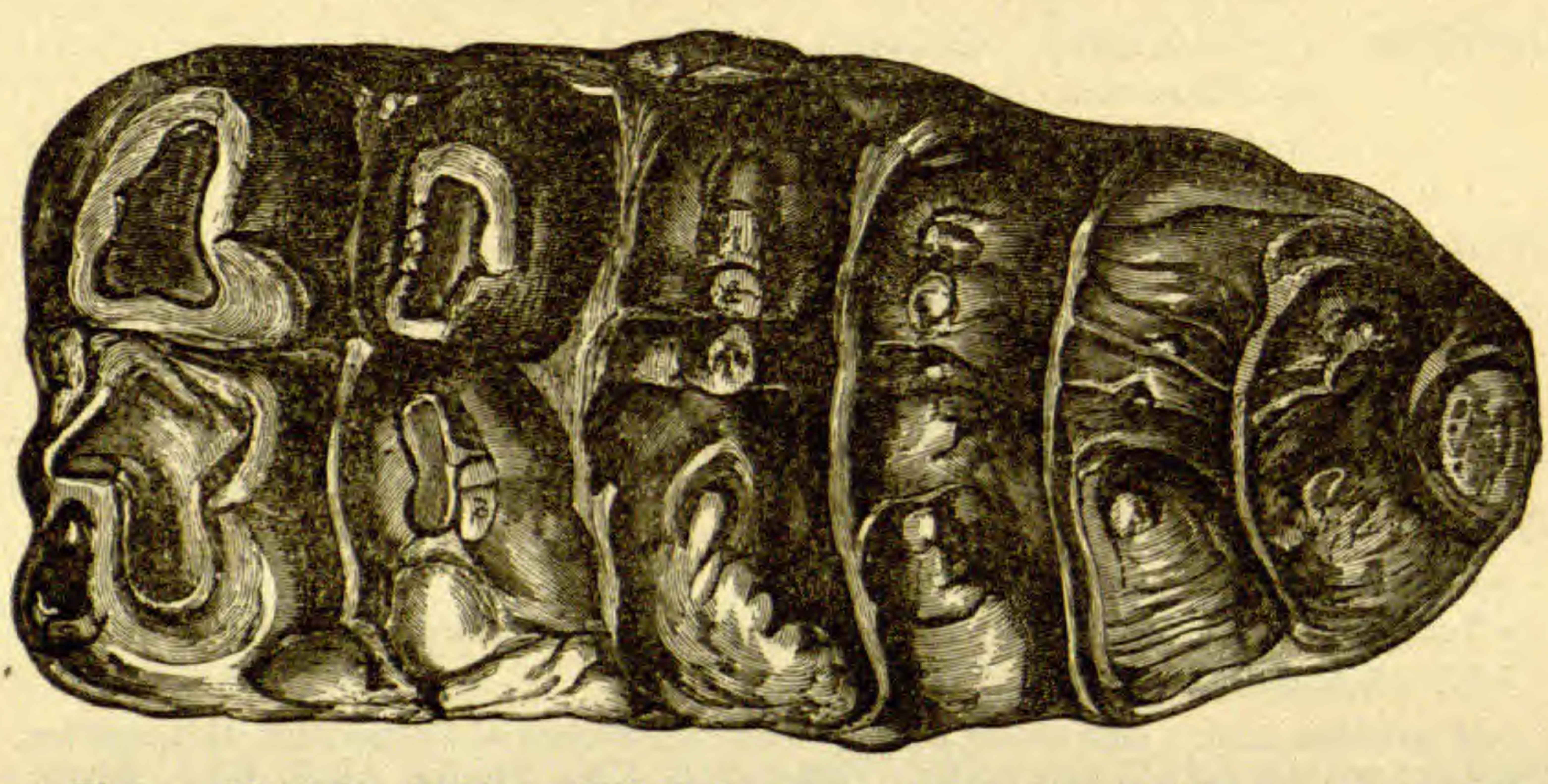
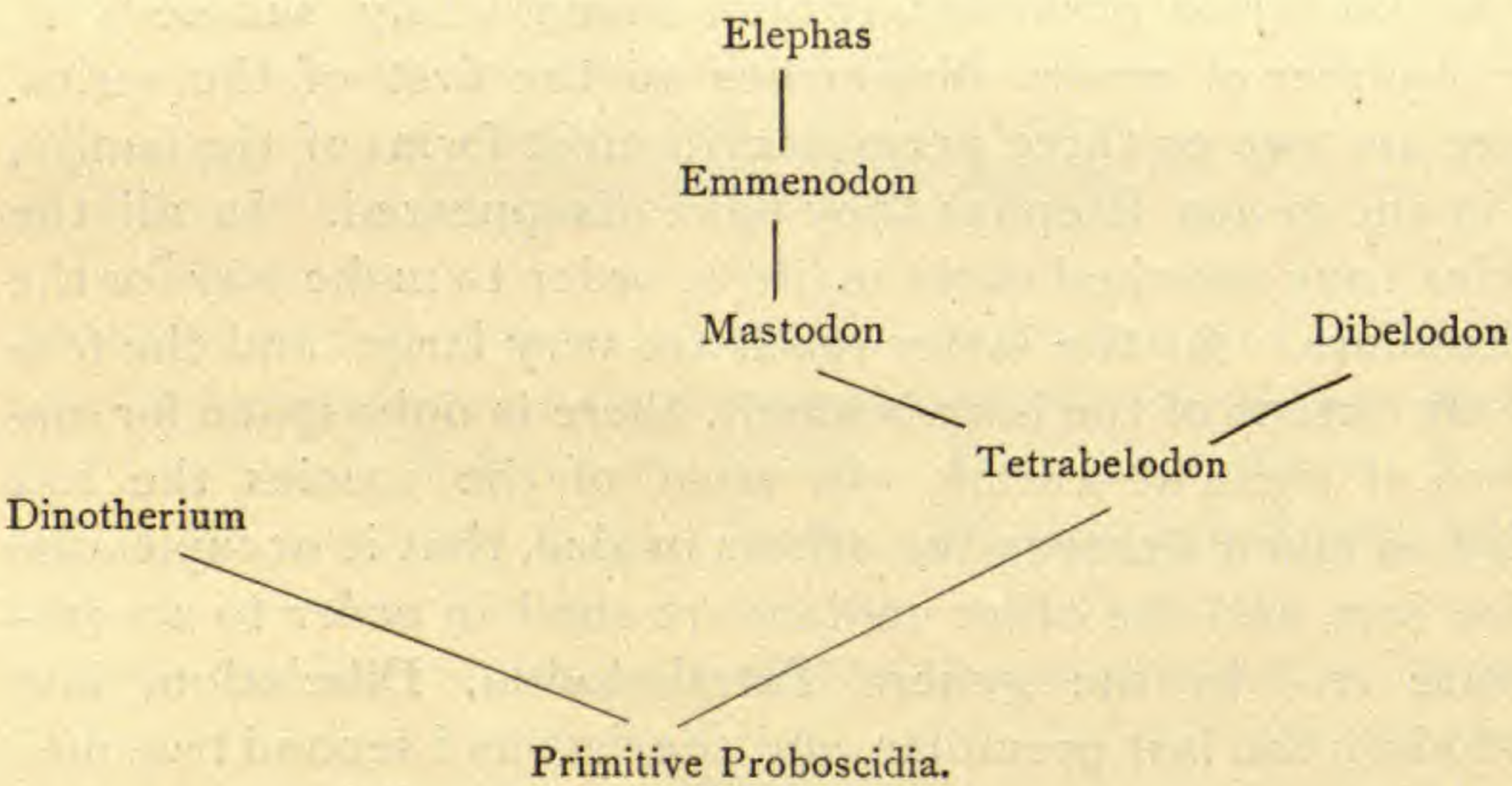


Fig. 4. *Mastodon latidens* Clift left sup. molar 3 from ? Pliocene of Borneo: two-thirds natural size. From Lydekker.

[1]According to Lydekker, premolars have not been observed.
[2]*Mastodon* Clift; *Stegodon* Falconer; *Elephas* Lydekker.

of the species referred above to Mastodon, mandibular tusks are present in the young, and occasionally one is retained to maturity, as sometimes seen in *M. americanus*. But such individuals are exceptional among their species. In some other species while the males possess them, they are wanting to the females. The specific character is in this case derived from the male.

The molar dentition in this family possesses a number of peculiarities which have been worked out mainly by Falconer, Owen, and Lydekker. There are probably deciduous molars in all the species, and they are generally three in number. The posterior of these has the same number of cross-crests as the posterior premolar, which immediately succeeds it. The number of crests diminishes to the first of the series. There are two or three premolars in most forms of the family, but in the genus Elephas they have disappeared. In all the species they are shed early in life in order to make way for the true molars. As the latter teeth are very large, and the fore and aft extent of the jaws is small, there is only space for one or two of them at a time. In most of the species the last molar so much exceeds the others in size, that it occupies the entire jaw, and the other molars are shed in order to accommodate it. In the genera Tetrabelodon, Dibelodon, and Mastodon, the last premolar, and the first and second true molars are isomerous, *i. e.* have the same number of cross-crests. In Emmenodon and Elephas they are heteromerous ; that is, the number of cross-crests successively increases from front to rear. Thus in the three genera named the ridge formula is ; P. M. 2—2—3 ; M. 3—3—4, and P. M. ?—? 4 ; M. 4—4—5 or 4—5—6. In Emmenodon the ridge formula is, P. M. ?—?—?—5 ; M. 6-7—6—7-8 ; and P. M. ?—6-7 ; M. 7—8-9—10-12. In Elephas the formula extends from M . 6—6-7—8-9, to M. 9-15—14-16—18-27. Each genus then has a certain range of variation in the number of molar crests, extending from a smaller to a larger number. This successive increase in complexity has been regarded by Falconer as the index to the successive evolution of the species, and rightly so. As already remarked, however, other measures of the same succession cannot be overlooked, especially as the ridge formula changes in so gradual a manner as to render it unavailable as a basis of exact divisions, as has been remarked already by Lydekker. It is evident that the primitive Proboscidia had incisor teeth in both jaws, and that these had more or less of the usual enamel investment. The gradual modification of these features is therefore another indication of the line of descent of these animals. The primitive Proboscidia had likewise four premolars, as is now seen in Dinotherium. The successive loss of these teeth is no less an index of the evolution of the modern types of the order, than the other modifications referred to. In general, then, the phylogeny of the order may be represented thus :



Within each genus certain parallel modifications of the composition of the crowns of the molar teeth may be observed. The cross-crests may be single, or they may be divided up into tubercles. The valleys between them may be open (1) or they may be blocked by (2) a system of single intermediate tubercles ; (3) by numerous intermediate tubercles ; or (4) by the thickening of the primary tubercles. I arrange the species according to these characters.

	Tetrabelodon.	Dibelodon.	Mastodon.
1	*T. ? brevidens.*		*M. americanus.*
	T. turicensis.		*M. borsoni.*
			M. latidens.
2	*T. angustidens.*	*D. shepardi.*	*M. ? cautleyi.*
	T. productus.	*D. cordillerarum.*	*M. falconeri.*
	T. serridens.	*D. tropicus.*	

PLATE X.

Tetrabelodon campester Cope.

	T. euhypodon.		*M. arvernensis.*
	T. longirostris.		
3	*T. campester.*	*D. humboldtii.*	*M. sivalensis.*
	T. pandionis.		*M. punjabiensis.*
4			*M. mirificus.*
			?M. atticus.

Parallels between the species of Emmenodon and Elephas also exist. As but two species of the former genus are known, we must look for future discoveries to increase the number of correspondences. The species of both genera which approach nearest to Mastodon have a smaller number of cross-crests, which are of lesser elevation, and whose intervening valleys are occupied by but a shallow deposit of cementum (fig. 3, C. D.) These are the Stegodons of Falconer; (1). In the other group, (2) the crests are numerous and elevated, and their interspaces are filled with cementum. (Fig. 3, E. F.)

	Emmenodon.	Elephas.
1	*E. elephantoides.*	*E. bombifrons.*
		E. ganesa.
		E. insignis.
2	*E. planifrons.*	*E. meridionalis.*
		E. hysudricus.
		E. antiquus. etc.

It is observable that each type of molar teeth of the three genera first compared, has representatives in the regions where their species occur ; North America, Europe and India.

The North American species of this family are distinguished by the following characters of the molar teeth.[1]

I. Intermediate molars with not more than three crests ; (trilophodont).

a. Crests acute, transverse.

β. Valleys uninterrupted.

Last superior molar with three crests and a heel; crests low, not serrate. *T. brevidens.*

Last superior molar with four crests and a heel; crests elevated, not serrate. *M. americanus.*

ββ. Valleys interrupted.

[1]From the AMERICAN NATURALIST. 1884. p. 524.

Edge of crest tuberculate.. *T. serridens.*

aa. Crests transverse, composed of conic lobes.

β. Valleys little uninterrupted.

Last inferior molar narrow, with four crests ; an accessory tubercle in each valley; *D. shepardi.*

β. Valleys interrupted.

Last inferior molar with four crests and a heel ; symphysis short, M. 150; smaller size.. *T. euhypodon.*

Last inferior molar with four crests and a cingulum ; symphysis longer, M. .280 ; size medium.. *T. productus.*

Last inferior molar with five crests and a heel; symphysis very long, M. .450; size largest.. *T. angustidens.*

"*aaa*. Crests broken into conic lobes ; those of opposite sides alternating.

Last inferior molar narrow, supporting four crests and a heel........ *T. obscurus.*"

II. Intermediate molars with four transverse crests ; (tetralophodont).

A long symphysis; crests well separated, tubercular, with accessory lobes interrupting valleys.. *T. campester.*

Symphysis very short; crests thick, closing valleys by contact; no accessory cusps; (Leidy)... *M. mirificus.*

III. Intermediate molars with 9–16 crests.

β. Valleys filled with cementum.

Last molar with 18–27 cross-crests ; .... *Elephas primigenius.*

The stratigraphic position of these species is as follows :

Pleistocene.

Mastodon americanus.

Elephas primigenius (less abundant).

Pliocene.

Elephas primigenius (more abundant).

Tetrabelodon serridens (horizon probable).

Dibelodon shepardi.

Upper Miocene (Loup Fork).

Tetrabelodon euhypodon.

" *productus.*

" *angustidens.*

" *campester.*

Mastodon mirificus.

Ticholeptus bed.

Tetrabelodon brevidens.

The horizons from which were obtained the *Tetrabelodon obscurus* Leidy and the *Dibelodon shepardi* Leidy, are not sufficiently well-known. In the valley of Mexico, the *D. shepardi* is from the Pliocene. No species of the order has been found below the Ticholeptus beds ; a horizon about parallel with that in which the order first appears in Europe. The statement of Marsh that the genus has been obtained in the lower White River beds is an error. (King, Survey 40th parallel, I p. 412.)

The *Tetrabelodon brevidens* Cope is the oldest North American species, and presents a very simple type of molar. The last superior has but three cross-crests and a heel, a smaller number than exists in any other species of the genus. The tooth is wide, and the crests are low. They are well divided in the middle by a fissure. Their edges are entire, but obtuse, and the first and second internal have a thickening at the base next the median fissure, which wears into a trefoil. These thickenings close the valleys at their base, but soon spread apart. They are absent from the third crest. The valleys are bounded on the inner side by a well defined ledge, which is represented by a rudiment on the external side. Enamel thick and smooth. Length of molar, 157 mm.; width at second crest, 98 mm.; elevation of second crest, 54 mm. This tooth resembles that of the *Mastodon americanus* more nearly than that of any other North American species, and is still more like that of the *M. borsoni* of Europe. The reduced number of its crests indicates it as the most primitive

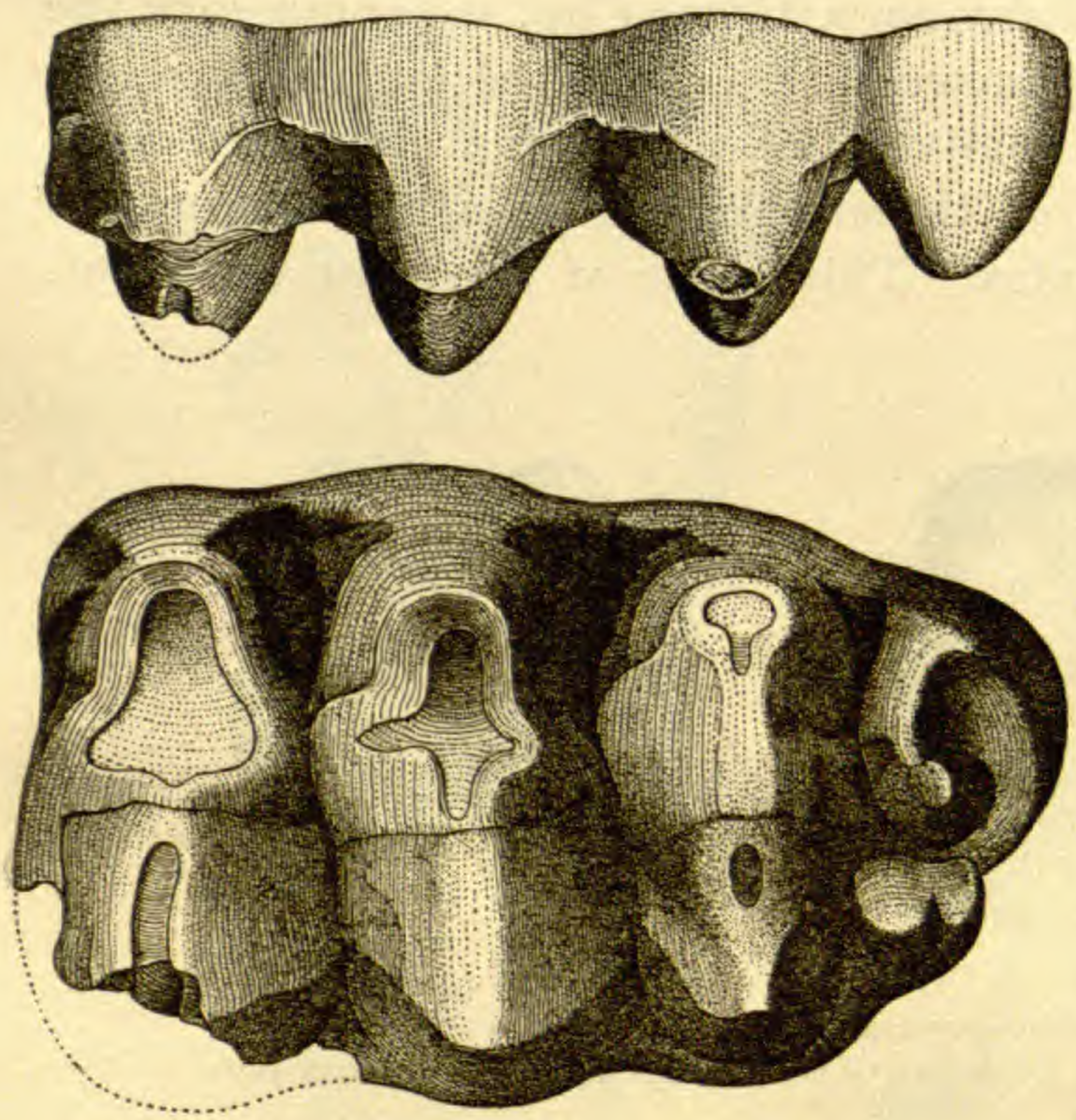


FIG. 5. *Tetrabelodon brevidens* Cope; last superior molar; from Ticholeptus bed of Montana. Four-ninths natural size. Original.

of the elephants, and as its horizon is the oldest, I have suspected that it had well developed incisor teeth in the lower jaw, and have, therefore, placed it provisionally in the genus Tetrabelodon. It is probably ancestral to the *M. americanus*, but, perhaps, not through American forms, since none with the same type of molar have been yet found in the formations which intervene between those in which the two species occur. Such forms occur in Europe, as the *Tetrabelodon turicensis* and the *Mastodon borsoni*. Unless some species of synchronous age with these is found in North America, we may suppose that the *Mastodon americanus* derived its immediate descent from Asiatic and European forms.

With the *Tetrabelodon angustidens* Cuv. we commence the series in which the transverse crests of the molars have the appearance of being composed of distinct but appressed conic tubercles. In most of them, the valleys are more or less interrupted by tubercles. This is one of the most abundant,

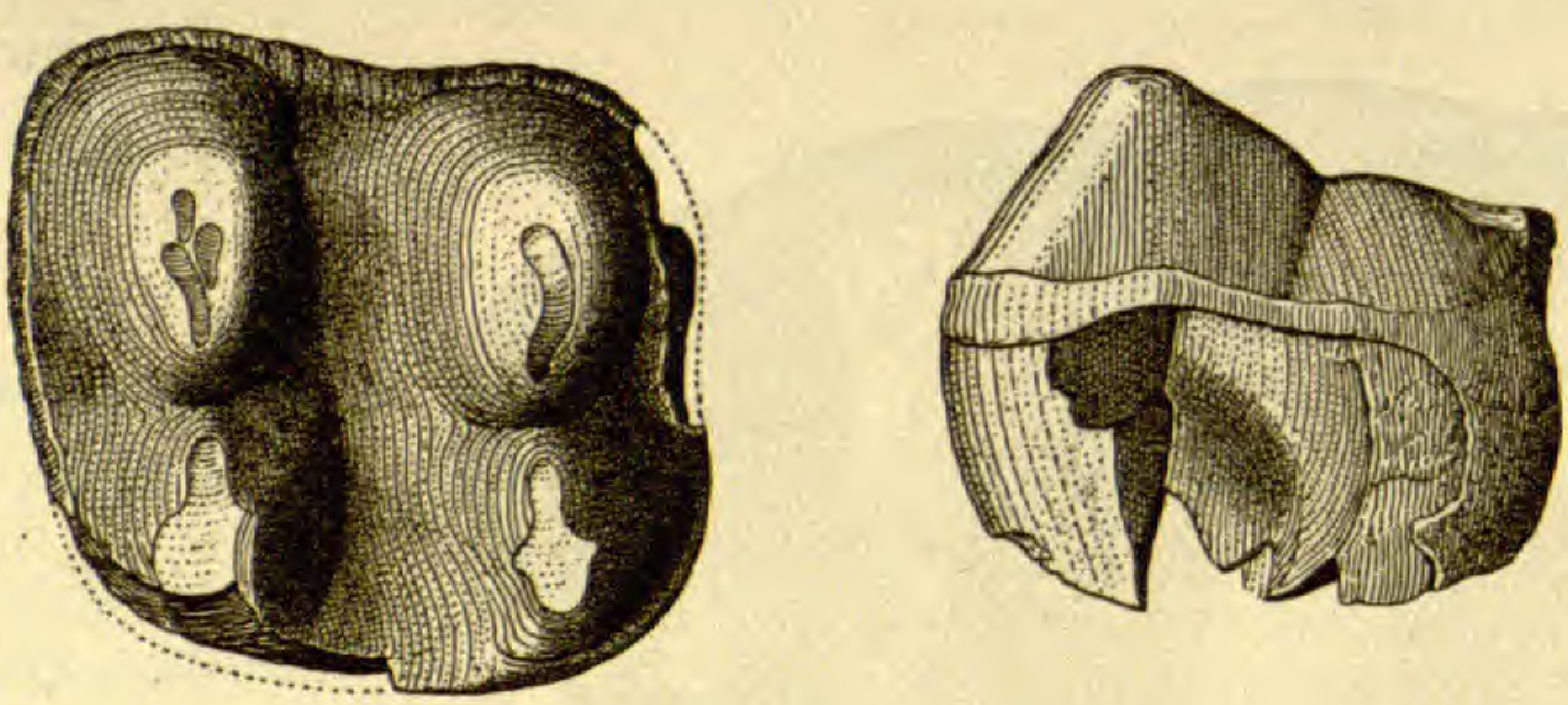


FIG. 6. *Tetrabelodon angustidens proavus* Cope; typical specimen from the Loup Fork bed of Colorado, two-thirds natural size. Original.

as well as the most widely distributed species of the family, extending its range from India to Central North America, through Europe. I have seen specimens from the Loup Fork beds of Kansas, Nebraska, and Dakota. Their size exceeds those of the typical European form, and the second (and probably third) true molars have a narrow fourth cross-crest. It is possible that it may become necessary, with more complete information, to distinguish this form as a species

PLATE XI.

Tetrabelodon proavus Cope.

under the name of *Tetrabelodon proavus.*[1] Probably, the same species has been recorded by Whitfield, from the phosphate beds of South Carolina, and compared with *M. obscurus.* The skeleton of the European form is represented in Plate XII. In a lower jaw in my possession, the left ramus measures m. 1.080 in length, of which .420 is symphysis.

The *Tetrabelodon euhypodon* Cope was founded on a nearly perfect left mandibular ramus with last molar tooth and tusk,

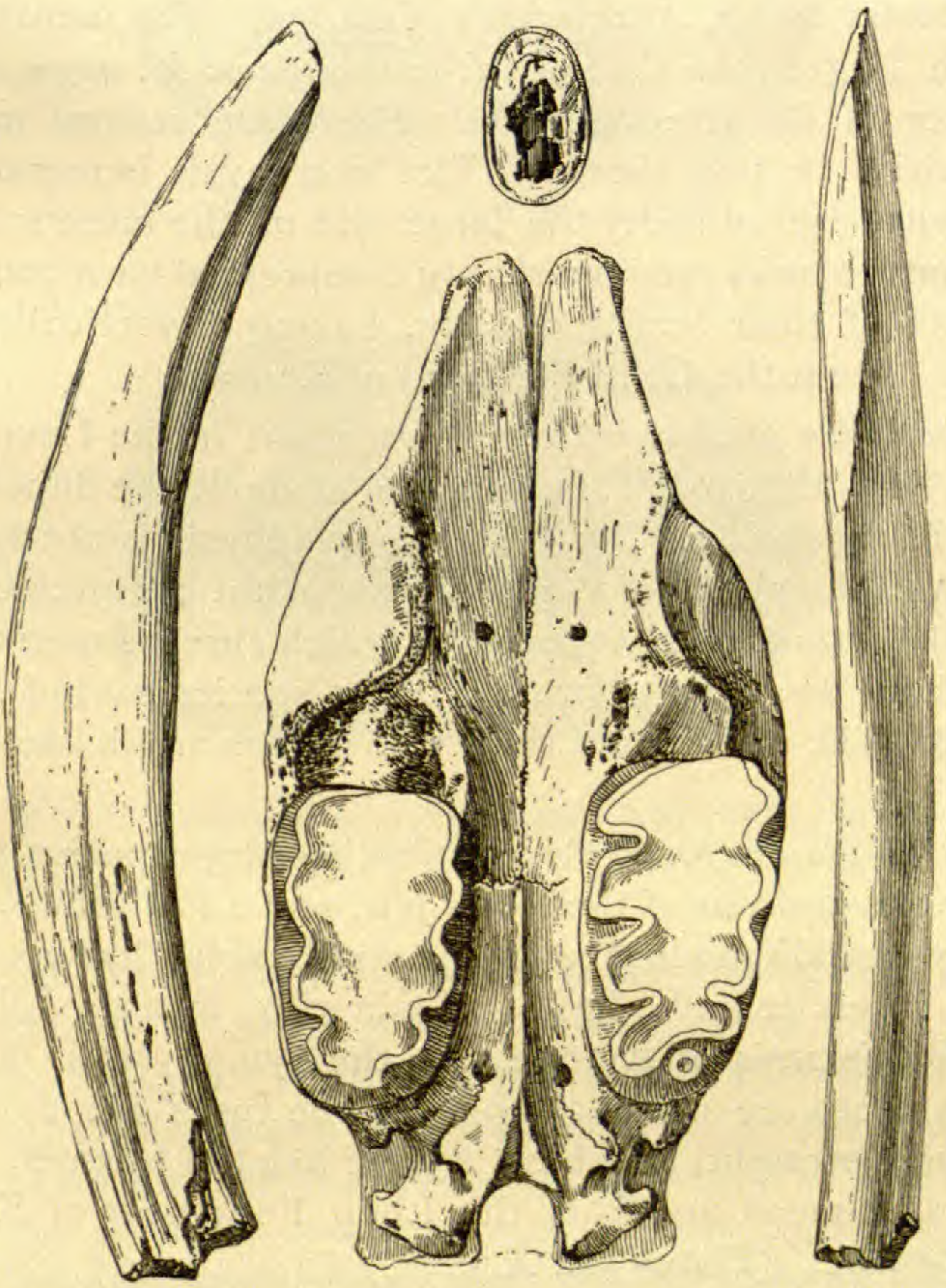


FIG. 7. *Tetrabelodon euhypodon* Cope; Loup Fork bed of Kansas. Palate with superior molars and superior incisors, of individual represented in Plate XIII; one-seventh natural size. Original.

[1] This species was originally represented by a penultimate milk molar, with two cross-crests, and the fragments of a probable last premolar. The former is about the size of that of the *M. angustidens*, but is more regularly quadrangular, and is composed of but four tubercles, united in pairs. (Fig. 6.)

with entire palate with both last molar teeth and tusks. The superior tusks are compressed distally, and the inferior tusks are large and have an enamel band ; they are cylindric. The jaws indicate a smaller species, but the molar teeth are as large as those of the larger American form of *M. angustidens*, and as long as that of *M. americanus*, but narrower. Its symphysis is not prolonged, and the ramus is low and not compressed. Length of ramus posterior to symphysis, M. .500 ; of last lower molar, .182 ; width of do., 75. The mental tusk is much larger than that of *M. productus* or *M. angustidens*. Diameter of its alveolus, .068. There are several marked peculiarities in this species. The symphysis is remarkably short, when we consider the large size of the inferior tusks. The superior tusks are remarkably compressed for a considerable part of their length distally, having a vertically oval section. From the Loup Fork bed of Kansas.

Tetrabelodon productus Cope is abundant in the Loup Fork beds of New Mexico. It is a species of about the dimensions of the *T. angustidens* Cuv., but the symphysis is not so produced, and the ramus of the lower jaw is not compressed and elevated. It is the only species in which three superior premolars have been demonstrated; other species having generally two. The second and third true molars are in use at one time.

Tetrabelodon campester Cope is a rather large species, with a very long symphysis of the lower jaw, and a low ramus. The teeth are tetralophodont, and the sixth molar has six cross rows of tubercles and a heel. It is in some measure allied to the *T. longirostris* of Europe, but the symphysis is longer, and the teeth are more complex. The tusks are cylindric and nearly straight, and have a wide band of enamel. The known specimens are from the Loup Fork beds of Kansas and Nebraska. (Plates IX, X.)

The *Dibelodon shepardi* Leidy was founded on an inferior sixth molar tooth from California. I subsequently[1] described specimens of the same from the Pliocene bed of the valley of Mexico, where it was abundant. The molar teeth are rather

[1] "Proceed. Amer. Philosoph. Society," 1884, p. 5.

simple in construction, and resemble those of the *D. cordillerarum* Desm., but the species has a short, elephant-like symphysis.

The *Tetrabelodon serridens* Cope was founded on a first or

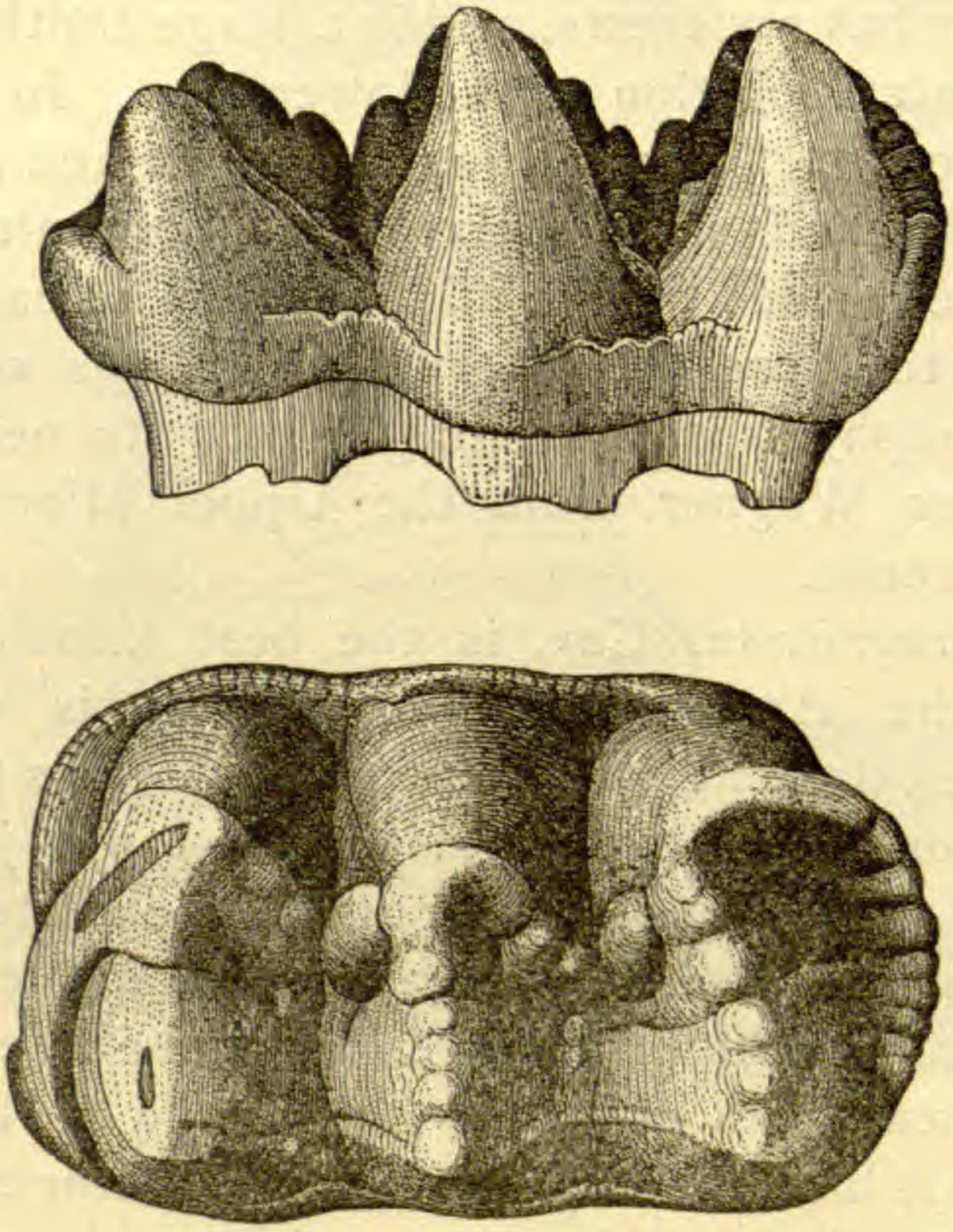


FIG. 8. *Tetrabelodon serridens* Cope; ?first molar. Typical specimen from ?Pliocene of Texas. Four-ninths natural size. Original.

second true molar from Texas. It is peculiar among American species in its acute elevated, entire crests, with tuberculo-serrate edges. It thus resembles the *M. turicensis*, but differs in well-developed longitudinal crests at the inner end of the external half of the crests, which consist of two tubercles on the posterior side of a crest, and one on the anterior side of the next succeeding crest. Strong anterior and posterior cingula; edge of each cross-crest with six or seven tubercles. Length of crown, M. .130; width, .080; elevation, .061 Length of *M. americanus*, but narrower. Remains of a large Tetrabelodon from Florida have been described by Leidy under the name of *T. floridanus*. Its molars present the tuberculated crests of the *T. serridens*, and no important characters appear to separate it from the latter.

The *Mastodon mirificus* Leidy is known from a left ramus of a lower jaw, which supports the last molar. The intermediate molars are probably four-crested (tetralophodont), and the last molar has six crests, and is a large tooth, occupying the entire dentary portion of the lower jaw. In this respect it differs from the *Tetrabelodons campester* and *longirostris*, where the fifth and sixth molars are in simultaneous use. The crests are divided on the middle line, and each half is so expanded as to close the intervening valleys very early in wear. Its symphysis is short and acute. Its nearest ally is the *M. atticus* Wagner, from the Upper Miocene beds of Pentelicus, Greece.

Mastodon americanus Cuv. is the best known and latest in time of the American elephants. It is one of the largest species, and, after *T. brevidens*, possesses the simplest molar dentition. The symphysis of the lower jaw is short and decurved. The skull is wider and less elevated than that of the mammoth, and the tusks are shorter and less recurved. It was very abundant during the Plistocene age throughout North America, from ocean to ocean, and as far south as Mexico ; but it has not been found in the latter country. Its remains are usually found in swamps, in company with recent species of Mammalia, and with *Equus fraternus* and *Bos latifrons*. The carbonaceous remains of its vegetable food have been found between its ribs, showing that, like the mammoth, it lived on the twigs and leaves of trees.

It is at first sight curious that this, the simplest of the family of elephants in the characters of its molar teeth, appears latest in time on this continent. But it must be regarded as an immigrant from the Old World, where an appropriate genealogy may be traced. Its nearest ally, *Mastodon borsonii*, existed just anterior to it, during the Middle and Upper Pliocene, and this species was preceded in turn in the Middle and Upper Miocene by the *T. turicensis*, which possesses the same simplicity of the molar teeth. In its mandibular tusks the latter possesses another primitive character, which was nearly lost by its North American descendant.

PLATE XII.

Tetrabelodon augustidens Cuv. From Gaudry.

An ingeniously constructed fraud, consisting of parts of molar teeth of this species fastened together by cement, which was treated with wax, so as to resemble enamel, was described by me as representing a distinct species of this order, under the name of *Cænobasileus tremontigerus*.[1] The specimen was manufactured in southwestern Texas.

Elephas primigenius Blumenbach, the mammoth, was at one time distributed throughout North America, as far south as the valley of Mexico, inclusive. Its remains are found in the Upper Pliocene of Oregon, and in the Pliocene of Mexico, unaccompanied by the *Mastodon americanus*, which had not appeared by that time. In the Eastern States its remains occur with those of the *Mastodon americanus* at the Big Bone Lick, in Kentucky. It was not found in the Port Kennedy, Pennsylvania, Bone-fissure, although the Mastodon was there. This absence may have been accidental. Says Leidy[2]: "The animal (*Elephas primigenius americanus*) was probably of earlier origin, and became earlier extinct than the latter," an opinion which my own observations confirm. Since no earlier species of elephant proper is known from North or South America, we must regard this one as an immigrant from Asia, where, indeed, its remains abound. It remained longer in Siberia than in North America, since whole carcasses have been discovered imprisoned in the ice, near the mouth of the Lena River. These specimens had a covering of long hair, with an under hair of close wool.

Leidy and Falconer have observed that the teeth of the elephants from Eastern North America can be easily distinguished from those of the Mammoth by the greater attenuation of the enamel plates. Leidy also observes that the lower jaw is more acuminate in the former. He proposed, therefore, to distinguish it as a species, using Dekay's name, *E. americanus*. Teeth from Escholtz Bay, Alaska, he regards as belonging to the true *E. primigenius*.

Falconer regarded the true elephant of Texas as a distinct species, which he named *E. columbi*. He distinguished it by the coarse plates of the enamel, and by the wide lower jaw,

[1] "Proceedings American Philos. Society," 1877, p. 584.

[2] "Extinct Mammalia of Dakota and Nebraska," p. 398.

with curved rami, and short symphysis. So far as the dentition goes, I have specimens of this type from Colorado and from Oregon. The Oregon specimen presents the same type of lower jaw as does one from Texas, in my possession. Specimens from the valley of Mexico are abundant in the museums of the City of Mexico, and their characters do not differ

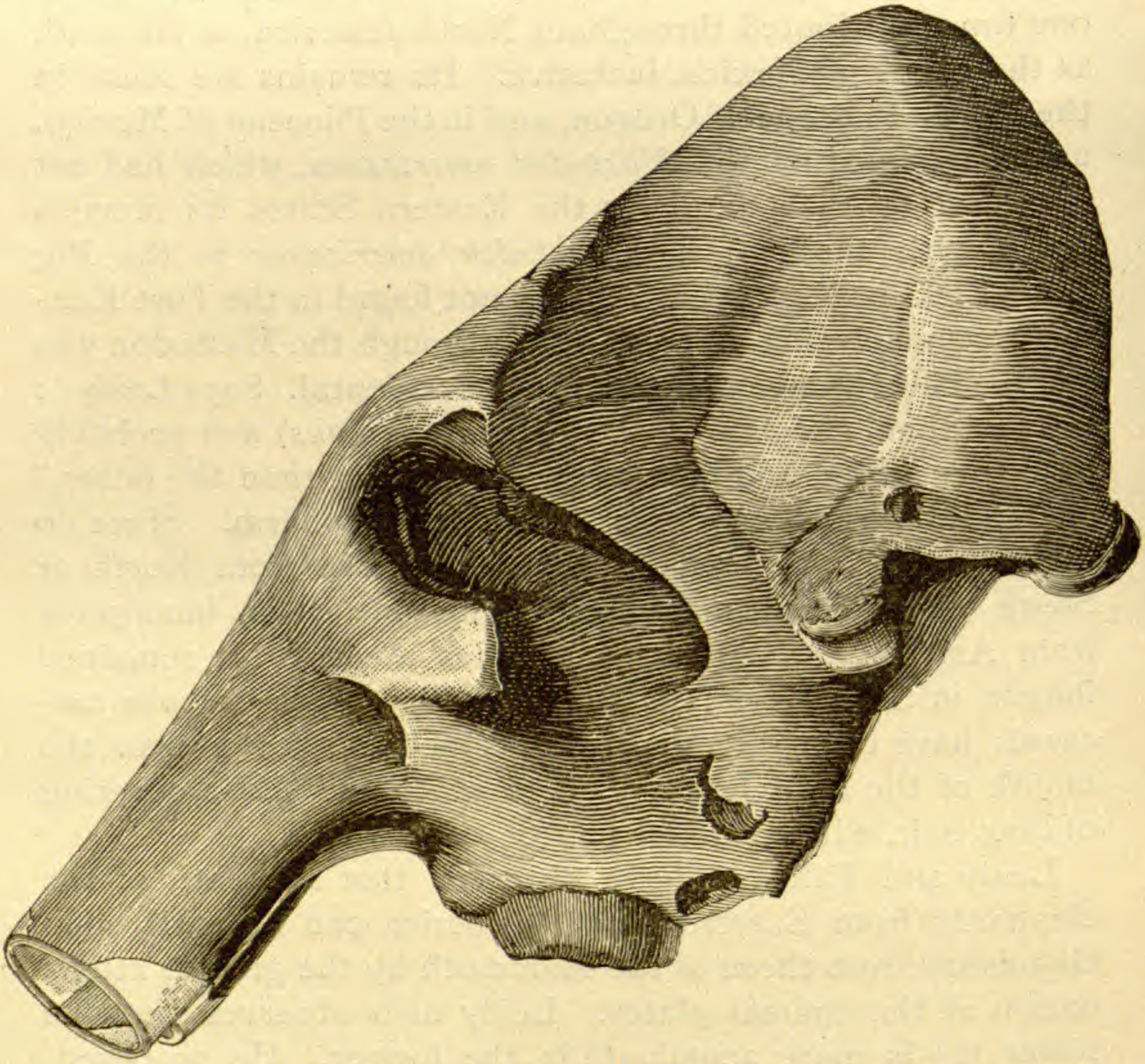


FIG. 9. *Elephas primigenius columbi* Falc., from Texas. Natural size. Original. Profile of skull represented in Plate XIV.

from those from Texas. I have in my museum an entire skull, lacking the lower jaw, (Plate XIV.), from the "orange sand" of the city of Dallas, in Northeastern Texas, which only differs in form from that of the *E. primigenius*, as figured by Blumenbach and Cuvier, in the shorter and wider premaxillary region. This is one-half wider than long (from the molar alveolus) while in the Ilford Mammoth in the British Museum, figured by Leith Adams,[1] the length of this region equals the width. The skull agrees with those of the *E. primigenius*, and differs from those of the *E. indicus* in the narrower proportions of the posterior part of the cranium. The teeth are of the coarse-plated *E. columbi* type. The individual is not very large, though old. The diameter of the tusks at the alveolus is 110 mm. In a fragment of a huge specimen from South-western Texas, the diameter of the tusk at the base is 210 mm.

As a result, it is not clear that the two American forms can be distinguished as yet from the *Elephas primigenius* or from each other, except as probable subspecies, *E. p. columbi*, and *E. p. americanus*. But more perfect material than we now possess may yet enable us to distinguish one or both of these more satisfactorily. No American species of the family exceeded this one in general dimensions, especially the form *E. p. columbi*.

EXPLANATION OF PLATES.

PLATE IX.

Tetrabelodon campester Cope. Palate with teeth from below, one-fourth natural size; from Loup Fork bed of Kansas. Original.

PLATE X.

Side view of jaws of individual of *Tetrabelodon campester* represented in Plate IX., one-eighth natural size.

PLATE XI.

Tetrabelodon angustidens proavus Cope, mandibular ramus and symphysis from above and in profile, one-sixth natural size. Fig. A, first true inferior molar of a young animal, one-third natural size. Fig. B, last superior premolar of young, perhaps of this species, two-fifths natural size.

[1] "Memoirs of the the Palæontographical Society," 1879, p. 69. Monograph of the British Fossil Elephants Pl. VI., VII.

PLATE XII.

Tetrabelodon angustidens Cuv. Entire skeleton 1-26 natural size, restored by Gaudry. From the Miocene of France. From Gaudry "Enchainements du Règne Animal."

PLATE XIII.

Tetrabelodon euhypodon Cope, mandibular ramus from above and in profile, one-eighth natural size. From the Loup Fork bed of Kansas. Original.

PLATE XIV.

Elephas primigenius columbi Falc. Cranium. From Plistocene of Texas, 1-7.7 natural size. Original in Mus. E. D. Cope. The white spaces are light-colored bone, except at ends of premaxillaries, which are plaster.

PLATE XV.

Outlines of crania of Proboscidia, much reduced; from Falconer; front views.

Fig. 1, *Dinotherium giganteum.* Fig. 2, *Mastodon americanus.* Fig. 3, *Dibelodon cordillerarum.* Fig. 4, *Mastodon perimensis.* Fig. 5, *Mastodon sivalensis.* Fig. 6, *Elephas bombifrons.* Fig. 7, *Elephas ganesa.* Fig. 8, *Elephas insignis,* including *a* and *b*, very young. Fig. 9, *Emmenodon planifrons.* Fig. 10, *Elephas africanus.* Fig. 11, *Elephas meridionalis.* Fig. 12, *Elephas hysudricus.* Fig. 13, *Elephas namadicus.* Fig. 14, *Elephas indicus,* including *a*, var. *mukna*, and *b*, young. Fig. 15, *Elephas primigenius,* after Fischer.

PLATE XVI.

Outlines of crania of Proboscidia, much reduced; from Falconer; profiles.

Fig. 1, *Dinotherium giganteum,* from Kaup. Fig. 2, *Mastodon americanus.* Fig. 3, *Tetrabelodon angustidens,* after De Blainville. Fig. 4, *Dibelodon cordillerarum.* Fig. 5, *Mastodon perimensis.* Fig. 6, *Mastodon sivalensis.* Fig. 7, *Mastodon arvernensis,* from Nesti. Fig. 8, *Tetrabelodon longirostris,*

PLATE XIII.

Tetrabelodon euhypodon Cope.

after Kaup. Fig. 9, *Mastodon latidens.* Fig. 10, *Emmenodon elephantoides.* Fig. 11, *Elephas bombifrons.* Fig. 12, *Elephas ganesa.* Fig. 13, *Elephas insignis.* Fig. 14, *Emmenodon planifrons.* Fig. 15, *Elephas africanus.* Fig. 16, *Elephas meridionalis.* Fig. 17, *Elephas hysudricus.* Fig. 18, *Elephas namadicus.* Fig. 19, *Elephas indicus.* Fig. 20, *Elephas primigenius.*

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

THE island of Santa Cruz, from the Mission Church of Santa Barbara, looks not unlike Capri, from the City of Naples. The same blue sky arches over it, the same Mediterranean haze envelops it, its outlines are softened by its distance, and its cliffs rise equally precipitantly from the sea. In my tarry at Santa Barbara, in the spring of 1887, I had repeatedly turned my eyes seaward, across the channel, longing for the opportunity, which at last came, to cross the intervening waters, and set foot on this island. My trip across the channel was productive of both pleasure and profit, and may not be without interest to my readers.

Although a comparatively narrow channel separates the Santa Barbara islands from the mainland, the means of communication are not always at hand. The enterprising fisherman, Larco, often crosses it in his Italian sailboat, the "Genova," but his accommodations for passengers are more or less limited. The vessel owned by the proprietors of the island was not at my disposal, and the only thing left was to charter a craft for my own use. Fortunately, it was possible to find such a vessel, and I was able to visit the nearest of the Santa Barbara islands, long ago discovered by Cabrillo, upon which, according to some authorities, he was buried.[1]

[1] Other historians say this intrepid discoverer found his grave at a neighboring island of San Miguel. Certain it is that he was the first European to sail up the Santa Barbara Channel, and that he lost his life on this voyage. His grave, wherever it may be, is not yet marked by monument or commemorative stone.

The "Angel Dolly," which is at anchor off the wharf at Santa Barbara, was found to be admirably suited for my trip, and after a few preparations, I embarked on her, and hoisting her sails, we turned her southward to the rocky cliffs of the island of the Holy Cross. The "Angel Dolly" is a small schooner of about twenty tons burden, with a cabin, which the passengers share with the captain, a forecastle for the crew, and a capacious hold. The crew consisted of a captain, one man before the mast, and a cook. The cabin I found well suited for my scientific work, and I transformed it into a laboratory, the mess table serving well for microscopic work when the vessel was on an even keel. My dredge, ropes, and nets were well stored in the hold, and at noon, in the middle of March, we hove anchor, set her sail, and went to sea. It had been my intention to visit the island of San Miguel, but the wind was so light that we shaped our course directly to Santa Cruz.

The weather, when we left Santa Barbara, was foggy, and after getting outside the zone of giant kelp,[1] we were becalmed. As a result we drifted back and forth all the afternoon, and finally found ourselves down the coast towards Carpenteria, the storehouse and wharf of which place we saw a few miles away, at nightfall. Although the distance across the channel is about twenty-eight miles, we made little progress that night, and drifted about in the fog until Sunday morning. After many calms, puffs of air, and baffling winds, we sighted, Sunday morning at ten o'clock, the lofty peak of Punta del Diablo, the most lofty headland on the island of Santa Cruz. We ran in toward the land, through the fog, to the neighborhood of the shore, and anchored in a small fiord at the base of Monte Diablo. This fiord, which we will call Star Cañon, is enclosed by lofty cliffs many hundred feet high. As we sailed into it, I saw, for the first time on the Pacific ocean, a large Salpa, which rivals the *Salpa maxima* of the Mediterranean, a floating Ascidian, the "solitary

[1] This zone forms a curious belt, skirting the shore at Santa Barbara. It is composed of the floating fronds of a giant alga (*Nereocystes*), and is situated about three hundred yards from the shore. This zone imparts a highly characteristic appearance to the coast of many parts of Southern California.

form" of which is as large as a man's hand, and the "chain form" is many yards in length.

Looking into the cañon[1] from our anchorage, we notice that the high cliffs of the brow, which appears an unbroken peak from Santa Barbara, have a cleft form with jagged edges, as if they had been broken asunder by volcanic forces. This effect is thought to be due to the recent elevation of the island, and to tell the same story as the raised terraces on the eastern and western ends of the island. In the chart, by the Coast Survey, a mountain called Ragged Mountain occupies the position of this break. The mode of formation of this cañon and fiord[2] is not wholly clear to me. That water has played an important part in its formation is doubtless true, but, at the same time, the sharp break indicates some other and more violent geologic agency. The perpendicular walls of the cañon are certainly from 600 to 900 feet high. The cañon makes up through the mountains, and in the present season a good stream of fresh water flows out of it past the shingly beach to the cove. On the mountain side we noticed little vegetation, but here and there a clump of prickly pears, and small bushes with yellow poppy flowers. The rock is a coarse conglomerate, the embedded boulders of black asphaltic color, and the matrix red. The matrix is in many places very much eroded, and the hard, embedded, angular rocks stand out in relief, sometimes clinging to the cliff by a single edge. The embedded rocks are angular, and little water-worn, except where they are exposed to wave action.

[1] This fiord is almost directly opposite Santa Barbara, under the high peak, which appears from this city to be the apex, or highest point of the island. Its name is not given on the excellent chart of the island, which I made use of on my trip.

[2] From my work with the dredge I am led to believe that these chasms in the islands which are called cañons extend for some distance under the water. I have found records that the officers of the Coast Survey have made similar observations. If such a submarine continuation of these cañons occur, it is difficult to explain them as wholly the result of erosion, or if of aerial erosion, the islands may have sunk subsequent to this action. The evidence on the west end of the island points to elevation, or in this way the elevated terraces were interpreted.

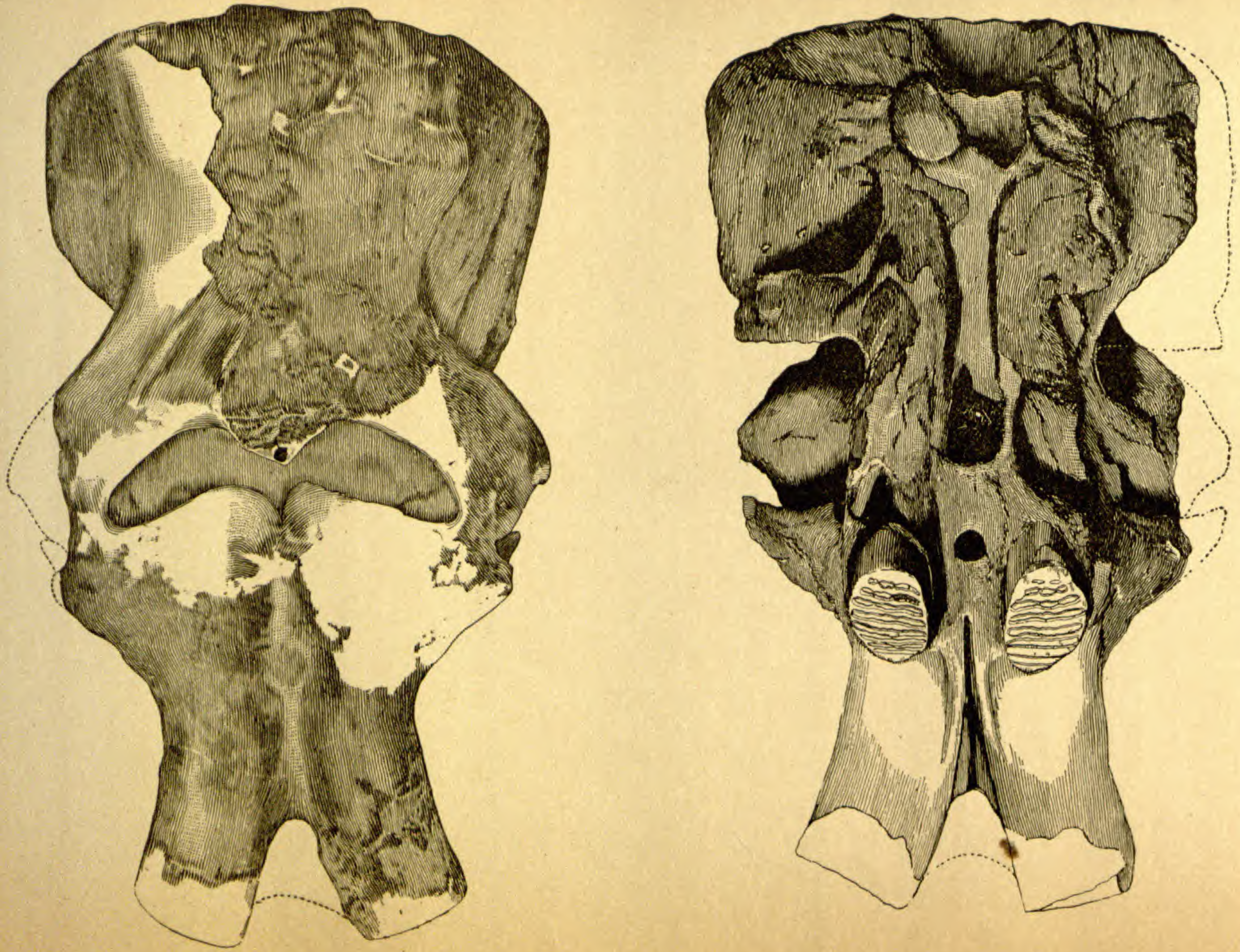
Some of the neighboring islands like Anacapa, show similar elevation, with enormous denudation. The form of this island from the sea is highly suggestive, but I was unable to land upon it.

The fiord in which the "Angel Dolly" rides at anchor is well protected from the prevalent gales, and the water, although deep, is easily sounded by our anchor. We anchored near the shore, not far from the beach, at the end of the cañon. After all had been made snug aboard, we rowed to the shore, and took a stroll up the cañon, following the bed of the brook. The cañon is well wooded with many kinds of trees, and with ferns and mosses, with here and there, wild flowers. As we landed on the shore we started up two small, wild foxes, *Urocyon littoralis*, so abundant on the island, and came within easy gunshot of them.

On each side of the cañon the cliffs rise precipitantly, almost perpendicularly, so that it is impossible to climb them, and it is with great difficulty that we made our way along their base. Many large boulders lie strewn along the bed of the stream, and there are many deep basins of pure, fresh water, fed by the sparkling mountain stream from the cañon. In one or two places the bed of the stream is dry, the water having made a channel for itself through passages under the rock or soil. At certain places these dry sections of the bed of the stream are coated with a white deposit. There were many cottonwood trees as far up the cañon as we were able to penetrate. Near the beach we noticed the remains of an old camp-fire, and the skins of two sheep, which told the story of a former camping party, probably of fishermen, visitors to this lonely and picturesque place. There are also many abalone shells (*Haliotis*), the animals of which had also, no doubt formed part of the meal of these visitors.

The level deposit of soil at the mouth of the cañon must have been a favorite camping place for the Indians who once lived in great numbers on this and neighboring islands, for on the side hill there is a high shell heap where they had thrown the debris of their camp. This shell heap was formed in great part of the shells of a large Balanus, Haliotis, and Mussels. On the sides of the rocks above it many Indian inscriptions were cut in the hard rocks of the conglomerate. These inscriptions were made with some care and consist of parallel grooves in the rock across which, at right angles, were other grooves all of undoubted Indian origin. We returned to the

PLATE XIV.



Elephas primigenius columbi Falc.

"Angel Dolly" and transported our cooking utensils on shore preparatory to a camp there under the brow of the cliffs of the cañon.

In the afternoon I took a sailor and one of the seal boats of the schooner and rowed down the shore to the westward under Punta del Diablo to the "Seal Rookery." This boat ride was the most wonderful trip which I have ever taken on the coast of California. The cliffs to the west of Star Cañon rise perpendicularly to the height of many hundred feet, so that it is impossible to climb them except in the small fiords or cañons which extend into the mountains. Immediately after rounding the high headland to the west of Star Cañon we come to the first cañon, which is well wooded and surrounded by mountains which are grandly picturesque. We did not land in this fiord but continued to the second, which was even more rugged and abrupt than the first. This cañon presented to us a landing place, and we rowed through the heavy surf, landing on a small beach. The cañon is well wooded but closed a short distance from the beach by a high boulder, which has fallen into it, so that the cañon is almost blocked up. The boulders, which stop up several of the cañons, are thought to have been eroded from the cliff in the position they at present occupy, and not to have been transported from higher up the cañon by water or ice.[1]

We made our way back of the boulder through a crevice between it and the cliff and continued up the cañon a few hundred yards, but the way gets more difficult, the loose

[1]Something analogous to this is to be seen in the boulders of red sandstone which are strewn along on the mesa at the foot of the Santa Inez mountains back of Santa Barbara. These rocks are sometimes of great size and, according to Whitney, were washed down from the mountains which everywhere show signs of great erosion. They become very thickly massed together in some places and often reach enormous proportions. I was unable to find glacial striæ on the sides of the Santa Yeury range although I repeatedly looked for them.

One of the most famous of these large erratic rocks is that near Montecito which bears the Indian inscription done in red paint. Beyond the Mission Church they are very numerous in some places blocking up the cañons as in the island of Santa Cruz. In some places they are so numerous that they almost form boulder rivers. Just back of the Spanish part of Santa Barbara between the city and the mesa there are many eroded valleys and as we pass over the mesa to the foot of the Santa Yeury range the erratic rocks increase in size and number.

rocks more numerous and the walls of the cañon more and more precipitant. The same conglomerate is present here as at Star Cañon, near which our schooner is anchored.

I made a sketch of the place and took again to boat passing under the brow of Punta del Diablo, one of the grandest points of the island.

Under the base of Diablo opens "Devil's Cañon" or "Devil's Cove," a most picturesque, wild and rugged combination of land and sea. In this part of Santa Cruz there are no beaches and no zone of kelp, but the water sinks to a great depth hard by the shore, and dredging was impossible with the implements at my disposal. At the base of Punta del Diablo there are two conical elevations rising as islands out of the sea. These elevations when approached from the east appear perfectly symmetrical, the more distant from the point being capped by an eagle's high nest. The hills are green to their summits.

Near these conical islands we rowed into a grotto of wonderful beauty. It extends deep under the mountain and as our boat made its way in, we saw many seals and sea-lions on the ledges of the rock. As we rowed in, these huge animals dove into the sea with hoarse barking and swam into the depths of the cave. We fired at them with our rifles and the reverberation was something deafening. In the cave, which extended many feet beyond, a tremendous sea was rushing at every incoming wave. The whole grotto reminded me of the famous grotto of Capri in the Bay of Naples.

Beyond Punta del Diablo the cliffs take the form of a gigantic saw, the top of the precipices being worn out into valleys which are symmetrical one after another. Beneath these saw-like valleys the rock shows much erosion especially near the level of the sea At one place a perfectly formed human figure which appears to be in the act of stepping into the sea, can be made out. A tremendous surf breaks on the base of the cliffs and here and there where there are partially submarine grottos or caves the escaping air throws the water to great heights with a loud noise.[1] Behind us the monster

[1]These spouts of water thrown into the air by the resistance of the air compressed in a half submarine grotto by an incoming wave are among the most interesting

cliff of Punta del Diablo extends almost perpendicularly out of the water. The view of the coast looking both east and west is perfectly grand. Away to the west we sight the conical rocks and islands which form the eastern side of the "Seal Rookery."

As we row along we see here and there on the sides of the cañons a few sheep and one or two wild hogs. The east side of the Seal Rookery is bounded by islands with natural arches and lofty cliffs. Off these islands a short distance there is a small island with a flat top, and near it are two beautiful natural arches. The flat rock is white with guano, and the natural arches are high enough to allow a boat to pass under them. There is no landing place of any size at the Rookery, but vast numbers of seal are seen basking in the sun. Here we see much kelp, and for the most part the coast everywhere is bold and rugged. At the Seal Rookery we turn back towards Star Cañon and after a hard pull we came at last to the smooth water in which the schooner is at anchor.

One of the most beautiful of all the cañons which we passed was Lady's Cañon, a most picturesque place with smooth water and cliffs rising on all sides. The scenery here is very grand. Floating kelp was found at several places and one or two gigantic floats of the "Sea-Onion" were found, but as a general thing the coast is bare and no zone of kelp like that of Santa Barbara was seen.

phenomena of the coast. Their height is often very considerable and the noise with which the water is forced out is often very great. The surf upon the base of the cliffs is often very heavy after the sudden winds which often arise without a moment's warning.

The sudden and local character of the gusts of wind is in some cases due to the cañon configuration of the coast. A most marked instance illustrative of this explanation was experienced in my approach a few weeks later to the harbor of Port Harford the port of San Luis Obispo. We had steamed along the whole afternoon over a tranquil sea without a ripple when suddenly on our approach to this port there came down a violent gust of wind out of the cañon such that the steamer seemed to pass immediately into a raging tempest which as suddenly ceased when we drew up at the wharf.

(To be continued.)

THE POLAR DIFFERENTIATION OF VOLVOX, AND THE SPECIALIZATION OF POSSIBLE ANTERIOR SENSE-ORGANS.

BY JOHN A. RYDER.

IN a recent communication upon this subject which the writer made to the Academy of Natural Sciences of Philadelphia, the fact was pointed out that in *Volvox minor* there are very distinctly differentiated anterior and posterior poles or hemispheres. The anterior or empty pole is so named here because it is the one which is always directed forwards when the animal is in motion. The posterior pole is so named because it is always in a posterior position when the organism is moving freely and normally, and it is further distinguished from the anterior in that it is in this hemisphere, in *V. minor* at least, in which the germs are produced which give rise to young Volvoces. Roughly speaking the nearly spherical cænobium or colony of Volvox may be divided into an anterior and a posterior hemisphere. Through the centres of these hemispheres there passes an imaginary axis around which the colony rotates in either a sinistral or dextral direction, but progressive locomotion is always in the direction of the anterior empty pole of the cænobium. This differentiation of the poles of the colonies of Volvox appears to have been known to Ehrenberg, who figures them but makes no farther mention of the fact. Hicks is reported in the *Midland Naturalist*, 1880, to have observed that the young leave the parent cænobium by breaking through the wall of the hinder or spore-bearing hemisphere, a fact which I can confirm.

While these facts have been partially recorded by previous observers, there is another group of facts which I have noticed which are far more important and remarkable and serve to establish beyond question the polar differentiation of Volvox, and also raise the suspicion that this animal or plant, whichever it is, is endowed with a very primitive sensory apparatus which is developed to an importance anteriorly, eight or ten times as great as at the posterior pole. It is well known that each one of the biflagellate cells of Volvox contain superficially embedded a reddish lenticular refringent body known since Ehrenberg's time as "eyes" or "eye spots." One of these "eye spots" lies not very far from the base of one of the flagella in each cell, and produces a slight rounded projection of the thin layer of clear protoplasm immediately overlying and surrounding it. In optic section these reddish bodies are seen to be lenticular or nearly so, the outer face being less convex than the inner. This is best seen in the "eye-spots" of the anterior pole. These "eye-spots" strange to say, bear a constant and definite relation to both the imaginary axis around which the colony revolves and the flagella of its cells. They are placed not quite on the extreme outer periphery of the cells as reckoned from the centre of the globular colony, but nearly so. The anterior ones at the anterior pole consequently look forward, while the others of the rest of the cells look in all other directions, the hindmost ones looking directly backward.

Now comes the most singular and interesting fact which I have observed, viz: *that the "eye-spots" of the cells of the anterior pole are eight to ten times as large as those of the hinder pole.* The passage from the large "eye-spots" of the anterior pole to the smaller ones of the posterior pole is very gradual, as can be readily observed with a moderately high power. These "eye-spots" diminish so much in size on passing to the cells of the posterior pole as to be finally visible only as a minute refringent reddish globule pushing out the protoplasm of the cell slightly in the same way as the larger anterior "eye-spots" push out the superficial plasma of the cells of the anterior pole.

It is therefore plain that if these organs are visual or sensitive to light or any other natural agent, they are best developed in just the position in which they are of the most service to the organism, viz., at its anterior pole. These facts raise the query whether Ehrenberg was not after all justified in regarding the reddish spot in each cell of the colony as *eyes.* While these eyes are obvious to any observer it is remarkable that no one has hitherto called attention to their very unequal development at the anterior and posterior poles of Volvox. It is equally remarkable that none of the extant figures of Volvox correctly represent the definite relation of position of the "eye-spots" to the axis of rotation of the whole cænobium or colony and the flagella of the cells.

The facts which are here noted in regard to Volvox serve rather to strengthen the claims of zoologists to this singular organism, which is actually found to combine features of the vegetable and animal world in its physiological activities. While its respiration, chlorophyl, and modes of reproduction seem to affiliate it with the plant kingdom, the obvious differentiation of a system of anterior organs, which refuse any other identification than that of sensiferous structures give it claims upon the animal kingdom. If we look upon Volvox as a form which has permanently not passed beyond the ideal blastula stage and which lies near the point of divergence of Metaphyta from the Metazoa we shall probably assign it to nearly its true position. It has many interesting features, one of which is its blastula-like form; its cells embedded in cellulose and united by protoplasmic bonds into a sort of syncytium; its differentiation of a directive anterior empty pole apparently provided with a more specialized sensory apparatus, as pointed out above, and of a posterior reproductive pole or hemisphere, in the cells of which the supposed sensory apparatus is so reduced in importance as to have been nearly suppressed. Carrying our reflections farther, we may be permitted to suppose that conditions of organization may and do exist, as evidenced in Volvox as here described, in which structures and functions may be manifested, which we must regard as sensiferous, yet in so low and generalized a form in a blastula-like type, that we find the organs developed in every cell, the only evidence of differentiation or specialization obtainable being that which occurs at that pole of the blastula which is habitually brought into the most important or dangerous relation to the environment. The end result being that a type comparable to the hollow blastula has the sensiferous apparatuses of the cells at its constant anterior pole better developed than in those around its equator and still better than in those at its constant posterior pole. The diffusion or extension of the primordial visual apparatus of the protozoan grade such as is seen in Euglena, is a result merely, in Volvox, of the permanent attainment of the colonial grade of development which has ended in a sort of blastula-like form, each cell of which is provided with a sense organ. In other words we have in Volvox a blastula-like type with a sensory apparatus apparently developed at its anterior pole, while at its posterior pole this sensory apparatus is so little developed as to be nearly absent, possibly owing to disuse. The degree of development of this supposed sensiferous apparatus at opposite poles in Volvox stands in an obvious relation to the respective importance of such a contrivance at those poles in relation to the welfare of the organism. It is probable that, if what I have here described is really a visual or other sensory apparatus, it is the most primitive and unspecialized compound sensiferous organ yet detected in the living world. At any rate it is probably to be regarded as a compound organ in the same sense that the retina and ommatidia of other and higher forms are to be regarded as compound organs in that they are cellular aggregates. The further study of these remarkable structures and relations in Volvox is desirable, and as the organism is accessible to many students it is to be hoped that such study may not be long delayed, and that not only a more careful study of the minute structure of the "eye-spots" may be carried out, but also that figures will be produced which will give adequate prominence to the most important of the facts which I have here attempted to put upon record.

THE DEVELOPMENT OF THE THEORIES OF CRYSTAL STRUCTURE.[1]

IN 1822, the Abbé Haüy[2] declared that since all crystals of the same substance, whatever their external form, may be

[1] Abstracted by. W. S. Bayley from an article by H. A. Miers in *Nature* of January 17, 1889.

[2] "Traité de Cristallographie." (Paris, 1822.)

reduced by cleavage to the same solid figure, this cleavage solid has the form of the ultimate particles into which any crystal may, in imagination, be separated by repeated subdivision, and that this is, therefore, the form of the structural unit, although not necessarily that of the chemical molecule. Hence a crystal is to be regarded as constructed of polyhedral particles, having the form of the cleavage fragment, placed beside one another in parallel positions. A crystal of salt, for example, which naturally cleaves parallel to the faces of the cube, is constructed of cubic particles.

Upon the relative dimensions of the structural unit depends the form assumed by the crystals of a given substance.

This theory not only accounts for the existence of cleavage, but further defines the faces which may occur upon crystals of a substance having a given cleavage figure; for, if once it is assumed that a crystal-face is formed by a series of the particles whose centres lie in a plane, it follows that all such planes obey the well-known law which governs the relative positions of crystal-faces.

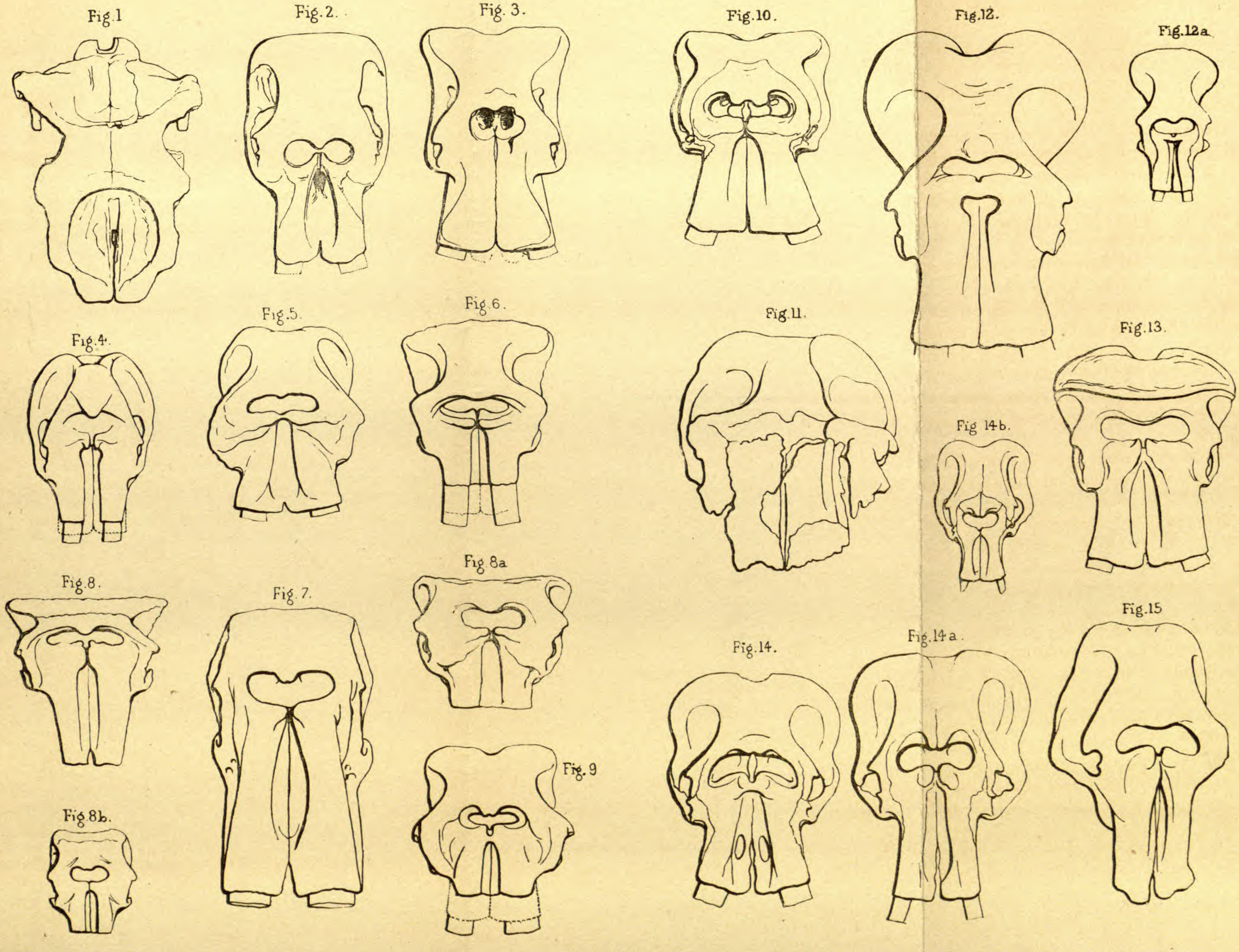
A natural advance was made from the theory of Haüy, without detracting from its generality, by supposing each polyhedral particle in Haüy's system to be condensed into a point at its centre of mass, so that the positions of the molecules, and therefore of the crystalline planes, remain the same as before; but the space occupied by a crystal is now filled, not by a continuous structure resembling brickwork, but by a system of separate points.

In such a system of points, if the straight line joining any pair be produced indefinately in both directions, it will carry particles of the system at equal intervals along its entire length; in other words, all the structural molecules of a crystal must lie at equal distances from each other along straight lines. The interval between particles along one straight line will, in general, be different from those along another, but the molecular intervals along parallel straight lines will always be the same.

Bravais,[1] following in the steps of Delafosse and Franken-

[1] "Etudes cristallographiques." (Paris, 1866.)

PLATE XV.



Crania of Proboscidia.

heim, investigated the possible ways in which a system of points may be arranged in space so as to lie at equal distances along straight lines—in other words, so as to constitute what may be called a *solid network* (*assemblage*, *Raumgitter*).

The geometrical nature of a network may be best realized as follows: Take any pair ($O\ C_1$) of points in space, draw a straight line through them, and place points at equal distances along its entire length (C_2, C_3, . . .); such a line may be called a *thread* of points (*rangée*). Parallel to this line, and at any distance from it, place a second thread of points ($A_1\ a_1$), identical with the first in all respects; in the plane containing these two threads place a series of similar equidistant parallel threads ($A_2\ a_2$, &c.) in such positions that the points in successive threads lie at equal intervals upon straight lines whose direction ($O\ A_1$) is determined by the points upon the first two threads. Such a system of points lying in one plane may be called a *web* (*réseau*). Now, parallel to this plane, and at any distance from it, place a second web ($B_1\ b_1$), identical with the first. Finally, parallel with these, place a series of similar equidistant webs in such positions that the points in successive planes lie at equal intervals upon straight lines whose direction ($O\ B_1$) is determined by the points in the first two webs.

In this way a *network* of points is constructed, in which the line joining any two points is a *thread*, and the plane through any three points is a *web*.

The space inclosed by six adjacent planes of the system, having no other points of the network between them is a parallelopiped ($O\ A_1\ B_1\ C_1$), from which the whole system may be constructed by repetition, and which may be taken to represent the structural element (*molécule soustractive*) of Haüy.

The complete investigation of all possible solid networks led Bravais to the conclusion that these, if classified by the character of their symmetry, fall into groups, which correspond exactly to the systems into which crystals are grouped in accordance with their symmetry.

It follows that two (not, however, independent) features of crystals are fully accounted for by a parallelopipedal arrangement of points in space—namely, the symmetry of the crystallographic systems and the law which governs the inclinations of the faces (law of rational indices).

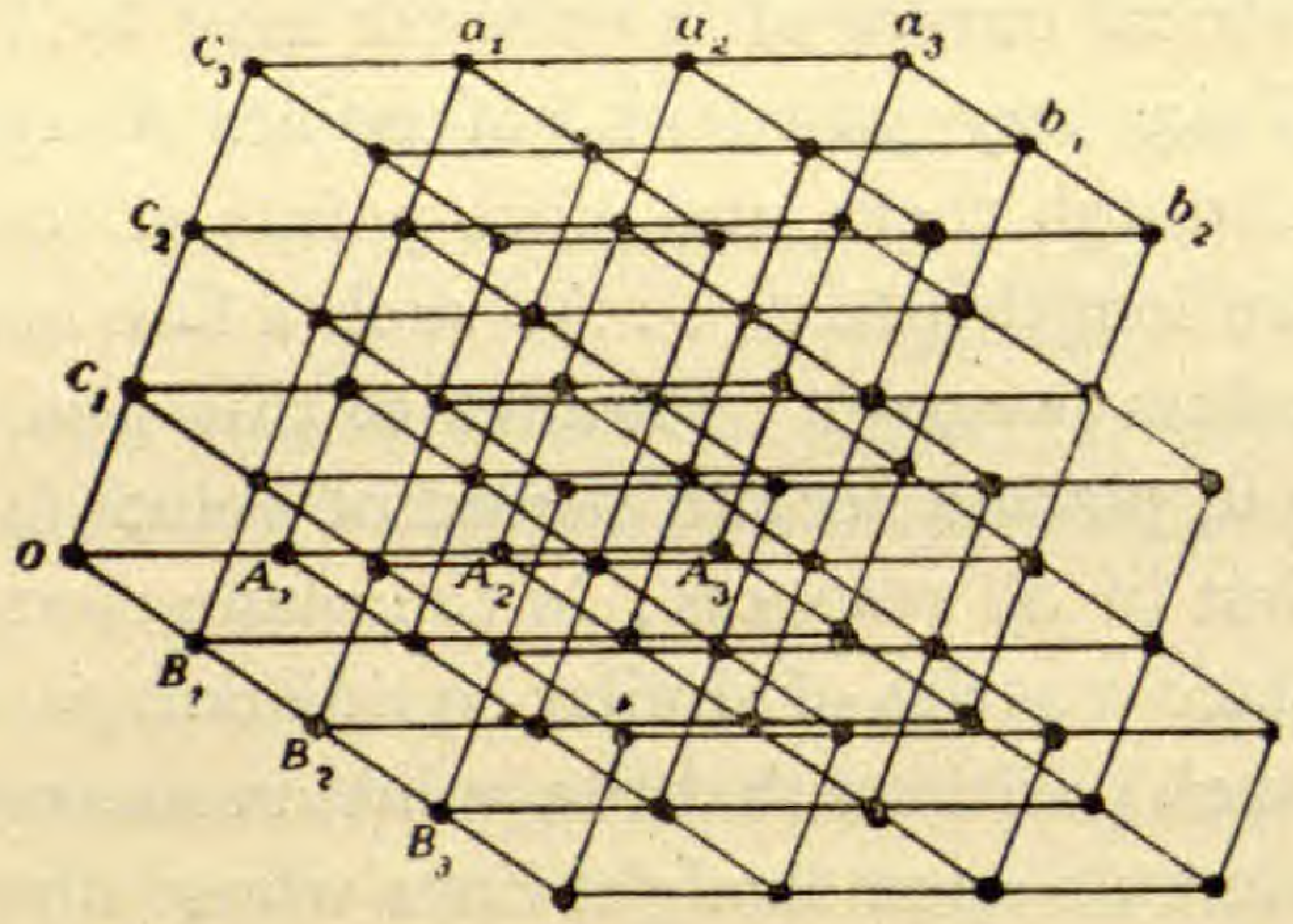


Fig 1

There are, however, subdivisions of the various systems consisting of the merohedral or partially symmetrical crystals belonging to them, which are not explained by the geometry of a network; these consequently were referred by Bravais, not merely to the arrangement of the molecules in space, but also to the internal symmetry of the molecule itself.

Hence the theory of Bravais, while able to a certain extent to explain the form of crystals, requires an auxiliary hypothesis if it is to explain those modifications which are partially symmetrical or merohedral.

Sohncke,[1] treating the problem in a different manner, and reasoning from the fact that the properties of a crystal are the same at any one point within its mass as at any other, but different along different directions, inquired in how many ways a system of points may be arranged in space so that the configuration of the system round any one point is precisely similar to that round any other. Such a configuration may be called a *Sohncke system* of points in space (*regelmässiges Punktsystem*).

From his analysis of this problem, it appears that there are

[1] "Entwickelung einer Theorie der Krystallstruktur." (Leipzig, 1879).

sixty-five possible Sohncke systems of points, and that these may be grouped according to their symmetry into six classes, corresponding to the six crystallographic systems; and further that there are within each class minor subdivisions, characterized by a partial symmetry corresponding to the hemihedral and tetartohedral forms of crystallographers.

The theory of Sohncke contains within itself the essential features of a Bravais network of structural molecules, and also the auxiliary hypothesis regarding the arrangement of parts within the molecules which is required to account for merohedrism. On close examination the arrangement of Sohncke proves to be a simple extension of that of Bravais.

Each of Sohncke's arrangements may be regarded as derived from one of the parallelopipedal networks of Bravais if for every point of the latter be substituted a group of symmetrically arranged satellites. It is not necessary that any particle in a group of these satellites should actually coincide with the point of the Bravais network from which the group is derived; and the points of the Sohncke system do not themselves form a network; it is only when all the points in each group of satellites are condensed into one centre that a Sohncke system coincides with a Bravais network.

To any particle of one of the satellite groups corresponds in every other group a particle similarly situated with regard to the point from which the group has been derived. Every such point may be said to be homologous with the first.

Each complete set of homologous points is itself a Bravais network in space, and consequently a Sohncke system may be regarded as a certain number of congruent networks interpenetrating one another: the number of such networks, in general, being equal to the number of points which constitute each group of satellites.

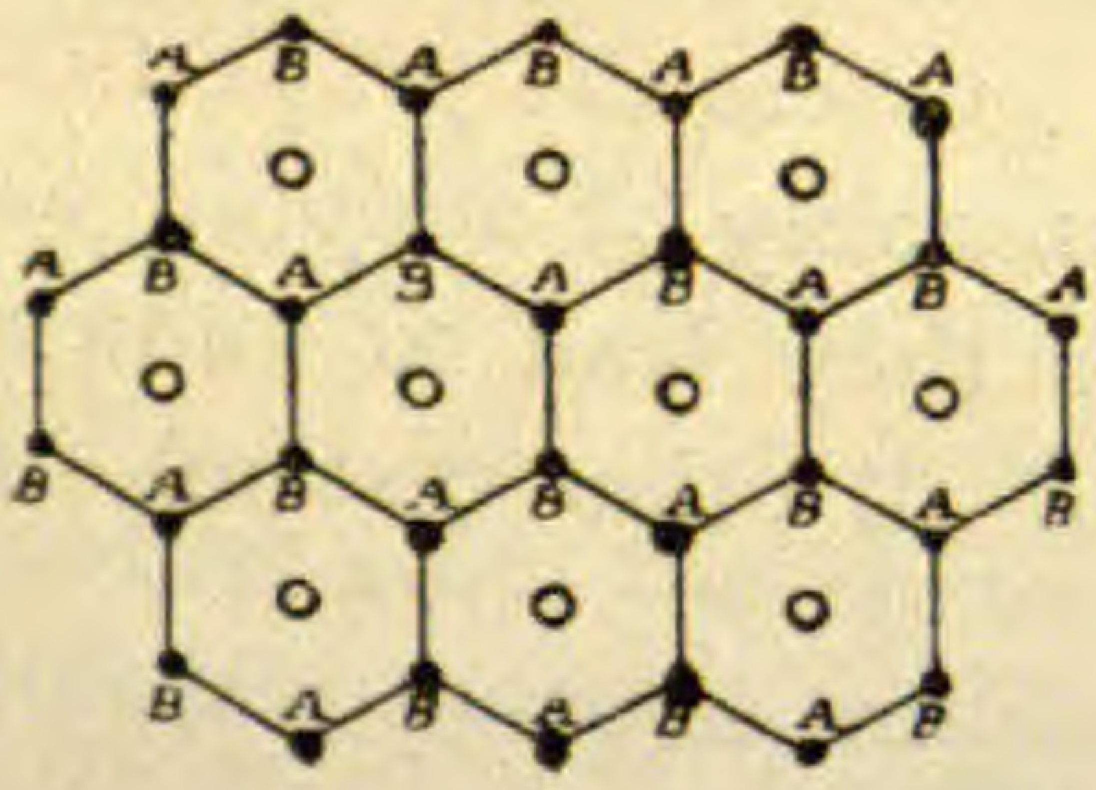


Fig 2

The relation of a Sohncke system to the network from which it is derived may be illustrated by a bees'-cell distribution of points in one plane, *i. e.*, by points which occupy the angles of a series of regular hexagons. Thus, in the adjoining figure the dots form a Sohncke system in one plane, since the configuration of the system round any one point is similar to that round any other; but they do not form a Bravais web, since the points do not lie at equal distances along straight lines.

If, however, points, represented in the figure by the circles O, be placed at the centres of the hexagons, they will by themselves constitute a web, and the hexagonal system may be derived from this web by replacing each of its points by a group of two satellites, A and B. Or, from the second point of view, the arrangement may be regarded as a triangular web, containing the points A, completely interpenetrated by a similar web, containing the points B.

It is a remarkable feature of the Sohncke systems that some among them are characterized by a spiral disposition of the particles along the threads of a right- or left-handed screw: now this spiral character, which does not belong to any of the Bravais networks, supplies a geometrical basis for the right- or left-handed nature of some merohedral crystals which possess the property of right- or left-handed rotary polarization.

The theory of Sohncke, as sketched above, appeared to be expressed in the most general form possible, and to include all conceivable varieties of crystalline symmetry.

It has, however, recently been pointed out by Wulff[1] that the partial symmetry of certain crystals belonging to the rhombohedral system—that, namely, of the minerals phenacite and dioptase—is not represented among the sixty-five arrangements of Sohncke.

Other systems of points in space have also been studied by Haag[2] and Wulff, which do not exactly possess the properties of a Sohncke system, and yet might reasonably be adopted as the basis of crystalline structure, since they lead to known crystalline forms.[3] These, however, and all other systems of

[1] *Zeitschr. f. Kryst.* xiii. (1887) p. 503.

[2] "Die regulären Krystallkörper." (Rottweil, 1887.)

[3] Cf. W. Barlow, *Nature*, xxix. (1884) pp. 186, 205.

points which have been proposed to account for the geometrical and physical properties of crystals, may be included in the theory of Sohncke after this has received the simple extension which is now added by its author.

In Bravais's network all the particles or structural elements were supposed to be identical, and in Sohncke's theory also there is nothing in their geometrical character to distinguish one particle from another.

In Fig. 2, the hexagonal series of dots may, as was said above, be regarded as composed of a pair of triangular webs, A and B; now these, although identical in other respects, are not parallel, for the distribution of the system round any point of A is not the same as that round any point of B until it has been rotated through an angle of 60°.

It is possible, however, to conceive similar interpenetrating networks which differ not only in their orientation but even in the character of their particles. The centre of each hexagon, for example, may be occupied by a particle of different nature from A and B to form a new web, O. The three webs are precisely similar in one respect, since their meshes are equal equilateral triangles; moreover, if the *position* of the points alone be taken into account, the whole system would form a Bravais web, *i. e.*, if the particles of O were identical with those of A and B. If, however, as is here supposed, the set O consists of particles different in character from A and B, the distribution round any point of O is totally distinct from that round any point of A or B. The points O are geometrically different from the points A B. The web A is interchangeable with B, but O is interchangeable with neither The interpenetrating networks are no longer to be regarded as consisting necessarily of identical particles, if an explanation is to be given of all the geometrical forms existing in nature.

The above figure represents a Sohncke system, A B, of particles of one sort interpenetrated by a Bravais web, O, of another sort; but there is no reason why two or more different Sohncke systems, no one of which is identical with a Bravais network, may not interpenetrate to form a crystal structure.

In its most general form, then, the theory may now be expressed—

A crystal consists of a finite number of interpenetrating Sohncke systems which are derived from the same Bravais network. The constituent Sohncke systems are in general not interchangeable, and the structural elements of one are not necessarily the same as those of another.

Or, since each Sohncke system consists itself of a set of interpenetrating networks, the theory may be thus expressed—

A crystal consists of a finite number of parallel interpenetrating congruent networks: the particles of any one network are parallel and interchangeable; these networks group themselves into a number of Sohncke systems in each of which the particles are interchangeable but not necessarily parallel.

The number of kinds of particles which constitute the crystal may therefore be equal to the number of Sohncke systems involved in its construction.

The structural units are no longer, as they were in the theory of Bravais, necessarily identical, but may represent atomatic groups of different nature.

The system in Fig. 2 consists of two sets of particles, A B and O; and, if a large enough number of these be taken, any portion of the system (*i. e.* any crystal constructed in this manner) consists of the particles united in the proportion of two of the first group to one of the second. Such an arrangement, then, may represent the structure of a compound, $O A_2$.

"When, for example, a salt in crystallizing takes up so-called water of crystallization which is only retained so long as the crystalline state endures, the chemical molecule salt + water cannot be said to exist except in the imagination, for the presence of such a molecule cannot be proved. To obtain an easily intelligible example, without, however, pronouncing any opinion as to whether it may be realized, imagine the centred hexagons in the figure to be constructed in such a way that each corner consists of the triple molecule $3\ H_2O$, and each centre consists of the molecule R. The chemical formula would then be $R + 6H_2O$, and yet a molecule of this constitution would not really exist; on the contrary, the structural elements in the crystallized salt would be of two sorts—namely, R and $3H_2O$."[1]

Hence it is geometrically possible that the structural elements of a crystal may be different atomic groups which are held in a position of stable equilibrium by virtue of being interpenetrating networks.

A GENERAL PRELIMINARY DESCRIPTION OF THE DEVONIAN ROCKS OF IOWA; WHICH CONSTITUTE A TYPICAL SECTION OF THE DEVONIAN FORMATION OF THE INTERIOR CONTINENTAL AREA OF NORTH AMERICA.

BY CLEMENT L. WEBSTER.

The area of the Devonian rocks in North America presents at least four distinct types of stratigraphy in their sections, in different parts of the continent.

The four types blend, more or less, at their borders, but in their central area are quite distinct.

The four areas may be called,—

(1) "*The Eastern Border Area,*" including the outcrops of Gaspé, New Brunswick, Maine, and other places in Northern New England.

(2) "*The Eastern Continental Area,*" including the New York and Appalachian tracts as far South as West Virginia, and extending Northwestward into Canada West and Michigan.

(3) "*The Interior Continental Area,*" typically seen in Iowa, and extending into Missouri, Illinois, Indiana, and probably Northward toward the valley of the Mackenzie River, and—

(4) "*The Western Continental Area,*" best known through Hague and Walcott's studies of the Eureka, Nevada, sections.[2]

Each of these four types presents sections of the Devonian, which

[1] Sohncke, *Zeitsch. f. Kryst.* xiv. p. 443.

[2] This classification of (in part) Professor H. S. Williams (American Geologist, Special Number, October, 1888, p. 228) we here adopt, provisionally.

in most of the details of stratigraphical, lithological and palaeontological composition, differs greatly from the others; although all at the same time, by various links of evidence, demonstrate that they represent the same geological age, and usually show, more or less distinctly, a similar order of sequence.

In this report it is our aim to deal, more particularly, with the typical section (Iowa) of the Interior Continental Area.

The area of surface occupied by the rocks of Devonian age in Iowa comprises a wide strip of country, the general trend of which is Northwestward and Southeastward.

It is about two hundred miles in length and fifty miles in width; the general details of its outlines may be seen upon the geological map of the State; which, however, demands some important modifications.

The rocks of this age, in Iowa, have been referred by geologists to different epochs; for instance, the shales and sandstone, which occupy the upper portion of the Devonian stratum near the mouth of Pine Creek, and at other points on the Mississippi, to the Chemung group; and the limestone and shales, occupying a "lower"? horizon, at Davenport, Iowa City, Independence, &c., and the shales at Rockford and Hackberry, to the Hamilton Group (Hall's Geology of Iowa, Vol. I. Part 1 and 2, 1850).

The rocks also at Cedar Falls, have been referred by Professor A. H. Worthen, to the Chemung group (*Loc. cit.*)

Some years later, in 1873, a reëxamination of some of the rocks of this age was made by Hall and Whitfield, and the limestone at Waterloo, and the shales at Rockford, were declared to be the equivalents of the New York Corniferous and Chemung Groups, respectively (23d Report on State Cabinet of New York, pp.,223-226) Again, Prof. H. S. Williams, in 1883 (American Journal of Science, February, 1883), referred the shales at the top of the Devonian, at Rockford and Hackberry, to the base of the Chemung of the New York Geologists, and, more recently, to the upper part of the Hamilton of the New York Section (American Geologist, Special Number, 1888, pp, 240, 242, &c.).

On the other hand, Dr. C. A. White (Geology of Iowa, 1870, Vol. I., p. 178) is of opinion that *all* the Devonian strata of Iowa, belong to a single epoch, the Hamilton.

By various other writers, the rocks of this age have been referred to each of the several divisions of the New York section.

The thickness of the Devonian rocks of Iowa, have been variously estimated by different writers on the subject, at from 150 feet to 200 feet.[1] This formation is quite conformable both with the Niagara rocks below, and the Carboniferous rocks above, throughout nearly, or quite their entire extent in the State. These rocks, as they occur in this State, are separable into *three* general, more or less well marked lithological and palaeontological divisions, and whose order of sequence can be made out.

The lowest division of this section, which, in its general lithological character, as observed in its Eastern extension at different points along the Mississippi, at, and adjacent to Davenport, is a rather hard, gray, brown, and buff limestone; at times somewhat arenaceous and argillaceous, with slight intercalated beds of shale, and gray and brown brecciated limestone, sometimes attaining a thickness of eight feet. A portion at least, of the rocks of this division, are here separated from the underlying Niagara limestone by a fault, the space being filled by coal measure deposits.[2]

This formation carries, at different horizons, a rich and varied fauna; while at other horizons, the strata are devoid of organic remains.

These rocks contain a fauna which represents both the Corniferous, Hamilton, and Chemung faunas, as well as a few forms characteristic of the Trenton and Niagara rocks below. Of the very large numbers of species of fossils (more than two hundred) collected from these rocks, over three-fourths are found to be characteristic of the Corniferous epoch. Of those forms representing the fauna of other epochs, their ratio of occurrence is, as in the following order: Hamilton, Niagara, Chemung and Trenton.

Or in other words, the larger number are peculiar to the Hamilton group, the second largest number are peculiar to the Niagara group, the third Chemung, and the fourth Trenton.

The following enumeration is that of some of the species characteristic of this division:

Arcophyllum oneidense	Cladopora fisheri
Callonema bellatulum	Cystiphyllum impositum
Callonema lateradum	Cystiphyllum vadum

[1] Hall's Geology of Iowa, Vol. I., Part I, 1858; C. A. White, Geology of Iowa, 1870; J. D. Dana, Manual of Geology, p 267; H. S. Williams, American Geologist, Special Number, October, 1888, p 233.

[2] A. S. Tiffany, Geology of Scott County, Iowa, and Rock Island County, Illinois, &c., p. 13.

Diphyphyllum simcoense
Orhoceras faculum
Strophodonta nacrea
Syringopora perelegans
Syringostroma densum
Zaphrentis nitida
Acrophyllum oneidaense
Alveolites subramosus
Atrypa hystrix
Aulacophyllum convergens
Aulacophyllum princeps
Blothrophyllum promissum
Centronella hecate
Chonophyllum vandum
Cladopora pinguis
Cladopora robusta
Clisiophyllum ohioense
Callonema imitator
Cyathophyllum clintonensis
Cyathophyllum cornicula
Cyathophyllum impositum
Cystiphyllum ohioense
Favosites canadensis
Favosites limitaris
Orthis iowensis
Platyceras carinatum
Pleurotomaria hebe
Phillipsastrea gigas
Spirifera fimbriata
Spirifera gregaria
Spirifera varicosa
Strophodonta hemispherica
Terebratula elia
Zaphrentis compressa
Zaphrentis exigua
Zaphrentis prolifica
Zaphrentis wortheni[1]

Leperdita cayuga
Productella subaculeata
Syringopora nobilis
Syringostroma columnare
Zaphrentis exigua
Zaphrentis subconstricta
Alveolites squamosus
Atrypa aspera
Atrypa reticularis
Aulacoplyllum reflexum
Bellerophon pelops
Centronella glansfagea
Chonetes lineata
Cladopora labiosa
Cladopora pulchra
Clisiophyllum convergens
Crania bordeni
Cyathophyllum arctifossum
Cyathophyllum coalitum
Cyathophyllum conigerum
Cyathophyllum houghtonii
Cyathophyllum davidsonii
Favosites basalticus
Favosites emmonsii
Naticopsis humilis
Paracyclas lirata
Pleurotomaria aplata
Pleurotomaria rotalia
Proetus canaliculatus
Spirifera mucronata
Spirifera euruteines
Strophodonta concava
Strophodonta patersonii
Zaphrentis cruciforme
Zaphrentis conigera
Zaphrentis gigantea
Zaphrentis ungula

[1] For a portion of this list of species we are indebted to Mr. A. S. Tiffany, of Davenport, Iowa,

No well-marked lithological or biological sub-division of these rocks has been observed.[1]

In the eastern extension of the Corniferous rocks, in Iowa, they are seen to be succeeded upward by gray, brown and buff, calcareous and argillaceous shales, limestone, and coarse and fine-grained sandstones of the Hamilton group.

While at some localities the two divisions are sharply defined, both lithologically and biologically, still at other points these characters of the two formations so gradually blend as to make it a matter of great difficulty, if not an impossibility, to designate just where the line of separation between the two groups should be drawn.

As might be naturally expected, throughout the area occupied by these divisions, the mingling of their faunas is much more strongly marked at their junction with each other.

In their interior area, the line of division between the two groups is nowhere distinctly shown, either by lithological or biological evidence. According to the record of the boring of the artesian well at Davenport, kindly furnished me by Mr. A. S. Tiffany, and which may be considered as approximate, the thickness of the Corniferous rocks, in that vicinity, is shown to be one hundred and eighty feet.

At one locality, Independence, the Corniferous limestones are succeeded upward by a blue shale, which here forms the base of the Hamilton, and which, from its order of sequence, we would consider to be the equivalent of the "Marcellus Shales" of eastern sections, although differing in some respects, in its lithological and biological characters, from them.

The beds of this serial are somewhat variable, lithologically, consisting of thin bands of concretionary limestone, and dark blue, argillaceous, fine-grained shales, which are highly charged with bituminous matter, and interlaminated by seams of coal, from one-eighth to one-fourth of an inch in thickness. This shale weathers, on exposure, to a light blue clay, and contains an abundance of fossil shells, a few species of corals and cerinoid remains ; while some of the beds hold numerous remains of land plants (*Lepidodendron* and *Sigillaria*).

[1] This Division has been referred, by Rev. Dr. Barris, to the Upper Helderberg, and its thickness estimated at nearly one hundred feet, ("Local Geology of Davenport and Vicinity.") Proceedings of Davenport Academy of Science, VOL. II, 1880. This formation has also been referred to the Corniferous, by Mr. A. S Tiffany, (Geology of Scott County, Iowa, and Rock Island County, Illinois, etc., 1885.)

This division represents an old shore deposit, and carries, in its fauna and flora, evidence both of its terrestial and marine origin; and marks, as well, the dawn and culmination of terrestial vegetation of the old Devonian time, in Iowa.

The thickness of this division is probably thirty feet or more, although only about twenty-five feet have actually been observed.

These shales, which represent only a *local* sub-division of the Hamilton, were first recognized by Mr. D. S. Deering, of Independence; and subsequently described by Prof. S. Calvin, as "Some Dark Shales Below the Devonian Limestone at Independence, Iowa" (Bulletin of U. S. Geological Survey, Vol. IV., No. 3, 1878.)

In this publication, the statement was made (p. 726) "That the shale in question is not a mere local deposit, but is distributed all along the outcrop of the Devonian Rocks of Iowa."

An extended study of all the Devonian rocks of this State, and the record of numerous borings along its Eastern outcrop, and at other points, has failed to adduce any evidence of the existence of this formation at other localities.

One of the highest members of the Hamilton, in its Eastern extension, is a soft, friable, brownish-yellow sandstone, which is well shown as it out-crops on Pine Creek, some distance above "Pine Creek Mill." This stratum of sandstone here forms a bold escarpment or cliff, about forty feet in height, is obliquely and discordantly stratified throughout, dips rapidly in a southerly direction, and is, so far as observed, devoid of fossils.

At Independence, the blue shales (equal Marcellus Shales) are succeeded upward by heavy bedded, sometimes indistinctly stratified dove-colored and buff limestone, and intrusive beds of shale, with a thickness of twenty-one feet. The lower portion of the limestone here is indistinctly stratified, but is often crossed diagonally and irregularly by seams which cause it to split into uneven slabs and fragments.

As we recede to the West and Northwest from the attenuated Eastern outcrop of the Hamilton, the rocks overlying the blue shales are seen to rapidly increase in thickness, until, on the Wapsipinecan River, only one and one-half miles from the exposure of blue shales they are seen to attain an estimated thickness of sixty-five feet; while on the same stream at Littleton, ten miles to the Northwest, the same rocks are observed to attain a slightly greater thickness.

The following is a partial list of the species occurring at this horizon :

The rocks of the lower portion of the Hamilton are generally heavier bedded, more compact, and uniform in texture, and usually a more pure limestone than those of the upper portion The prevailing color of the strata of this horizon, is blue, and bluish-gray.

In the northern portion of Johnson County, (for instance, at the "State Quarry," Robert's Ferry, Solon, etc.,) occurs a bed of peculiar grayish-white limestone, nothing like it being known to exist in other portions of the State.

This bed has a thickness of from six inches to six feet, or more, is very crystalline throughout, and is made up, to a considerable extent, of broken shells of different species of Brachiopoda, some of which are not known to occur elsewhere in Iowa.

For convenience in subsequent allusion, this bed is here designated the *Shell Bed.*

Underlying this shell bed is a stratum of very hard, fine-grained, blue brecciated limestone.

This limestone is observed at various localities in this portion of the State, and is known to extend as far North as Raymond Station, in Black Hawk County.

The upper portion of this division is made up, for the most part, of thin bedded magnesian and common limestone, and soft, impure, calcareous, argillaceous and silicious, shales and sandstones, of a prevailing grayish-buff color.

In the Eastern portion of Floyd County, some beds of shale, occupying a considerable area, are extensively sun-cracked ; this indicating an elevation of the sea-bottom here, and the exposing of it for some time to etheral conditions and the burning rays of the sun.

The extreme upper portion of this division is almost everywhere, a hard, fine-grained, and brittle, grayish or dove-colored limestone, and singularly devoid of organic remains.

Immediately succeeding the limestone, in portions of Floyd, Cerro Gordo and Worth Counties, and constituting the highest member of the Hamilton group in the State, is a stratum of stiff blue clay, varying from twenty to twenty-five feet in thickness.

This formation, which is entirely devoid of organic remains, may be best seen as it outcrops on Lime Creek and Willow Creek, in Floyd and Cerro Gordo Counties, particularly at Rockford, Hackberry, and a locality three miles west from Mason City, on Willow Creek.

This serial, judging from its lithological character and order of sequence, appears to be the equivalent of the "*Genesee Shales*" of the New York section, and to which division we would here refer it.

As we have before intimated, the base of the Hamilton, represented by the blue Shales at Independence, carries a rich Fauna, and evidence, also, of the former existence of a rich, and perhaps varied, flora, which was restricted to this zone.

Of the fossil species occurring in this serial, the following may be enumerated :

Strophodonta arcuata	Strophodonta variabilis
Strophodonta calvini	Strophodonta canace
Strophodonta reversa	Orthis infera
Atrypa reticularis	Atrypa hystrix
Spirifera subumbonata	Rhynchonella ambigua
Gypidula munda	Productus dissimilis
	Lepidodendron and Sigillaria

Also several other undetermined species of Brachiopoda, and corals, and one or two species of crinoids.

Of the above list of species, only two, *Atrypa reticularis*, and *A. hystrix*, are known to occur in the Corniferous limestones below, while only three or four forms are at present known to extend upward into the middle Hamilton, (the shales, limestone, etc., lying above the blue shale and below the blue clay).

The two species *Atrypa reticularis* and *A. hystrix*, as they occur in the overlying rocks, assume a form so altered as to be as readily distinguished as if they were distinct species. The number of blue shale species which occur in the shales at Rockford, is greater than those of all the other divisions combined. A peculiar feature of this blue Shale Fauna, is the depauperation of most of its species.

As to the flora of this division, it is, as we have before stated, indigenous to it ; none of the other serials containing any evidence of the former existence of either terrestial or marine plant life.

The rocks of the middle Hamilton carry a rich and varied fauna, more particularly in its lower and central portions.

Athyris vittata
Atrypa hystrix
Aulopora serpens
Aviculopecten pecteniformis
Calceocrinus clarus
Cladopora lichenoides
Cladopora fisherii
Platyceras rectum
Platyceras auriculatum
Crania bordeni
Cryptonella planirostra
Cyathophyllum davidsonii
Cystiphyllum americanum
Phacops bufo
Discina media
Stromatopora alternata
Gomphoceras lunatum
Megistocrinus latus
Meristella haskensii
Monticulipora monticula
Orthis iowensis
Orthis livia
Paracyclas ohioensis
Pentamerella dubia
Favosites hamiltonensis
Platyceras ammon
Platyceras argo
Platyceras bucculentum
Platyceras cymbium
Spirifera aspera
Spirifera ziczac
Spirifera raricosta
Spirifera subvaricosa
Spirifera subattenuata
Spirifera fimbriata
Spirifera mucronata (*rare*)
Spirifera formosa
Streptorhynchus chemungensis
Strophodonta demissa
Zaphrentis exigua
Atrypa reticularis
Aulopora conferta
Aviculopecten parilis
Chonetes pusilla
Chonophyllum ponderosum
Cladopora romerii
Platyceras symmetricum
Platyceras cymbium
Platyceras bucculentum
Crania hamiltonensis
Cryptonella rectirostra
Cyathophyllum scyphus
Heliophyllum halli
Discina doria
Discina seneca
Stromatopora incrustans
Leiorhynchus alta
Megistocrinus farnsworthi
Meristella meta
Euomphalus cyclostomus
Orthis vanuxemi
Paracyclas lirata
Pentamerus comis
Philipsastrea gigas
Favosites niaulus
Platyceras tetis
Platyceras conicum
Platyceras carinatum
Platyceras erectum
Spirifera raricosta
Spirifera tullia
Spirifera varicosa
Spirifera subumbonata
Spirifera pinnata
Spirifera parryana
Spirifera mannii
Spirifera euruteines
Terebratula romingeri
Stromatopora incrustans

In places these rocks contain a rich fish fauna, as well as numerous new and described species of shells, corals, etc., which are not at present known to occur in the rocks of any other area.

The mingling of the lower and upper (Chemung) Devonian faunas is here greater than in any of the other divisions of the rocks of this age in the State.

The grouping of Fossils of the middle Hamilton, differs considerably at different localities; although not to such an extent as has been heretofore generally supposed. The lithological character of the beds of the middle Hamilton, are usually very variable, so variable, indeed, as to make it a matter of great difficulty, and often an impossibility, to trace any particular bed for any considerable distance by this character.

Some portions of the strata of this horizon, as at Charles City and Independence, are traversed by more or less regular wave-like undulations.

The thickness of the Corniferous and Hamilton rocks vary somewhat in different portions of their area.

According to the record of the boring of the artesian well at Cedar Rapids,[1] the thickness of the Corniferous and Hamilton strata is, at that place, shown to be 380 feet.

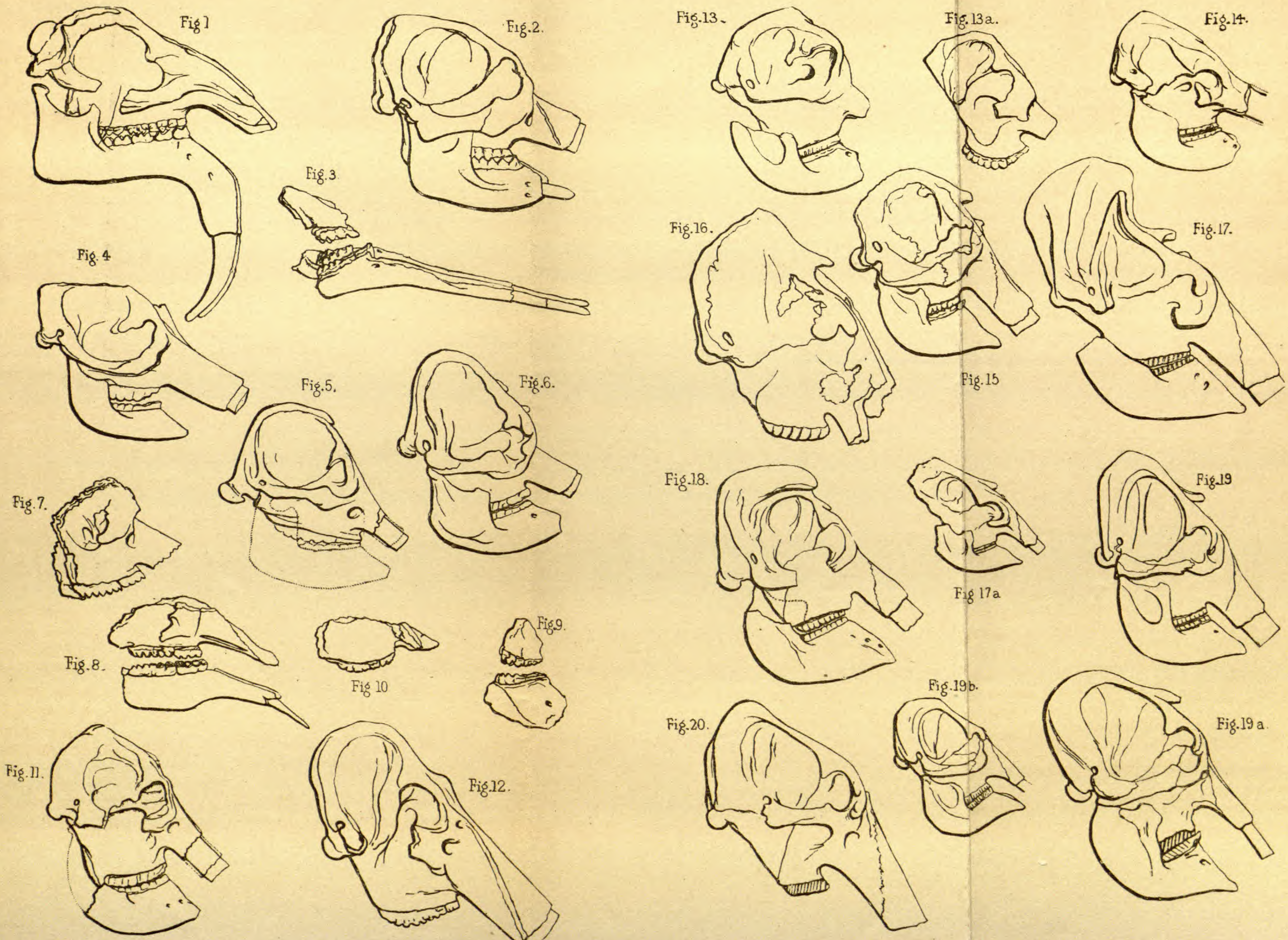
Adding to this thirty feet, for the blue shales at Independence, and fifty feet (estimated thickness) for the Hamilton rocks (including the blue clay at Rockford etc.) lying above the highest beds of the Cedar Rapids section, we have an aggregate thickness, of the rocks of the Corniferous and Hamilton groups in Iowa, of 430 feet.

Succeeding the Hamilton, in the northwest portion of its area, is the highest division of the rocks of this age in the State.

This serial, which is plainly a sequent of the Hamilton, is known to attain a thickness of forty-five feet, and is made up, for the greater part, of a yellowish brown argillaceous, and sometimes slightly arenaceous, shaley limestone, which weathers to a stiff yellow, sometimes light buff, clay; and in places contains considerable numbers of ferruginous concretions. These shales are sharply defined, both serially, lithologically, and palaeontologically, and are a vast repository of beautifully preserved fossil remains; a large majority of which are peculiar to them.

[1] We are under obligations to C. J. Fox, Esq., superintendent of the Cedar Rapids Water Co., for a record of this boring, together with samples of the rocks (2225 feet) passed through.

PLATE XVI.



Crania of Proboscidia.

This formation carries *two* faunas ; one at the base, and another occupying the remainder of the division.

The fauna at the base is represented by considerable numbers of very minute, and finely preserved Brachiopoda, Gastropoda, Crustaceans, Foraminifers and Corals, a large number of which are as yet undescribed.

Not more than one or two of the forms, occurring at the base of the shales, are known to occur outside this formation.

Of the described species of this fauna, the following may be enumerated.

Athyris minutissima. C. L. Webster.
Platystoma mirum. Webster.
" pervetum. Webster.
Naticopsis rarus. Webster.
Turbo strigillata. Webster.
" incerta. Webster.
Holopea tenuicarinata. Webster.
Cyclonema brevilineatum. Webster.
" subcrenulatum. Webster.

For a more detailed description of this fauna etc., reference may be made to a paper on "Description of New Species of Fossils From the Rockford Shales of Iowa," which appeared in the November number of this Journal for 1888.

Of some of the described species which constitute the fauna of the higher horizon, and which are mostly typical of it, the following may be given.

Rhynchonella subacuminata. Webster
Paracyclas sabini. White.
" validalinea. Webster.
Atrypa reticularis.
" hystrix.
" " *var* planosulcata. Webster.
" " *var* elongata. Webster.
Spirifera whitneyi
" hungerfordii.
" strigosus. Meek, (*S. orestes*, H. and W).
" substrigosus. Webster.
" norwoodii. Meek, (*S. cyrtinaeformis*, H. and W).
" fimbriata.
" macbridei.

Smithia fohnanni.
" multiradiata.
Stromatopora incrustans.
" expansa.
" solidula.
Caunopora planulata.
Fistulipora occidens.
Alveolites rockfordensis.
Aulopora iowensis.
" saxivadum.
Zaphrentis solida.
Campophyllum nanum.
Chonophyllum ellipticum.
Cystiphyllum mundulum.
Spirorbis arkonensis.
" omphalodes.
Acervularia inequalis.
Callonema lichas.
Stromatopora alternata.
Crania famelica.
Strophodonta arcuata.
" reversa.
" demissa.
" canæ.
" variabilis.
Productus dissimilis.
Streptorhynchus chemungensis..
Orthis iowensis.
Leiorhynchus iris.
Terebratula navicella.
Cryptonella salvini.
Naticopsis giganteum.
Loxonema pexatum.
" crassum. Webster.
" iowense. Webster.
" giganteum. Webster.
Pachyphyllum woodmanii.
" crassicostatum. Webster.
" ordinatum. Webster.
Pachyphyllum crassum. Webster.

Platystoma lineatum.
Ambocoelia umbonata.
Productella truncata.

Aside from the foregoing enumeration, we have in our cabinet, large numbers of undescribed forms. Two-thirds or more, of the species which constitute the fauna of this horizon, are not known, at present, to occur outside of it.

When species, common to the shales, occur in any of the rocks below, and when fossils, peculiar to the lower groups, extend upward into the shales, they usually appear under a form, so altered that specimens from the different formations may be distinguished as readily as if they were distinct species.

About one-third of the species of the upper shale fauna occur in other divisions of the Devonian of this area, as well as most other areas of North America ; and very closely allied forms also occur in the European strata of this age (see description and figures of fossils in the geology of Russia and the Ural mountains etc.; also Walcott's Monograph, Palaeontology of the Eureka District, U. S. Geological Survey, 1884, and U. S. Geological Survey of Fortieth Parallel, Vol. IV ; as well as a paper by H. S. Williams, "On a remarkable Fauna at the base of the Chemung group of New York," American Journal of Science, February, 1883).

For a more detailed description of this formation, and its faunas, reference may be made to the following preliminary reports, which appear in various numbers of this Journal for 1888. "Notes on the Rockford Shales," and "Description of new species of Fossils from the Rockford Shales of Iowa," also "Contributions to the knowledge of the Genus Pachyphyllum," and "Description of new and imperfectly known species of Brachiopoda from the Devonian rocks of Iowa ; " as well as to a paper on "A description of the Rockford Shales of Iowa." which is accompanied by a map of the area occupied by the shales, that appears in Vol. V. of the Proceedings of the Davenport Academy of Science.

From the description of this formation here, and in previous preliminary reports, it will be seen in reality, to constitute a *new and distinct group of strata*, carrying *two* rich and varied faunas ; but which has not heretofore been recognized as such, and which is not developed in any other area in North America, or Europe ; although *all* contain links of evidence which demonstrate its Devonian age.

For this group of strata, heretofore provisionally designated by us as the "Rockford Shales," we would propose the name *Hackberry Group*, from Hackberry, in Cerro Gordo county, Iowa, where the most extensive and typical exposure of this formation isobserved.

In our forthcoming Monograph on the Devonian formation of Iowa, alluded to in a former paper ("Description of new species of Fossils from the Rockford Shales of Iowa," this Journal for November, 1888) a detailed description of the rocks of its several divisions, together with a list of all the Fossil species known to occur in them, will be given.

CONCLUSIONS.

It is thus shown, 1st, that the type section (Iowa) of the central continental area, differs materially from the type sections of other areas of North America.

2d. That there were nearly or quite as striking alterations of conditions during the successive deposition of strata in Iowa, as are indicated at the east, and that the rocks of this section are separable into well-marked natural divisions and subdivisions, not heretofore generally recognized as such.

3d. That the Devonian rocks of Iowa, instead of attaining a thickness of only one hundred and fifty feet to two hundred feet, as given by previous writers, are now known to attain an aggregate thickness of four hundred and seventy five-feet.

4th. That the Corniferous limestone is developed in Iowa to a thickness varying from one hundred and eighty feet to two hundred feet, and carries a fauna which is, to a great degree, peculiar to this stage.

5th. That the Corniferous limestone is succeeded upward by shales, limestones, clays, and sandstone of the Hamilton group.

6th. That the base of the Hamilton is marked, locally, by a thirty foot stratum of Blue Shales, carrying a peculiar fauna and flora which represents the "*Marcellus Shales*" of eastern areas, but which has not been heretofore so recognized.

7th. That what has been designated, by most writers on the subject, as Corniferous, Hamilton, and Chemung, limestone, sandstone, and Shales, does in reality represent the *Middle* Hamilton.

8th. That the upper portion of the Hamilton, in the northwest portion of its area, is represented by a stratum of blue clay from twenty to twenty-five feet in thickness, which, though devoid of Fossil remains, yet represents, in its order of sequence, the "*Gen-*

esee Shales" of eastern sections; and the present writer is the first to recognize it as such.

9th. That in the Iowa section is represented (so far as is at present known) the extreme western, attenuated, representatives of the eastern "*Marcellus Shales*" and "*Genesee Shales.*"

10th, That the upper Hamilton (blue clay) is succeeded upward by a stratum of Argillaceous Shales, which everywhere occupy the highest position in the Devonian series in the State, and has an observed thickness of forty-five feet; although known to have attained a greater thickness prior to the glacial period, during which time they were more or less extensively eroded.

11th. That these Shales, which have been designated (provisionally) by the writer, in all his preliminary reports, as the "Rockford Shales," constitute, lithologically, stratigraphically, and biologically, a *new* and heretofore unrecognized (as such) group of strata, and which is not developed in any other area in North America, or Europe; although *all* contain links of evidence which demonstrate its Devonian age, and for which the writer has in this report proposed the name *Hackberry Group.*

EDITOR'S TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

The Philadelphia Academy of Natural Sciences has recently attacked the problem of original research in a practical manner. For many years the activity of the institution was restricted to the publication of work produced by scientific specialists on material contained in their own collections, and in the museums of other institutions. To this function it subsequently added that of giving instruction to classes in the natural sciences. We have often pointed out that the former line of activity is not enough for an institution which at one time was the only academy of original research in this country; and we have also expressed the opinion that the teaching of the natural sciences to classes of beginners, is not one of its proper uses. We have schools for teaching elsewhere, but academies of original research are too few for any one of them to be diverted from its proper object.

Recently the management of the Academy has undertaken some explorations in the Bermuda Islands, and the results are coming into print. Large collections of Invertebrata were made, and reports on these by Professor Heilprin are being published in the Proceedings. These embrace much matter of interest, and illustrate what can be done with a moderate outlay in regions not remote. The recent appropriation by the State of Pennsylvania of $50,000 to the institution comes at a favorable period for advancing this excellent work. There are various ways in which this can be done. Our own belief has been and still is, that the best possible use for money at the present time is the endowment of some of the professorships which are as yet unoccupied. The most important agency in original research is men of ability and energy. They can be relied upon to obtain material more cheaply and effectively than persons not familiar with specialties. And these men should be members of the governing body of the Academy, ex-officio.

In case the Academy should adopt such measures the wealthy citizens of Philadelphia cannot better advance the general intelligence as well as the reputation of their community, than by sustaining them by material aid. A new wing should be added to the present building, with improved facilities for work and better light in some of its departments than the present building affords. The new wing should be erected for a smaller sum than the old one cost.

At its April meeting the United States National Academy of Sciences elected officers for six years; elected five new members, and some foreign correspondents; and conferred the Watson and Draper medals. Most of the old officers were reelected, a new Vice-President (Prof. S. P. Langley), and a new member of the council being exceptions. In reelecting the incumbent of the office of President, the Academy made a mistake which it cannot afford. This is to be regretted, as the

Academy is not as well known in the country as it should be, and of course it is important that when and where it is known, nothing should detract from the respect with which its acts should be regarded. No organization allied to the Government can expect to escape the pressure of interests involved, but it is an omen of evil when the interests of persons override the interests of science and of the Academy. The majority of the Academy has not in this instance the excuse of ignorance, and one is lead to fear that not a few of their number deliberately approve of methods that bring science into disrepute, and justify reflections on that country and on that society where they are not only tolerated, but rewarded.

The American Society of Psychical Research has made an appeal for money with which to carry on its work. We hope that this appeal will meet with a prompt and abundant response. The society has done a great deal of excellent work, and the field before it is an immense one. The subject of its researches is of the greatest interest, both scientific and popular, and its importance cannot be overrated. The manner in which its work has been done is worthy of the highest praise, and the country cannot afford to let it languish for want of the necessary assistance. When we consider the comparatively small outlay necessary to the production of its results, we think the endowment of the society one of the most worthy objects that can attract the attention of the liberal.

RECENT LITERATURE.

PLOWRIGHT'S UREDINEÆ AND USTILAGINEÆ.[1]—Students of the fungi may well rejoice that at last we have a book in the English language which discusses with some fulness the structure, biology and classification of the Rusts and Smuts.

[1]*A monograph of the British Uredineæ and Ustilagineæ*, with an account of their Biology including the methods of observing the germination of their spores and of their experimental culture, by Charles B. Plowright, F. L. S., M. R. C. S. [etc.] Illustrated with woodcuts and eight plates. London. Kegan Paul, Trench & Co., 1 Paternoster Square. 1889. 8vo. x., 348 pp.

In this volume, the author, who has long been favorably known as a student of the Rusts more particularly, takes up the various parts of his subject in the following order. viz., Biology of the Uredineæ; Mycelium of the Uredineæ; Spermogonia and the so-called Spermatia; Æcidiospores; Uredospores; Teleutospores; Heterœcism; Mycelium of the Ustilagineæ; Formation of the Teleutospores of the Ustilagineæ; Germination of the Teleutospores of the Ustilagineæ; Infection of the Host-plants by the Ustilagineæ; Spore-Culture; The Artificial Infection of Plants. After this follow the systematic portions including nearly two hundred pages of generic and specific descriptions.

Descriptions, synonymy and references to literature and exsiccati are well worked out. All measurements (which are very generally given) are in micromillimetres. Many biological notes are given after the descriptions, thus adding much to the value of the work.

The genus Uromyces is subdivided as follows into artificial subgenera:

I. Euuromyces: A.	Auteuuromyces	represented by	11	species.
B.	Heteruromyces	"	4	"
II. Brachyuromyces,		"	0	"
III. Hemiuromyces,		"	6	"
IV. Uromycopsis,		"	3	"
V. Micruromyces,		"	4	"
VI. Lepturomyces,		"	0	"
Making a total of			28	species.

The genus Puccinia is similarly subdivided:

I. Eupuccinia: A.	Auteupuccinia	represented by	23	species.
B.	Heteropuccinia	"	20	"
II. Brachypuccinia,		"	5	"
III. Hemipuccinia,		"	14	"
IV. Pucciniopsis,		"	3	"
V. Micropuccinia,		"	19	"
VI. Leptopuccinia,		"	12	"
Making a total of			96	species

The remaining smaller genera are represented as follows:

Triphragmidium—2 species; Phragmidium—9 species; Xenodochus—2 species; Endophyllum—2 species; Gymnosporangium—4 species; Melampsora—17 species; Coleosporium—4 species; Chrysomyxa—2 species, and Cronartium—1 species. In addition there are descriptions of imperfect forms as follows: Uredo—11; Cæoma—6; Æcidium—21. There are thus descriptions of 167 genuine species, and 38 imperfect forms.

In the Ustilagineæ the genera are represented by species as follows: Ustilago—21; Sphacelotheca—1; Tilletia—3; Urocystis—9; Entyloma—7; Melanotænium—1; Tubercinia—2; Doassansia—2; Thecaphosa—2; Sorosporium—1. The allied and associated species, viz., Graphiola—1; Entorrhiza—1; Tuberculina—1, and Protomyces—5, are added as a supplement, bringing the total of Ustilagineæ up to 57 species. The whole number of descriptions in the book is two hundred and sixty-two.—*Charles E. Bessey.*

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Branner, John C.—The Cretaceous and Tertiary Geology of the Sergipe-Alagôas Basin of Brazil. Transactions of the American Philosophical Society, Vol. xvi, 1889. From the author.

Broom, R.—On a Monstrosity of the Common Earth-worm, *Lumbricus terrestris L.* Transactions Natural History Society, Glasgow. From the author.

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Ellis, Havelock—Women and Marriage, or Evolution in Sex. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

AFRICA; BORELLI'S TRAVELS IN GALLA-LAND.—Sr. Borelli has surveyed portions of the country to the south of Abyssinia. Mount Harro (3,150 metres) and the Dendigrons of which it forms a part, form the watershed between Hawash, the Abai (Nile) and the Omo or Ghibie. The explorer went to Kiffan in the Kingdom of Gomma, and accompanied the king to Giren the capital, and to the summit of Mount Maiguddö (3,300 m.) whence the mountains of Culld, Centab, Aruzulla, etc., were seen and their positions ascertained. He then went to the Peak of Ali, to the market Cornbi, and to the cascade of the Ghibie, 40 metres high. Then traversing the desert between Gimma and Giangerò, he attempted to visit Mount Borguda where it is said that human sacrifices are offered on the first of every month but was attacked by the lancemen of Giangerò, and compelled to fly. Afterwards he visited the river Omo with the idea of passing south of the town of Vallamo to Cuccia, but was hindered by the king of Gimma. Another attempt to reach Borguda was defeated by the Giangerò, so, traversing the country of Abalti, he entered that of the Daddalé, and then returned to Antoto, whence he started for Zeila on the 9th October last.

The Giangerò are neither Musselmen nor Christians, yet adore a single spiritual indefinable god, to whom they sacrifice with knives at the first moon of every month 47 males who always belong to two honored families. All the Giangerò, by an operation performed when young, have but one testicle, and cut their hair that they may not appear women.

The river Omo does not turn to the east, as shown on all maps, but at 5° N. lat., bends westward and then turning southward falls into a lake or rather extensive marsh, known as Sciambara. This information was derived by Sir Borelli, from the testimony of more than 100 merchants in the habit of traversing the country in caravans. These merchants also asserted that the Omo leaves Lake Sciambara at its southern extremity, and ends by sinking under ground near a very large lake, which Borelli believes to be the Victoria. Thus the Omo may be the true source of the White Nile.

[1] This department is edited by W. N. Lockington, Philadelphia.

EUROPE; THE KOPIAS SEE.—HERR SUPAN (Petermann's Mitteilungen III. 1889.)—gives an account of the Kopias See, in the Bæotian mountains of Greece, and of the works undertaken since 1883 by the engineer Pochet for its reclamation In the above mentioned mountains are three basins, the Kopias, Likeri and Paralimni, all of which are permanenly or periodically filled by lakes which drain into the sea through the earth. The largest of these is the Kopias See which extends northward in two bays and westward is continuous with the wide valley of the Kephissos. Near the edge of this lake and not above twenty metres above its level, lie the ruins of Thebes and Livadia. The Kephissos and many other streams fall into these basins, and as the rainfall of the region varies greatly at different seasons and in different years, so does the level of the waters of the lake, thus banishing cultivation from any spot within several metres in height of the lowest level. In 1852 and 1864 even the ruins of Livadia were covered. Yet in the oldest period of Grecian history the kingdom of Minyas with its capital Orchomenos, occupied the sight of the Kopias, and in three spots traces of the canals and other works made to control the waters may be seen. The modern works consist of a ring-canal and an inner canal. These canals unite in the eastern bay of the lake, and the united canal is carried by a succession of cuttings and tunnels through the Likeri and Paralimini lakes into the sea.

GEOGRAPHICAL NEWS.—The greatest known depths of the various oceans are thus given by Dr. Supan (Petermann's Mitteilungen, III. 1889).

North Pacific Ocean	44° 55′ N. lat.	152° 26′ W. long.	8513 metres.
South Pacific "	24° 37′ S. "	175° 0 W. "	8101 "
North Atlantic Ocean	19° 39′ N. "	66° 26 W. "	8341 "
South Atlantic "	0 11″ S. "	18° 15′ W. "	7370 "
Indian Ocean	9° 18″ S. "	105° 28′ E. "	5852 "

THE archives of Savona, a city not far to the west of Genoa, Italy, prove that the family of Christopher Columbus lived at that city about 1470.

AT the coming Paris Exhibition there is a globe 40 metres in circumference, that is, upon a one-millionth scale. All the regions will thus be represented with their correct curvature. This globe will not be so large as that of Mr. Wyld, which for a long time disfigured Leicester Square, London, but will have the advantage in truthfulness, since Mr. Wyld's globe showed the various countries upon the interior surface, and therefore with a concave instead of a convex curvature.

OUT of the total population of 46,855,704 of the German Empire on Dec. 1, 1885, 22,933,664 were males and 23,922,040 females. As regards religion 29,369,847 were returned as evangelicals, 16,785,734 as Catholics, 563,172 as Israelites, and 125,673 as of other Christian creeds.

THE population of Bulgaria and Roumelia on January 1, 1888 was found to be 3,154,375, including the Russians, Servians, Germans, French, etc., sojourning in the country. The Bulgarian race includes 2,336,250 individuals. The Turks in the two countries number 904,000, with a curious predominance of the feminine sex, which counts 607,000. The same preponderance of females is observable in the Greeks, who number 56,000 females against 28,000 males. Among the Bulgarians and other races the male sex is in excess.

SOUNDINGS recently taken from the English ship Rambler in the Chushan archipelago near the Chinese coast, have proved the existence of submarine rocks which rise to a metre or even half a metre of the surface. These lie between 30°-3′-25″ and 30°-21′ N. lat, and 122°-12″ and 122°-25′25″ E. longitude.

BRITISH NEW GUINEA is divided into three sections, a western, from the Dutch boundary to the river Aixd, a central extending from the Aixd to the island of London in about 144°-15′ E. long. and an eastern which includes all the Lyonisiades to Rossel. A recent report of Sir John Douglas gives an account of all recent explorations.

IN his account of his ascent of Mount Kibo (Kilimanjaro) Otto E. Ehlers states that the tracks of an elephant were visible in the snow at a height of 5,000 metres together with tracks of buffaloes and antelopes. The last traces of vegetation were also found at the same elevation, (*Petermann's Mitteilungen*, III. 1889).

ASIA.—THE PRESENT FLORA OF KRAKATOA.—M. Treub, who arrived at Krakatoa, June 19, 1886, gathered near the coast the seeds or fruits of sixteen species of plants, and upon the mountain, eight species of flowering plants, and eleven of ferns. Four of the phanerogams were composites. When it is remembered that all plants previously existing upon the island perished in consequence of the heat of the eruption, and that the whole island was at that date covered with a thick layer of scoria, the existence of a new flora is surprising proof of the part played in plant-colonization by currents, wind, and birds. All the species found upon the coast, except *Gymnothrix elegans,* a grass which is very common in Java, are identical with those colonizing species which are found in recent coral islands. Only two of the mountain species were identical with those of the coast. As regards the number of individuals, M. Treub says, "three years after the eruption, the new flora of Krakatoa is composed almost entirely of ferns. The phanerogams occur insolated here and there." Yet the soil is not at all favorable in its composition for the growth of ferns, which have been preceded by two species of mosses and six of algæ, the decay of which has furnished aliment to the ferns which in their turn prepare the ground for the phanerogams.

THE ISLAND REUNION.—According to M. A. Blonde (*Bull. d. l. Sociéte dé Géographie*) the island of Bourbon, or, as it is now called Reunion, discovered in 1545 by the Portuguese Mascarenhas, and taken possession of by France in 1649, is of elliptical form, its greater axis running N.W. and S.E., and its greatest length and width being 71 and 57 kilometres respectively. The island is entirely volcanic, and seems to have been formed by a volcano originally situated at the N.W extremity, but which was displaced southward until it finally reached the S.E. extremity, where it is still in activity. The route of this volcano is marked by extinct craters ranged symmetrically on both sides of the axis, the principal those of Mufate, Ciloss, and Salazie. From these great circles spring the three great torrents of the island, the rivers Galets, St. Etienna, and Midi. These are separated by high mountains, among which are Grand-Beirard, 2,970 metres, Cimandef 2,250, Pitore de les Neiges, 3,069, and Salago, 2,150 m.

NEW GUINEA.—According to Prince Roland Bonaparte the share of Holland in New Guinea has an area of 382,000 sq. kilometres, that of England 230,000, and that of Germany 232,000. The last includes 52,000 sq. kil. of smaller islands, which are now known as the Bismarck archipelago, while the German portion of the mainland has received the title of Kaiser Wilhelm-Land. Another brochure of the same writer gives maps of the Gulf of Huen (New Guinea), according to Fleuriece, D'Entrecasteaux, and Mosely, also a corrected map from the recent explorations of Finsch and Von Schweinitz.

CAPT. BINGER'S JOURNEY.—Capt. Binger, who, two years ago, undertook a journey of exploration from Bamaka towards the Gold Coast, has been heard from, his last letter being dated Salagha, Dec. 11, 1888. M. Binger encountered great difficulty in leaving the territory of Lamery. It was his proposition to study carefully the mountains whence the Joliba takes its source, and it was arranged that so soon as he gave notice of his arrival at Kong, a victualling party should march along the Akka from Grand-Bassam to relieve him. In March, 1888, M. Binger reached Kong. From Kong, M. Binger proposed to make an excursion to Xendi, returning to Kong by the Gottogo. The French residents of the Slave Coast, having heard of the arrival of a white man at Salagha, sent a messenger to him, who brought back an answer in which M. Binger stated that, leaving Salagha the next day and, repassing Kong, he trusted to reach Grand-Bassam in April, 1889. The ease with which the communication was sent from the Slave Coast, (Grand Popo and Agoue) shows that Kong is more accessible from this part than from the Gold Coast.

GEOLOGY AND PALÆONTOLOGY.

AN INTERMEDIATE PLIOCENE FAUNA.—Mr. Geo. C. Duncan sent me a collection of remains of Mammalia from a lake deposit in Oregon which has an interesting character. The list of species is short, and but few of them are determinable. It is as follows:

Canis sp.
Elephas or *Mastodon*.
Holomeniscus or *Auchenia*.
Aphelops sp.
Hippotherium relictum sp. nov.
Equus sp.

These bones do not resemble in color those from near Silver Lake, Oregon, which are black. They are yellowish brown or light brown, like those from the locality in Whitman Co., which were recorded in the last number of the NATURALIST. The interest of the list consists in the fact, that it represents the first time a fauna which contains at the same time the large true horses and lamas, and the three-toed horses and Aphelops rhinoceros. The latter forms belong to the Loup Fork horizon, and the former to the Pliocene, and they have not been found hitherto in association in the Rocky Mountain Region. The fauna described from Florida, by Leidy, is probably of Loup Fork or Upper Miocene age, and the mammalia are similar to or identical with those of the same horizon in Kansas and Nebraska.

This fauna represents an older period than the Upper Pliocene of Silver Lake, and may be, very probably, the contemporary of that of the Pliocene lake of Idaho, from which I have described numerous species of fresh-water fishes. The deposits containing them I called the Idaho beds (Proceedings Academy Philadelphia, 1883 p. 153), and they may be regarded as representing the middle or lower Pliocene. The new Hippotherium is characterized as follows:

Represented by two superior and three inferior molar teeth. The grinding surface is nearly square, and the crown is short, and moderately curved. The section of the internal style is a wide oval, and it presents no angle or point of approximation to the protoconic crescent, and conversely none to the posterior column. The latter has the usual connection with the hypoconic crescent, but projects as far inwards as the anterior area, and is well defined. The enamel-boundaries are quite simple. The usual loop of the posterior inner border of the anterior lake is rudimental in an anterior true molar, and in the last molar it is small and subround. No isolated loop. A single short process of the border towards the internal column. Cementum abundant.

Dimensions of superior molars, No. 1; diameters of grindface; transverse, 19 mm.; anteroposterior, 16 mm. No. 2; transverse, 19 mm.; anteroposterior, 18 mm.—*E. D. Cope.*

STORMS ON THE ADHESIVE DISK OF ECHENEIS.—In a paper published in the *Annals and Magazine of Natural History* for July, 1883, Mr. Storms endeavors to solve the different questions pertaining to the structure and morphological interpretation of the adhesive disk of Echeneis, and closes with the following remarks suggested by *Echeneis glaronensis*:

"1. As to the position in classification of the genus Echeneis;

"2. As to the general form of the body of *Echeneis glaronensis* as compared with that of living species.

"1. Authors have classed this genus in various families of Acanthopterygians. Joh. Müller makes of it a group of the Gobiidae; L. Agassiz and, after him, most authors class them with the Scombridæ.

"Certainly none of the characters of *Echeneis glaronensis* point toward the Gobiidæ; on the contrary, in the shape of the head, the structure of the ventrals, the size of the pectorals, the shape of the caudal fin, etc., it differs more from the Gobiidæ than the living forms do. On the other hand, by all these characters and others, *Echeneis glaronesis* ought to be classed among the Cotto-Scombriform Acanthopterygians. But here the difficulty begins. If we adhere strictly to the characters of the families given by Dr Günther, *Echeneis glaronensis*, on account of the number of its vertebræ (10+13 according to Dr. Wettstein,) should be classed among the Carangidæ, whilst all the living forms having more than 10+14 vertebræ ought to be put with the Scombridæ. The other characters of *Echeneis glaronensis* do not determine in which of the two families it ought to be placed.

"2. A careful comparison of the proportions of all the parts of the skeleton of the fossil Echeneis with those of the living forms, such as *Echeneis naucrates* or *Echeneis remora*, shows that the fossil differs nearly equally from both, and that it was a more normally shaped fish than either of these forms. The head was narrower and less flattened, the preoperculum wider, its two jaws had nearly the same length. The ribs, as also the neural and hæmal spines, were longer, the tail more forked, and the soft dorsal fin much longer. In fact it was a more compressed type, probably a far better swimmer than its living congeners, as might be expected, if the smallness of the adhesive disk is taken into account."

It is evident from the above description of Dr. Storms that the *Echeneis glaronensis* represents a genus distinct from the existing forms of the family. This new genus may be named Opisthomyzon, from the fact that the sucking disc is more posterior in position than in the living forms.—*E. D. Cope.*

SKETCH OF THE GEOLOGY OF SPAIN.—The *Reseña Geographica y Estadistica* of Spain, issued during the past year, contains an introductory article upon the geology of the peninsula by D. Juan Bisso. During the Cambrian age the surface of Spain presented a multitude of isles and islets, composed in great portion of igneous rocks, but containing also stratified crystalline strata. The principal island, already quite extensive, occupied the greater part of Galicia, the north of Portugal and small portions of the present provinces of Caceres, Salamanca, and Zamora. Another isle occupied the eastern portion of the present Castilian provinces of Avila, Segovia, and Toledo. A great number of islets were strewn in what is now the southern part of Portugal, Estremadura, and north-western Andalucia. Toward the North arose some points in the line which eventually became the northern Cordillera. Later on, at the close of the Cambrian, the important slate deposits of the Pyrenees arose above sea-level, together with portions of Estremadura, and of the southern Andalucian mountains.

Throughout the Silurian and Devonian periods the main island increased considerably, so that at the commencement of the Carboniferous, it occupied all Galicia, the west of Asturias, and the provinces of Leon and Zamora, its southern line running by Ledesma, Salamanca, Sepulveda, and Siguenza, and then turning south in an irregular curve so as to embrace, in the same mass, the sites of Madrid, Toledo, Cuidad Real and Alcarez. Its most southerly extension reached the Sierra Morena, and its western coast extended to Oporto. At the same period a great part of the Pyrenees had emerged, as well as many islands, in Catalonia, between Burgos and Soria, in western Aragon and eastern Castile. In the south parts of the Sierra Nevada and the extreme south-east of the peninsula had appeared. Permian strata have not been, with certainty, met with in Spain.

In the Triassic period the principal mass already extended much to the southeast, and in Portugal and Huelva had almost reached its present limits, comprehending Seville and Cordova in its southern extension. In the northeastern it occupied all of Oviedo and Leon, Zamora and Salamanca, great part of the provinces of Valencia and Santander. The Pyrenees formed a zone as now; almost all the southeastern islands united forming a tract occupying great part of the present provinces of Murcia, Almeria, Granada and Malaga.

The Jurassic seas must have occupied but a small extent, since at the conclusion of the Triassic, the greater part of the present peninsula had emerged, including part of the Basque provinces, eastern Castile and northern Andalucia, while the remainder of Andalucia was occupied by many islands.

Subsequent submergence made the Cretaceous seas larger, the eastern coast of the principal mass receding to the line of Santander, Reinosa, Burgos and Segovia, while a gulf extended in the north from Santander almost to Oviedo, and the Pyrenees were partly submerged. Yet in the same period the islands of Aragon and the eastern part of Castile became united into a peninsula, joined to the mainland by a narrow Isthmus at Avilar. This peninsula extended southward to the Sierra Albarracin. At the same time the islands between Burgos and Calatayud became united into one, those along the coast from Gerona to Fortora also joined, and those of Murcia became united to the great southeastern island.

At the end of the Cretaceous period the peninsula was completed almost as it now stands, except that the sea covered the entire basin of the Ebro, penetrating between the islands of the coast from Gerona to Murcia (again partially submerged) and through passes opened in the Pyrenees. There was also a narrow lake in the center of Galicia. During this period immense nummulitic deposits accumulated in the Ebro basin, until the sea finally shallowed into a series of lakes, which in Eocene times filled up with a different series of deposits.

In Miocene times, the sea penetrated only between the Murcian and Andalucian islands, into the basin of the Guadalquivir, in the north at some points in Galacia, and along a narrow zone on the eastern coast. Lakes still existed in the basin of the Ebro, and also through most of the provinces of the Castilles and Leon. In Portugal a number of smaller lakes occupied much of the area about Leiria, Lisboa, Evora and Castro-Verde.

In the Pliocene age the sea still penetrated by various points, especially into the valley bed of the Guadalquiver. Many small deposits occur in the valleys. All that the Post-pliocene has done has been to fill up various depressions with extensive diluvial and alluvial deposits.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The serpentine of Montville, N. J., occurs in veins and as isolated nodules in crystalline dolomite, and also as a thin coating on irregularly rounded masses of a gray crystalline pyroxene, with the chemical and optical properties of diopside. The examination of thin sections across the contact between the enclosing serpentine and its nucleus of pyroxene shows conclusively that the former is the direct product of alteration of the latter. In almost all cases the resulting serpentine is found to be slickensided and grooved as if it had been shoved along against some hard substance, and had thereby suffered planing. The origin of the pressure producing this shoving is thought by Mr. Merrill[2] to be the increase in volume which the pyroxene undergoes in its change to serpentine. Even when the alteration is complete and no trace of the original pyroxene remains, the origin of the serpentine through the hydration of some magnesium mineral is shown by the crowding of the calcite grains associated with the serpentine into broad fan-shaped masses. Analyses of the pyroxene core and serpentine surrounding it substantiate the conclusions reached by the microscopic study of thin sections.

	SiO_2	MgO	CaO.	Al_2O_3	Fe_2O_3	FeO	Ign.
Pyroxene	54.22	19.82	24.71	.59	.20	.27	.14
Serpentine	42.38	42.14		.07	.97	.17	14.12

From the fact that no veins of quartz are to be found in the serpentine, it is thought that sufficient magnesium was furnished by the dolomite to change all of the silica of the pyroxene into serpentine.—The ophiolite from Thurman, Warren Co., N. Y., is observed by the same author[3] to have originated in the same manner as the serpentine from Montville. In this case, however, the original pyroxene occurs in little grains and concretionary masses scattered through calcite.—The rocks to the north of Lake Bolsena in Italy consist principally of trachytes, according to Klein,[4] and those to the south of a leucite bearing series. The former include olivinitic and non-olivinitic varieties in different members which the amount of plagioclase varies largely. The leucite rocks embrace tephrites, basanites and leucitophyres. The first two contain porphy-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.
[2] Proc. U. S. Nat. Museum. 1888. p. 105.
[3] Amer. Jour. Sci. March. 1889. p. 189.
[4] Neue Jahrb f. Min., etc., B. B. vi p. 1.

ritic crystals of leucite, augite, plagioclase, sanidine, magnetite, apatite, hauyne, nepheline and more or less olivine in a groundmass composed of microlites of leucite, augite and plagioclase, and a very little glass. According to the predominance of one or the other of the constituents they are divided into basaltic, doleritic and tephritic varieties, and these are further subdivided into olivinitic and non-olivinitic sub-varieties. To the northeast of the Lake there is an augite-andesite with a zonal plagioclase in which the different zones possess very different extinction angles. The paper in which these rocks are described contains a fine series of analyses.—An interesting occurrence of basic concretions in the granite of Mullaghderg, County Donegal, Ireland, is described by Hatch.[1] The rock is a dark, coarse-grained, sphene-bearing, hornblende-granitite containing microcline, orthoclase and oligoclase. Sections of orthoclase nearly parallel to the orthopinacoid are traversed by two sets of strongly refracting markings parallel to the cleavage lines. The markings are due to the deposition of a mineral with an extinction of 14° in the formerly existing cleavage cracks. In this granite are flattened spheroids of three or four inches in diameter, which consist of a reddish granite nucleus and a zonally and radially developed periphery composed of plagioclase, magnetite and a little brown mica. A resumè of the literature of spheroidal granites is given and a classification of the spheroids is attempted.—A second[2] paper on the dyke rocks of Anglesey is occupied with a description of the diabases and diabase porphyrites of the islands of Anglesey and Holyhead, England. A hornblende-diabase from a large dyke running along the east side of Holyhead Mountain contains a large amount of apatite, and augite crystals that have been enlarged by the addition of original hornblende material.[3]—Dr. Bonney[4] regards the isolated masses of green sandstone occurring in the sand pits near Ightham in Kent, England, as having originated *in situ* by concretionary action. The individual grains are connected together by chalcedony and quartz, the latter forming a fringe around each one of the grains and the latter filling in the remaining interstices.—Dr. Hatch[5] records the analysis of a micrograniti̇c keratophyre from near Rathdrum, County Wicklow, Ireland.

[1] Quart. Jour. Geol. Soc. 1888. p. 548.
[2] Cf. AMERICAN NATURALIST, 1888. p. 453.
[3] Harker: Geol. Magazine, 1888. p. 267.
[4] Geol. Magazine, 1888. p. 297.
[5] Geol. Magazine, Feb. 1889. p. 70.

The rock consists almost exclusively of a microcrystalline groundmass of quartz and albite in which are a few porphyritic crystals of the latter mineral. These are sometimes broken up into patches divided by narrow seams of feldspathic substance with an extinction different from that of the albite. The analysis yielded:

SiO_2	Al_2O_3 Fe_2O_3	CaO	MgO	K_2O	Na_2O	Ign.
77.29	14.62	tr	.38	.16	7.60	.57

—Gonnard[1] mentions pyrite, oligoclase, emerald, garnet, beryl, calcite, chlorophyllite, apatite and tourmaline as accessory constituents of the gneiss occurring along the banks of the Saône near Lyons, France.—Kloos[2] has examined the thin sections of rocks that have been subjected to great artificial pressure, and finds in them no signs of mineral crushing. He advises care in ascribing to pressure the crushed appearance of minerals in rocks. He is inclined to regard the phenomenon as due to increase in volume under chemical change.—A typical picrite occurring in boulders near St. Germans in the Liskeard District in Cornwall, England, is mentioned by Bonney[3] as containing augite which has been changed successively into brown and green hornblende, and colorless needles of the same mineral, while the original form of the augite has remained. —Glaucophane has been discovered by the same author[4] as a secondary product of augite in a diabase occurring in a block in the Val Chisone, Cottian Alps.—Aggregates of topaz, a little feldspar, kaolin and mica have been found by Salomon[5] in a granular quartz rock (one variety of the greisen) resulting from the silicification of the granite at Geyer in Saxony.—The green-sand from just above the chalk beds in Kent, England, is composed[6] of grains of quartz, flint, feldspar, glauconite, magnetite, spinel, zircon, rutile, tourmaline and occasional grains of garnet, actinolite, epidote and chalcedony.—An eclogite from near Frankenstein in Silesia consists essentially[7] of omphacite and a calcium garnet. The omphacite contains inclusions of smaragdite, and portions of the garnet have passed over into zoisite through the loss of calcium and the assumption of water.

[1] Bull. Soc. Franç. d. Min. XII. p. 10.
[2] Zeits. d. deutsch. geol. Gesell. XL. 1888. p. 612.
[3] Min Magazine, Oct. 1888. p. 108.
[4] Min. Magazine, Dec. 1887. p. 191.
[5] Zeits. d. deutsch. geol. Gesell. XL. p. 570.
[6] Miss. Gardiner: Quart. Jour. Geol. Soc. Nov. 1888. p. 755.
[7] Traube: Neues Jahrb. f. Miner., etc. 1889. I. p. 195.

MINERALOGICAL NEWS.—*New Minerals.*—*Dahllite*[1] occurs as a yellowish white incrustation on red apatite from the Odegärden mine at Bamle, Norway. It is found in little fibres with a density of 3.053 and a composition as follows :

CaO	FeO	Na_2O	K_2O	P_2O_5	CO_2	H_2O
53.00	.79	.89	.11	38.44	6.29	1.37

corresponding to $4\,(Ca, Fe, Na_2, K_2)_3\,(PO_4)_2 + 2\,Ca\,CO_3 + H_2O$. Before the blowpipe the mineral decrepitates without fusing. It is uniaxial and negative.—*Eudidymite*[2] is founa in tabular crystals in the elaeolite syenite of Langesundfiord at Aro, Norway. It is a white mineral with an easy basal cleavage, a hardness of 6, and specific gravity of 2.553. It is minoclinic with $a : b : c = 1.7107 : 1 : 1.1071$ and $\beta = 86° \; 14' \; 27''$. The plane of its optical axis is the clinopinacoid. The acute bisectrix is inclined 58½° to c in the acute angle β. $2Va = 29° \; 55'$ for yellow light, and the dispersion is inclined with $\rho > \upsilon$ Its analysis yielded :

$S:O_2$	BeO	Na_2O	H_2O
72.19	11.15	12.66	3.84, corresponding

to Na. H. Be. Si_3 O_8.

—*Lansfordite* is a white mineral resembling calcite. It is described by Genth[3] as forming stalactites 20 mm. in length in an anthracite coal mine at Lansford, Schuylkill Co., Pa. Its composition is $MgO = 23.18$ per cent, $CO_2 = 18.90$ per cent, $H_2O = 57.79$ per cent, $= 3\,MgCO_3 + Mg\,(OH)_2 + 2\,H_2O$. Its hardness is 2.5, and specific gravity 1.692.—*Rare Minerals.*—Messrs. Diller[4] and Whitfield have identified the blue mineral present in fibres penetrating the quartz and plagioclase of the pegmatoid portion of a biotite gneiss at Harlem, N. Y., as *dumortierite.* In thin section the mineral is seen to have a cleavage parallel to $\infty \bar{P} \bar{\infty}$ and a second parallel to some prismatic plane. It contains long tubular cavities parallel to the vertical axis and is frequently polysynthetically twinned parallel to some plane in the prismatic zone. It has a hardness of 7, and specific gravity of 3.265. The analysis of a specimen of the mineral obtained from a rock composed principally of dumortierite and quartz, from Clip, Arizona, yielded :

[1] Brögger and Bäckström: Oefv. af. Kongl. Vetenskaps Akad. Förh. Stockholm. 1888. No. 7.
[2] Brögger: Nyt. Magazin for Naturv. XXX. II. p. 196.
[3] Genth: Zeits. f. Kryst. XIV. p. 255.
[4] Amer. Jour. Sci. Mch. 1889. p. 216.

SiO_2	Al_2O_3	MgO	B_2O_3	P_2O_5	H_2O
27.99	64.49	tr.	4.95	.20	1.72

equivalent to 3 $Al_8 Si_3O_{18} + Al(BO_3)_2 + 2 H_2O$. Damour,[1] who first analysed the mineral regarded it as a simple silicate of aluminuium of the formula $Al_8 Si_3 O_{18}$.—Additional observations upon *bertrandite* increase materially our knowledge of this rare mineral. Investigations by Urba[2] upon the crystals coating the faces of feldspar from Pisek, Bohemia, and the walls of cavities in this mineral yield results analogous to those obtained by Penfield[3] in the case of the Mt. Antero crystals. According to Urba $a : b : c = 7191 : 1 : 4206$. In addition to the cleavage parallel to $3P\bar{\infty}$ Urba finds also a very perfect one parallel to oP. The new plane $\frac{4}{9} P\breve{\infty}$ is also discovered. Analysis of the Pisek mineral gave: SiO_2=49.90, BeO= 42.62, H_2O=7.94. The Mt. Antero crystals[4] are bounded by the three pinacoids. Of the two basal planes one is flat and the other rounded in consequence of an oscillatory combination with a brachydome. The distribution of the electrical properties of the crystals show them to be hemimorphic, as indicated by the oscillatory combination on one only of the basal planes. The mineral has recently been discovered at Stoneham, Maine. Mr. Penfield[5] has examined crystals from this locality and has identified on them the planes oP, $\frac{1}{2} P\bar{\infty}$, $3 P\breve{\infty}$, $\infty P\breve{\infty}$, and $\infty P\breve{3}$. The crystals are double wedge-shaped, are hemimorphic in the direction of their vertical axis, and are elongated parallel to the brachy-axis. One twin with oP as the twinning plane was observed. A calculation of the axial ratio gave $a : b : c = .5973 : 1 : .5688$.—Pisani[6] has analysed *cupro-descloizite* from Zacatecas, Mexico and has found in it:

Vd_2O_5	As_2O_5	PbO	CunO	ZnO	H_2O
17.40	4.78	53.90	8.80	11.40	3.20

The mineral has a brown color on a fresh fracture, and a specific gravity of 6.06.—A new analysis of the very remarkable mineral *melanophlogite* has been made by Pisani.[7] The mineral was found in iittle colorless cubes associated with calcite, sulphur and celestite in a limestone geode from near Girgenti, Sicily. After purifying as carefully as possible it yielded:

[1] Bull. Soc. Min. d. France. IV. p. 6.
[2] Zeits. f. Kryst. XV. p. 194.
[3] Cf. AMERICAN NATURALIST. 1888. p. 1023.
[4] Penfield. Amer. Jour. Sci., Mch. 1889. p. 210.
[5] Ib. p. 210.
[6] Bull. Soc. Franç. d. Min. XII. p. 38.
[7] Bull. Soc. Franç. d. Min. Dec. 1888 XI. p 298.

SiO_2	SO_3	Fe_2O_3 Al_2O_3	Loss.
91.12	5.30	.43	1.52.

—*Kröhnkite* ($Cu SO_4 + Na_2 SO_4 + 2 H_2O$) from Chili, is monoclinic, according to Darapsky[1] with $a : b : c = 1 : 2.112 : 0.649$. B $= 64° 8'$. Its hardness is 2.5, and specific gravity, 1.98.

BOTANY.[2]

THE TREATMENT OF EXSICCATI IN THE HERBARIUM.—Whether exsiccati should be kept as they are published, or cut up and distributed in the Herbarium, is a question of sufficient importance, it seems to me, to warrant a brief consideration. Exsiccati are generally arranged arbitrarily, and unless well indexed, are often labyrinths to those who are unfamiliar with them. Those which have a separate index to each fasciculus are bad enough, but, unfortunately, many of the largest and best sets have no index at all, and those whose indexes are published separately are continually outgrowing them. If distributed in the herbarium, the specimens are always at hand, and a student does not need to examine indexes to see whether a given species is in such or such a set, but can find all the specimens from every set together in the herbarium, thus saving time and patience, and making comparison of specimens more easy. Much of the synonomy becomes in time forgotten and obsolete, and many exsiccati are for this reason almost useless. But if distributed, the synonomy of each specimen can be kept up with the times by means of labels on the sheet on which it is mounted, and thus many specimens made useful which otherwise would be of but little value for reference.

The common objection to cutting up and distributing exsiccati is that it destroys their identity. But in most exsiccati the name, etc., is printed on the label of each specimen, and if not, these labels can easily be stamped. References to exsiccati are, as a rule, by number, but if distributed, the specimens can be found by name without the number, and when found the number is with them to show that they are the specimens referred to. Besides, if distributed, they can be found by many who have not noticed these references.

[1] Neues Jahrb. f. Min., etc. 1889. I. p. 192.
[2] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

A strong objection, however, to cutting up exsiccati is found in cases where species are described in them, and the exact dates of the descriptions are wanted. These dates are generally given on the covers of the fasciculi, and are, of course, lost if the set is cut up and the specimens distributed. This can be partially remedied by preserving these covers, as the number of each specimen will indicate to which one it belongs; and this one objection is certainly overcome by the manifest advantages of wider usefulness, greater convenience of reference, and saving of time otherwise spent in determining synonomy.—*Roscoe Pound.*

ANEMONE CYLINDRICA GR. WITH INVOLUCELS.—Last year, in running over some Nebraska plants from Lincoln, with Mr. Pound, we noticed undoubted specimens of *Anemone cylindrica* Gr., with one or two peduncles bearing two leaved involucels. Further examination of numerous specimens collected in the same vicinity at different times shows this peculiar feature to be of quite common occurrence. The leaves of the involucels are similar to those of the involucre.

Authors, in characterizing this species, describe the peduncles as naked; it is remarkable, then, that this peculiarity should occur so commonly.

It may be a hybrid with *A. dichotoma* L., which is provided with an involucel, and occurs here commonly.—*H. J. Webber.*

POLYGONUM INCARNATUM ELL. WITH FOUR-PARTED PERIANTH.—A form of *Polygonum incarnatum* Ell. is found commonly in the vicinity of Lincoln, Neb., having the perianth four-parted instead of five-parted as always described. On most heads, however, a few flowers may be found having the normal five sepals. *P. incarnatum* belongs to the section Persicaria Tourn., characterized as having a five-parted perianth. *P. virginianum* L., belonging to the section Tovaria Adans., which has the perianth four-parted, is found in the same vicinity. It is the *only* other four-sepaled species occurring.—*H. J. Webber.*

INFECTION OF THE BARBERRY; HOW PERFORMED.—Let us suppose that we wish to perform the classical infection of the barberry with *Puccinia graminis*. In the autumn, six young barberries, small enough to be covered with a bell-glass, having been planted, as soon as their leaves are fully developed in the spring, they may be infected in the following manner: A quantity of *Puccinia graminis* having also been provided in the autumn, and kept during the winter in the mode before explained,[1] as soon as the barberry foliage is ready, test the germination power of the *P. graminis* by placing a few fragments in water in a watch-glass. If it germinate freely and produce a good crop of mycelical spores, as proved by microscopic examination, the contents of the watch-glass may be at once employed. It is best to do your infection experiments in the evening. Water one of the barberries freely, through the nose of a watering-can, and then cover it with a bell-glass ; then water the outside of the bell-glass. By so doing, the temperature of the enclosed air is reduced, and the inside of the bell-glass, as well as the leaves of the barberry become bedewed with condensed vapor. After leaving it a few minutes, remove the bell-glass and apply the germinating spores with a camel-hair pencil. As the promycelial spores easily become diffused in the water in the watch-glass, by stirring it with the camel-hair pencil the water becomes equally charged with them ; then by simply brushing the water on the leaves you may be pretty sure of successfully infecting the plant. Replace the bell-glass and give it another douching outside with the watering-can. If sufficient material has been prepared, each alternate barberry may be infected in the same manner. The bell-glass need not be kept over the infected plants more than two or three days. If the weather be very bright, the bell-glasses should be shaded by putting a piece of matting or carpet over them to prevent the foliage being scorched by the sun. In the course of eight or ten days the yellow spots, on which the spermogonia are produced will appear, and in two or three weeks the perfect æcidiospores will be developed. It will then be seen that only those barberries to which the spores were applied have the æcidiospores on them, while the alternate plants remain free. If an attempt be made to infect a plant in the daytime, when the sun's rays are full upon it, it will be found that the water all runs off the leaves ; but by operating in the evening, in the manner directed, the leaves are bedewed with a thin layer of moisture, and no difficulty will be found in applying the spore-charged water.—*C. B. Plowright, in Monograph of Uredineæ and Ustilagineæ.*

A TRUE FIELD MANUAL OF BOTANY.—The publishers announce that they will bring out an edition of the new revision of "Gray's Manual," with narrow margins, and with limp cover binding, for field use. As this will bring the book

[1] Bundles of straw containing teleutospores are to be collected in the autumn, and kept out of doors during the winter, so that they may be subjected to the same vicissitudes of temperature and moisture as would happen to them in a state of nature.

down to a pocket size, every teacher ought to insist upon this edition for use in his botanizing classes. It is understood that the revision will include the plants of the prairies, and of the great plains up to the eastern limits of the region covered by "Coulter's Manual," *i. e.*, about the 100th meridian. —*Charles E. Bessey.*

DISTRIBUTION OF KANSAS FUNGI.—Dr. W. A. Kellerman and Mr. W. T. Swingle, well known mycological students of Manhattan, Kansas, have undertaken to make a distribution of Kansas fungi. The first fascicle consists of twenty-five species very neatly put up, with printed labels. The species represented are the following:

Aecidium aesculi E. & K. *Aecidium dicentrae* Trelease. *Ceratophorum uncinatum* (Clinton) Sacc. *Cercospora cucurbitae* E. & E. *Cercospora desmanthi* E. &. K. *Cercospora lateritia* Ell. & Halsted. *Cercospora seminalis* E. & E. *Gloeosporium apocryptum* E. & E. *Gloeosporium decipiens* E. & E. *Melasmia gleditschiae* E. & E. *Microsphaera quercina* (Schw.) Burrill. *Peronospora arthuri* Farlow. *Peronospora corydalis* DeBary. *Phragmidium speciosum* Fr. *Puccinia emaculata* Schw. *Puccinia schedonnardi* Kell. & Sw. *Puccinia* (*Leptopuccinia xanthii*) Schw. *Ramularia virgaureae* Thuem. *Roestelia pyrata* (Schw.) Thaxter. *Scolecotrichum maculicola* E. & K. *Septoria argophylla* E. & K. *Septoria speculariae* B. &. C. *Sphaerotheca phytoptophila* Kell & Sw. *Uredo quercus* Brondeau. *Ustilago zeae mays* (DC.) Winter.

ZOOLOGY.

THE NERVOUS SYSTEMS OF ANNELIDS AND VERTEBRATES.—Mr. John Beard analyzes in a recent number of *Nature* the Annelidan features found in the development of the Vertebrate nervous system, and adds some points of his own. He claims that the spinal ganglia arise not from the neural ridges but from the adjacent ectoderm, and in such a manner as to justify their comparison with the parapodial ganglia described by Kleinenberg in Lepadorhynchus. Again, the two halves of the neural plate are separated at an early stage by a median groove of ciliated epithelium, and therefore the nervous system is ontogenetically paired. This ciliated groove ultimately furnishes the epithelial lining of the neural canal, and except the fact that in the annelids the ciliated groove is not invaginated, the resemblance is thus rendered very close.

The Origin of the Vertebrate Pelvis.[1]—Professor Weidersheim presents the following hypothesis of the origin of the Vertebrate pelvis. The *inscriptiones tendineæ* of the ventral myocommata which are immediately below the posterior limbs, develop cartilage, and unite on the middle line, forming the simple median pubis of the Lepidosirenidæ and of the Urodele Batrachia. In the Ceratodontidæ this pubis has a short lateral process which is directed upwards and backwards. In Lepidosirenidæ this process is much more elongate, and is derived from a metamorphosis of the tissue of the myocomma. At its distal (superior) end it passes into fibrous connective tissue. This is the cartilaginous beginning of the ilium, which in most Batrachia and in higher Vertebrata reaches the vertebral column.

A Boy with a Tail.—The *Naturaliste*[2] gives a figure (from a photograph) and a description of a boy who lives near Saigon, who has a tail about eight inches long. It originates at the usual point, but contains no vertebræ. The extremity is bent outwards, like the horizontal part of a crank. The boy has also a mammiform enlargement on each buttock. He is about twelve years of age.

Zoological News.—Echinoderms.—L. Cuénot (*Arch. Zool. Exp. et Gen.*, 1888) details the anatomy of several brittle stars. While many of his statements do not well admit of abstract, it may be noticed that he finds, not hæmoglobin as has been reported, but a colored ferment, which converts peptones into albuminoids.

Ludwig (*Zeitsch. wiss. Zool.*, xlvii, 1888) describes *Ophiopteron elegans*, a brittle star which apparently has the power of swimming ; while in the same number Brock has a revision of the Ophiurids of the Indian Archipelago.

Worms.—Völtzkow (Semper's *Arbreten* viii.), investigates *Aspidogaster conchicola*, which is familiar as a type of the trematodes in Huxley's "Invertebrata." The egg undergoes total segmentation and is enclosed by a cellular membrane, as in other Trematoda. The penis, vulva, receptaculum vitelli,

[1] Bericht. d. Natu-forsch. Gess. Freiburg, i. e., Bd. IV., Heft. 3.
[2] No. 48, March, 1889.

etc., are ectodermic, but the internal generative organs are of mesodermic origin. The young forms pass into the stomach of the mussel, from which it works its way into the pericardium and kidneys of the host. The details of the adult structure are given.

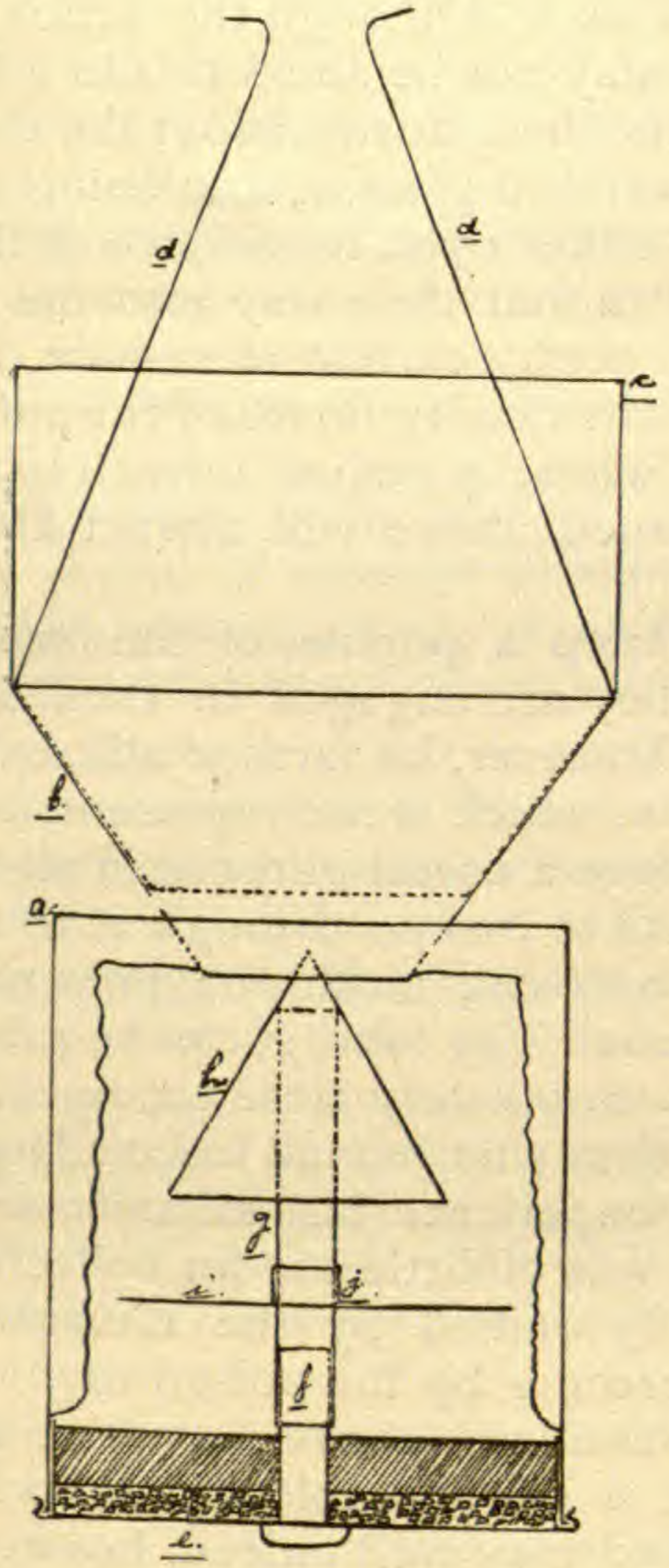
At the meeting of the Linnean Society of New South Wales, Nov. 28, 1888, Mr. J. J. Fletcher described twenty new species of Australian earthworms, twelve belonging to the genus *Cryptodrilus*.

MOLLUSCA.—The land-shell, *Subulina octona* Chem., hitherto regarded as peculiar to the West Indies, has been found in a coffee plantation in New Caledonia. Its introduction is as yet unexplained.

ENTOMOLOGY.

AN INSECT TRAP TO BE USED WITH THE ELECTRIC LIGHT. —Some experience in collecting insects at the electric lights last summer led me to the conclusion that a simple piece of apparatus, which could take the collector's place, when he was forced to go home to steal a few hours for sleep, would be a boon to the insect-hunter. Having once gained the idea I at once endeavored to realize it, with the following result:

I obtained a three-quart tin pail, represented by *a* in the accompanying drawing, about six and one-half inches long by five and a half in diameter, and had a tinner cut out of the bottom a three-inch circle. Then taking a funnel six inches and a half in diameter at its widest part my tinsmith cut off the smaller end so as to leave an opening at this end of two and a quarter inches in diameter. This frustrum of a hollow cone, *b* in the drawing, is then soldered fast to the bottom of the pail *a*, the flaring end being outward and the smaller end projecting within the pail a half inch or more. A flat, hexagonal piece of tin, *c*, was next made to fit the funnel, *b*, and, after being carefully adjusted so as to stand vertically across the center of the mouth of the funnel, was firmly soldered in this position. Two pieces, *dd*, of steel spring, No. 8 wire, were then fastened to opposite sides of the funnel. These wires when pressed together at the top will pass into the small opening in the bottom of the globe of the U. S. Electric Light Co.'s lamp, and when released from pressure will spring back to their normal po-



sition and the projecting ends will rest upon the inner surface of the globe, and thus furnish a means of support for the apparatus. The lid of the pail, *e*, which forms the bottom of the trap, has soldered to its inner face a cylindrical tube of two inches or a little less in length; between this tube and the rim of the lid is put first a layer of crystals of potassium cyanide and over this a half-inch layer of plaster of Paris, which should be carefully smoothed down and then moistened with sufficient water to form a hardened crust over the top a quarter of an inch or a little more in thickness. The lid will have to be supported in the mouth of the pail in some way similar to that illustrated by the working drawing. Finally, a cylindrical tube, *g*, four and one-half inches long is made just large enough to fit snugly over the tube, *f*, and a hollow cone, *h*, with a diameter of three and a height of two and one-half inches is fastened to its top. If it is thought desirable a disk, *i*, about four inches in diameter, with a collar, *j*, may be made to slide up and down the tube *g*.

The whole inside of this trap, except the lower face of the hollow cone, *h*, should be painted black to allow the prey as little light as possible to aid them in making their escape; and the cone, *c*, should be thickly pierced with small holes one inch from the top. It is also well to varnish both sides of the vertical plate, *c*, the inside of the funnel, *b*, and the upper surface of the hollow cone, *h*, to make "Facilis desensus Averni." I have substituted glass for tin in the plate, *c*, as this material is probably entirely invisible to insects, they are more likely to heedlessly dash against it, while they may flutter about the bright tin. But it is much more difficult to fasten to the funnel than tin, is easily broken, and I have not been able to see that it is, in practice, superior to tin. Although the action of the trap seems simple enough it may not be amiss to add a few words on this point. The insects that cluster about the electric lights will dash against the vertical plate, *c*, and being unable to obtain a foot-hold easily either upon its surface or that of the funnel, they will be likely to find their way into the inside of the trap, where they are pretty certain to remain, being prevented from escaping by the deadly fumes of the potassium cyanide and the cone, *c*, whose polished lower surface lighted up by the holes mentioned above will attract them away from the single opening.

The disk, *i*, merely serves to keep a portion of the insects separate from the others while they are engaged in their desperate death struggles; it may, however, be farther utilized as a support for a coarse wire screen, which is not represented in the drawing. This screen will serve a useful purpose in allowing beetles and other small insects to escape through it to the bottom of the trap; in this way only can moths be preserved in a fit state for museum specimens. The tube, *g*, can be raised or lowered so as to more or less completely close the opening in the bottom of the funnel and thus shut out all insects larger than a certain size. My limited experience last summer with this trap convinced me that it was of little use for collecting *Lepidoptera*, as they were usually ruined by the *Coleoptera*, which are much less easily overcome by the poison used. I have not tried the wire screen mentioned above, however, and this modification may preserve a considerable number very well. It answers the desired end very well indeed, however, for all the other orders, and it is especially useful in collecting small *Hemiptera*, *Neuroptera*, *Diptera* and *Hymenoptera*. I have frequently found a pint or more of insects in the trap when I came to examine it in the morning after exposure for a whole night.

Many of the forms will of course occur in unwelcome abundance, and the task of looking over the whole mass carefully is no slight one but it pays. I have in a single night taken a few more than a hundred species, and in three consecutive nights as many as a hundred and fifty species, but I have no doubt but that this record can be easily broken if some of my experiment-loving brother or sister entomologists will follow the suggestions offered in this paper.—*Jerome McNeill.*

EMBRYOLOGY.[1]

THE QUADRATE PLACENTA OF SCIURUS HUDSONIUS; OR, THE COMMON RED SQUIRREL.—In 1887, the present writer called attention to the existence of certain vestigiary placental structures developed during the early stages of the mouse, rat and field-mouse, which indicated that the discoidal placental disk of the late stages of fœtal life of these forms had been derived from one, the placenta of which was zonary or girdle-like in form, as in the cat, dog, hyrax, elephant, etc. All of the forms of rodents mentioned, however, possess at a late stage a very distinctly discoidal placenta, the development of which seems to be associated with the so-called *inversion of the germ layers*, which is so marked a feature of their ontogeny, and one also which renders its processes amongst the most specialized and complex known to embryologists. The notice published in September, 1887, as to the persistence of a girdle-like vestige of the decidua continuous with opposite sides of the placental disk, afforded only tentative evidence of the derivation of the discoidal placental from the zonary form. Recently some remarkably conclusive evidence, favoring such a view, has fallen under my observation in fœtuses of the common red squirrel. Mr. J. P. Moore, one of the pupils in the biological laboratory of the University of Pennsylvania, during the latter part of March, brought in a gravid female red squirrel in which two fœtuses were found, *in utero*, which are the basis of the following account.

These fœtuses measured 16 mm. in length from the vertex of the head to the end of the body. The two cerebral vesicels had just appeared as a pair of smooth saccular diverticula from the sides of the anterior end of the neural tube. The spinal cord filled out the vertebral canal entirely, and the two enlargements, brachial and lumbar, were distinctly visible through the integument of the dorsal median line. The limbs were so far developed as to show the digits distinctly differentiated. The stage, in fact, represents one which is very nearly equivalent to that of the human embryo at three months.

The peculiarity of the most importance in the present case, in relation to the question of the origin of the discoidal placenta in other forms, is the unusual shape presented by that organ, which is quadrate in *Sciurus hudsonius*. Both fœtuses

[1] This department is edited by Professor JOHN A. RYDER, University of Pennsylvania, Philadelphia.

were found in one horn. They formed ovoidal swellings of the uterine cornu separated from each other by a slight interval. They were nearly an inch long and not quite three-fourths of an inch in diameter. Upon carefully inserting the point of a scissors through the uterine wall ventrally, and opening it so as to expose the embryo in its membranes, it was found that the latter were not adherent to the mucosa, except over a small quadrate area on the mesometric side. After the placenta was forcibly detached with part of its decidua, the scar left on the uterine wall measured 9 mm. in length over its short diameter which coincides with the direction of the passage in the cornu. Its diameter the other way or transversely to the uterine cornu was 12 mm. The edges of the scar forming its short diameter were slightly elevated so as to form a pair of slight folds projecting above the non-placental area above and below the embryo. These folds represent a very rudimentary decidua reflexa, traces of which are also present in forms with a zonary placentation. The edges of the scar forming the margins of its long diameter pass gradually into the mucous membrane of the uterine walls, and there is no such well-marked fold representing a reflexa as appears on the other sides. The peculiar quadrate form of the placenta was equally manifest in its fœtal part, or that to which the umbilical cord and membranes are attached. The area of the placenta in millimetres is, in round numbers, 9x12 = 108 sq. mm. Over all the remaining portions the fœtal membranes were not attached to the uterine mucosa. There was a strongly developed *decidua vera* over the placental area.

If we now compare this peculiar quadrate placenta with the ordinary zonary type the homologies of its parts will become clear, and I think it affords demonstrative evidence of the direct derivation of this quadrate form from one which was zonary. If, for example, we select the zonary type, as seen in the cat of the third or fourth week of intra-uterine life, and mark off a quadrate portion of the placental girdle which will be as 9 is to 12, 9 being the width of the girdle and 12 the proportional length of a segment of it measured along its curve, we shall have a placenta which is the morphological equivalent of that seen in the red squirrel.

In the rabbit's uterus of the eighth day of gestation there is a proliferation or thickening of the dorsal or mesometric side of the uterine wall, which betrays distinct traces of a squarish figure. As this represents the site of the future placenta in the rabbit it is plain that the squirrel has retained in a far more pronounced manner traces of the primitive girdle-like placenta. It seems, in fact, as if that portion of the placental girdle directed away from the blood supply had been suppressed, leaving, as in the case of the red squirrel, only a segment of the original zonary placenta on the mesometric side.

This diversity in the form of the placenta, even in types where the uterus is divided into a pair of tubular cornua, is associated with the mode of vascular supply of the uterine walls. In the cat, mouse and rabbit there is present a rich plexus of vessels all round the uterine tube interposed between the outer and inner muscular coats. The mouse has very few uterine glands, the rabbit and cat on the other hand have them very numerously imbedded in the wall of the mucosa. The area where active proliferation of the uterine wall goes on together with hypertrophy of the uterine gland differs greatly in form in different types. In the mouse the hypertrophy is at first mainly confined to the connective tissues of the uterus; in the rabbit, cat and squirrel it is at first mainly associated with changes in the size, form and thickness of the walls of the tubular glands. All of these phenomena in turn are associated with the manner in which the blood supply for the maternal placenta is distributed. If the blood-vascular supply is developed mainly on the mesometric side, there appears to be a tendency to develop a discoidal placenta from the dorsal segment of the uterine mucosa which is in contact with the embryo and its membranes. If the blood-vascular supply of the uterine walls persists around the whole circumference of the tubular horn of the uterus there will be a tendency to develop a girdle-like placenta, as in the cat. If the muscular supply of the uterus opposite the mesometric side is, on the other hand, suppressed to any great degree, the continuation of the placenta fails to be formed on that side, and the quadrate segment of the girdle leading finally to the discoidal form is developed. As I have shown in a former note, that the mode of contact of the tubular uterine wall with the spherical ovum had something to do with the evolution of a zonary type of placentation, it may be well to indicate in this connection that there is also a physiological factor to be considered in the blood supply of the uterus during gestation and the way in which such supply is modified. The factors at work in the differentiation of the placenta in the mammalia may be said to be mechano-physiological in character. The method of the establishment of formal relations between the surfaces of the embryo and parent during fœtal development are purely mechanical These primary conditioning factors are further modified by changes in the physiological processes incident to gestation. While these points just insisted upon must be borne in mind in working out a final interpretation of the method of evolution of the various forms of the placenta, the quadrate placenta of the red squirrel appears to be of great significance, as bridging the gap between the discoidal and zonary forms; it plainly shows how the passage from the one to the other was effected. This is all the more interesting from the circumstance that both square and round forms are met with in one and the same order, but in different suborders.

Recently my views as to the origin of the amnion and placenta have been criticized by Minot in the *Journal of Morphology*, ii., pp. 432-434. In reply, it may be said that my theory of the amnion has little in common with that of Van Beneden and Julin, which is the reason I did not cite them. My theory of the origin of the amnion, despite my critic, remains the only one which is tenable. In the same way, my theory of the genesis of the girdle-like placenta is equally safe from annihilation at the hands of morphologists. As I entertain a great respect for a vast mass of data which might be cited in proof of my position, I should be doing less than my duty not to insist upon standing by the latter.—*J. A. Ryder.*

PHYSIOLOGY.[1]

EFFECTS OF STIMULATING NERVE CELLS.—The fact that activity of a gland cell produces in the cell protoplasm changes, which may be recognized by the microscope, has long been known. Not only is the morphological appearance altered, but also the behavior of the cell toward staining reagents. The highly interesting fact that analogous changes accompany the activity of nerve-cells has been discovered by Donaldson and Hodge[2] in the case of the cells of the posterior root ganglia. Korybutt-Daszkiewicz[3] of the Warschau Pathological Laboratory endeavors to advance the subject one step further by showing that the activity of the cells of

[1] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] Cf. *The American Journal of Psychology*, Vol. i, p. 479, 1888.

[3] *Archiv f. mik. Anatomie*, Vol. xxxiii, p. 51, 1889.

the spinal cord affects the staining qualities of the cells. In the frog the sciatic plexuses are laid bare, the nerves are cut, and the central end of the eighth nerve is stimulated at regular intervals for one hour, each stimulation of three minutes being followed by a rest of two minutes. The spinal cord is then removed, hardened, sectioned, and double-stained with hæmatoxylin and safranin. For a control experiment the spinal cord of another frog is, in each case, prepared in exactly the same manner, with the exception of the nerve stimulation. An active and a resting cord are thus obtained for comparison. The nuclei of the cells of the grey matter are colored—some red and some blue-violet. Enumerations give in the control (resting) cord to 1 red, 8.97 blue nuclei; in the stimulated cord to 1 red, 2.71 blue; in the active cord the relative number of red is 3.31 times greater than in the resting one; in parts of the cord lying immediately adjacent to the entrance of the stimulated nerve, the red nuclei are relatively even more abundant. The chemical condition of the nuclei is evidently altered so as to make them more susceptible to the safranin than to the hæmatoxylin. [It is to be regretted that the author apparently enumerates all the cells, even those of the supporting tissue, with the nerve cells.]

Gaseous Exchange in the Lungs.—Professor Bohr, of Kopenhagen, has recently carried on a series of experiments, the results of which indicate the incorrectness of the commonly received opinion that the passage of oxygen and carbonic dioxide between the air and the blood in the lungs is a process of simple diffusion.[1] By a modification of Ludwig's stromuhr the blood of the carotid artery of a dog was, in its passage, exposed to the air of a closed chamber until equilibrium had been established between the blood and the air; the latter was then analyzed, and the partial pressures of the gases determined; these partial pressures represent the tensions of the same gases in the blood. The tensions of the gases in the expired air were determined at the same time. In nearly all cases in the blood the carbon dioxide tension was found lower, the oxygen tension higher, than in the expired air. The results would have been still more striking, could the air of the pulmonary alveoli have been used, since there the CO_2 tension is necessarily greater, the O tension less, than in the expired air. The experiments indicate that each gas, in passing through the alveolar and capillary walls passes from a place of low to one of high tension, a fact which

[1] *Centralblatt f. Physiologie*, 1887, p. 293, and 1888, p. 437.

is inexplicable on the hypothesis of diffusion. The author ascribes to the lung tissue a distinct secretory power for both O and CO_2, a quality which is possessed by the swim-bladder of fishes.

DR. H. P. BOWDITCH'S "Hints for Teachers of Physiology"[1] is an admirable little book, intended for the use of teachers in grammar schools and upward. It contains numerous suggestions of methods by which text-book instruction may be supplemented by "simple observations and experiments on living bodies or on organic material, thus imparting to pupils a knowledge of the foundation on which physiology rests, and, at the same time, bringing the impressions made on the senses to aid the memory in retaining the facts communicated in a purely didactic way." Digestion, circulation, motion, voice, animal heat, respiration, vision, and hearing are treated, but by no means exhaustively, for the author does not attempt a complete treatise on physiology. The hints are so excellent that it is a pity that the work is not more full.

PSYCHOLOGY.

MINOT'S REPORT ON DIAGRAM TESTS.—During the past year a large number of postal cards were distributed, each bearing the printed request: "*Please draw ten diagrams on this card, without receiving any suggestion from any other person, and add your name and address.*"

The committee has received for examination 501 postal cards, with diagrams upon them. A few of the cards had more than ten diagrams upon them, and of such cards only the first ten diagrams on each were counted. A few cards had less than ten diagrams.

The cards were divided into three sets; 1, men; 2, women; 3, without names. Each set of cards was numbered, and the diagrams on each card numbered.

Such tests as the diagrams, on which this report is based, demonstrate the slightness of our real individual distinction and separation. The similarity is so great that the same visual images arise in many of us with approximately the same readiness.

We come here to a domain of psychology which has been but little and inadequately studied, namely, the frequency

[1] "Guides for Science Teaching," No. 14, pp. 58, Boston, D. C. Heath & Co., 1889.

and the readiness with which ideas recur. In a previous report in the Proceedings (*ante*, pp. 86) I have shown that even in so indifferent a matter as the ten digits, there are unconscious preferences of the mind, or, in other words, that the notions or images of certain digits come forward oftener and more readily than of others ; and I have also shown *ante*, pp. 90-91, that the order of relative frequency is similar for different persons. It is probable that all ideas possess each its special degree of readiness of appearing in consciousness, and that the degree of readiness is approximately the same for a great many persons. This similarity probably also prevails in regard to the majority of ideas.

This aspect of our mental processes puts the problem of thought-transference in a somewhat different light from that in which we have been asked to view it. It is evident that if two people are requested to think of some one thing as a class, such as a letter of the alphabet, a playing card, a baptismal name, there is by no means an equal chance of their selecting any one ; on the contrary, there is not only the probability that they will think of a special one first, but there is a chance of their both thinking of the same one, for the relative frequency or preponderance of one idea or image out of a set has been shown to be similar for a number of people. In order to prove the reality of thought-transference, it must be demonstrated that the observed coincidence of thoughts can *not* be explained by the law of relative frequency.—*From Proceedings of the Society of Psychical Research.*

MICROSCOPY.[1]

THE CULTURE OF INFUSORIA.[2]—*Damp chambers.* The first requisite in the culture of infusoria is suitable damp chambers, constructed with a view to reducing the evaporation of the water of the preparations to a minimum. Evidently, bell-jars, admitting a large volume of air, will not serve the purpose. Low, flat-bottomed dishes, with vertical sides, and about 20 cm. in diameter, are recommended. The dish is partly filled with fine, well-washed sand, and in this are planted longitudinally two upright strips of glass, of such a height that the superior edge is 4 or 5 mm. below the level of the edge of the dish.

On these upright pieces as supports are placed three others,

[1] Edited by C. O. Whitman, Director of the Lake Laboratory, Milwaukee.

[2] E. Maupas. La Multiplication des Infusoires ciliés. *Arch. de Zool. Expér. et Gen.* xvi., no. 2, 1888, p. 179.

the middle one having a width of 4-5 cm., the two others 2 cm. only. It is on these three slips that are placed the object slides bearing the infusoria. The whole is covered by a glass plate, fitted as hermetically as possible to the edge of the dish. The dish being filled with rain water up to the horizontal strips, the air space is reduced to a layer of 4 or 5 mm. in thickness. This layer of air is always saturated with moisture, and the preparations suffer only an extremely feeble evaporation.

For sorting and transporting infusoria, glass pipettes, about 10 cm. long, are used. The tapering end should be thin, and its opening not over 1 mm. in diameter. The infusoria are first placed *en masse* in a large drop of water upon a slide, and examined with a low magnifying power. The inside of the pipette is wet by filling it once with water. An infusorian having been selected under the microscope, the mouth of the pipette is placed near that side of the drop of water where the infusorian is found. As soon as the pipette touches the drop, a portion of it is drawn in by capillary attraction, carrying with it the specimen sought, together with, perhaps, others not wanted. The contents of the pipette are expelled upon a second slide. If the drop contain several infusoria, a drop of rain water is added, and the manœuvre with the pipette repeated. In this way the isolation of an infusorian may be surely and rapidly accomplished. After each operation with the pipette, it should be washed with care, by forcing fresh water through it several times. Some infusoria have a strong adhesive power, and it often happens that they are left adhering to the internal surface of the tube ; hence the importance of washing after each experiment.

The isolated individual is covered with an ordinary cover-slip, preferably one 18 mm. square. The cover-slip may be supported by small pieces of bristles from a tooth-brush. As these pieces have a mean thickness of about .3 mm., it follows that the space inclosed represents a volume of about 100 cu. mm., and will hold 10 cg. of water, or about 5 drops. The entire space should be filled with water. It is very important in such work to use pipettes, slides, and slips that are perfectly clean. The least trace of a reagent left on the cover-slip may be enough to render the whole preparation valueless.

Infusoria thus inclosed and protected may live indefinately under perfectly healthful conditions. Supplied with proper food, they will develop and multiply with all the energy of their highest power of reproduction.

Supply of food. In order to supply carnivorous species easily with food, it is necessary to find among the more common infusoria a species of small size, that can be readily cultivated.

Cryptochilum nigricans answers perfectly these conditions. It is herbivorous, and occurs everywhere in abundance. In order to utilize it as food for carnivorous species, proceed as follows :—Prepare an infusion by cutting up a few pinches of hay in water, and heat the same for a few minutes to a temperature of 60° C. for the purpose of destroying strange species. Allow the infusion to stand two, three, or four days, according to temperature, until Schizomycetes have developed in it ; then sow some Cryptochila in it, taking care not to introduce other species at the same time. The vessel containing the infusion should always be covered with a closely-fitted plate of glass. The Cryptochila, finding abundance of food in the Schizomycetes, thrive and multiply by myriads. When the culture begins to decline—as it always will in regular course—it can be revived two or three times by adding crumbs of bread in small quantity. Too much bread causes acid fermentation which destroys the infusoria. Instead of hay, pepper might be employed for these infusions, but it would be necessary to determine by experiment the quantity that could be safely mixed with a given volume of water. Too large quantities have been found to give infusions that checked the development of the infusoria.

Having thus obtained a well stocked infusion, the mode of serving the Cryptochila to the carnivorous species isolated in the manner above described, is as follows :—Place a drop of the infusion on a slide, and cover it with a cover-slip. It will then be seen that the Cryptochila collect round the edge of the cover, and in this position they are easily drawn into a pipette, and then delivered over to the carnivorous species. This mode of feeding enables one to make sure that no foreign species is introduced into the culture. Other species would undoubtedly serve the purpose of food as well as Cryptochilum, for example, *Colpidium colpoda.*

In the culture of herbivorous species, Maupas uses boiled flour as food. A pinch of flour is placed in a sufficiently large quantity of rain water, and boiled two or three minutes. With this pap one can easily supply the needs of Paramaecium, Colpidium, Glaucoma, Vorticella, and probably all species that ordinarily feed almost exclusively on Schizomycetes. This food is easily prepared, and is readily served by allowing it to flow in small quantity under the cover-slip of the preparation. It keeps only a short time, and hence must be renewed every day or two.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

United States National Academy of Sciences.—The annual stated session of the National Academy of Sciences was held in Washington, D. C., beginning Tuesday, April 16, 1889, at 11 A. M.

The following officers were elected to serve for six years: President, O. C. Marsh; Vice-President, S. P. Langley; Home Secretary, Asaph Hall.

Six members of the council of the academy were also chosen, those elected being Gen. F. A. Walker, Boston Mass., formerly Commissioner of the Census Bureau; Gen. M. C. Meigs and Prof. Simon Newcomb, of Washington; Prof. Ira Remsen, of Johns Hopkins University, Baltimore, Md.; Prof. G. J. Brush, New Haven, Conn., and Dr. B. A. Gould, Cambridge, Mass.

New members of the academy were elected as follows: Prof. Sereno Watson, botanist, Cambridge, Mass.; Prof. Lewis Boss, director Dudley Observatory, Albany, N. Y.; Prof. C. S. Hastings, physics, Sheffield Scientific School, New Haven, Conn.; Prof. Arthur Michael, chemist, College Hill, Mass., Dr. C. A. White, United States Geological Survey.

The following papers were read:

On Composite Coronagraphy,[2] D. P. Todd, introduced by S. Newcomb; Notice on the Method and Results of a Systematic Study of the Action of Definitely Related Chemical Compounds upon Animals,[1] Wolcott Gibbs and Hobart Hare; On Sensations of Color,[1] C. S. Pierce; Determinations of Gravity, C. S. Pierce; On the Pliocene Vertebrate Fauna of Western North America,[1] E. D. Cope; On the North American Proboscidia,[2] E. D. Cope; On the Mass of Saturn,[3] A. Hall, Jr., introduced by G. J. Brush; On the Rate of Reduction of Nitro-compounds,[3] Ira Remsen; On Some Connection Between Taste and Chemical Composition,[3] Ira Remsen; Recent Researches in Atmospheric Electricity,[3] T. C. Mendenhall; Measurement by Light Waves,[3] A. A. Michelson; On the Feasibility of the Establishment of a Light-wave as the Ultimate Standard of Length,[4] A. A. Michelson and E. W. Morley; On the General Laws pertaining to Stellar Variation,[4] S. C. Chandler; Review of the Trivial Names in Piazzi's Star Catalogue,[4] C. H.

[1] Read April 16.
[2] Read April 17.
[3] Read April 18.
[4] Read April 19.

F. Peters; On Cretaceous Flora of North America,[1] J. S. Newberry; Spectrum Photography in the Ultra-Violet,[1] Romyn Hitchcock, introduced by A. Hall; The Plane of Demarcation between the Cambrian and Precambrian Rocks,[1] C. D. Walcott, introduced by R. Pumpelly; Report of the American Eclipse Expedition to Japan, 1887,[1] D. P. Todd, presented by S. Newcomb.

BOSTON SOCIETY OF NATURAL HISTORY, Jan. 2, 1889.—Rev. John J. Gulick of Japan read a paper on "Lessons in the Theory of Divergent Evolution, Drawn from the Distribution of the Land Shells of the Sandwich Islands." Dr. Gulick illustrated his talk with specimens of shells from the island of Oahu, and drew several conclusions therefrom. He showed varieties to be but incipient species, and species but special varieties, and stated that divergent evolution does not necessarily depend upon environment. He also stated that areas of distribution vary directly as the power of migration, and in closely allied groups the degree of divergence is measured by the geographical separation. At the close of this paper, Dr. Gulick's ideas were discussed by the members of the society, Professor Hyatt speaking at some length. Dr. D. F. Lincoln then described the "Surface Geology of the Middlesex Fells," illustrating his talk with map drawings and specimens of rocks from the region, after which Mr. J. Walter Fewkes spoke shortly of the significance of the so-called "Fossil Palms" and similar rock formations of the Bermuda Islands. Feb. 21, 1889.—Last November, in connection with work on the Boston, Revere Beach & Lynn railroad, some Indian graves were discovered near Winthrop Centre, and Prof. F. W. Putnam gave the results of his discoveries in the place. He showed lantern views of seven skeletons which were unearthed, together with pictures of weapons, pottery, and shell beads found in the graves. All of the skeletons were found within a small area, and all of them buried in the same positions, their faces toward the east. In all the graves many shells were present.

Mr. H. G. Woodward gave a general description of the geology of Brighton, and the surrounding vicinity, and showed specimens of rocks illustrating the geological peculiarities of the place.

[1] Read April 19.

SCIENTIFIC NEWS.

From 1885 to 1888 the regretted Professor Cienkowsky practised (in Russia) 20,310 vaccinations against *charbon* in sheep. The average loss was 0.87 per 100. In a flock of 11,000 sheep, the ordinary mortality among which was 8.5 to 10.6, the mortality after inoculation fell to 0.13 per 100. In another case, thirteen months after the preventive inoculation, 18 sheep out of 20 resisted the action of virulent charbon.

At the international exhibition of geographical, commercial, and industrial botany, which will be held at Antwerp, in 1890, the third centenary of the invention of the microscope will be celebrated. The exposition will illustrate the past history of the microscope and its present state by means of microscopes and microscopical appurtenances of past and present times, as well as by photo-electrical microscopical exhibitions showing the history and uses of the microscope, animal and vegetable structure, and adulterations of food, etc., etc. These exhibitions will continue during the entire period of the Exposition.

The next meeting of the British Association for the Advancement of the Sciences will be held at Newcastle, (England), from September 11th to 18th.

A Congress of Zoölogists will be held in Paris during the Exposition, in the month of August. Among the patrons as announced, appear the names of men of all nations.

On the shores of Lake Issik-Kul in Central Asia a monument is to be erected to the explorer Prjevalsky, after a design by Bilderling, his comrade. According to the *Invalide Russe* "the monument represents a picturesque rock 28 feet high, on the top of which is perched a large eagle, emblem of strength, intrepidity, and intelligence. The eagle grasps in its talons a map of Central Asia, the arena of the scientific exploits of the deceased, and in its beak an olive branch, symbol of the peaceful scientific conquests which Russia owes to Prjevalsky. On one side of the rock is a large bronze cross, between which is the inscription, 'Nicholas Mikhailovitch Prjevalsky, born 29th of March, 1839, died 20th of October, 1888.' In the interior of the rock is cut a spiral staircase crowned with an enlarged copy of the medal struck by the Academy of Sciences in 1887 in honor of Prjevalsky, and showing the original inscription: 'To the first explorer of Nature in Central Asia.'"

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ARBOREAL TADPOLES.

BY W. J. HOLLAND.[1]

ON the 20th of July, while engaged at Nikko in collecting entomological specimens, I entered a small field enclosed by a low stone wall near the banks of the Daiya-gawa in the lower part of Iri-machi, not far from the famous red bridge. The field had evidently once been used for growing tea, but had lain neglected for several years, and was partly overgrown by weeds and tangled bushes, among which were a good many willows some of them already twenty or more feet in height. While beating this growth for beetles I observed, pendant from the branches of a thrifty clump of willows, several objects which at first reminded me of hornets' nests save that they were of a light reddish color. They hung over a pool of stagnant water about twenty feet in diameter situated upon what I took to have formerly been the site of a house. A nearer inspection of these objects convinced me that they were not infested by aculeate insects and that in attempting to get at them I would not run any painful risk save that of being mired in the stagnant pool. I observed that one of the objects seemed to be in an apparently decomposing condition, saturated with moisture, and dropping to pieces. Long filaments of slimy froth-like matter were hanging from it, and clinging in streamers from the twigs of the trees just below. I also ob-

[1]Naturalist of the U. S. Eclipse Expedition to Japan, 1887. Extract from the Report of the Expedition made by Prof. D. P. Todd and presented by Prof. Simon Newcomb, at the meeting of the National Academy of Sciences, April 19, 1889.

served a great many black ants traveling out upon the willow twigs, and a few of them apparently entangled upon the surface of the mass which was falling to pieces. With some difficulty and with the help of a coolie, I succeeded in drawing the most perfect of these objects within reach, and by cutting the willow branches getting it entire to the ground.

I was quite confident that it was of insect origin and my curiosity to ascertain its nature and structure was great. I asked the coolie what it was. His reply was the usual "Wakarimasen," *Anglice* "don't know." The outer surface was dry and had the appearance of very thin brown wafer. At the places where the willow twigs passed in and out of the mass there were projecting points and at the apices of these in several instances there was an exudation of glairy matter, which had the appearance of very fine soap suds. All over the exterior were the bodies and wings of small insects which had evidently been entrapped in the mass when it had been soft. A few ants and flies were struggling in the bubbly, vesicular scum, which was freshest near one or two of the branches at their insertion into the mass, as I have described. Taking my pocket knife I opened the curious structure and found its interior to be composed of a mass of tough, glairy, froth, resembling the white of an egg that has been well beaten, but of a dirty, yellowish brown color. What, however, was my amazement to find scattered through it, and wriggling about hither and thither, a colony of tadpoles, of which I counted twenty-two. They were black in color with white bellies, exceedingly lively, and apparently, very much at home. Here and there in the mass were the remains of insects, principally legs and wings and the chitinous outer coverings of the abdominal and thoracic segments of black ants.

Having no means of preserving the tadpoles with me, as I had hastily gone to Nikko with Professor Todd, leaving my alcohol behind me at Tokio, I resolved to let the best of the remaining two nests remain until the morning of the 22d, when I resolved to secure it, and if possible take it with me to Tokio. I however took down the largest of the two remaining nests, which was already beginning to drop to pieces. In this were also a few tadpoles. A diligent search of the pool failed to reveal any tadpoles in its shallow, miry depths. The next day I revisited the spot. The nest I had designated for myself still remained undisturbed upon the branches, but was drenched with the passing showers. It rains at Nikko in July every day beginning about noon. I made a rough sketch of the object. The following day I repaired to the spot to get the nest, and also armed with a large jar kindly provided by Dr. Whitney, into which to put the tadpoles, and scum should it come to pieces. Unfortunately during the night the elements had made partial wreck of the coveted prize. It was broken in places and hanging down in wet streamers. I took a number of these with the enclosed tadpoles and put them into the jar. But soon they dried up. All that I had left to me was a mass of partly desiccated scum, with some dead tadpoles in it. I allowing this to dry out hard and in this state brought it home to America.

Upon examination I find that the tadpoles have been preserved in the mass in a highly desiccated condition. When alive they were about three quarters of an inch in length. In their dried form they are, it is needless to say, much smaller. By immersing in a mixture of glycerine and water, I have succeeded in partially restoring the form to one or two of them.

These with the bulk of the dried froth I have sent to Prof. Edw. D. Cope, of Philadelphia, who assures me that the phenomenon I have observed is one of much novelty.[1]

Chiromantis guineënsis is said to deposit its eggs upon the branches of trees on the margin of streams in Western Tropical Africa, surrounding them by a frothy, viscous mass of

[1]Since writing the above I have received a letter from Professor Cope, from which I make the following extract:

"The larvæ are different from those of terrestrial Batrachia in possessing a large hypoblastic yolk, the only approach to such condition having been describen in the Genus Alytes. Large yolks are reported in certain tree-frogs, and a few others, and it becomes interesting to know the type of frog which has laid these arboreal eggs. Professor J. A. Ryder to whom I submitted the dried eggs, says that the intercellular corpuscles have the truncate form usual in Batrachia."

matter, which is dissolved by the moisture in the rainy season when they become detached and drop into the water where they are hatched. A similar phenomenon has been observed in the case of one of the Hylidæ which has its habitat in Southern Brazil; but in neither case has it been observed that the eggs hatch while attached to the trees. In the case of the Japanese Batrachian it is plain that the hatching takes place upon the trees and the larva possibly undergoes some of its transformations in the nidus suspended among the branches. Whether the glairy mass is due to the swelling, under the action of the semi-tropical rains, of material deposited by the female at the time of oviposition I cannot tell. As against this view is the fact that the dried scum after prolonged soaking in water fails to regain its old vesicular, bubbly form. It may be that the froth is secreted by the bodies of the tadpoles themselves, or that both the tadpoles and the parent batrachian are concerned in its production The large quantity of the mass favors the latter view. The nests were fully a foot in diameter. The presence of dead insects in large numbers in the midst of the masses as well as adhering to its outside suggests that the tadpoles feed upon these.

I looked diligently for the adult batrachian in the vicinity, but failed to discover any frogs in the trees near by or in the pool. Later in the season the trees and bushes are fully alive in places with Hylidæ.

I trust some observer with better opportunities than I had in my brief and hurried visit to Nikko will solve the mysteries of the life history of these arboreal tadpoles.

EXPLANATION OF PLATE XVII.

Fig. 1. Section of nest one-third natural size, representing internal structure and position of tadpoles in the mass.

Fig. 2. Sketch presenting a view of the position of the tadpoles amidst the vesicles. (Enlarged.)

ACROSS THE SANTA BARBARA CHANNEL.

BY J. WALTER FEWKES.

(Concluded from the April Number.)

ON our return to the "Angel Dolly" we found that our cook had prepared a most delicious dinner on shore. We had roast leg of mutton, cooked on a spit, abalones fried and stewed, and coffee. The abalones we collected everywhere on the shore. The animal was cut out of its shell, pounded until tender in an Indian mortar, and then fried in batter. The taste of these animals, after our row in the open air, was fine, but it is doubtful whether we would have eaten the abalones with the same zest under any other circumstances. We ate our dinner under an overhanging roof of rock in a partially formed cave, the floor of which was the shingle of the beach of the cañon. I was reminded of the times when wild men did the same, probably in the same cave, as the abundant shell heaps and inscriptions show that they undoubtedly did. On the roof of the cave there was noticed a curious product of the erosion of the rock, such as I have never seen before. In the mass of conglomerate there is a pocket of grayish rock projecting from the surface and worn into cells, the edges of which stand out in sharp relief. These cells, not unlike honeycomb in form, are rounded, smooth, and several inches in diameter. The edges of the cells are sharp and smooth. The mode of formation of this curious pocket is not clear to me. It is a mass of rock several feet in width, and was formed on the roof of the overhanging conglomerate under which we ate our dinner.

In the afternoon we tried collecting on the black reef, which partially breaks the sea from Star Cañon on the east. I found the sea very high on the reef, but on the lee side a few good things were found. We noticed that the rocks on the seaward side were covered with mussels, among which were a few sea-urchins and beautiful starfishes. The bottoms of the pools in the reef were covered with Zoophytes which, when fully expanded, made them look like flower beds. Among them were several large Anemones of the genus Bunodes, and many Serpula. Many of the Actinians were over a foot in diameter when fully expanded. The rock which composes the reef is a black asphaltic formation, similar to the embedded rock of the conglomerate on the shore.

We returned to the "Angel Dolly," and found the cook had caught two large fishes known as Garibaldis, which with "craw-fish," Panulirus, were served for our supper on board the schooner.

The mainland of Santa Barbara looked dim in the distance as I walked the deck after supper, but the sky above us was clear, and I watched the evening star, Venus, sink below the top of Monte Diablo. It was a very beautiful sight. The air was calm, and there was but a slight swell on the surface of the Channel, which had an almost glassy calm. I was, however, tired out by my experiences, had a good night's rest preparatory to new exploration on the morrow.

On the next morning we concluded to take the "Angel Dolly" up to Prisoner's Harbor, several miles to the eastward of Star Cañon. I thought the best way for me to study the cliffs was to follow in a boat, letting the schooner work up under sail. This seemed more expedient, since the Harbor was exactly to the windward, and there seemed indications that the winds would be light. and perhaps it would be impossible to sail near the coast. The wind, however, freshened considerably after we started, and the "Angel Dolly" worked far ahead, standing out into the Channel. There was a heavy swell throwing high breakers on the cliffs.

Wherever we landed in our trip we were obliged to beach the boat through the breakers, and we were often plunged to our waists in water in landing. Just to the east of Star Cañon, after rounding the black ledge which was my collecting ground the day before, we coasted along past the "Indian Cemetery," from which many Indian remains have already been gathered, and in which many more are still buried. There seemed to be two separate regions of shell heaps, although the whole coast in this vicinity is white with the shells and debris of the camps of bygone times. In these burial grounds the individual graves were formerly indicated by the ribs or lower jawbones of whales set in the earth above them. None of these now exist, and these shell-heaps have long ago been dug into by eastern collectors. The shell-heaps were not wooded, but here and there are large patches of the prickly pear or "Tunis," and flocks of sheep now graze over the graves of the former lords of the island.

We continued our row past the Indian Cemetery to a natural archway, eroded by the sea, formed by a projecting cliff, on each side of which there is a deep cañon with precipitant cliffs on either side. The cliffs of these cañons are possibly 200 feet high, and so abrupt that they seem almost perpendicular. These natural archways rival in size the famous *Arco Naturale* of Capri, and are among the most instructive instances of erosion on the Californian coast. Of two fiords separated by the cliff of conglomerate, one which we may call Southeast Cañon has a long, narrow entrance, and is stopped up at its entrance by large boulders, which prevent access to the cañon. There is, however, a small, gravelly beach at the mouth of this cañon, upon which we landed. On the right, as we entered, there is a picturesque natural archway, with an old Indian fireplace perched upon it. There are a few pines and wild flowers growing from the crevices in the cliff. A buttress which divides the two fiords from each other is composed of conglomerate. On the right and left are slates in stratified masses, and red colored rocks, the conglomerate above the slates.

From these two cañons we made our way to Prisoner's Harbor, and after some difficulty boarded the "Angel Dolly," which came up soon after.

Without anchoring, for a considerable sea had arisen, we continued to the eastward of Prisoner's Harbor to a point opsite Chinese Harbor, and cast our anchor in smooth water near shore. The rocks at this place differ greatly fom those at Star Cañon. Here we find variegated formations forming white, chalk-like cliff much eroded, and very different from the black, asphaltic rocks of the region to the west of Prisoner's Harbor.

The hills about Chinese Harbor are white and red, and show marked terraces of elevation. At their base there is a continuous beach, made up of small stones and shingle. On the side of the cliff are many bushes, but no trees. The collecting on the beach gave me many mussels, abalones, and a few starfishes. The sea near the beach is turbid with sand, reminding me of the white water of the Florida Reefs.

The hills about Prisoner's Harbor were clothed with verdure. There is a good wharf, and near it the warehouse and a cluster of buildings belonging to the company which owns the island. The hills near the landing place are not as high as those at Star Cañon, and resemble those to the eastward. It is this formation which is mentioned in the meagre accounts which we have of the geology of the island of Santa Cruz.

At Prisoner's Harbor I collected many interesting animals, among which might be mentioned a huge Nudibranch, Chioræa, allied to Aplysia, many starfishes, sea-urchins, and molluscs. Here also I found the interesting Helix,[1] said to be peculiar to the island. One of the most interesting genera of Annelids collected on the rocks near the half-tide mark is the well known Sabellaria. Sabellaria on the Pacific coast builds a thick mass of sandy tubes cemented together, forming on the rocks an incrustation of great thickness. At Punta del Castillo near the end of the beach at Santa Barbara great masses of these colonial worm tubes can be seen, forming a honeycomb structure on the rocks left by every retreating tide. Each worm tube when left out of water is closed by a circular operculum which effectually blocks up the entrance, forming a kind of door to prevent possibly the egress of water. By this simple arrangement the animal can live for a long time out of the water. A most interesting method of casting off the excrementa is also illustrated in this worm. The operculum is situated at the cephalic extremity of the animal, and as the masses of tubes are crowded together, the posterior extremity of the animal is

[1] This species is rapidly being exterminated by the sheep, and in no short time will probably be extinct except in inaccessible cañons. Mr. Gulick records a like fate for certain Achatinellas peculiar to the Sandwich Islands.

brought to the blind ends of the tubes. There is, however, appended to this extremity a long tube, which, bending backward, opens near the open end of the case of sand. The vent of the animal is situated at the extremity of this tube and is thus brought to the surrounding water.

Encrusting the rocks in several places we also found a moist deposit of sand of one or two inches in thickness, also closely connected with an interesting habit of another and different group of marine animals. Bunodes, a common Actinian of the southern Californian coast covers itself with a coating of sand, and when the tide falls the animal contracts its tentacles, and nothing is to be seen but this sandy deposit, concealing the body of the Actinian. In this way the genus lives between successive rise and fall of the sea, shielded under its coating of sand for hours, enduring great changes of temperature and the lack of the pure sea water. Colonies of these Bunodes were found many feet above the low-water mark. They also are common on the rocks of the well known headland, Punta del Castillo, and can without difficulty be observed by anyone who will visit this locality at low or half tide.

The island of Santa Cruz, as pointed out by Mr. Greene, has a peculiar flora which has many species not found on the neighboring continent, and genera which are only found in lands widely distant from it. It has also a peculiar species cf Helix. In a word, although a continental island in its fauna and flora it reminds one of an oceanic island. Shall we interpret these facts by regarding it as a remnant of a continent or large body of land contiguous to California now submerged, or are other explanations to be sought? There is certainly not much to indicate an oceanic character to the Santa Barbara islands. Their peculiarity of flora can readily be explained by considering a change which has taken place in the climate of the mainland without affecting that of the islands. A change in the amount of moisture may have driven out the less hardy genera from the mainland, but left them still to survive on the islands. Moreover, a glacial period in California may have driven more hardy plants southward into a struggle with the less strong, in which the latter have succumbed. In a desiccation of the country the progress of the change would be less rapid on the island.

It seems to me that there is evidence that the island of Santa Cruz has lately been elevated out of the sea. This is the story of Ragged Mountain with its cleft summit, and of the elevated terraces to the west of Chinese Harbor. The deep cañons, however, show a much larger rainfall in the past when they were made than at present, and the enclosed asphaltic boulders standing out in the conglomerate are good indications of great erosion. The huge rocks blocking up the entrance to the cañons do not seem to have been brought there from the hilltops, but eroded by a mountain torrent on either side have simply dropped into the position which they now occupy. In most of these cañons the torrents which caused them have dwindled in size, although still large in the rainy season, while in many their beds are now dry during part of the year. If there ever was a glacial period on this island the tracks of it at present have been obliterated, or were not discovered in my superficial examination. There has been great erosion, but the boulders clinging to the worn side of the rock by one angle would seem to indicate that that erosion was by water rather than ice.

As we left Santa Cruz on our return trip we sailed through multitudes of a beautiful Velella, common in the channel at certain seasons of the year. These little blue sail-boats are often thrown up on the beach at Santa Barbara, and are common as far north as Monterey and San Francisco. Its northern limit is many miles north even of the limits of the state.

A curious little physophore, *Athorybia californica*[1] was also seen in the channel near Santa Cruz. This beautiful animal has never before been recorded from the Pacific waters of our west coast, although a similar genus has been described by the author from Key West and the Florida Keys.

The largest and most attractive of the Medusæ seen in my trip back was a mammoth Pelagia with mouth tentacles four feet long, and of a beautiful pink color. A lovely Hydromedusa,

1 An account of the anatomy of this physophore is given in the *Annals and Magazine of Natural History*.

polyorchis, is one of the most common jellyfishes in these waters.

Perhaps the most interesting of all the Medusan denizens of the fiords of Santa Cruz is a small Hydromedusa, not larger than a small pea, which has this remarkable character. In place of clusters of tentacles about the margin of the bell it has but a single tentacle placed at the point of junction of the radial tube and the circular vessel. This single tentacle is a short, stiff appendage, exactly similar to one of the four tentacles of Dipurena, a genus found at Newport, Rhode Island. It is, in fact, as if we had a Dipurena with three of the tentacles missing and a single one remaining. In this Californian genus, however, there is but one of these curious, club-shaped, stiff appendages. A similar genus has never been recorded; to this species I have given the name *Microcampana conica.* The most peculiar structural character is found in the number of radial vessels in this jellyfish. All similar Hydromedusæ have but four, eight, or more radial tubes. There are some which have six, which however are not related to Microcampana. This genus has six radial tubes. Moreover, there exists on the apex of the bell, as in our Stomatoca, a prominent prolongation or projection never seen in Dipurena, its nearest ally.

There are many other Hydromedusæ in these waters, a notice of which would prolong this account beyond its limits. A huge Sphaeronectes, with a bell a quarter of an inch in diameter, a genus never seen before on this or on the Atlantic coast of the United States, a beautiful Physophore, Diphyes, and a host of others[1] were found.

On the return trip to Santa Barbara we sailed through a most extraordinary region of the channel in which there is a submarine petroleum well. The surface for a considerable distance is covered with oil, which oozes up from sources below the water, and its odor is very marked. The oil probably comes from the upturned asphaltic strata deep below the sea.

Near the oil well we sent down our dredge and brought up a most interesting Polyzoan, an account of which I have al-

[1] A full description of these animals with figures will soon be published by me.

ready published in the January number of the *Annals and Magazine of Natural History.* This animal has a jointed stem and an oval zoœcium. When it first came on board I thought I had discovered a living Cystoid or Blastoid, as its shape was almost the same as that of some genera belonging to these types so familiar to the geologist, but now long extinct. In this, however, I was disappointed, although abundantly rewarded in finding a new genus of Polyozoa, Astrorhiza.

The dredge also brought up great masses of a Retepora, which is called coral by the sailors in this locality, and are sometimes larger than a man's head. Innumerable other lower animals people these depths.

A fair but light wind brought us back to the wharf of Santa Barbara early in the evening of the day we left Prisoner's Harbor. We heard the sound of the evening bells of the Mission Church come down the side of the mesa, and as we threw our anchor the bright electric light of the city welcomed us home. The next morning a haze covered the base of the island of the Holy Cross, out of which rose the peak of Ragged Mountain like a monster from the sea. As the day wore on the fog lifted, and the soft African haze which gives the great charm to Santa Barbara ocean scenery took its place and the form of the beautiful island came out in all its extent, its outlines softened by the distance, and its dark cañons alternating with projecting headlands indistinguishable over the stretch of water which separates it from the mainland. The same island stands out clear in the beautiful light, unchanged since Cabrillo sailed up the channel for the first time fifty years after Columbus discovered the New World.

THE VEGETATION OF HOT SPRINGS.

BY WALTER HARVEY WEED.

THE vegetation of hot waters, though lowly organized and composed of obscure forms, is of considerable interest to all students of Nature, since the plants occur in very highly heated and mineralized waters under conditions that are fatal to all other forms of life. The ability possessed by the vegetation found in such waters to withstand such extreme and adverse conditions of environment shows the possible existence of this form of life during the early history of our globe, when the crust of the earth is supposed to have been covered with hot and highly mineralized waters. Such plants may thus represent the earliest links in the chain of evolution.

While the mosses Hypnum and Sphagnum have been found in warm waters (90°–100° Fahr.), the vegetable life of hot water consists wholly of fresh water algæ. Such plants are usually less striking in appearance than the sea-weeds, but assume most curious and interesting forms when subjected to the peculiar conditions that prevail in hot springs.

It has long been known that algæ occur in hot waters, and the descriptions of hot springs given by travelers often contain allusions to the presence of bright green "confervæ" living in the hot pools and streams. Algæ are common also in the hot waste waters flowing from many mills, the brilliant green growths lining the conduits. Where the plants present in thermal waters are of this color, their vegetable nature seems to have been readily recognized; but there is good reason to believe that the existence of algæ of other colors, particularly the pink, yellow and red, forms so common in the Yellowstone waters, have been overlooked or mistaken for deposits of purely mineral matter. That such is the case is not at all surprising, for the plants often surround themselves with a hyaline gelatinous envelope, or are encrusted and hidden by mineral matter extracted from, or deposited by, the hot waters, and sometimes obscuring the plant growth so completely that the organic nature of the substance is scarcely recognizable even by an algologist. Thus the Beggiatoæ, the characteristic vegetation of sulphur springs, were long considered a lifeless organic slime. Their silky threads are often completely hidden by grains of sulphur, or entombed beneath a deposit of gypsum.

The vegetable life of hot calcareous waters is very often shrouded in carbonate of lime, the growing tips alone projecting out of the stony mass. In ferruginous and in siliceous waters the mineral matter of the waters obscures and hides the vegetable filaments. Unfortunately, those who have studied the flora of hot springs have rarely published sufficient detail concerning the habitat of the species described to enable one to follow up this interesting feature of the subject, while the algæ have been studied rather from a systematic than a broad biological standpoint.

In reviewing the literature bearing upon the subject, I have found that vegetable life is a common accompaniment of thermal springs, and as widely distributed as the springs themselves. At the noted warm springs of Carlsbad, where the algous life has been studied by several botanists, there is a great variety of species, but the limiting temperature appears to be 130° Fahr.[1]

Sir William Hooker[2] and Baring Gould[3] both mention the occurrence of crimson algæ in the hot geyser waters of Iceland, and Hochstetter[4] and other writers[5] describe slimy confervoid plants lining the bottoms of hot pools and streams in New Zealand, the highest temperature at which such growths have been observed being 153° Fahr.

In the hot springs of the Azores, Mosely found algæ growing in water whose temperature was between 149° Fahr. and 156° Fahr., and on areas splashed by almost boiling water. At the volcano of Camiguin no vegetation was found until the water had cooled down to 113.5° Fahr.[6] In the Himalayan hot springs Dr. Hooker found a luxuriant growth of Leptothrix at 168°Fahr. and below.[7] Several other references were

[1] Abhandl. Schles. Gesell. 1862. Heft II.

[2] Journal of a Tour in Iceland. Vol. 1., p. 160.

[3] Iceland: Its Scenes and Sagas.

[4] Reise der Oe Frigate Novara.

[5] Skey. Trans. N. Z. Inst. Vol. X., p. 433. Spencer. Trans. N. Z. Inst. Vol. XV., p. 302.

[6] Journ. Linn. Soc. (Botany.) Vol. XIV., p. 328.

[7] Himalayan Travels. Jos. Dalton Hooker. Vol. I., pp. 27, 379.

found proving the abundance of algæ in waters of 150° Fahr. or below. The highest temperature at which these growths have been found is that observed by Professor Brewer at Pluton Creek, California, where algæ were found at 200° Fahr.[1]

In the hot springs of Ischia no life was observed above 185° Fahr.,[2] and this appears to be the limiting temperature in the hot waters of the Yellowstone National Park.

A comparison of the species found in hot springs shows that they are limited to a few groups. Although the true Confervoideæ and the Protococcoideæ are represented in gatherings from hot waters, the Oscillatorieæ form the most characteristic vegetation of hot springs, species of Oscillaria and Hypheothrix being very common. *Hypheothrix laminosa* (a species variously known under a number of synonyms) has been found in New Zealand, Java, St. Paul, Camiguin, Iceland (?) and the Yellowstone Park, being very common at the last locality.

Desmids have been found in the hot waters of the Azores, three species of Pediastrum being described, and Corda figures and describes Desmids from the Carlsbad hot springs. The Diatomaceæ do not appear to be very abundant in hot waters. Dr. Jas. Blake found a number of species at 140° Fahr. in the hot springs of Nevada, and nine species were found by Berkeley in the gatherings from Thibet. They are comparatively rare in the Yellowstone gatherings from hot water, but very abundant in the cooled waters from the springs.

The examinations made by Mr. W. Archer of the gatherings of algæ from the hot springs of the Azores show that certain species were identical with forms common in cold surface waters in Great Britain. Prof. W. G. Farlow, of Harvard, who is studying a series of specimens collected by the writer from the hot waters of the Yellowstone Park, informs me that here also cold water forms are found, but modified by their conditions of environment. It is hoped the material in Professor

[1] Amer. Journ. Sci. (2.) XLVI., p. 31.

[2] Sachs, in *Flora*. 1864.

Farlow's hands will yield important information concerning the morphology of the species.

In a study of the hot springs and the geyser phenomena of the Yellowstone National Park, carried on in connection with my geological work in that region, I was surprised to find an abundant algous vegetation in the hot springs even at very high temperatures. It has been found by an examination of the hot springs of the region, of which nearly 3,500 have been individually and carefully noted, that algæ are almost universally present either in the springs themselves or in the streams flowing from them. The only exceptions to this are the mud bowls, and even here algæ are often found on the borders where kept moist by steam. This widespread occurrence implies that algæ can exist under a very great diversity of conditions. The springs examined differ greatly in the chemical composition of their waters, and include carbonated, calcareous and siliceous alkaline waters, and also those acid with hydrochloric or with sulphuric acids. The algæ also occur under equally diverse thermometric and hygrometric conditions; they have been found at all temperatures up to 185° Fahr., though from 160° to 185° they have thus far been observed only in running streams.

It is difficult to give a general description of the vegetable life of hot springs which shall be brief, and yet convey any idea of the beauty and the varied forms of these growths. The vegetation of the acid waters (with free HCl or H_2SO_4) is seldom a conspicuous feature of the springs. But in the alkaline waters that characterize the geyser basins, and in the carbonated, calcareous waters of the mammoth hot springs, the case is otherwise, and the red and yellow tints of the algæ combine with the weird whiteness of the sinter and the varied blue and green of the hot water to form a scene that is, without doubt, one of the most beautiful as well as one of the strangest sights in the world. Those who have been so fortunate as to have seen the hot water fountains of the Yellowstone will be sure to remember the delicate and charming tints that characterize the basins about Old Faithful and many other geysers of the upper basin, as well as the bright reds and yellows of Specimen Lake and the Orange Pool.

Early in the study which was made of these springs, it was noticed that the color of the vegetation was, in a degree, dependent upon, or related to, the temperature of the water. This is well illustrated by the occurrence of *Hypheothrix laminosa*, whose delicate filaments wave in the stream draining the Black Sand, where the following relation of color to temperature was observed:

White—185°.

Flesh pink—181°, becoming browner as the temperature falls.

Pale yellow—164°.

Yellow green—155°.

Emerald green—135°–140°.

Dark green—130°. These colors merging, of course, into one another, but being very prominent at the temperature given. Other growths are:

Orange—125°.

Red—110°.

Cedar brown—90°.

An examination of the growths forming the first series by Professor Farlow proves that the flesh-colored and white growth, occurring at 180°–185°, shows but traces of algæ filaments in amorphous matter. At 164° the structure was more decidedly filamentary and the color light yellow. The bright green forms at 155° were in a better condition for study, and the dark green filaments at 130° were in good condition. *Hypheothrix laminosa* probably attains its fullest and most perfect development in these waters between 130° and 155° Fahr.

In those clear bowls of hot but never boiling water called *laugs*, the algæ often form a leathery sheet lining the sides and bottom of the pools. Each sheet consists of a great number of thin, membranous layers aggregating one-fourth to one-half inch in thickness; the under layers are a rich tomato red, and the surface covered with a thin, incoherent fuzz of green, through which the red tint beneath shows and produces an olive tone.

The algæ tinting the hotter *laugs*, with temperatures of 140° to 160° Fahr., are bright yellow, and form a loose, velvety nap on the soft, siliceous sediment.

Where the overflow from a spring is constant in volume the channels are rapidly filled, choked and dammed back by masses of red and green algous jelly from one-half to five inches thick. This form of growth and the process of sinter formation has been already described elsewhere.[1] The channels carrying off the periodic discharge of the geysers are also brilliantly tinted by algæ, but modified by the deposit of silica. The channels of Old Faithful are a brilliant gamboge yellow near the geyser, merging into orange, which changes abruptly into brown, while farther away the growth is cedar red.

In these cases the plants form a thin, slippery coating upon the siliceous sinter, and is much encrusted by silica. Where from any cause the algæ growing in these channels are deprived of their supply of water, the siliceous jelly enveloping the growth is rapidly dried, and becomes hard, white and opaque, effectually concealing the algæ. Where channels are lined with a membranous growth, this shrivels up into curious convoluted forms, or into papyrus-like rolls. In fact, whatever the nature of the algæ present in the siliceous waters, all appearance of vegetable life is soon lost on drying, owing to the hardening of the silica. In calcareous waters the change is none the less complete, and the green or red growth rapidly bleaches out and becomes all but invisible to the casual observer in the deposit. The filaments may, however, be freed from the lime by the aid of acid.

[1] Amer. Journ. Sci. May, 1889.

PLATE XVIII.

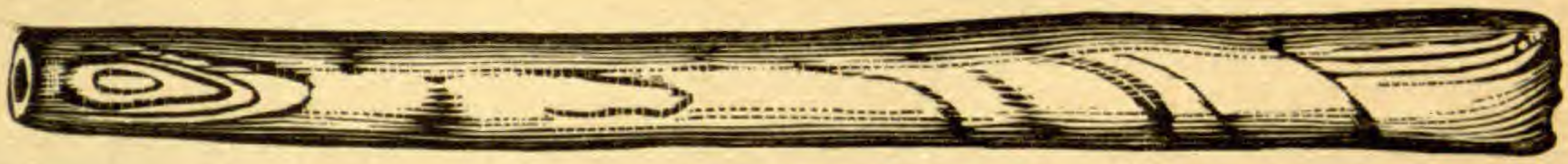

Fig. 1. Shell Bead.

Fig. 2. Bone Harpoon.

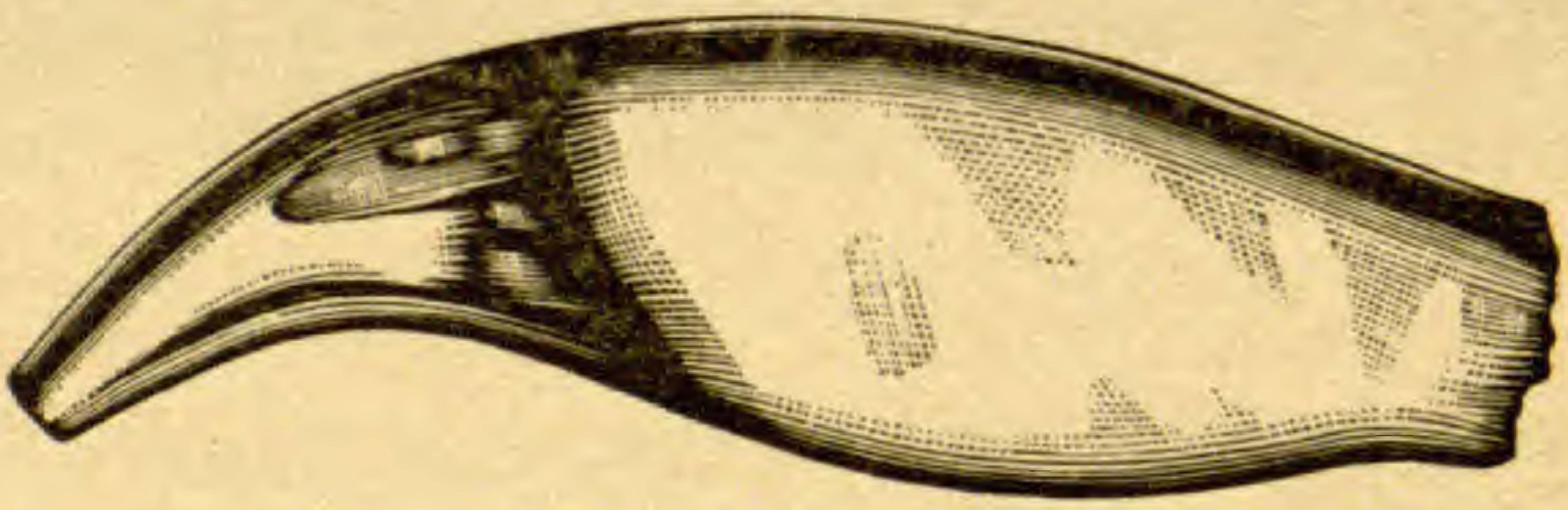

Fig. 3. Bear's Tooth.

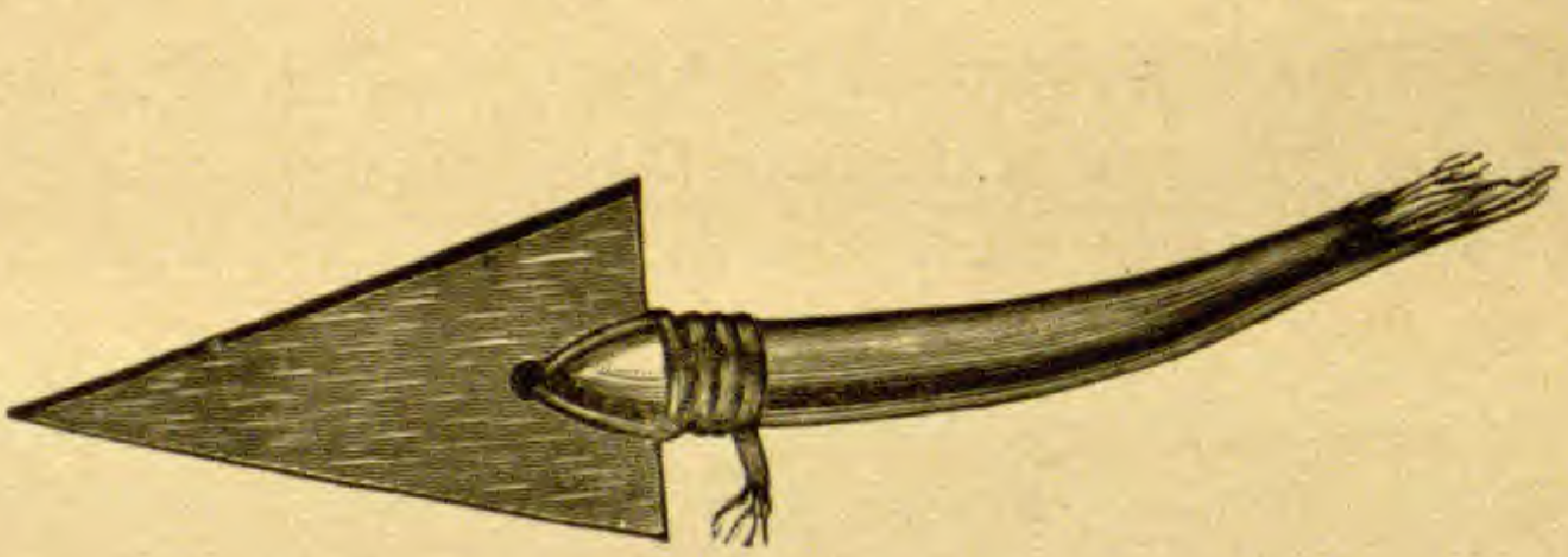

Fig. 4. Arrow-head.

CAYUGA INDIAN RELICS.

CAYUGA INDIAN RELICS.

BY W. M. BEAUCHAMP.[1]

I HAVE been much indebted to Mr. W. W. Adams, of Mapleton, Cayuga County, for valuable information regarding New York Iroquois sites, and for the opportunity of examining and figuring many fine and remarkable relics. Like some other parts of the Iroquois territory, the occupation of the country about Cayuga Lake, by settled inhabitants, seems very recent. There are a few old sites, but by far the larger part are of historic times. There are half a dozen early earthworks in the county, but most of them are distant from the lake. As in the country of the early Senecas, there is little earthenware, and that of a coarse kind, contrasting strongly with the abundant supply of the territory of the Onondagas and Mohawks. From history, traditions and remains, as well as language, it seems probable that the Cayugas and Senecas branched off from the parent stock at Lake Erie, perhaps on both sides; while the three eastern nations led the van on the north of Lake Ontario to the St. Lawrence, and thence passed southward to their later homes. Archæologists certainly have good reasons for such a belief.

There were travelers and early hunters and fishermen along Cayuga Lake, some of whom had small villages there for a time. A few left mica in graves, and lost some fine articles in the camps or by the wayside. Long shell beads were used by some, and as these have been found in recent graves as well, they form a link with the past. The wearers were probably the first true Cayugas. These long beads were formed from the columellæ of sea shells, and one is six and three-quarter inches long, while a number are but little less. Out of one

[1] Rev. W. M. Beauchamp has long been noted for his investigation of Indian archæology in Western New York. He is an indefatigable laborer, and his investigations have been of great benefit to the science. He is more disposed to observe and record facts than to develop theories. His last remark in the above paper is worthy of consideration. It has come to be a maxim in some parts of the world that prehistoric objects are to be found, not in number as they exist, but according to the number and diligence of their seekers.—T. W.

grave Mr. Adams took four which aggregated twenty-two inches, and six more formed a line of the same length. Fig. 1 is of the exact size of one of six taken from a grave last year. This grave contained a most curious assortment of articles, of which I will speak particularly before concluding. While smaller beads of this kind occur on historic sites, and very rarely on prehistoric villages, I know of none so large elsewhere in New York. The chiefs who wore them in their first splendor must have been proud of their ornaments.

While prehistoric shell beads of any kind are so rare through the old Iroquois territory of New York, the small council wampum, of course, is found only on later sites. The Five Nations had none of this before the coming of the Dutch. This is a fact now clearly established. There are other late beads of bone, stone, porcelain, glass, and discoid and oval shell beads. Sometimes mere shells of Melampus and Marginella have been strung, but never any fresh water univalves, as far as I know. The Venetian glass beads are often of many colors and intricate patterns, and sometimes of singular beauty. Some plainer glass beads are quite attractive also.

Ornaments of perforated red slate and pipestone belong also to the later sites, but most of those gathered by Mr. Adams now grace the cabinet of Mr. A. G. Richmond, of Canajoharie. A pretty little mask of Catlinite, smaller than a finger nail, came from a recent Cayuga grave. I have seen but one other as small, and that from an Onondaga site of A. D. 1700. Shell and bone ornaments include the familiar Iroquois forms of disks, crescents, fishes, and those to which we can hardly give a name. Combs came with the white man, but the Indian soon made for himself those of bone or horn, the top generally symmetrically arranged, as two men, two serpents, two birds. Fine examples of these have come from Cayuga sites—indeed, the best I have seen.

The bone harpoon, Fig. 2, is from a recent Cayuga grave, and most large harpoons that I have known are not old, say two hundred and fifty years or less. I have figured them from historic sites of the Onondagas and Mohawks besides.

This one is stained red, a rare feature, and it presents other peculiarities. A smaller slender and delicate harpoon was found near the lake shore, and I have seen none prettier. It has six barbs on either side, and seems much older than the one represented. The same form, but less delicate, occurs on the Seneca River.

Both copper and iron fish-hooks are met with, and sometimes the corroded metal has preserved the cord. None of bone or horn have appeared near Cayuga Lake, though several have been found in Onondaga and Jefferson Counties. Three or four prehistoric specimens, with barbs, have come to my notice. Among other Cayuga fishing implements are innumerable flat sinkers and perhaps the ovoid grooved stones. The former are of more general distribution than the latter.

Bears' teeth occur, as in other places. Fig. 3 is one of sixteen from the same grave. They were used much earlier, and often perforated for suspension. Human teeth I have found thus perforated. While examining an old Cayuga burial place, Mr. S. L. Frey, of Palatine Bridge, found an arrow made of a fossil shark's tooth, only altered by cutting slits to bind it to the shaft. A single glass bead, found at the same time, makes its age doubtful.

Stone arrow and spear-heads are in moderate numbers; scrapers and drills very rare, owing to the small number of early Cayuga sites, these being early implements. Some of the triangular arrows, made of sheet copper or brass, occur, generally with one or two perforations for binding the arrow, but sometimes with none. Fig. 4 shows one with part of the shaft remaining attached. They are of the same pattern as those found with the Fall River skeleton. Mr. Adams has also belts with copper tubes, suggesting those encircling the skeleton mentioned. Such arrows in Onondaga belong to the latter half of the seventeenth century. The copper age of the Five Nations lasted nearly a century, when they adopted silver for ornaments. During the earlier period of European contact they used copper wire bracelets, brooches and ear-rings, bronze rings, copper beads, and other articles. Of these Cayuga affords good examples, as well as the other cantons. Iron is found on all recent sites.

Good clay pipes have proved abundant near Cayuga Lake, and the ridge along the sides of the stems of many is an unusual feature. They present the common variety in form and ornament. Fig. 5 is called a wolf-totem pipe by Mr. Adams, who took it from a grave last spring. It is of the type common two hundred years ago. A little later the Indians reversed the arrangement of the head or ornament. A curious detached terra cotta Cayuga ornament represents a man's head with a pointed helmet. These detached ornaments are found in other parts of the Iroquois territory. Slender pewter and iron pipes are, rarer, but the former have quite a range. Stone pipes were little used by the Cayugas or their predecessors.

Figs. 6 and 7 Mr. Adams calls gambling flints. The larger one may be a frequent form of knife, or he may be correct in his name. The smaller one is quite likely to have had such a use. Had they shown signs of wear, I might have thought them Indian gun-flints; but there is no good reason for this, and their place in a chief's grave gives them some importance. They are not of the scraper form, and are too small for ordinary knives. Twenty-one occurred in one Cayuga grave, but I have found them singly in Onondaga County. They are neatly chipped, and suggest the bone, stone and clay counters once used, now represented by peach stones and deer buttons.

One curious article Mr. Adams has loaned me, which is probably old. The point of a flint arrow had been broken off, and below the fracture a deep indentation was neatly chipped, making the whole not unlike a rude fork. Like the concave or curved scrapers of Onondaga County, it may have been employed in forming arrow shafts, though not a true scraper like them.

Fig. 8 is of a horn implement, perhaps a punch for ornamenting pottery, though of rather a late date for that. This is a Cayuga form, but they are found on other sites of the middle of the seventeenth century. In a very old grave Mr. Adams found a slender marrow-bone, the central part shaved down into a long elliptical opening. The cavity was filled with paint, and a slender pestle for mixing paint almost closed the orifice. In this grave was a large piece of mica.

Some old burial places present curious features. In one spot an upper stratum of bones had been disturbed, but on removing a layer of soil two inches thick another would be found, and thus until the fourth bottom course was reached. Sometimes a single skeleton occupied one course, and then there might be three or four side by side. Ten or twelve would be the average in the successive burials, but in one case there were over twenty. One or more skeletons would have accompanying articles, and these were early burials.

Here is a curious and suggestive list of articles found in a Cayuga chief's grave last year by Mr. Adams: "Seventeen flints, 2 gun-flints, 6 bullets, 6 baldric beads, 1 bone harpoon, 3 buckhorn handles, 1 knife with buckhorn handle, 21 gambling flints, 3 bars of lead, 5 rubbing stones, 16 bears' tusks, 2 axes, 1 brass kettle, 2 pair shears, 4 pair bullet moulds, 2 gun-locks with flints, 47 pieces gun-locks, 2 iron shears, 32 knives and cutting implements, 1 gun, 1 pipe, 1 piece death paint (plumbago), 1 piece mica, 2 trigger guards, 1 wormer, 1 gun-cleaner, steel and 2 flints, a quantity of powder in a cloth bag, 2 melting ladles, 2,500 wampum beads." Each bar of lead weighed three pounds. The mica shows a modern as well as ancient use, and some other articles would elsewhere be thought old.

Of recent articles Mr. Adams has obtained a large number, and some of those of the Jesuit period are of much interest. Copper kettles prove much more frequent than vessels of clay, and many articles still used by the New York Indians occur. The valley of the Salmon Creek was once rich in remains, and accounts were published long ago of the large quantities of iron and brass taken thence to Auburn for sale. They were plowed up for a space of several miles in length along the bottom lands.

As in other cases, the Cayuga relics cannot all be classified, and some are found which are sufficiently puzzling. Among these are some of the ruder implements. These may be passed over now, but the foregoing account will show what may sometimes be done in a short time in a field supposed to have been exhausted.

DAYS AND NIGHTS BY THE SEA.[1]

BY FRANCIS H. HERRICK.

FOR one who has spent his life inland, a visit to the sea and especially to the tropical sea is an event to date from. The revelation of a new world awaits him. Strange forms innumerable meet him at every turn, and he soon comes to realize that the sea is the great home of life.

The simple outfit of thirty years ago is utterly inadequate for the student of nature of to-day who hopes to add anything of importance to our knowledge of the organic world. He needs not only good microscopes, drawing materials, ample aquaria and dredging apparatus, but a large assortment of chemical reagents, the uses of which in the preservation and study of living matter has almost revolutionized the science of biology.

Nearly all marine animals discharge their eggs into the water in vast numbers, and the young which are hatched from them, in most cases, lead an independent swimming life at the surface of the ocean. This locomotor larval period as it is called, may extend over weeks or months, and is shared by animals which in the adult state have the most diverse habits, such as the coral, the barnacle, and the mussel, which are firmly anchored to some solid support, the starfish and sea-urchin, the jellyfish and annelid, the crabs and prawns, the salpas and amphioxus; and also the fishes, the highest type of marine life which pass their early stages at the surface of the

[1] Part of a lecture delivered in the "University Lecture Concert Course," Jan. 31, 1889. Western Reserve University, Cleveland, Ohio.

PLATE XIX.

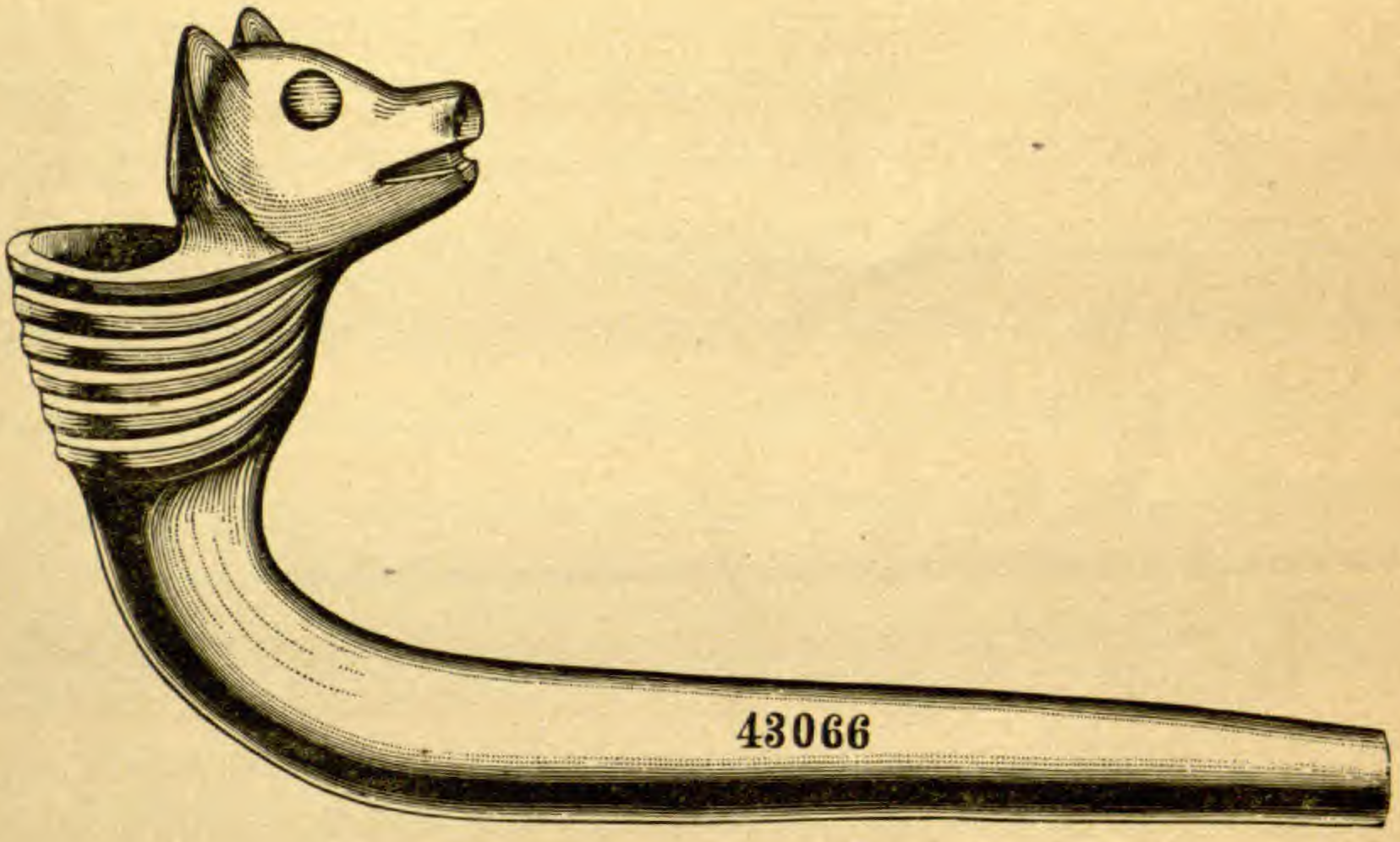

Fig. 5. Clay Pipe.

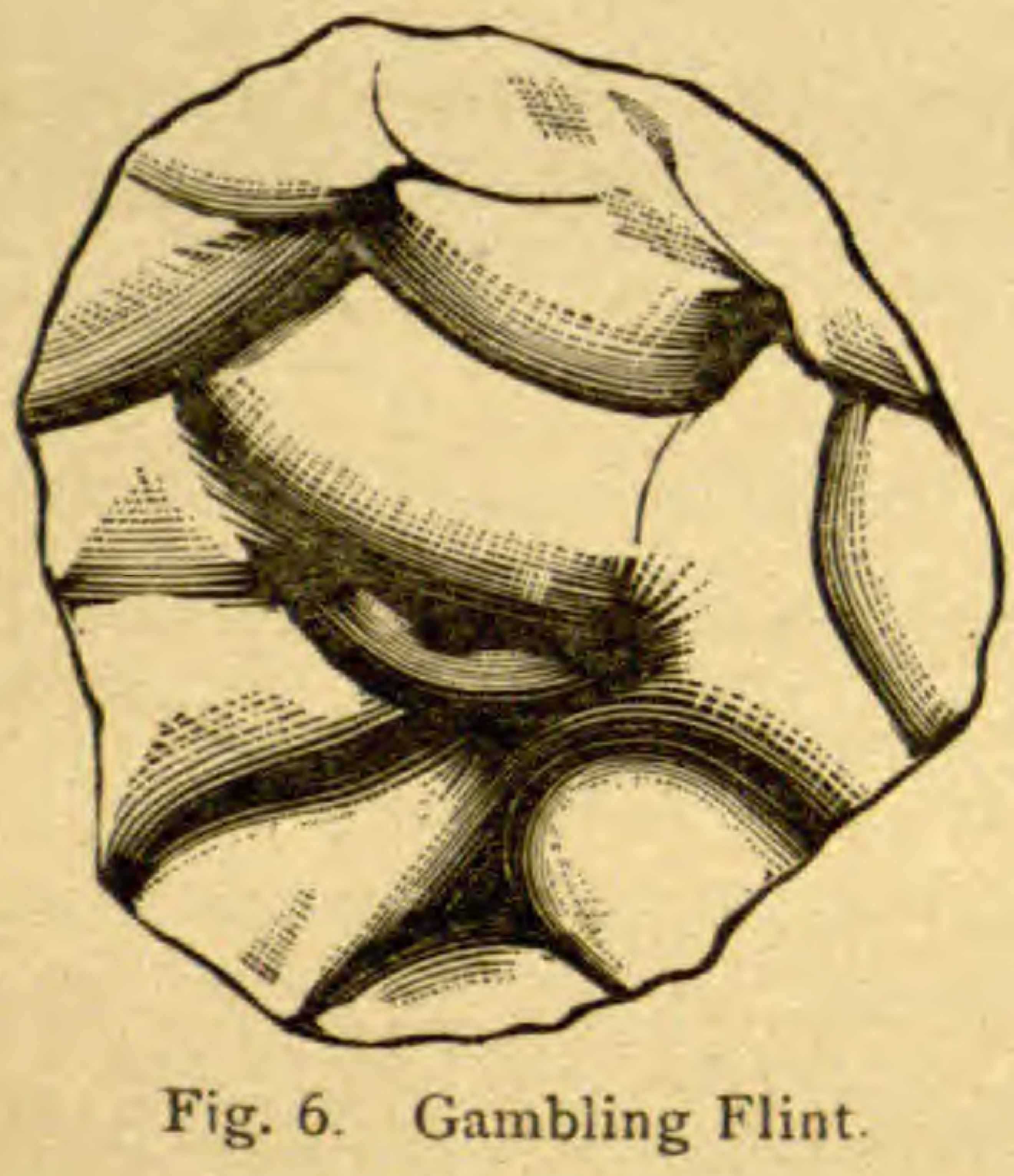

Fig. 6. Gambling Flint.

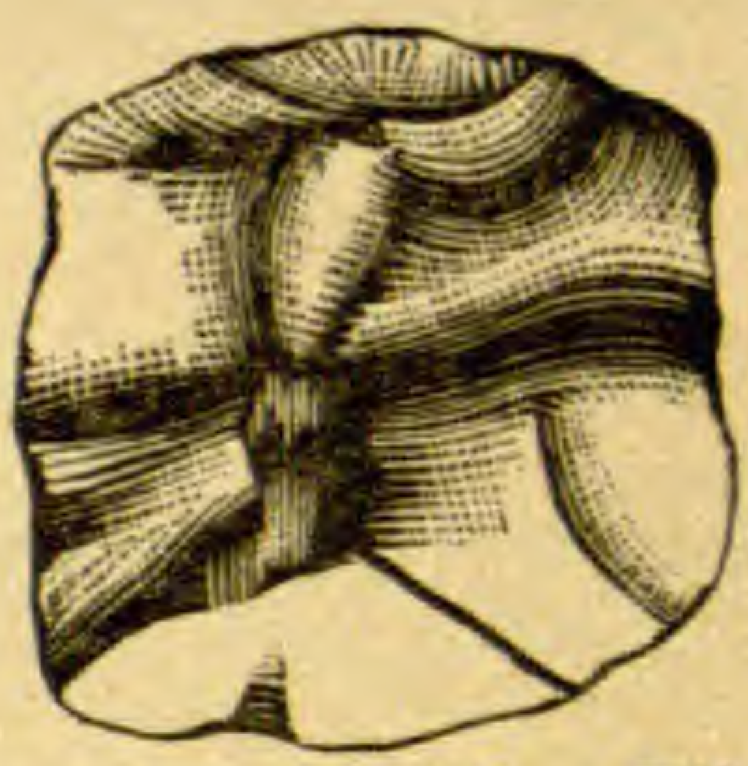

Fig. 7. Gambling Flint.

Fig. 8. Horn Implement.

CAYUGA INDIAN RELICS.

sea. The young of these and of a hundred other forms swarm in the surface water on still evenings, in countless myriads, the most delicate creatures, many of them as transparent as glass, and so small that it requires a microscope to see them. After passing through metamorphoses more wonderful than any described in the tales of Ovid, the remnant of this host which nature allows to live, takes on adult characters. The young crab or prawn after having gone by several aliases, and played as many distinct roles, sheds it skin once more, sinks to the bottom and except in point of size is indistinguishable from an adult. One would hardly have guessed that a larva like that of the mollusc with its enormous locomotory sails, and its delicate fringes of cilia, would ever develop into a sedentary slow-moving gastropod, or that the grotesque microscopic larva, shaped like a painter's easel, would ever turn into into a symmetrical starfish with its five horizontal rays.

If one spends a few hours in the gulf stream on a calm day or night, he cannot fail to be impressed by that vast stratum of living beings, which this great ocean current bears hourly upon its bosom. Once when off our southern coast, we sailed through a school of medusæ which must have covered many square miles of ocean. They were little brown bells, the size of thimbles, and the indigo water was peppered with them. We encountered them at about four o'clock in the afternoon and for more than an hour their numbers did not sensibly diminish. But at night the dark waters glow with the phosphorescence of those minute and obscure beings whose presence one would not suspect by day unless he had microscopic eyes. Through every mile that the ship ploughs her way, her bow encounters a steady stream of shooting stars. Every movement in this living water precipitates a shower of sparks, and every spark is due to an organism. There are stars of the first magnitude, like the large medusæ glowing like red-hot cannon balls, besides a whole galaxy of lesser lights.

Much of the time of a naturalist at the seaside is spent in the collection and study of these pelagic larvæ and the adult forms which they represent. A calm summer's evening when not a ripple breaks the mirror of the surface, is best for this purpose. With a companion to take turns at rowing, or to hold the net, we glide off in the darkness to some point where a distinct current sets, or better still where two currents meet, for in such places pelagic larvæ are most abundant. The apparatus for "surface collecting" as it is called, is simple enough. It consists of a tow net made of bolting cloth or coarsely woven silk, through the meshes of which the microscopic animals cannot pass, and a bucket of sea water. The net is put out and allowed to skim the surface as the boat moves slowly through the water. If the place and time are very favorable the net soon begins to glow, as if made of platinum gauze, heated white hot, and at short intervals it is cautiously raised to the boat, and the sparks are washed off into a bucket of sea water, and the process repeated. After returning to the laboratory, the water containing the evening's catch is carefully examined by each student, who selects and preserves those particular organisms which he happens to be at work upon at the time.

If a tall beaker of this water is dipped from the bucket and held up to the light we may behold a most remarkable and fascinating sight. Every drop is teeming with life. The myrmidons of the deep are here. The young of almost every type of marine life has a representative in our glass, but so disguised are many in their undeveloped state that only the specialist may recognize them. They vary in size from half an inch long down to microscopic proportions. Some are adults. There are innumerable larvæ of crustacea, of grotesque shapes, moving with quick jerks; some with the body stuck full of spines, or with a huge straight spear growing out of the forehead; glass-like Ctenophoræ reeling through the water, propelled by encircling bands of irridescent cilia; veliger mollusks floating with sails wide spread; bead-like larvæ of annelids, which swim with rapid rotatory movement: the colorless eggs and quaint fish embryos, whose large black eyes and enormous golden yellow yolk sacs, attract the eye while their transparent body is hardly visible; the pulsating bells of ghost-like jelly-fish, rising and falling as they deliberately contract and expand their discs; the floating Siphonophoræ transparent as the air and delicate as spun glass. In the turmoil of the moment a thousand strangely beautiful forms pass rapidly before the eye.

The larvæ selected for study are carefully set aside in beakers of sea water, or in watch glasses, and it is sometimes possible to keep them alive for a number of days, and observe their transformations, but usually unless there is means of providing them with freshly aërated sea-water, this is not possible. Some forms are so delicate that one is hardly able to bring them in alive. They die as soon as caught.

Where it can be done, by far the most satisfactory method of studying the development or life history of an animal is to procure the adults and keep them under observation until they deposit their eggs. The development of the ova can then be studied with the closest detail, not only by the superficial view of the growing embryo, but by means of the sectional method which has yielded such valuable results to natural science in the past ten years.

In the case of many animals, such as fishes, "king crabs," oysters, starfish, and sea urchins, where the sexes are separate, the ripe eggs can be obtained and fertilized artificially, and the complex processes by which the highly organized fish or mollusc is slowly built up by changes which start in the germ cells, can be witnessed in all their details. Animals differ very widely in this respect however, and the vitality of the ova is connected in some cases certainly with that of the animals themselves. Starfish or Ophiurans may be sadly mutilated without killing them, and some of the molluscs are notoriously hardy. A year and a half ago I brought from the West Indies a collection of marine shells, gathered in the water or on the coral rocks on shore. They were done up in a package and sent with other collections to my home in New Hampshire. The next fall when the bundle was opened, much to my surprise a number of the univalves (*Tectarius muricatus*), were alive and crawling about. In one of our eastern colleges, some molluscs brought from the Holy Land were placed in the college collection and duly labelled, when some of them exhibited their vitality by walking off the museum cards.

The "Horseshoe," or King Crab which anyone who goes to the Atlantic seaboard can usually find on any sand-flat, is an animal remarkable not only for its great antiquity, but for its extreme hardiness which is perhaps one cause of its great age. They are found fossil in the primary rocks, in the Cambrian and Silurian formations, and therefore excepting the Foraminifera, they are among the oldest animals known. The related trilobite has perished utterly, and a whole army of other forms, but the King Crab has existed during all these ages and has altered but little; hence we must infer that their conditions of life have been nearly uniform during this immense period. When the embryology of this animal was being studied at the Marine Laboratory of the John Hopkin's University at Beaufort, N. C., a few years ago, an attempt was made to fertilize the eggs artificially. As the ova did not at first show any of the usual signs of development, but began to swell as if undergoing decomposition, they were set aside and forgotten. In about 3 weeks from this time the dish was examined by chance, when it was seen that the young king-crabs were just leaving the shell, notwithstanding the fact that the water in which they had lived was impure, and had nearly evaporated. The following anecdote which illustrates what the adult King Crab can stand, I heard from Professor Brooks of the Johns Hopkins University. While he was studying with Louis Agassiz at Cambridge, Milne-Edwards, the renowned French naturalist sent to this country for some specimens of the American King Crab, on which he was then preparing his well known monograph. The animals as soon as captured were taken to the Cambridge laboratory and thrown under a building, where they remained some weeks, exposed to a low temperature. They were then packed up and sent abroad, and when they reached Paris, some of them were still alive. It is interesting to notice that this animal is not a Crab at all, nor indeed a Crustacean, as the recent study of its development has most certainly shown. It is more nearly related to the Spiders.

The case is very different with the ova of many other animals, for instance the eggs of prawns such as the Lobster and the Shrimp. They are not discharged into the sea, and left to take their chances with enemies, but are attached to the body of the animal which carries them about until they hatch. In most cases they are fastened by fine threads of glue to the swimming legs, and as the constant motion of these appendages is shared by the eggs, the latter are always well aërated. If the ova are removed from the animal, they invariably die.

Some Crustacea (like the Stomatopods) lay their eggs in masses in burrows in the sand or in coral rocks, and if they are removed and placed in an aquarium, they also die. But if the habits of these animals are studied, it is found that either the male or female is always brooding over the eggs and fanning them with its legs, thus supplying the needed aëration by the currents of water set up. This process of supplying the necessary oxygen is seen in fish-hatching houses, where the eggs are laid upon shallow trays, over which a stream of water is constantly passing.

The eggs of animals like the Corals and Sea-fans can be easily obtained in the breeding season, by placing a colony of the polyps, like a piece of living coral, in a glass dish or aquarium. The minute spherical eggs or young will be discharged through the mouths of the polyps and float to the surface, when they can be skimmed off, transferred to other dishes and their development watched. With the modern appliances and methods of research, the naturalist of to-day can investigate the problems of animal life with far better success than was possible a generation ago. How is the life history of an animal written? How do we trace the numerous links in the chain of events between the one-called, apparently homogeneous egg, to the highly complex animal which produces the egg? To answer this question very briefly we may conveniently select the shrimp, although we might choose equally well a fish, a sea-urchin or a coral.

It is well known that the eggs of the higher animals, the mammals, are few in number, and that when fertilized, they are not discharged, but remain and develop in the body of the parent. Partly for this reason the embryology of the higher forms is much more difficult, but the eggs of the lower animals, like Crustacea, Corals and Starfishes, are deposited in very great numbers. The number of eggs laid by the edible Crab (*Neptunus hastatus*) of the Southern States, for instance, is estimated at 4½ millions. The eggs are not only passed out of the body, but in many cases develop quite independently of the parent. Consequently a store of food called *yolk*, is laid up in the egg, as we see in the hen's egg, for the use of the growing embryo.

We start with the fertilized germ cell the egg, although it should be remembered that there is a long series of events before this is reached. The germinal cell itself is derived from other cells in the tissues of the mother and the tissues which compose the body, are themselves derived from the egg, and this cycle is repeated generation after generation. The male germinal cell, which in fertilization unites with the ovum, has a similar origin, so that the egg, from which the animal springs is not as simple a structure as one might suppose, but a microcosm in itself, containing as it must the hereditary germs of a long and complex line of ancestors.

As a rule an egg does not develop unless it unites with another kind of cell, called the male germinal cell. This rule is however violated, in the case of the parthenogenetic insects, the Gall-wasps, Bees and Moths, and in some Crustacea, where the eggs develop without fertilization, and where the males are sometimes wanting.

The egg of the shrimp, like that of the hen or tortoise consists of a large mass of food-yolk, surrounding the more essential part of the cell,—the nucleus, as it is called, the whole being enveloped by a protective membrane, the shell. Beginning then with the single egg-cell (which, if fertilized, is of course duplex in nature,) the animal is slowly developed by the division and differentiation of its products. The nucleus and sometimes the whole egg with it, divides into 2, 4, 8, 16 parts in geometrical ratio. The resulting cells however do not separate as in the lowest forms of life, but remain united, and do not long continue alike but become differentiated. A very complex physiological division of labor is finally established among them, and when the adult condition is reached, the body is a colony of probably many million of cells, constituting various tissues and organs, all of which work correlatively and harmoniously for the good of the whole. The adult healthy body may thus be compared to an ideal state, where the cells represent individuals or individual minds, all of which have the same faculties, although developed in different degrees. Yet all these subordinate units work together in a wonderful way for the good of a higher unit, the body or state. As the state has its executive and police officers to guard its interests and enforce obedience to its laws, so the body has the nerve cells of the nervous system, which in health regulate and coördinate the working of all the other organs.

This fundamental conception of living things, known as the Cell Theory, was announced 50 years ago. It is no longer a theory but a fact, and from it every problem in biology must proceed.

How then is it possible to follow these delicate and intricate processes by which the complex cell-state or community, which we call the animal, is developed from the egg? The changes are chiefly internal, while the eggs, which are usually of microscopic size, are frequently opaque, and the protoplasm or living matter of the cells themselves, is colorless. Difficulties such as these, however insurmountable they may have been a generation ago, have been completely overcome, and it is now an easy task to divide an egg, which we will say is 1-25 of an inch in diameter, or the size of a pin's head, into a series of 100 sections, each 1-2500 of an inch in thickness. These may then be placed in serial order on a strip of glass, and each of the 100 sections, which can now be studied with high powers of the microscope, is seen to be a picture in color, which plainly tells of the marvellous processes which have been going on unseen in the colorless living protoplasm of the cells.

The eggs of our Shrimp are taken at short intervals during several days or weeks, so that the series will represent the whole history of growth from the egg to the young prawn. The ova are then killed and hardened by suitable reagents, and finally preserved in alcohol. They are then stained with certain dyes like carmine, hæmotoxylon, or osmic acid (which both kills, hardens, and stains protoplasm at the same time). A great step was taken in modern biology (and especially embryology) when it was discovered that protoplasm has such a remarkable affinity for the aniline and vegetable dyes. The colorless and invisible can be made to yield the secret of hidden change in colored pictures. Furthermore it is probable that certain kinds of protoplasm, or protoplasm in certain stages combines only with particular dyes.

The stained eggs are then saturated with paraffine and embedded in a block of this substance. The paraffin block is clamped in the holder of a microtome, an instrument for cutting very thin sections, and then, thanks to the property of the paraffine, each section, as soon as cut by the passage of the knife, adheres by its edge to the section following, so that a paraffine ribbon can be cut, a yard long if necessary, in which the embedded egg will now appear in the form of a series of very thin colored sections, arranged in serial order. It is then a simple matter to fix them upon a glass slide, to remove the paraffin, and to seal the whole in a drop of balsam. Thus may we bring out the hidden writing and read the secret manuscript.

We have not the time to follow in any detail the life history of an animal like the Shrimp, however interesting it might be, to see how from the simpler the complex arises, how the adult with its tissues and organs each so remarkable and often complicated in itself, arises from comparatively simple beginnings, and how the individual in its own life history repeats in an abbreviated and modified form, the history of the race. But we do well if we realize this wonder of wonders, the development of the higher animal with its marvellous organs, the eye, the heart and brain from the egg cell. If the eye or the brain is complicated, what must we say of this unicellular germ, the egg, in which in large measure certainly, the adult structure must potentially exist.

Some may think that since the young of different animals are subjected to peculiar conditions, to varying climate, food and the like, their differences in structure may be influenced by their surroundings. But this objection is easily answered, for we can rear the eggs of such diverse forms as the fish, the sea urchin, and the oyster in the same tumbler of water, where the conditions are identical. We are thus brought face to face with the great problem of *heredity*, that is, the law by which all living things tend to resemble the parents from which they sprung, or some ancestor belonging to their immediate race, in spite of variability or adaptation to environment. That the coral polyp reaches a certain stage of development and stops, that the starfish travels by this same road but advances far beyond, the young always coming to resemble the adult; that the higher animals pass still farther along this path; that the child resembles its parents often to a trick of speech or to a shade of mental or moral character, or that sometimes the character of a preceding generation makes its appearance, is one of the most remarkable phenomena which man has observed. Marvellous as it is, it seems not to be inscrutable, and the studies of recent years are lightening its dark passages.

It may be asked, of what use is the knowledge of the structure and development of animals below man. The chief aim in natural science is to discover relations. The life history of a coral is valuable for the light it throws on the problem of all organic life. The great laws governing all living matter are the same. We can only read the complex through the simple. The lower we pass in the scale of animal and plant life, the simpler the structure, the more nearly are the problems reduced to lowest terms.

The most interesting object in nature is man, and apart from the high claims of pure science, of knowledge for its own merit, our studies naturally come to a focus in man. The history, the welfare and the destiny of man are questions which interest all civilized people.

Biology or the natural history of living things deals with the phenomena of organic nature, and to man, its central figure it constantly returns. Morphology, the study of structure, physiology the study of function, pathology the study of disease, and medicine the study of treatment go hand in hand, and are mutually dependent. We sometimes hear well meaning though misinformed persons speak of naturalists who spend laborious years of travel and devote their lives to research as if they were bitten with the mania of discovering new species. This is, of course, a great mistake. The history of every science begins with the naming of things, but this day is long past, and as Agassiz said in one of his cabin lectures when on his way to Brazil in 1865: "This is now almost the lowest kind of scientific work." . . . . "The work of the naturalist, in our day, is to explore worlds the existence of which is already known; to investigate not to discover." . . . . "The discovery of a new species as such, does not change a feature in the science of natural history, any more than the discovery of a new asteriod changes the character of the problems to be investigated by astronomers. It is merely adding to the enumeration of objects. We should rather look for the fundamental relations among animals; the number of species we may find is of importance only so far as they explain the distribution and limitation of different genera and families, their relations to each other and to the world under which they live. Out of such investigations there looms up a deeper question for scientific men, the solution of which is to be the most important result of their work in coming generations. The origin of life is the great question of the day. How did the organic world come to be as it is?"

A generation has passed since these words were uttered, yet how true they still read! Much indeed has been accomplished in this period; the horizon of all science has widened. The germ theory of infectious disease has become a science and is now revolutionizing the practice of medicine and surgery. Says a well-known physician "Looking into the future in the light of recent discoveries, it does not seem impossible that a time may came when the cause of every infectious disease will be known." . . . . "What has been accomplished within the past ten years as regards knowledge of the causes, prevention, and treatment of disease far transcends what would have been regarded a quarter of a century ago as the wildest and most impossible speculation." Embryology has been enriched by the discovery of new means of research. Some of the best work in physiology has been done. Darwin's theory of the origin of species has been tested as a working hypothesis, and been found fruitful in valuable results. The work of the naturalist by its application to the economic industries of the nation can appeal to all classes. The service of the Fish Commission and of the Entomological Bureau annually save the country from great losses, and add to its resources. Our valuable food fishes are artificially raised, and the depleted pond, river or sea coast can be stocked anew. The oyster can now be reared from eggs artificially fertilized, and the young lobster has this last year been safely transported across the continent, and planted on the shores of the wide Pacific.

But the study of nature has another and less serious side, and here I refer to out-door nature as well as to in-door pursuits. It adds pleasure to life. It gives a zest and object to every walk or ride which one takes in the open air, to every camping and hunting excursion to the woods. It lengthens life, or what is the same thing, our experience, because we see just so much more of this beautiful world. Many people think that science is not only difficult but dry. This is a sad mistake. The scientific treatises which Charles Lamb would class with books that are *not* book, may be tedious to the beginner, but the student is not restricted to these or to the musty folios of the past, in making his acquaintance with animal and plant life. Technical works are not intended to be read but, like dictionaries, they are useful to consult.

"Botany," says Sir John Lubbock, "is by many regarded as a dry science. Yet without it one may admire flowers and trees as one may admire a great man or a beautiful woman whom one meets in a crowd; but it is as a stranger. The botanist" or "one with even the slightest knowledge of that delightful science—when he goes out into the woods or into one of those fairy forests which we call fields, finds himself welcomed by a glad company of friends, every one with something interesting to tell."

The faculty of observation, so preternaturally acute in some minds like Aristotle's or Humboldt's or Darwin's, is rudimentary or dormant in a very large part of mankind. Said Emerson "if men should see the stars but once in a thousand years how would they wonder and believe!" The cheapness of the pleasure may be fatal to its enjoyment. They see only the mud and soot, where the gold and the diamond lie. They have eyes but do not use them, and like Laura Bridgman are cut off from many of the enjoyments of nature. As Lubbock well says, many still "love birds as boys do—that is, they love throwing stones at them; or wonder if they are good to eat, as the Esquimaux asked of the watch; or treat them as certain devout Afreedee villagers are said to have treated a descendant of the Prophet—killed him in order to worship at his tomb."

The study of Natural History, or Biology, if we use the newer term not only awakens the mind by cultivating the faculty of observation, but widens our enjoyments and enlists our sympathies, giving us a new and human interest in the manifold living beings around us which hold life by the same tenure as ourselves. It also fits in well with those instincts which we seem to have inherited from primitive man, with hunting and fishing, and also with travel, the facilities for which were never greater than in our day, and with short vacations in the country, all of which it enhances in interest, and to all of which it insures success.

Says T. Digby Pigott, "Of all the poor creatures, whose fate it was to be strangled or battered to death by Hercules, there was only one who made a really good stand up fight, and at one time seemed to be fairly beating him. He was Antaeus, the son of the earth. Every time that he fell and touched his mother—we should say 'ran out to the country'—he came up again with fighting powers renewed. It was not till Hercules found out his secret and held him up, never letting him fall—we should say 'stopped his Saturdays till Mondays out of town'—that he quite broke him down. It is a myth in which the wisdom of the ancients is written for our admonition, in whom the ends of the world have come, the lesson that the best cure for a tired head and irritable nerves is the touch of Mother Nature,—to escape from the din of the city, and the everlasting cry of 'extra specials,' and lose oneself if only for a day among the wild creation."

The life and structure of the simplest animal or plant is a marvel, the greatness of which we are utterly incapable to conceive, and one of the plainest teachings of everyday science is that mere *size* is no test of importance. One might suppose that the microscopic cell was too small to be taken into account at all and to spend days and nights in the study of such objects must be a stupid sort of amusement: But an Elephant is only an aggregate of these little cells, and the nefarious microbe or floating spore, so small that it takes the highest powers of the best microscopes to clearly discern it, and so light that it floats in myriads on the wings of the viewless air, it is also a cell, and unfortunatly for man, when breathed into his lungs may be capable of multiplying indefinitely, and producing terrible disease and death. The coral polyp, insignificant enough when contemplated singly, is able to girdle the globe, only give it the time and favorable conditions. The leaven however small, which is hid in the meal, will in due time leaven the whole lump.

The mountains were not upheaved in a day. The hills have been carried by the touch of the rain-drop, and the flow of the ice stream and river. The smallest fragment of coral rock, which is among the youngest of modern formations, is but a phase in the endless cycles through which all matter runs. The rain united with the carbonic acid of the earth and air divides the solid rock, and the rivers from the four corners of the earth carry down the molecules of lime in a ceaseless current with the common sea, where says Dana "after circulating over thousands of miles and for unknown times, they are brought to light and rendered tangible again by the incessant labors of millions of minute living gelatinous bodies, and by these insignificant organisms the lime is built up again into masses almost rivalling the original in dimensions and importance, but losing in this, its new dress, all traces of its divine origin and divine age." Thus he says, "we may have rocks from the snow-covered summits of the Himalayas, the limestones of the burning plains of India, and the strata of inaccessible China, removed from their respective districts—into the great common receptacle."

Modern science teaches that the small has produced the great, that the earth as we now know it has been fashioned by forces which are in operation to-day. The small indeed may be the most significant, and size in the vocabulary of biology at least may be an unimportant term.

SOLENISCUS: ITS GENERIC CHARACTERS AND RELATIONS.

BY CHARLES R. KEYES.

THE genus Soleniscus was established by Meek and Worthen to include gastropod shells closely allied to the widely known Macrocheilus; and said to be distinguished from the latter chiefly by the presence of a single elevated fold on the columella and by being produced anteriorly into a short canal. The authors described under this genus but a single species—*S. typicus*. Miller,[1] however, in 1877, included also *Macrocheilus hallanus* Geinitz. Four years later White[2] described from New Mexico *S. planus* and *S. brevis*; and afterwards[3] referred to the genus five other species which had orig-

[1] Am. Palæ. Foss., p. 162.

[2] Exp. and Sur. west 100th Merid., Supp. to Vol. iii.

[3] Ind. Geol. Rep. for 1883.

inally been placed under Macrocheilus. Upon the characters mentioned, principally, Macrocheilus and Soleniscus have been separated. The former was considered to embrace all the Devonian and a few of the Carboniferous forms described under the genus; and the latter the majority of the American Carboniferous species, generally known under the other generic title.

Of Macrocheilus there have been described from Europe nearly fifty species; two-fifths of which are from the Devonian. From America thirty-four species have been named; of these five are from the Devonian, three from the Lower Carboniferous and the rest from the Coal Measures. The American Devonian forms are exceedingly rare; and nothing beyond the original descriptions is known in regard to them. With one exception, they have been, in all probability, erroneously referred to the genus. The species described from the Carboniferous of North America will doubtless be reduced, after a careful comparison, to one-half the number now recognized.

Macrocheilus was founded by Phillips[1] in 1841, and under it were enumerated *Buccinum breve* Sow., *B. imbricatum* Phillips, *B. acutum* Sowerby and three other species. Phillips, however, expressly remarked that the first two of these properly belong to other groups, and that he regarded the third form as more typical. *B. acutum* Sow. hence becomes the type of the genus; and was thus considered by de Koninck and other European writers. An examination of numerous specimens of *Macrocheilus* (*Buccinum*) *acutum* shows that the shell possesses a more or less thickened lip, and a prominent revolving fold on the columella. De Koninck[2] long ago recognized this fact, stating that "La columelle est garnie d'un pli oblique et quelquefois de deux; le second pli n'est que faiblement exprimé et ne s'observe bien que dans les échantillons d'une conservation parfaite." It thus appears that the form described as *Buccinum acutum* by Sowerby is in all respects a typical Soleniscus and that therefore that genus and Macrocheilus are identical.

[1] Palæ. Foss. Cornwall, p. 103.

[2] Desc. des Anim. Foss. de Belgique, p. 474. 1844.

But Phillip's term Macrocheilus was preoccupied by Hope, in 1838, for a genus of insects and therefore becomes unavailable. Conrad, in 1842, proposed Plectostylus for a group of fossil gastropods which evidently belonged to Macrocheilus; but this name also had been used by Beck five years before. In 1860, Meek and Worthen founded the genus Soleniscus, for certain paleozoic shells which now appear to be very closely related to the type of Macrocheilus. Inasmuch as the latter term had been previously used, Bayle, in 1879, substituted the name Duncania, which he subsequently[1] changed to Macrochilina. The generic title *Soleniscus* therefore takes precedence for the *Macrocheilus* group, typified by *Buccinum acutum* Sow., and *S. typicus* M. and W., the synonymy being as follows:

Buccinum Sowerby, etc., [*in part*] (*non* Linné).

1841. *Macrocheilus* Phillips. Palæ. Foss. Corn., p. 103. (*non* Hope, 1838, Coleoptera).

1842. *Plectostylus* Conrad. *Jour. Acad. Nat. Sci.*, Phila., Vol. viii, p. 275. (*non* Beck, 1837).

1860. *Soleniscus* Meek and Worthen. *Proc. Acad. Nat. Sci.*, Phila., 1860. p. 467.

1879. *Duncania* Bayle. *Jour. de Conchyliologie*, Vol. xix., p. 35.

1880. *Macrochilina* Bayle. Ibid., Vol. xx., p. 241.

If the assumed differences in certain characters of the Devonic and earlier Carboniferous species described under Macrocheilus are real, and are of sufficient import to separate generically this group from *Soleniscus*, as has been suggested, some other generic term must be employed to designate the group. In this case, Bayle's name Macrochilina might easily be made to answer; but it is very doubtful whether this would be expedient. A more advisable plan would be to transfer to other genera the several species described under Macrocheilus, but which perhaps do not properly belong there. In this way it is thought that Soleniscus will form naturally a very compact and easily distinguishable group, at least in so far as the American species are concerned, and apparently also the European.

Soleniscus consequently embraces paleozoic gastropods

[1] Jour. de Conchyliologie, (3), Vol. xx., p. 241. 1880.

having the shell fusiform or subovoid; the spire always acute; body whorl relatively rather large; aperture suboval, rounded anteriorly, angular behind; labrum thin; columella imperforate, and provided with a more or less distinct fold; surface smooth.

As observed by White, the twisted ridge on the columella is scarcely discernible in the perfect shell until the outer lip is broken away, when it is seen to become more and more pronounced as it passes inward from the aperture. By the removal of the lip the anterior portion of the shell seems more extended than in the unbroken specimen; and this feature was made unduly conspicuous by Meek and Worthen when they established the genus under consideration. Although seldom noticed on account of the apertural part of the shell being filled with matrix, a more or less well defined columellar fold is observable in the most of the hitherto called *Macrocheili*. This plication, very slightly developed in some forms, passes, in the various species, by imperceptible gradations into a conspicuous revolving ridge as exhibited in *S. typicus*. The callus of the inner lip varies so greatly, according to the state of preservation and the locality, that only in a general way can it be relied upon as of generic importance.

The following species, originally described as Macrocheili may be considered as properly belonging to Soleniscus:

S. typicus M. & W.
S. acutus Sow.
S. humilis Keyes.
S. kansasensis Swallow.
S. hallanus Geinitz.
S. planus White.
S. brevis[1] White-
S. (?) *attenuatus* Hall.
S. gracilis Cox.
S. klipparti Meek.
S. altonensis Worthen.
S. newberryi Stevens.
S. paludinæformis Hall.
S. carinatus Stevens.

With two or three exceptions, perhaps, the other described species of the fusiform group from the American Carboniferous are apparently synonymous with one or another of those here enumerated. The genus probably includes besides *S. acutus*

[1] *S. brevis* White is synonymous with *Macrocheilus ventricosum* Hall, but the latter was preoccupied by Goldfuss (*Pet. Germ.*, *Dritter Theil*, p. 29, 1841-44).

Sow. the majority of European forms now known under Bayle's Macrochilina.

In America, Soleniscus is one of the most characteristic genera of the Upper Carboniferous. The forms fall naturally into two categories: (*a*) the elongate or fusiform shells; and (*b*) the subovoid or subglobose varieties.

Those of the first group predominated in the earlier part of the epoch, while those of the second were more abundant in the latter part. The fusiform species occur most plentifully in the bituminous shales immediately associated with the coal seams. This would indicate that these gastropods were marsh or brackish-water forms, rather than denizens of the open sea. The subovoid forms are more commonly found in calcareous strata and were probably more strictly marine than the other members of the genus. Aside from the apparent difference in *optimum habitat* the shells of the two sections present some distinctive structural features which, taking all things into consideration, may eventually warrant a generic separation. This might with advantage be done with the American species, but whether it could be satisfactorily applied to the numerous foreign forms has not, as yet, been determined. The shells of the first category, compared with those of the second, have the volutions much more convex, the spire greatly depressed, the body whorl relatively much larger, and the aperture correspondingly ample, while the columellar ridge is usually obtuse and sometimes scarcely defined.

EXPLANATION OF PLATE XX.

Figs. 1, 2, 3. *Soleniscus acutus* Sow. 4. *S. humilis* Keyes. 5. *S. newberryi ?* Stevens. 6. *S. gracilis* Cox. 7. *S. attenuatus* Hall. 8. *S. typicus* M. & W. 9. *S. attenuatus ?* Hall. 10. *M. primogenium* Conrad. 11. *S. klipparti* Meek. 12, 14. *S. brevis* White. 13. *M. intercalare* M. & W. 15. *M. ponderosum* Swallow. 16. *S. paludinæformis* Hall. 17. *M. texanum ?* Shumard. 18. *S. planus* White. Last five after White.

RECENT LITERATURE.

HAECKEL'S REPORT ON THE SIPHONOPHORÆ COLLECTED BY H. M. S. CHALLENGER during the years 1873–1876.—This report forms Part lxxvii. of the zoological series of reports, and consists of 383 pages and fifty lithographic and chromo-lithographic plates. The author's long-continued and elaborate investigations of living Siphonophoræ and medusæ in the Mediterranean, Atlantic and Indian Oceans have enabled him to make it a generic monograph of the class. He distinguishes seventy-five genera, all clearly defined and described at length, containing 245 species. The plates are exquisite; remarkable both for beauty and elaborate finish of detail.

The following synopsis shows the distribution of the species.

Family.	Genera.	Species.
ORDER I. DISCONECTÆ.		
Discaliidæ	2	5
Porpitidæ	4	15
Velellidæ	3	16
ORDER II. CALYCONECTÆ.		
Eudoxiidæ	8	28
Ersæidae	2	4
Monophyidæ	6	17
Diphyidæ	8	35
Desmophyidæ	2	2
Polyphyidæ	3	8
ORDER III. PHYRONECTÆ.		
Circaliidæ	1	3
Anthoriidæ	2	3
Apolemiidæ	3	4
Agalmidæ	10	32
Forskaliidæ	4	11
Nectaliidæ	2	2
Discolabidæ	3	11
Anthophyridæ	4	9
ORDER IV. AURONECTÆ.		
Stephaliidæ	2	2
Rhodaliidæ	2	3
ORDER V. CYSTONECTÆ.		
Cystalidiæ	1	2
Rhizophyridæ	6	11
Salaciidæ	1	2
Epibulidæ	2	4
Physaliidæ	4	11

WHITE'S REVIEW OF THE FOSSIL OSTREIDÆ OF NORTH AMERICA,[1] and a Comparison of the Fossil Forms with the Living Forms.—This is a compilation of material already published, arranged to show the geological history of the oyster family, addressed rather to the general reader than to the special student. The author recognizes three genera, and a sub-genus among fossil forms, but groups all the living species under one genus—Ostrea proper. Mr. Ryder contrib-

[1] A Review of the Fossil Ostreidæ of North America, and a Comparison of the Fossil with the Living Forms. By Charles A. White, M.D. With Appendices by Prof. Angelo Heilprin and Mr. John A. Ryder. Extract from the Fourth Annual Report U. S. Geol. Survey.

utes as an appendix an interesting sketch of the life history of the oyster. Of the forty-eight plates which accompany the paper ten, are excellent drawings of living species, so that the reader can compare for himself the fossil and the recent forms. A second appendix, North American Tertiary Ostreidæ, by Prof. Angelo Heilprin, completes the review.

RUSSELL'S GEOLOGICAL RECONNAISSANCE OF SOUTHERN OREGON.[1]—This paper is the result of the author's own observations in this region, and his conclusions are summed up as follows :

" The rocks are almost entirely igneous. The basins are orographic valleys of the Great Basin type. During the Plistocene the excess of precipitation over evaporation was greater than at present. A number of the Plistocene lakes did not overflow. Many of the lakes which now occupy basins of extensive Plistocene lakes that did not find an outlet are either fresh, or hold but a small amount of mineral matter in solution. Many of the basins now occupied by arid deserts were then filled with lakes. No glaciers existed during the Plistocene period in that part of Oregon east of the Cascade Mountains, and south of the forty-fourth parallel."

The paper is illustrated by two excellent maps and several cuts of sections in different localities.

THE PELAGIC STAGE OF YOUNG FISHES, by Agassiz and Whitman.[2]—This memoir is a continuation of the papers on the young stages of osseous fishes commenced by Mr. Agassiz in 1877, and is devoted to descriptive sketches of the different fish eggs and young fishes that have come under the author's notice. As far as possible figures of the characteristic stages of each species have been given, and many of the sketches supplement those formerly published by Mr. Agassiz. There is added a synoptic table of the characters of various eggs and young fishes with reference to the plates where they are figured, which will enable the student to identify them with little difficulty.

WRIGHT ON THE SKULL AND AUDITORY ORGAN OF THE SILUROID HYPOPHTHALMUS.[3]—The object of this paper is to

[1] A Geological Reconnaissance in Southern Oregon. By Israel C. Russell. Extract from the Fourth Annual Report U. S. Geol. Survey, 1884.

[2] The Pelagic Stages of Young Fishes. By Alexander Agassiz and C. O. Whitman. With nineteen plates. Extract from the Memoirs of the Museum of Comparative Zoölogy, Vol. xiv., No. 1, Part i., 1885.

[3] On the Skull and Auditory Organ of the Siluroid Hypophthalmus. By R. Ramsay Wright, University College, Toronto. Extract Trans. Roy. Soc., Canada, 1885.

show that Hypophthalmus possesses an air-bladder connected with the auditory organ by intervention of a Weberian apparatus, formed of parts of the anterior vertebræ, modified after precisely the same plan as in the other siluroids ; but that the apparatus in question and air-bladder exhibit a reduction recalling that in the genera *Loricaria* and *Hypostomus*. It is enclosed by an extension of the occipital bone, which explains why it has been overlooked by naturalists hitherto. The author bases his conclusions on a series of sections, selections from which are represented in three plates which accompany the paper.

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Agassiz, A.—The Coral Reefs of the Hawaiian Islands. Bull. of Museum of Comparative Zoology, Vol. xvii., No. 3. From the Author.

Allen, J. A.—Notes on a Collection of Birds from Quito, Ecuador. List of Birds Collected in Bolivia by Dr. H. H. Rusby, with Field Notes by the Collector. Extracts from Bull. Am. Mus. Hist., Vol. ii., No. 2. From the Author.

Annual Report of State Geologist of New Jersey, 1888. From George Cook, State Geologist.

Barrois, Chas.—Observations sur la Constitution Géologique de l' ouest de la Bretagne. Extract des Annales de la Société Géologique du Nord, T. xvi., séance du 7 Nov., 1888. From the Author.

Bates, H. H.—Discontinuities in Nature's Methods. Extract from the American Anthropologist, April, 1888. From the Author.

Boulanger, G. A.—An Account of the Fishes Obtained by Surgeon-Major A. S. G. Jayakar, at Muscat, East Coast of Arabia. Extract from the Proceedings of the London Zoöl. Soc., Dec. 20, 1887. From the Author.

Branner, John C.—Geology of Fernando de Noronha. Extract from Am. Jour. of Science, Vol. xxxvii., Feb., 1889. From the Author.

Brongniart, Charles.—Sur un Nouveau Poisson fossile du terrain houiller de Commentry (Allier) *Pleuracanthus Gaudryi.*

————Sur un Nouvel insecte fossile des terrains carboniféres de Commentry (Allier) et sur la faune entomologique du terrain houiller. Extracts Bull. de la Société Géologique de France, Troisiéme série. Tome seizieme. From the Author.

Bulletin No. 4. Penn. State College. Agricultural Station, July, 1888.

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Edwards, W. H.—Description of the Preparatory Stages of *Arge galathea* Linn, with Notes on Certain *Satyrinæ.* Extract from the Canadian Entomologist, Vol. xxi. From the Author.

Farlow, W. G.—Memoir of Asa Gray. Read before the National Academy, April 17, 1889. From the Author.

Frederico, Leon. — La Lutte pour l'Existense Chez les Animaux Marins. From the Editors.

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Hay, O. P.—The Amphibians and Reptiles of Indiana. Extract from Ind. Agricult. Report, 1886. From the Author.

Hector, James.— Reports of Geological Explorations During 1885. Bull. of Colonial Museum and Geological Survey of New Zealand. From the Author.

Henshaw, Henry Wetherbee.—Who are the American Indians? Reprint from the American Anthropologist. From the Author.

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Kuntz, G. F.—Precious Stones, Gems and Decorative Stones in Canada and British America. Reprint from 1887 Report Dep't Mineral Statistics, Geol. Survey of Canada.

Macloskie, G.—The Poison-Apparatus of the Mosquito. Extract from the Am. Nat., Oct., 1888. Concessions to Science. From the Author.

McGee, W. J.—Notes on the Geology of Macon Co., Missouri. Extract from Acad. Sci., St. Louis, Vol. v., No. 1. From the Author.

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Osborn, H. F.—Evolution of Mammalian Molars to and From the Tritubercular Type. Reprint from the Am. Nat., December, 1888. From the Author.

Penrose, R. A. F—Nature and Origin of Deposits of Phosphate of Lime. Bull. of U. S. Geol. Survey. From Department of the Interior.

Potts, Wm. — Evolution of Vegetal Life. Extract from Modern Science Essayist, Vol. i., No. 5. From the Ideal Publishing Co.

Proceedings of the Department of Superintendence of the National Educational Ass'n., Feb. 14-16, 1888.

Purdie, Alex.—The Anatomy of the Common Mussels *Mytilus latus*, *M. edulis* and *M. magellanicus*. Bull. of Col. Museum and Geol. Survey of New Zealand. From James Hector, Director.

Reports for the Year 1886–7, 1887-8, Presented by the Board of Managers of the Observatory of Yale University to the President and Fellows.

Schlosser, Max.—Ueber die Beziehungen deraus gestorbenen Säugetierfaunen und ihr Verhältniss zur Säugetierfauna der Gegenwart, Sonderabdruck aus dem Biologischen Centralblatt, Bd. viii., No. 19, 1 Dec., 1888. From the Author.

Shufeldt, R. W.—Osteology of *Circus hudsonius.* Reprint from the Journal of Comparative Medicine and Surgery. From the Author.

Swinhoe, C. Col.—Catalogue of the Moths of India, Groups Pyrales and Geometrites. From the Trustees of the Indian Museum.

Taylor, Thomas.—Food Products. Reprint from Annual Report of U. S. Department of Agriculture. From the Author.

Thomas, Cyrus.—Aids to the Study of the Maya Codices. Extract from the Sixth Annual Report of the Bureau of Ethnology.

Walcott, Charles.—Description of New Genera and Species of Fossils from the Middle Cambrian. Advance sheets issued June 11, 1889. Proceedings of the U. S. Nat. Museum. From the Author.

Will, Ludwig. — Entwickelungsgeschichte der viviparen Aphiden. Separatabdruck aus den Zoologischen Jahrbüch. From the Author.

Winchell, N. H.—The Geological and Natural History Survey of Minnesota. Report for 1887. From the Minn. Geol. Survey.

Woodward, A.—Preliminary List of the Foraminitera from the Post Pliocene Sand at Santa Barbara, Cal. Extract from the Journof New York Microscopical Soc. From the Author.

GENERAL NOTES.

GEOGRAPHY AND TRAVEL.[1]

ASIA, ETC. — THE KE ARCHIPELAGO.—The small Ke Archipelago, in 130″-55′-33°.15″ E. longitude and 5°-10′ to 6°-10′ S. latitude is described in the Proceedings of the Royal Geographical Society by the brothers G. and A. Langen. The two largest islands are Nuhuroa or Little Ke and Nuhujund or Great Key, at the Southern extremity of the group. To the west of these or near Little Ke are many smaller islands. Great Ke is of volcanic formation, and contains eminences from 700 to 1,000 metres above sea-level. An earthquake in April, 1884, seems to have considerably diminished its size, and given origin to several islands around it.

[1] This department is edited by W. N. Lockington, Philadelphia.

The soil of Nuhuroa and the other islands is coral with a little quartz. Nuhuroa contains the only perennial stream, which is voluminous, singularly fresh, and rises in the centre of the island, so that the writers suppose that a subterranean basin, fed from springs on Great Ke or even in New Guinea, must exist. The population of the group in 1870 was 21,000 but small-pox reduced it in 1881 to 19,456. The greater part of the people reside in Nuhujund. About a third are Mahometans. The group belongs to Holland, but is in the hands of a German Colonizing Society.

AFRICA.—THE BASHILANGE.—Lieut. H. Wissmann has published in *Petermann's Mitteilungen* (xii. 1888) a short monograph of the people known as the Bashilangi who number in all about 1,400,000, and inhabit the country between the Kasi, and the Lubi, and affluent of the Sankura. These Bashilangi are the product of the mixture of the ancient people, of the district with the invading Baluba, who came from the S. E. They are divided into four tribes, the Bashilamboa, about 560,000 strong, who occupy the western third of the territory ; the Bashilambembele, 420,000 strong ; the Bashilacassanga to the S. number 280,000 ; and the Bena Luntu northwards, 40,000. With the exception of the Bena Luntu, who are real savages, and live in family aggregations, the Bashilange are grouped in towns, and by the efforts of Calamba Mukengke, new head chief, have acquired a certain degree of civilization. Their country is about twice the size of Sicily, is well watered, and not very mountainous.

BURMA AND MANIPUR.—Col. R. G. Woodthorpe has forwarded the Royal Geographical Society of London an account of his work in and around the little known district of Manipur, where 2,800 square miles were triangulated by his surveyor, Mr. Ogle. The Brahmaputra at this part of its course flows generally parallel to the hills which separate, first, Assam from Cackar, and then Assam from Burma. These hills, increasing in height, finally culminate in lofty peaks, which singularly enough, are not on the main range, but upon spurs running out from it. Saramethè, the loftiest of these, rises to 13,000 feet. Toward the south these hill ranges part Manipur from the Lushai country, and then separate Burma from Chittagoriq. Northeast, as far as the Patkoi Pass they form the watershed between Assam and Burma. Beyond Savamethi the peaks gradually diminish in height to Maium Peak, which is only 7,000 feet. Here a drop of 3,000 feet occurs, the range narrows, and the Patkoi Pass offers a means of communication between Upper Assam and Upper Burma.

At about 25°-20′ the Chindwin River receives the Tuzu, a considerable tributary, but the exact point of junction has not yet been observed. The Tuzu flows from the northeast, and its destination seemed problematical, since its valley appeared to be shut in on both sides by lofty peaks through which no exit was possible. Col. Woodthorpe, however, discovered that the river, after joining another stream coming from the southwest, turns off at right angles, and makes its way through a magnificent gorge between Saramcthi and another mountain 11,000 ft. high. The teak forests of the Chindwin River are very valuable, and are exploited by an Angle-Indian Company. King Thebaw's repudiation of his agreement with this company was one of the causes of the war that led to the annexation of Burma.

South of Manipur and West of Burma, lies a mass of lofty hills, inhabited by several closely allied tribes, among whom are the Chins.

AMERICA.—THE LIMITS OF VENEZULA AND BRAZIL.—Count E. Stradelli has furnished the *Bolletino della Societa Geographica Italiana* (Aug. and Sept., 1888, Jan'y, 1889) with an interesting account of his journeys in Brazil. The January issue contains the trip from Cucahy to Manaos. In the course of this article the dividing line between Brazil and Venezuela is given. This line commences at the principal source of the Memagui, an affluent of the Haguieni, which latter is a tributary of the Rio Negro. The point is 2°-1′-29.3′ N. latitude and 70°-34′-57.65″ W. longitude. Disputed territory extends farther west, but here the Colombian, Republic and Ecuador have claims. The boundary follows the watershed to 70°-20′-44.11″ W. longitude, thence goes to the sources of the Macacuny in 1°-12′-3″ N. latitude, and 69°-22′-35″ W. longitude, descends the Rio Negro to 78°-34′-18.50″ W. longitude thence goes straight to the Serro Cupy, and follows the water-parting by the Mountains Imeri, Tapyra Pecô, and Curupira. Hence it inclines to the north, following the Parima range which divides the basin of the Rio Branco from that of the Orinoco. At the Serro Maschiati, 4°-31′ N. latitude and 47°-9′-35″ W. longitude, it re-assumes the east and west direction along the Pacaraima range. It passes by Mont. Piauassu in 3°-32′-24″ N. latitude, between the rivers Uraricàparà and Auapira, and Mount Rorainia, and thence to the confines of British Guiana. Most of this boundary runs through an inhospitable and unexplored country.

FONTANA'S EXPLORATIONS IN PATAGONIA.—The Italian explorer Fontana seems to have added considerably to the knowledge of the rivers of Argentine Patagonia. The Stalufu or Stanlufu is identical with the Corcovado, runs over a very sandy bed and is bordered with thick forests of beech and pines, rarely interrupted by meadows. Slightly to the south of this river the Carrenliefie runs directly into the Ocean near Point Hualà. The Corcovado is a plentiful stream, fed in its upper course by *six* affluents, the principal of which is called by the natives Uncaparia. Forty-one less important streams were discovered, among them the Quemquemtreu, Maritea and Pichi-Leufu (*the orthography is Italian*) also six before unknown lakes.

GEOGRAPHICAL NEWS.—The latest Stieler's Hand-Atlas has a map of Africa in seven sheets, upon a scale of 1–10,000,-000 with all the latest changes. *Petermann's Mitteilungen* (35 Band. 1889, iv.) gives a list of the principal authorities drawn upon.

O. F. EHLERS states that he could find no trace of the presence of a crater upon the summit of Kibo (Kilimanjaro) which he estimates at upwards of 6,000 metres in elevation.

W. J. ORCHER, British Vice-Consul at Cheng-Mai or Zimme, has made an excursion to Cheng-tung, a market and thoroughfare about 200 miles to the Northeast of the former place, situated on a platform some 2,700 feet above the sea. The soil around is poor and but little cultivated, and the place owes what prosperity it possesses to its position.

Dr. BAUMAN, who accompanied Dr. Meyer, speaks of the good climate of the mountainous country of Uambara, between Pangaua and Umba in East Africa. The land is a mass of crystalline rock, covered partly with forest, partly with savanna, in places without vegetation. The Wachamba are the principal people and build two sorts of villages, one on slight elevations in valleys, with two concentric stockades and circular fences; the other on almost inacessible heights. They are agricultural, and are nominally Mussulmens. The Wachugu to the north are a taller people, and speak a different tongue; their houses are similiar, but they are almost entirely pastoral.

H. JOHNSTONE states that the difficulties encountered by the Deutsche Ostafrikanische Gesellschaft are chiefly due to the efforts made by that company to diminish the influence of the Banyans or East Indian merchants, who are the most honest and enterprising traders of these parts. The English company will take care to avoid this mistake. The number of East Indians now residing in Zanzibar amounts to 7,000. The Banyans proper antedate the Portuguese in these parts.

H. TROGNOTZ gives the following as the correct areas of the countries of South America according to the latest data:

Brazil	8,361,350	Peru	1,137,000
Dutch Guiana	78,900	Bolivia	1,334,200
French Guiana	129,100	Chili	776,000
British Guiana	229,600	Argentine Republic	2,789,400
Venezuela	1,043,900	Uruguay	178,700
Columbia	1,203,100	Paraguay	253,100
Ecuador	299,600		
			17,813,950

This is exlcusive of the Falkland and Galapagos Islands.

GEOLOGY AND PALÆONTOLOGY.

PRESTWICH ON UNDERGROUND TEMPERATURES.[1]—The author treats the subject solely from the geological point of view. He gives tables of temperatures of coal mines, of mineral mines, of artesian wells, and bore-holes, and of tunnels. After rejecting all doubtful and uncertain cases he obtains the following values for their several gradients:

	Thermometric gradient, per 1° Fahr.
Coal mines	49.5 feet.
Mineral mines	43.2 "
Artesian wells	50.0 "

The mean of the three thus gives a general thermometric gradient of 47.5 feet per degree. In view, however, of the many causes which have interfered with the value of even the best observations, the author thinks it may be a question whether a general average gradient of 45 feet per degree would not be nearer the true normal.

[1] On Underground Temperatures, with Observations on the Conductivity of Rocks; On the Thermal Effects of Saturation and Inhibition; and On a Special Source of Heat in Mountain Ranges. By Joseph Prestwich, M. A., F. R. S. Extract from Proc. Roy. Soc., 1886.

DAVIDSON'S MONOGRAPH OF RECENT BRACHIOPODA.[1]—During the last hundred years the recent Brachiopoda have attracted considerable attention, and a large number of valuable papers have been published upon them, but no satisfactory general monograph treating of the shell and animal *conjointly* has appeared. This omission Davidson has supplied. The literature of the subject is voluminous and the labor of collating and revising alone has been enormous, but the result is a book the student will appreciate. The descriptions are characterized by a clearness and precision that shows the master. The numerous plates drawn by the author are exceptionally fine.

To Miss Agnes Crane is due the credit of editing this able work. Previous to Dr. Davidson's lamented death Miss Crane had been studying the Brachiopoda under his guidance, and at his request the proof-sheets of this memoir were read by her on the author's behalf.

BARROIS' FAUNE DU CALCAIRE D'ERBRAY[2]—A large quarto of 346 pages and 17 plates. After a brief introduction, in which the author gives his views of the formation of the *Calcaire d'Erbray*, follow five chapters devoted respectively to the Stratigraphy; the Description of 200 Species of Invertebrate fossils found in the *Calcaire d'Erbray*; Discussion of Former Works on the Fauna of Erbray; a Comparison of the Fauna of *Calcaire d'Erbray*, with Equivalent Faunas of Other Regions; General Considerations on the Fauna of *Erbray*. In conclusion the author remarks: "Les calcaires on plutôt les récifs coralliens du Harz, d'Erbray, appartiennent pour nous, à l'étage Gedinnien; ceux de Bretagne et d'Espagne, à l'étage Coblenzien; ceux de Cabrières à l'étage Eifélien; ceux des Ardennes, aux étage Gèvétien et Frasnien. L'identité de leurs conditions de formation a pu, a dû même dans certains cas, donner aux faunes suscessives de ces calcaires plus d'analogies entre elles, qu'avec les faunes synchroniques de faciès different."

GAUDRY SUR LES DIMENSIONS GIGANTESQUES DE QUELQUES MAMMI FERES FOSSILES[3]—A short paper in which the

[1] A Monograph of Recent Brachiopoda, by Thomas Davidson. Extract from the Trans. Linnean Soc. of London; Vol. iv., part 1, 1886.

[2] Faune du Calcaire d' Erbray. Par Charles Barrois. Contribution à l'Etude du Terrain Devonien de l'Ouest de la France. 1889.

[3] Sur les dimensions gigantesques de quelques Mammiféres fossiles. Par M. Albert Gaudry. Extrait des Comptes rendus des Séances de l' Académie des Sciences t. CVII, 1888.

author gives the following table of the comparative size of some of the fossil mammalia:

Premier rang.......................*Dinotherium giganteum*
du Miocene superieure de l'Attique.

Deuxième rang.........................*Elephas antiquus*
du quaternaire (phase chaude) des environs de Paris.

Troisième rang......................*Elephas meridionalis*
du pliocene superieure de Durfort.

Quatrième rang......................*Mastodon americanus*
du plistocene des Etats-Unis.

Cinquième rang......................*Elephas primigenius*
du plistocene de Siberie (phase froide); et Eléphants actuels.

THE PLISTOCENE LAKE OF NEBRASKA.—Prof. J. E. Todd (*Proceedings Am. Association for Adv. of Science*) calls attention to several facts, hitherto unpublished, which indicate that eastern Nebraska, western Iowa, and south-east Dakota were occupied by a fresh water lake when the drift first began to be deposited in that region. The facts and considerations are as follows:

1. An extensive deposit of fine sand, containing a few fossil bones, overlain in some places by a lead-colored clay without pebbles, and some fossiliferous silt resembling loess, is found occupying much of the region, especially the lower levels. Ten localities were mentioned where these formations have been observed, the more notable being at Fairview, Dak., Mills Co., Iowa, and Lancaster Co., Neb. A large fossil claw of some gigantic mammal (*Megalonyx*) was shown, which was obtained from Mills Co., Iowa, in the sand below the drift.

2. The occurrence of a stratum of volcanic ashes in such position as to show that wide areas were occupied by still water, just preceding the deposition of the drifts in some parts and during it in others. The localities described and pictured were in Knox Co., Neb., and near West Point, Neb.

3. An objection which may be urged, from the depth of the channel of the Missouri River in this region, is removed by several facts which go to show that said channel has been wholly excavated since the glacial epoch.

(*a*). The rock under the present bed is unglaciated and unoccupied by drift deposits as has been recently demonstrated by observations made in sinking piers of bridges at Blair and Omaha.

(*b*). The Missouri is still deepening its trough with every flood. This has been determined by soundings at such times.

This fresh water lake, from its time and location, may be quite confidently considered a portion of the great body of water which occupied the western plains during late Tertiary times, and which was named by King, Lake Cheyenne.

GEOLOGICAL NEWS.—GENERAL.—The Rev. B. Baron states his belief, derived from an examination of the flora, that Madagascar separated from the African mainland during or even before the early Pliocene. This agrees with the deductions of Wallace. Five-sixths of the plant genera occur elsewhere, but four-fifths of the species are peculiar. The central part of the island is mainly gneiss and other crystalline rocks, with a strip parallel to the main axis of the island, and roughly to that of the crystalline rocks of the continent. The sedimentary strata occur chiefly in the west and south, and comprise eocene, upper cretaceous, neocomian, Oxfordian, lower oolite, and lias. The highest elevations are topped with lava, which is mostly basaltic. There is no active volcano now upon the island.

CAENÖZOIC.—E. T. Newton (Geol. Mag.) describes some recent additions to the preglacial Forest-bed fauna; including *Cervus rectus* n. sp. He refers the bovine remains to *Bison bonasus*, and the phocine to *Phoca barbata*. The narwhal, beluga, and *Phocaena communis* are also added to the list.

Sig. Ristori describes a Scylla found near Verona, but not sufficiently well preserved to warrant the formation of a new species, though it evidently differs from *S. serrata* and *S. michelini*, M. Edwd., and also from *S. hassiaca* Th. Ebert. It is the only example of the genus yet found in the Italian Territory.

Sig. Ristori (Boll. Soc. Geol. ii., vii. 188) describes an Inuus, *I. caudatus*, from the Pliocene of the Valdarno. This species had previously been erected into the type of a new genus by Igino Cocchi.

Oreopithecus bimbolia Gervais, is declared by Sig. Ristori not to be an anthropoid ape, but to appertain to the Cynopithecinae. The example is from the Miocene of Montebamboli.

F. Bussane (Boll. Soc. Geol. ii., vii. 1888) describes a species of Ephippus to which he gives the name of *E. nicolosi*, discovered in the middle Eocene of Val Sordino, near Lonigo (Veronese). It is near *E. longipennis*, Ag., but has denticulated spinous rays in dorsal and anal.

From an examination of fossil plants found near Rome, G. Antonelli concludes that in the plistocene period the neighborhood afforded a good number of land and fresh water species, mostly of a woody nature, and identical with recent plants of the same district, so that the climate must have been much the same as now.

The Bolletine of the Geological Society of Italy, 1888, has an account of the pliocene foraminifera of Ca dë Reggio, by Mario Malogili.

G. Ristori describes some Lower Miocene crustacea of Piedmont, including a new Neptunus (*N. convexus*) and *Mursiopsis pustulosus*, nov gen. et. sp., also *Callianassa canaverii* and fragments of unnamed species. Mursiopsis belongs to the Calappidae, and has points of resemblance to Hepatus, Mursia, Lambrus, and Calappilia. The carapax is convex in front, reëntering at the sides, and straight behind, and is trilobed like Calappilia or Lambrus.

A new species of Clupea, from the Oligocene strata in the Isle of Wight, is described at length by E. T. Newton, in the *Quarterly Journal of the Geological Society*, February, 1889. As he is unable to refer the specimens to any known species, he proposes the name *Clupea vectensis*.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—The palæopicrite[2] of Bottenhorn, Hessen-Nassau, consists essentially of olivine and augite, both of which have yielded interesting alteration products. The olivine, when fresh, is discovered in twins, whose twin-

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Brauns: Zeits. d. deutsch. geol. Gesell. xl., p. 455.

ning and composition plane is a clino-dome. Upon alteration it gives rise to the rare mineral webskyite[1] and tremolite. The former is found to be an intermediate product in the passage of olivine into serpentine. Its analysis yielded results which indicate for it a composition corresponding to H_2 (Mg. Ie) $S{:}o_4$ + 2 Aq, that is a hydrated olivine, with part of its magnesium replaced by hydrogen. Its specific gravity is 1.745. The augite of the rock is brown in color, and, like the olivine, gives rise to a peculiar alteration product. This is a green garnet with the composition:

S:	Fe_2O_3	Al_2O_3	Ca O	Sp. Gr.
34.95	30.12	1.77	33.29	3.977

With it is associated helminth. Pseudomorphs of serpentine after magnetite are described in the same rock. A pseudomorph of calcite after chrysotile is mentioned as occurring in chrysotile veins in a diabase from Amelose, and pseudomorphs of the same mineral after the olivine of this diabase are briefly alluded to. An interesting addition to the study of jade and nephrite has been made in the shape of an article by Messrs. F. W. Clarke and G. P. Merrill[2] on the chemical and microscopical characteristics of the materials composing some of the instruments on exhibition in the U. S. National Museum. Analyses, specific gravity determinations, and the study of thin sections of nineteen specimens lead the authors to the view that the jadeite and nephrite objects, which have been gathered from widely scattered localities, cannot be depended upon in the work of tracing the migrations of ancient tribes of people, since (1), the material of which the objects consist is by no means always a pure jade or nephrite, and (2), these substances themselves, when obtained from different sources possess very different characteristics. The analyses and microscopical studies yield little new in regard to the structure of true jade. The paper is of importance as affording proof of the existence of a true jade in Alaska, and as a record of the results of the examination of many jade instruments not heretofore described.

Near the village of Trevalga[3] is a shell of eruptive rock, from seventy to a hundred feet thick, interstratified with slates. Foliation is highly developed throughout its mass in a direction parallel to the cleavage of the slates. In places it is

[1] Cf. AMERICAN NATURALIST, November 1887, p. 1021.

[2] Proc. U. S. Nat. Museum, xi., 1888, p. 115.

[3] Hutchins: Geol. Magazine, Mch. 1889, p. 101.

coarsely laminated, a soft chloritic or micaceous material, alternating with layers of a hard, compact, non-foliated stony substance. The hard layers consist of calcite and feldspar in a mosaic of feldspar, chlorite, calcite, muscovite, secondary quartz, epidote, biotite, and iron compounds. The softer strata contain a great deal of chlorite and epidote is present, the other constituents remaining the same. The epidote is thought to have originated before the development of schistisity in the rock. Both layers have practically the same composition, and are therefore regarded as parts of the same magma. Both show evidences of the result of pressure in the case of their individual components. Only in certain portions, however, (in the softer layers) has this pressure produced foliation.—Ascension Island in the South Atlantic Ocean is entirely of volcanic origin. Its rocks embrace principally trachytes and andesites. The most widespread and the oldest of these, according to Renard,[1] is a pyroxene trachyte with a glassy base, which is locally so largely developed as to yield a trachyte-obsidian. In both phases little microlites of orthoclase are twinned according to the Carlsbad law, showing interpenetrative crosses in the thin section. By the assumption of hornblende the rock passes into a hornblende-trachyte, and by the local accumulation of silica a transition into rhyolite is noticed. The surface of the island is covered with scoriaceous basalts. In some localities an andesite occurs in which the augite is bronzite. Over several circumscribed areas the volcanic rocks contain, as inclusions, fragments of granite, diabase, and gabbro.—A few notes on the rocks occuring in the auriferous tracts of Mysore Province, South India, are communicated by Burney[2] as an appendix to an article by Attwood on the structure of the region. The rocks embrace eclogites, hornblende, and mica schists, all showing evidence of the effects of great pressure and also dykes of various eruptive rocks. The gold is found in quartz veins in the schists.—An interesting trachyte[3] from the Cumana railroad tunnel, near Naples, Italy, contains sanidine, two varieties of hornblende, and rod-like aggregates of hornblende and pyroxene in a ground mass of sanidine, amphibole, and magnetite. In the vesicles of the rock are large, colorless pseudo-hexagonal crystals of sodalite, rods of black amphibole, pyroxene, little crystals of sanidine,

[1] Bull. Mus. Roy. d. Belg. T. v., No. 1, p. 5.

[2] Quart. Jour. Geol. Soc., Aug. 1888, p. 636.

[3] Johnston-Lavis: Geol. Magazine, Feb. 1889, p. 74.

and tufts of a fibrous titanium mineral.—The alteration of an epidiorite into a chlorite schist is described by Hutchings[1] from Tintagel N. Corniwall. The epidiorte contains, in addition to the usual constituents of this rock, grains of colorless epidote, a little calcite, a very little quartz and some secondary feldspar. As schistosity is induced the amount of calcite, chlorite, and quartz increases, and epidote disappears, until finally a typical chlorite schist results.—Brief descriptions of the rocks of Somali Land, in Northeastern Africa, and of the island of Socotra are given by Miss C. A. Raisin[2] in recent numbers of the *Geological Magazine*. Those of the former locality are granites, hornblende, diabases, porphyrites, gneisses, and talc and epidote schists, overlain by limestones and other sedimentary rocks. On Socotra is a felsite with corroded quartz crystals, in which the included groundmass forms concentric rings separated by quartz material.—Ternier[3] describes very greatly corroded quartz crystals in a micro-granilite from Osaka, Japan. These crystals are surrounded by little islands of quartz with the same optical orientation as the larger grains, and the entire group is enclosed in a zone, composed of fibres of quartz and orthoclase, of which the former extinguish parallel to the large quartz crystal.—Wyronboff[4] has analyzed a specimen of the black, opaque, friable obsidian, with a fatty lustre, that occurs at Obock, and obtained the following result:

$S:O_2$	A_2O_3	Fe_2O_3	MgO	V_2O	H_2O	Sp. Gr.
70.00	13.88	2.77	1.20	7.78	4.11	2.345

MISCELLANEOUS.—*Etched figures.*—It is well known that the character of the figures produced by etching a crystal of quartz with hydrofluoric acid varies with the nature of the crystal, and also with the symmetry of the face acted upon. With a knowledge of these facts, Messrs. Otto Meyer and Penfield have subjecte d a sphere of quartz to the influence of strong hydrofluoric acid, and have presented their results in a beautifully illustrated article. The difference in the case with which the acid etches various portions of a crystal of quartz is finely brought out by the shape which the sphere assumes

[1] Geol. Magazine, Feb. 1889, p. 53.

[2] Geol. Magazine, 1888, p. 414 and p. 504.

[3] Bull. Soc. Franç. de Min., xii., p. 10.

[4] Bull. Soc. Franç. d. Min. xii., p. 31.

[5] Trans. Connecticut Acad., viii., 1889, p. 158.

after prolonged action of the etching agent. It is found that the acid acts very unequally on different parts of the sphere, corresponding to the different crystallographic faces of the crystal from which it was cut, but equally with reference to the system of hexagonal axes. In this way the tetartohedral symmetry of the mineral is strikingly revealed. The action is greatest at the two extremities of the vertical axes, while at the ends of the lateral axes it seems to be almost nil. As a final result of the action of the etching agent the sphere is reduced to a lenticular body with a triangular cross section, with the three angles of the triangle at extremities of the lateral axes.—A comparison of the shapes and positions of the etched figures produced on halite and sylvite upon their exposure to moist air has been made by Brauns.[1] Those in rock salt are usually bounded by the planes of a tetratis hexahedron, which may vary in formula between $\infty O \frac{7}{2}$ and $\infty O \frac{21}{2}$. Occasionally a depression bounded by the planes $\frac{4}{3} O$ is $\frac{4}{3}$ observed. In both cases the position of the figures on the faces etched are such that they possess the same planes of symmetry as does the face upon which they are. On sylvite, on the other hand, the depressions have no planes of symmetry in common with those of the crystal face. Halite is therefore regarded as holohedral, while sylvite is gyroidally hemihedral. The same writer mentions the existence of twinning strialtuis on cleavage pieces of rock salt, whose twinning plane is 2O O.

NEW BOOKS AND PAMPHLETS.—" Les Mineraux des Roches "[2] is the first French book that treats of optical properties of minerals in a way to be of use to students in the study of thin sections of rocks. As the authors state in their preface, the new book is a natural complement to Fouqué and Lévy's " Mineralogie Micrographique." In the first part the author (Lévy) discusses the application of the principles of optical mineralogy to the study of minerals in thin sections of rocks. The methods made use of in this discussion are somewhat new to petrography, as they are based more upon mathematical considerations than is usual. The fundaments of crystallography and of optical mineralogy are presupposed, as is also a knowledge of spherical geometry and trigonometry. After deducing the mathematical relations of the optical axes and bisectrices, the curves of extinction in the principal zones

[1] Neues Jahrb. fur Min., etc., 1889, i., p. 114.

[2] " Les Mineraux des Roches," par Michel Lévy et Alf. Lacroix. Paris, 1888. Baudry et Cie. 218 fig., 1 pl., pp.

of monoclinic and triclinic minerals are constructed, in the manner familiar to the readers of the "Mineralogie Micrographique." The development of the laws of double refraction and pleochroism, etc., follow, and the facts thus developed are graphically illustrated by diagrams. A special feature of this portion of the book is a large, lithographic plate, by means of which the nature of the substance composing a crystalline particle of known thickness may be determined by noticing its color between crossed nicols. The general portion of the book concludes with an excellent chapter on microchemical reactions.

In the special portion, (by Lacroix), the chemical, morphological, and physical properties of a large number of minerals are given in concentrated forms. The appearance which these minerals present in the thin section, and their general characteristics, however, are not described, so that the book is in reality a text-book in optical mineralogy. The features which have made Professor Rosenbusch's "Mikroskopische Physiographie" so invaluable as a guide to the detective minerals *in rocks* are lacking in the volume before us, but many of those in which the latter is wanting are found in the former in good quality. "Les Mineraux des Roches" is really a complement to Rosenbusch's work, supplementing it in those very portions where the "Mikroskopische Physiographie" is weak. It is unnecessary to remark that the book of Lévy and Lacroix is one to be placed in the hands of a beginner in the study of optical mineralogy, although it will prove of inestimable value to him who is already familiar with the general principles of the science.—Mr. Eyerman[1] has collected in a pamphlet of fifty-four pages descriptions and notices of the new minerals and new mineral occurrences that have been discovered in Pennsylvania during the fourteen years since the appearance of Dr. Genth's "Preliminary Report on the Mineralogy of Pennsylvania." The analyses of Pennsylvania minerals that have been published during this period are reproduced, and a few original observations of new occurrences are given. Authorities are quoted in all cases, so that the pamphlet is of great value to anyone interested in the minerals of Pennsylvania.—The "Catalogue of a Collection of Precious and Ornamental Stones of North America, Exhibited at the Paris Exposition, 1889, by Tiffany and Co.,[2]" contains a very complete list of

[1] "The Mineralogy of Pennsylvania." Part i., Eastern Pa.

[2] New York. The De Vinne Press. 32 pp.

the valuable minerals and gem materials of North America, numbering, in all, three hundred and fifty-two specimens.

BOTANY.[1]

As Regards Some Botanical Latin.—Scientific Latin is often said to be the laughing-stock of philologists. This may not concern botanists very much, as they do not require anything but scientific usefulness of their Latin. Nevertheless, if they are to use Latin, it is best that they use good Latin, especially as that is not a matter of very great difficulty. A principal source of inaccuracy in botanical Latin is the fact that a large number of names had their origin in the last century, or even earlier, when impure, medieval Latin was dominant. Then modern botanists, in attempting to give these names classical forms, often make them still worse. Besides, scientific men are not always as good philologists as they should be, so that many modern names are faulty.

Whether medieval Latin should be retained in Botany, on account of its antiquity and long use, or the purer forms should be substituted, is no part of the present consideration. But I may say in passing that the Latin studied and written for the most part to-day is classical Latin, and for this reason attempts to retain eighteenth century forms are liable to result in inaccuracy and absurdity.

Some of the principal characteristics of eighteenth century Latin are the use of ch for c and y for i in many words, in imitation of the Greek, and the use of the feminine nominative form for the masculine in adjectives like campester and paluster. On the continent Pirus has largely replaced Pyrus for some time, and this spelling has been followed to some extent in this country. English authors retain the eighteenth century spelling. But as is usually the case in changes of this kind, authors are inconsistent, changing some forms, and retaining others capriciously.

Of German authors, Luerssen writes Pirus, Pirola, silvester, etc. Frank (in Leunis, Syn. der drei Naturreiche) uses classical forms throughout. Drude (in Encyklopaed. der Naturwissenschaft.) writes Pirus, but sylvestris. Koch (Dendrologie) does the same. Sachs seems to prefer classical forms, but

[1] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

uses both. Winter uses eighteenth century forms as a rule, but his lacrymans is a hybrid.

Saccardo (Syl. Fung.) uses classical forms as a rule, but, probably from carelessness, is very inconsistent. He writes Piri, Pirolæ, campester, paluster, silvester. But sylvatica and sylvana! He has sometimes lacrymans, and sometimes lacrimans.

French authors usually prefer Pirus—but sylvestris and sylvatica. Vesque, however, has Pyrus.

Of American authors, Gray always consistently uses eighteenth century forms. Watson (Index and Botany of Cal.) writes Pirus; but sylvestris and sylvatica, and, curiously enough, the diminutive Pyrola. Coulter uses eighteenth century forms as a rule, but has the hybrid sylvester. Britton uses eighteenth century forms consistently.

It will be noticed that those who retain the eighteenth century Latin do so consistently, while those who attempt to substitute classical forms do it capriciously and without system. There seems no good reason for this, and it is probably largely due to carelessness. At any rate, if Pyrus is to be spelled with an i, so should sylvaticus, sylvanus, and sylvestris, and the latter should have the termination ter. If eighteenth century forms are to be retained we should write lachrymans; otherwise lacrimans. We cannot split the difference in this matter.—*Roscoe Pound.*

THE PRONUNCIATION OF SCIENTIFIC NAMES.—The following are the rules for the pronunciation of scientific names, adopted by the Botanical Seminary of the University of Nebraska.

I. In general, all names of the branches, classses, orders, and families of the vegetable kingdom, and their subdivisions, and the names of all genera and species shall be pronounced according to the "Roman Method."

II. Generic and specific names derived from un-Latinized personal names may, if difficult to pronounce as Latin, be pronounced according to the rules of the language from which they are derived. But even in these cases the Roman pronunciation is recommended if it can be used.

III. Latin words which have become Anglicized shall be pronounced as English.

IV. The following is a conspectus of the Roman Method:

1. VOWELS.
   - A, long as in German; short as in ideă.
   - E, long as in German; short as in English (ănd).
   - I, long as in German; short as in English (it).
   - O, long as in English; short as in obey.
   - U, long as in boot; short as oo in foot.
   - Y, as I.

2. DIPHTHONGS.
   - Ae (ai) as long i in English,
   - Au as ow in now.
   - Eu as ew in few.
   - Oe (oi) as oy in English.
   - Ou (ow) as long u (Roman).
   - Ui as we in English.
   - Ei as in eight.

3. CONSONANTS.
   - C and G *always hard*.
   - S always sharp; never like z.
   - J like English y.
   - U like English w.
   - Bs like ps.
   - Ch like k.
   - Th always as in thin; never as in then.
   - Others as in English.

4. QUANTITY AND ACCENT.
   - (1) A vowel before another vowel or *h* is short.
   - (2) A diphthong is long.
   - (3) A syllable in which a vowel is followed by two consonants or a double consonant is long. Before nf, ns, gn, or gm the vowel itself is long.
   - (4) A syllable in which a short vowel is followed by a mute with *l* or *r* is common.
   - (5) Words of *two* syllables are always accented on the *first.*
   - (6) Words of *more than two* are accented on the *penult* if it is *long;* if it is *short* or *common*, on the *antepenult.*

5. SYLLABLES, ETC.
   - (1) Each vowel or diphthong constitutes a syllable.
   - (2) Every syllable should be pronounced.
   - (3) When a consonant is doubled or two come together, each should be pronounced.

THE "ROMAN PRONUNCIATION" IN HORTICULTURE.—Since the foregoing paper was received, the final volume of "Nicholson's Illustrated Dictionary of Gardening" has come to hand, and in it we notice with pleasure the article on the pronunciation of ordinal, generic, and specific names, by Percy W. Miles of the University of Dublin. After remarking upon the "chaotic state" of the pronunciation of the scientific names of plants, the writer observes that "the way in which many gardeners make havoc with the names of plants has been a frequent subject of satire with philologists and other writers." And again "the manner in which Latin has been, until lately, pronounced in this country is thoroughly inaccurate and unscientific, and so entirely insular that in speech it is often quite unintelligible to foreigners, even to those who are good Latin scholars. As one of the chief advantages of the uniform Latin nomenclature of plants is that thus a sort of universal or international language is created, it is evident how much has been lost by our predjudiced adherence to a provincial mode of pronunciation."

After much consideration and consultation with several eminent botanists, the writer determined to follow the Roman system of pronunciation in his article. He proceeds to give the essentials as to accentuation, quantity, and the pronunciation of particular letters, practically as given in the rules set forth above.

"It will be as well to guard the reader against the supposition that there exists at present for botanical names any recognized standard of pronunciation from which he may imagine that this dictionary often presumes to depart. The fact is that there is no such established standard. In many cases the common text-books are utterly at variance, and the usage, not only of good gardeners, but of educated botanists is often hopelessly divergent."

In but one point of importance, (and that is in fact of but minor importance,) are the rules different from those printed above. Mr. Miles says that *in all cases* of words commemorative of the names of men, we should pronounce the word "as nearly as possible in the way in which the name to be commemorated was sounded." Thus he would have us say *Stokes-i-a*, not *Sto-ke-si-a*, *Men-zies-i-i*, not *Men-zi-es-i-i*. We are of the opinion that the rule of the Seminar, given above, is preferable, and will in the end lead to the best results.—*Charles E. Bessey*.

ZOOLOGY.

Some Cases of Solid-Hoofed Hogs and Two-Toed Horses.—In 1878 "soliped" pigs were reported from Texas. Dr. Coues observed that in the new breed the terminal phalanges of the toes were united, to form a single broad phalange; above this, however, the other two phalanges remained perfectly distinct. The hoof is perfectly solid, and on its sole there was a broad, angular elevation of horny substance, curiously like the frog of the horse's hoof. The breed was so firmly established that no tendency to revert to the original and normal form was then observable. It was further stated that, in the cross of a solid-hoofed boar with a sow of the ordinary type, a majority of the litter has the peculiarity of the sire apparent.

There has just been reported to me from Sioux City, Iowa, (famous for its annual "corn palace") a similar case. Indeed, it would seem as if the owner was quite alive to their rarity and had been breeding them for some time, and had now as many as induced him to advertise them for sale, "not alone for being a curiosity, *but in a commercial sense a valuable production for mankind!*" The owner continues: "The experience of the writer convinces him that there is no better hog for the healthy growth of pork. These hogs are of long body, and have well proportioned hams and shoulders. It is true they have not the fine head of the 'improved' breeds. . . In size they are fair, a couple of barrows (accidently castrated) now near thirteen months old, without special care weigh over 350 pounds each. As yet there has been no sign of any loss from disease whatever (though diseases have been common in that district for years). A few boars, six to eight weeks old, will be sold . . . ." etc.

We are making further inquiries into the above, and will report results.

But it seems quite evident that these "mule-footed" hogs are of frequent occurrence in America. Some "get into print," and some don't. For instance we are obliged to the *Rural New Yorker* for two more cases. A known correspondent to that excellent periodical writes thus, from Cottonville, Louisiana, in the issue for September 22d: "As a curiosity which I never saw before, or even heard of, I send the foot of a 'mule-footed' hog. There is a herd of them ranging the woods, about eight miles north of Baton Rouge. None of the old settlers can give me any further information concerning them than "that they are a herd of wild hogs.'" An exact drawing is published with the above, which is enclosed for your reproduction. (Fig. 1.) The editor adds a note to

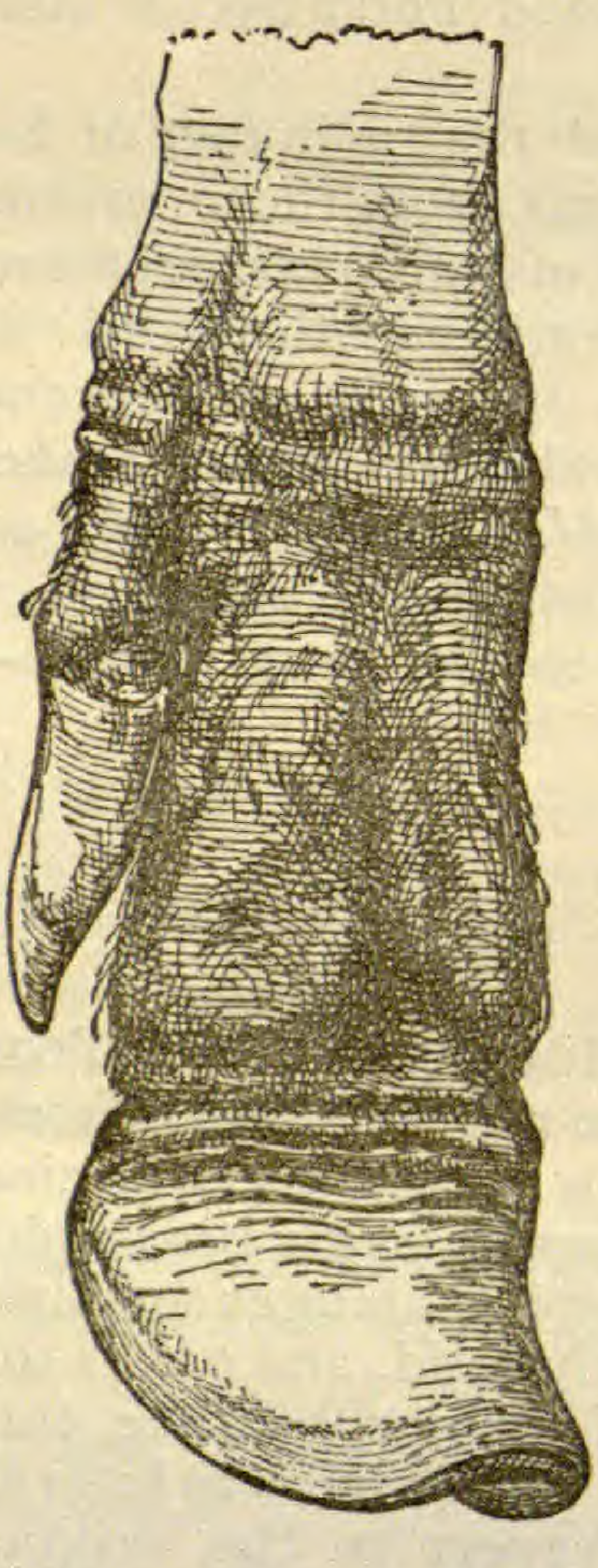

Fig. 1. Solid-hoofed Hog.

the above: "We have seen several of these 'mule-footed' hogs. In a small Southern town, a large Poland-China boar had one hind foot exactly like the one shown in our picture, and a large proportion of the young pigs from him were marked in the same way."

We have also had undoubted cases of extra-toed horses reported here. During the summer of 1885, *The Advertiser*, Constantine, this State, contained the following: "On Wednesday night of last week a mare belonging to Mr. Fred Hagenbuch, of Fabius, gave birth to a male colt, well formed and perfectly symmetrical in all respects, except that one of the feet is cloven and hoofed like the foot of a cow. Who has a mate for this colt?" This was quoted in *Breeder's Gazette*, Chicago, the leading breeder's paper of America, and brought out a response from Mr. N. C. Woolf, in issue for July 16th, thus: "My neighbor, Mr. D. M. Hall, has a two-year-old colt that exactly fills the above description. For a few months Mr. Hall has taken great pains in shoeing, and thinks he will succeed in making a pretty good hoof."

These cases are, I think, of sufficient interest to entitle them to be rescued from the oblivion that they must experience. And they are, I think, of sufficient value to have a place accorded them in THE NATURALIST.—*R. C. Auld*, Pinckney, Michigan, U. S. A.

INTERESTING CASES OF COLOR VARIATION.—As a contribution to the increased interest attaching to the recent discussions of color variation in animals, as bearing upon the problems of natural selection, the following may not be without value. The first is that of some remarkable variations in color in the common robin, Merula migratoria. Some two years ago, in the Spring of 1887, while studying the habits of this bird, strolling almost daily into their haunts, I was much struck by what at first appeared a strange bird among a group of robins. A moment's attention, however, disclosed the true character of the stranger, and showed it to be strange only in the matter of color, which was a motley of white and gray on the head, neck, shoulders and back. Though having no means of securing the specimen at the time, an attentive study of the marking showed that it could not be a case of albinism, as is so often the case in such variations. The bird was not seen for that time only, but I saw the same specimen a few days later, and then repeatedly during the Spring, as it proved to be a female, and nested near my home. No propagation of the variation appeared in the offspring that was appreciable.

The following Spring I noted evidently the same bird in the same locality, and at about the same time in the season. It remained in the neighborhood during the Summer, again nesting. In neither season did there appear any signs of transmission of the peculiarity to the offspring.

A robin similarly marked was noted by Mr. Amos. W. Butler, and reported by him through the Journal of the Cincinnati Society of Natural History. Altogether, the cases seem rather anomalous and outside the usual causes involved in such variation.

Another case of similar character came under my observation later. In the Spring of 1888 I captured two *moles, Scalops aquaticus* (?) on my lawn, both of which had markings of pure white on the neck and belly. In another specimen, only the skin of which I saw, but which was taken in the neighborhood, the white extended on one side to the back in irregular blotches, giving to the skin a strangely variegated appearance. As is well known, the color of this mammal is quite constant, and of a dark plumbeous or slaty hue, slightly lighter below. I have seen no record of a tendency to vary in the manner noted above, or indeed in any way in particular. The usual color is, of course, quite in keeping with its habits and environment, and in so far might be assumed as the result of natural selection. But how are we to account for these peculiar variations? Are they the expression of a tendency to revert to a primitive or to an ancestral type, or are they not rather in keeping with what is so often seen in plants as well as in animals under changed conditions, due to causes obscure in their nature and as yet very imperfectly understood? The recent discussions of these matters by Agassiz, Riley, and others, and the reference of Mr. Adam Sedgwick in a recent number of *Nature*, to the remarkable coloration in Peripatus, when its habits are taken into account, seem to lend great plausibility to the principle of "Saltation," or sudden and obscure variation.

Altogether, there seems reason for moderation in reference to *any theory* as yet proposed. Evidently, the evidence is not yet all in.—*C. W. Hargitt*, Miami University, Mar. 25, 1889.

THE BALD CHIMPANZEE.—Dr. P. L. Sclater describes in *Nature* (1889, p. 254), a couple of female apes from tropical West Africa, which resemble the chimpanzee, and yet differ in marked features. The ear is much larger, and the hair is generally sparse, so much so on the head as to permit the application of the term bald. The color of the face is blackish. In the chimpanzee the head is thickly clothed with hair, the face is flesh-colored, and the ears are smaller. Both these animals (which are in the London Zoological Garden) are carnivorous, catching and eating sparrows and pigeons. It is stated that this is never done by the chimpanzee. Dr. Sclater provisionally refers these animals to the *Anthropopithecus calvus* of Du Chaillu.

ZOOLOGICAL NEWS.—CŒLENTERATA.—Dr. H. V. Wilson records (*J. H. U. Circ.*, No. 70) that in *Cereactis bahamensis* the mouth occasionally grows together in the middle, leaving oval and anal openings at the ends. He also found a single larva of *Manicina areolata*, which exhibited the same peculiarity. In this connection reference is made to Sedgwick's celebrated paper on Metameric Segmentation.

In the same place Prof. J. P. McMurrich gives a list of the Actinaria of New Providence, enumerating fourteen species, of which *Cereactis bahamensis*, *Bunodes tæniatus*, *Aulactinia stelloides*, and *Gemmaria isolata* are new. The fact is also recorded that *Aulactinia stelloides* passes through an Edwardsia stage when eight nusenteries are present and the longitudinal muscles are arranged as in that genus.

ENTOMOLOGY.[1]

OBSERVATIONS ON ANTS, BEES, AND WASPS.[2]—Sir John Lubbock has published the eleventh part of his observations. He is of opinion that, though there may be nests of *Formica sanguinea* without slaves, an experiment which he has made seems to indicate that the slaves perform some important functions in the economy of the nest, though it is not yet determined what that function exactly is.

With regard to Ant-guests, he points out that Dr. Wasman has confirmed his observations, in opposition to Lespès, that, while ants are deadly enemies to those of other nests, even of the same species, the domestic animals may be transferred from one nest to another, and are not attacked. Attention is next drawn to Professor Emery's observations on mimicry among ants.

With regard to the color sense, Professor Graber has confirmed Sir John's observations on Ants and Daphnias, by

[1] This department is edited by Prof. J. H. Comstock, Cornell University, Ithaca, N. Y., to whom communications, books for notice, etc., should be sent.

[2] Journ. Linn. Soc. Lond., xx., (1888) pp. 118-36. 1889.

which he showed that they are sensitive to the ultra-violet rays, by similar observations on earth-worms, newts, etc. Light was found to act on decapitated earth-worms, though the differences were not so marked; the same held good for newts, when their eyes were covered over, and Graber hence concludes that the general surface of the skin is sensitive to light. Forel has made some observations on ants, the eyes of which were carefully covered by opaque varnish, so that they were rendered temporarily blind.

From experiments made with Platyarthrus, which have no eyes, the author found that they made their way into the shaded portion of a partly covered nest, and he remarks that it is "easy to imagine that in unpigmented animals, whose skins are more or less semitransparent, the light might act directly on the nervous system, even though it could not produce anything which could be called vision."

Sir John's experiments lead him to differ from M. Forel, who believes that bees have a certain sense of direction. The power of recognizing friends is discussed at some length, but the explanation of the fact still remains obscure. The most aged insect on record is a queen of *Formica fusca*, which lived for fifteen years; what is much more extraordinary is that she continued to lay fertile eggs; fertilization took place in 1874, at the latest, and there has been no male in the nest since then, so that the spermatozoa of 1874 must have retained their life and energy for thirteen years.

The seeds of *Melampyrum pratense* are, as Lündstrom has recently pointed out, closely similar to the pupæ of ants, and he has suggested that this may be an advantage to the plant by deceiving the ants, and thus inducing them to carry off and so disseminate the seeds. The author's own observations show that *Formica fusca* appears to take no notice of these seeds, but that, under certain circumstances, they are carried off by *Lasius niger*.

The observations of Mr. and Mrs. Peckham, on the special senses of Wasps, is referred to as containing conclusions which concur closely with those of Sir J. Lubbock.

A connected account of the author's observations is given in a recent work, "On the Senses, Instincts, and Intelligence of Animals, with Special Reference to Insects,"[1] which will be found useful as a handbook of the subject with which it deals. —*Jour. Royal Micr. Soc.*, 1889, p. 49.

BASAL SPOT ON PALPS OF BUTTERFLIES.[2]—Herr. E. Reuter states that in all the species of butterflies (between two

[1] 8vo, London 1888, 292 pp., 118 Figs.

[2] Zool. Anzeig. xi., (1888) pp. 500-3.

and three hundred) which he has examined there is at the base of the inner surface of the palps a naked spot which can be always easily seen. He consequently regards it as typical of the order.

It is generally well defined and ordinarily occupies the basal half of the first joint of the palp. The rings or furrows discovered by Landois are always present, though often indistinct or incomplete. When present, they ordinarily occupy the greater part of the basal spot, and are more or less parallel. They are best developed on the part of the surface which, in the natural position of the palps, is directed upwards and inwards; it is this part which is most commonly pressed against the basal part of the proboscis, which is provided with a raised ridge.

In addition to these rings there are peculiar forms of hairs which do not seem to have ever yet been described. They are conical in form, chitinous, are surrounded at their base by a circular membrane; they are all connected with nerve-fibers, on which, just before they enter the cone, a ganglionic swelling can be seen. There are several hundreds of these cones, and, in addition to them, there are immense numbers of similar, but much smaller, conical bodies. In the Micro-lepidoptera there are sometimes also pits or pores, and sometimes these are alone present.

There can be no doubt that we have here to do with specific sensory organs, but what is the special sense we do not know. The author is inclined to think that it is of an olfactory nature. The cones exhibit the greatest variability and highest grade of development in the Rhopalocera, and their variations may be of use in the definition of families and genera. In the Butterflies proper, the organ in question is always much larger and better developed in the male than in the female.—*Jour. Royal Micr. Soc.*, 1888, p. 943.

PARASITE OF COSMOPOLITAN INSECTS.—Under the title of "A Commencement of the Study of the Parasites of Cosmopolitan Insects,"[1] Mr. L. O. Howard gives a list of nearly 100 insects, common to the Old World and the New, together with a list of the European parasites of each, and a second list of the American parasites of each. This paper presents us with a large amount of information in a very compact space, and we hope it is only a forerunner of a more extended paper by the same careful author.

As illustrating the practical use that can be made of infor-

[1] Proc. of the Ent. Soc. of Washington, Vol. i., pp. 118-36.

mation of this kind, Mr. Howard gives the following interesting illustration :

"The Hessian Fly has been very destructive for two years past in England, and the question has been, and it is an important one, whence did it come? Two important wheat-growing districts furnish England with much of its grain, *viz.*, North America and Russia. Now it happens that within a few months of each other Dr. Riley monographed the North American parasites of this insect, and Dr. Lindemann the Russian parasites. No accurate way of fixing the source of the English supply was found, until Dr. Riley, on his recent trip to England, discovered that the parasites there were identical with the Russian forms, and, with one exception, specifically distinct from the American forms; the exception belonging to the Russian fauna as well as to the American. America is thus relieved from the onus, which falls on Russian shoulders."

THE EPIPASCHIINAE OF NORTH AMERICA.—Under this title the Rev. Geo. D. Hulst[1] monographs the American representations of that small group of moths of which Epipasachia is the typical genus. As to the zoological position of this group, he looks upon the Epipaschiinae as either connecting the Phycitidae with the Pyralidinae, or as the ancestral and now nearly obsolete stem from which, in different directions, the other two have arisen. He enumerates eleven genera, represented by nineteen species.

A STUDY OF THE CYNIPIDAE.—There is on our table a valuable paper on this subject, from the Agricultural College of Michigan, by C. P. Gillette. The paper is based on collections made in the vicinity of Lansing. Mr. Gillette makes many observations on the previously described species, and gives descriptions, with figures, of the galls of several new ones. A list of thirty-four species of Galls Flies, taken in this locality, and of the parasites bred from them, is appended to the paper.

COLEOPTEROUS LARVÆ AND THEIR RELATIONS TO ADULTS.—The present paper is the first of a series of investigations which it is my purpose to carry on in connection with the larvæ and their relations to adults. My studies are confined to the post ovarian stages, and in this discussion the term larvæ is used to indicate such conditions only. It is my purpose to inquire into the origin of larval forms, both ancestral and acquired, and to compare the results of the study of

[1] Entomologica Americana, Vol. v., pp. 41-52, 61-76.

the larvæ of the various groups of the animal kingdom with the results of the study of adults. The following questions are among those for which an answer is sought:

To what extent are larval forms representatives of ancestral stages in the history of animals, and to what extent are they adaptations on the part of the larvæ, and therefore secondary?

How far is it possible to assign reasons for the larval departures from ancestral type?

Has the larval departure from an ancestral type, where it has taken place, occurred in numerous individuals simultaneously, or have the variations appeared in one individual and then been transmitted from it to a long line of posterity.

Have the forms and habits of the adult any direct influence on the larvæ, or those of the larvæ on the adult?

Are larvæ reliable as a basis of classification.

Are larvæ of any value in teaching the past history of animals?

Are larvæ of any value in teaching relations?

In cases where larvæ are departures from the ancestral type, and therefore secondary, are they of any value in teaching past history or present classifications?

Are larvæ more or less variable than adults?

Are adaptive larval characters inherited by succeeding larvæ?

The present paper is the result of the study of the larvæ of beetles, this group being first selected as showing the greatest amount of variation within a single order. As a starting point a Campodeoid form is taken. This is the most widely distributed, and has frequently been pointed out as the closest representative of the ancestral insect living at the present day. Starting with the Campodeoid type the different families of beetles have been studied as far as is possible with our present knowledge of them. The following are the most important points presented by the study of this group.

1. With the exception of the Campodeoid type of larvæ, which is found in a number of families, all beetle larvæ are secondary modifications which have been introduced during the larval life of the beetles, and have never been represented by any adult features. They are, therefore, of no value in teaching the history of beetles except in their larval stages. They do not represent ancestral stages. They may, however, and frequently do, teach relationship, since the presence of a similar larva may indicate a recent common ancestor.

2. It is possible, amid the immense variety of larvæ, to rec-

ognize four somewhat distinct types: the Campodeoid type, a type slightly and variously modified from the Campodeoid type, a Scarabid type, and a maggot-like type, like that of the weevils. In many cases it is possible to determine definitely the sort of conditions that have produced the present type.

3. The division of larvæ into types seems to have no relation to the classification of adult insects into sub-orders. None of the classifications of adult beetles into sub-orders runs in any way parallel to the natural division of larvæ into groups. The classification of the families of larvæ does, however, run parallel to the classification of the families of adults, so that it is usually possible to tell from the structure of a larva to what family it belongs. To this rule there are many exceptions, some of which are easily explained by differences in habit. The exceptions are most common in the low, degraded types of larvæ. The classification of families into sub-families and genera seems also as a rule to run parallel with the classification of adults, though there are many exceptions to this rule. The exceptions are such as to indicate that in some cases the adult classifications are at fault, and in other cases that there is really no parallel between the two stages. From this we can draw the conclusion that the present larval types of beetles are about as old as families but not much older.

4. The amount of departure from the primitive larval type that any family of beetles presents, is no indication of the position in the scale of classification that the adults should occupy. At least this is true if we accept the classsification of adults recognized at present by our entomologists.

5. Family characteristics are usually well marked in the larvæ. Generic characteristics are also usually quite definite; specific differences are usually very small and do not seem to be very constant.

6. There is in most cases an evident relation between the habits of the larvæ of a family and those of the adults. This indicates that the habits acquired by one stage have subsequently had their effect on the habits of the other stage. It seems probable that in beetles the larvæ has been the first to modify its habits, and that the adult has subsequently acquired habits related to it. The larval stage seems thus to be more important than the adult; at all events it is more thoroughly protected, and is the first to be adapted to suit its surroundings.

7. The larvæ of beetles are much more diversified than their adults.

8. Although habits and the conditions that surround the larvæ have been very important features in the production of the present larval forms, some other force has been at work in producing, or rather in retaining them. For we find a great variety of larvæ at the present time with almost identical habits. This other force is undoubtedly heredity, which has frequently proved stronger than the modifying effect of the environment.

9. Beetle larvæ cannot be classified by the same characteristics used in classifying adults. The shape of the antennæ has no significance in the classification of larvæ, since it is almost uniform throughout the order. The shape of the legs, the number of tarsi, the shape of the coxal cavities, are of not much more value. The mouth parts seem to be of a little more value, and are of far less value in classification than they are in the adults.

10. The mouth parts of beetle larvæ, even in the typical Campodeoid form, are not Campodeoid in type, but approximate rather closely to those of the adult beetles. No traceable similarity can be found between the mouth parts of any particular family of larvæ and those of the adults of the same family, beyond the general similarity sometimes produced by like habits. It is true, however, that the mouth parts of all beetle larvæ are more like those of adult beetles than they are like those of any other order of insects. This is probably an example of what Hyatt and Cope call concentration of development, and which is elsewhere called precocious inheritance. It is an instance where the characters of the adult have been impressed on the larval stages.

11. In beetle larvæ we have quite a number of cases in which a similar larval type has been acquired independently in two or more families.

The above conclusions apply only to the group of Coleoptera, and while some of them will doubtless be found equally true of other orders of insects, some of them are probably peculiar to beetles.

This paper was discussed by Professors Hyatt, Putnam, and Fernald, and by Messrs. Sargent and Jackson.—*H. W. Conn, in Proceedings of Boston Society of Natural History*, Vol. xxiv., December, 1888.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island, Nov. 10, 1888.—This being the annual meeting, officers for the ensuing year were elected as follows: President, L. P. Gratacap; Treasurer, Samuel Henshaw; Recording Secretary, K. B. Newel; Corresponding Secretary, Arthur Hollick; Curator, W. T. Davis.

December 8, 1888.—Mr. L. P. Gratacap read the following paper upon the "Relation Between the Growth and Form of Leaves:"

It is obvious that the form of leaves must be the resultant of rates of growth in various directions. That a simple leaf with a single midrib will assume such a mature form as will express the equilibrium of the growing impulse along two axes, a longitudinal and a lateral one, and that as this ratio varies in favor of the first or the second, the leaf becomes ovate, circular, broadly elliptical, etc., or lanceolate, linear and elongated. And secondarily, in the case of the simple leaf, the point of intersection of the axis will modify the final form. If the lateral axis is developed at an early stage in the elongation of the midrib we have ovate leaves, if at a point half way along its length elliptical, if at the distal extremity obovate. And in leaves of a complex structure, whether palmate, pinnate or numerously veined with woody and rigid vascular fibres, we can resolve the entire form into a group of simple forms, wherein we may study the related rates of development in lamination (formation of parenchyma), and in vasculation (formation of ribs, veins, etc.). In other words, the rapid movement forward of rib cells would appear to interfere with or prevent the making of the leaf lamina, and their slow movement to assist it. In a leaf with several ribs the slow progress of the rib-making permits the coalescence of the marginal tissues, and forms polygonal and crenate circular leaves, and also tends to introduce bifurcation and deliquescence of the original fibre bundles. In one where the extention of the ribs is rapid this coalescence is checked and the leaf is sinuate, lobed, irregular and pinnatified.

It is thus apparent that a determination of the *actual* rate of growth in leaves may throw some light or be useful in assisting speculation as to the origin of leaf forms And it is also apparent that there might be a condition of things exactly the reverse of our supposition given above, and yet produce the same result. That is, a linear leaf might be a, so to say, slowly made leaf as well as a quickly made leaf, if the movements of its parts maintain a ratio which gives extension in length and not in breadth. And in many cases of turgid and dense tissues in leaves this is probably so.

However the measurement of a number of leaf growths including those of Morning-glory, Musk-melon, Water-melon, Maples, Magnolia. Peach, Japanese Quince, Five-finger, etc., made this year on Staten Island, do seem to show that the elongated leaves grow much the more rapidly, that the palmate and pinnate leaves stand next in order, and the circular and traverse leaves last. [A diagram was here presented showing these results, in part, with the rate per day of growth; also the slowly diminishing rate of growth of the leaf as it approached completion.]

Of course a number of considerations occur at once to modify the wholesale use of this conclusion. The relative size of the leaves compared should be similar, the condition or healthfulness of the plants alike, the nature of the plant tissue nearly the same, and the position and aspect of the leaves as regards favorable or unfavorable conditions for growth identical. The subject is suggestive and carefully followed up might lead to interesting results.

Mr. Arthur Hollick showed fossil leaf impressions in ferruginous sandstone, found near Arrochar station by Mr. Gilman S. Stanton. They are undoubtedly from the same formation as those from Tottenville (Cretaceous?) described in the Proceedings of December 8, 1883, and like them, were not in place where found, but occurred in Drift rocks. The specimens are too fragmentary for determination, but the fact of their discovery at this new locality is a matter of interest and is therefore placed upon record.

Specimens of bowlder clay from the same locality were also shown. It has been lately utilized for brick making. There is a fine exposure of modified drift overlaid by bowlder drift where the railroad has been cut through.

Dr. A. L. Carroll noted the discovery on Staten Island recently of *Bothriocephalus latus*—the first reported occurrence of this parasitic worm in America.

Specimens of the "Large Mocker Nut," (*Hicoria alba*, (L.) Britton, *var. maxima*, (Nutt.) Britton.) were presented—being an addition to the local flora. They were collected by Dr. Britton near Court House station.

Adjournment at ten o'clock.

February 9, 1889.—Mr. Charles W. Leng read a paper upon "The Buprestidae of Staten Island," illustrated by specimens of the species mentioned.

It is thought that the larvæ of many species take years to perfect their growth and an instance is recorded of a *Buprestis* emerging from the wood of a desk that had been in use for 20 years. One of our commonest species, *Chrysobothris femorata* is, however, said by Packard to complete its transformations in twelve months, so the usual period is uncertain.

This insect is found every year in numbers on oaks and occasionally other trees. I took the greatest number about 1880, when Mr. Davis and I found a log near Silver Lake literally alive with them. They would take short flights and lighting on the log, hide in the crevices of its bark, which by their color and deep wrinkled furrows they simulate to a degree. Many other species have this restless habit of flying from place to place, and on the wing, look and buzz very like flies.

Two species of *Agrilus* are also abundant—*ruficollis* and *otiosus*—the first usually on wild blackberries and the second on a variety of young saplings. When the trees around Martling's Pond were cut down about three years ago, a growth of saplings sprang up on which the species of *Agrilus* were quite plentiful, and besides many *otiosus* an occasional *bilineatus* or *interruptus* was found.

I have never found any of our other species in great numbers. Of the *Anthaxia* all my specimens have come from a clump of wild cherry in the Clove Valley. *Chalcophora* is said to breed in pine, but a good deal of beating has yielded little. The species have been found washed upon the beach, and one specimen of *liberta* was taken by Mr. Davis flying at Watchogue. Two species of *Brachys* occur on the leaves of certain oaks, and I have found them in North Carolina in great numbers. Probably they will be found abundantly somewhere on Staten Island.

Chrysobothris azurea was a notable capture of 1886, and is everywhere counted a rare insect, but from May to July of that year it was plentiful on a species of dogwood in a thicket now burned over and turned into "Prohibition Park." The house, built, as I am told, for the dominie, stands just above where the first was taken. The beetles were very quick in their movements, and were captured by beating the trees over an umbrella, out of which they flew again as soon as they touched it. Several were observed resting on the main stems of the young trees, with the anterior legs extended, and the last ventral segment touching the bark, and they were probably females depositing their eggs. None have been found since 1886, nor have I been able to find the larvæ in the few trees that are left.

SCIENTIFIC NEWS.

The Trustees and Director of the Marine Biological Laboratory are now forming a permanent and somewhat extensive library for the use of workers at Wood's Hall. They have received already a gift of money sufficient to secure a very considerable nucleus of sets of biological journals and other standard works, to which they now desire to add also monographs and special contributions. As members of the Committee on the Library, we venture to ask that you will send to Dr. C. S. Minot, Harvard Medical School, Boston, Mass., any copies of your own publications, as well as any duplicates or other books, etc., which can be spared from your own collection of biological works, and which you are willing to present to the Laboratory. All works received will be promptly acknowledged and duly catalogued.

C. S. MINOT,
W. T. SEDGWICK, } *Committee.*
C. O. WHITMAN,

BOSTON, *Feb.* 23, 1889.

AUDUBON MONUMENT COMMITTEE.—About a year ago we called attention, by means of a circular letter, to a project for erecting a monument to the illustrious naturalist, JOHN JAMES AUDUBON, and requested contributions for that purpose, the expense of the design adopted being estimated at from $6,000 to $10,000.

We have now received about $1,000, and rather than obtain the remaining sum in New York City—as our plan has been from the first to make the Monument a national one—we again call your attention to the matter.

In order to encourage subscriptions, we have obtained reproductions from the best portrait of AUDUBON extant, and will send these, of a size suitable for framing, *to every contributor to the* fund of *one dollar or more.*

Remittances should be sent to the undersigned.—*N. L. Britton, Secretary and Treasurer, Columbia College, New York City.*

The Dutch East India government grants annually $30,000 for the support of the Botanical Garden and Laboratory at Breitenzorg, Java.

It is proposed in Norway to start another North pole expedition in 1890, under the leadership of Dr. Fridjof Nansen.

THE NAUTILUS, a sixteen-page illustrated, octavo, monthly journal of Conchology will take the place of the *Conchologist's Exchange* formerly published by Wm. D. Averell, and will be the successor of that paper.

It will be under the editorial management of Mr. Henry A. Pilsbry, Conservator of the Conchological Section of the Academy of Natural Sciences, and the successor of the late Mr. Tryon in the publication of *The Manual of Conchology.—William D. Averell, Mount Airy, Philadelphia, Pa.*

Prof. A. C. Haddon, whose journey to the Antipodes has already been noticed in these pages, is engaged almost as much in anthropological as in zoological investigations. He was recently in Thursday Island, where he finds that the young men know nothing of ancestral conditions, and if observations be not made soon with the aid of the old men it will soon be too late. He will later go to the Louisiades and the neighboring islands, and then again to New Guinea. He will probably stop but a short time in Ceylon.

At a recent meeting of the Academy of Sciences of Paris, Prince Albert of Monaco drew attention to the fact that vessels running short of provisions might obtain food sufficient to support life indefinitely if provided with apparatus for collecting the surface swimming forms.

Dr. Heinrich Alexander Pagenstecher, director of the Museum at Hamburg, died January 5, 1889, of heart disease. Dr. Pagenstecher was long professor of zoology at Heidelberg, and while there wrote his four volumed "Allgemeine Zoologie." He was sixty-three years of age.

Dr. Whitman's *Journal of Morphology* receives, at the hands of Mr. G. P. Howes, well deserved praise in *Nature* for January 10.

M. G. Meninghini, professor of geology at Pisa since 1849, died January 29, aged seventy-eight.

Charles Brogniart has recently found fossil cockroaches of the family Mylacridæ in the Commentry formations of France.

THE

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SEGMENTATION OF THE OVUM, WITH ESPECIAL REFERENCE TO THE MAMMALIA.

BY CHARLES SEDGWICK MINOT.

THERE follows after impregnation a short pause, and then the ovum begins its process of repeated division, which is known as the "*segmentation of the ovum,*" the term having been introduced before it was known that each "segment" is a cell. The division or cleavage (Furchung) of ova was described by Prevost and Dumas, 1824, and again by Rusconi in 1836. By usage, the term segmentation is restricted to the production of cells up to the period of development, when the two primitive germ-layers are clearly differentiated and the first trace of organs is beginning to appear.

Segmentation nucleus. The impregnated ovum has a single nucleus which is known as the segmentation nucleus, and which is formed by the union of the male and female pronuclei.[1] It is the parent of all the nuclei subsequently found in the organism, and participates actively in the process of segmentation. It is very much smaller than the nucleus of the egg-

[1] Ed van Beneden in his first paper, Ascaris, **11**, affirmed that there was no real union of the pronuclei in the impregnated ova of that species, but Carnoy, **18**, showed that van Beneden's observations were incomplete, and Zacharias has stated, **50**, that they are so defective as to be fundamentally erroneous in regard to important phases, and he points out that in reality the eggs of Ascaris offer another proof of the actual union of the pronuclei. The impregnation in this Nematod has since formed the subject of numerous articles, see van Beneden and Neyt, **12**, Carnoy, **182**, Boveri, **15**, etc., etc.

cell before maturation; it is usually membranate, and has numerous fine granules of chromatine, *microsomata*, derived from the pronuclei; in some cases the microsomata from the male pronucleus are distinguishable from those of female pronucleus. In the rabbit the nucleus when first formed has indistinct contours, an irregular shape and a homogeneous appearance (Ed van Beneden, **8**, 699,) it soon enlarges, becomes regular, and acquires a distinct, centrally situated nucleolus, (Bischoff, **14**, 50, Coste **17**, Lapin Pl. ii. fig. 4,) presumably by the gathering together of the microsomata.

The position of the nucleus is always eccentric[1] so far as known, and approximately if not exactly the same as that of the egg-cell nucleus before maturation; accordingly, the degree of eccentricity varies as the amount of yolk or deutoplasm being least in alecithal and greatest in telolecithal ova. In brief, it may be said the nucleus tends to take the most central position possible with regard to the protoplasm of the ovum. The vitelline granules are not to be regarded as protoplasm, hence their accumulation may produce a one-sided distension without, however, in the least disturbing the uniform *radial* distribution of the protoplasm. The nucleus is surrounded by protoplasm with few or no yolk grains; in telolecithal ova the perinuclear accumulation is the court of protoplasm at the animal pole.

Period of repose. After the segmentation-nucleus is formed, there occurs a pause, which lasts according to observations on several invertebrates, from half to three quarters of an hour. It is probable that a similar pause ensues in the mammalian ovum, but there are as yet no observations to show whether it occurs or not. During this period the yolk expands slightly, unless, indeed, the expansion observed is due to the influence of hardening agents[2] and the monocentric radiation, which is present when the nuclei copulate, gradually fades out, and is

[1] It is often stated that the nucleus lies exactly in the centre, but I have been unable to find a single observation to justify the statement.

[2] Van Beneden states that osmic acid produces an artificial expansion of the ovum within the zona

replaced by a dicentric radiation which marks the end of the period of repose and the commencement of the first division of the ovum.

Karyokinesis of the ovum. Segmentation is a process of indirect cell division, and nowhere are more perfect karyokinetic figures to be found than in the segmenting ovum. It is, therefore, advisable to give a general account of the changes involved in every division, but inasmuch as karyokinesis is a phenomenon by no means restricted to embryonic cells, it is not one of the special subjects of the embryologist. I shall, therefore, attempt only a summary account, following in the main, O. Hertwig, **26**, 37-38, (compare Rabl's exhaustive memoir, **37**.)

It is probable that the resting nucleus has one pole at which the connection between the reticulum of the nucleus and the surrounding protoplasm is more intimate than elsewhere, as suggested by Rabl, **38**. This pole is marked by a clearer spot outside the nucleus, close against it and much smaller than it. This clear spot becomes the centre of the radiating arrangement of the protoplasm. It was, I believe, first observed by Flemming in the eggs of Echinoderms, has been seen in *Ascaris megalocephala* by van Beneden and Neyt, **12**, and by Boveri, **15**, in Siredon by Kolliker, 28, and in other cases. It is now designated as the sphere of attraction,[1] and is seen, at least in certain phases, to contain a separate central body (centrosoma of Boveri). It is not improbable that the "sphere of attraction" is identical with the *Nebenkern* of recent German writers. In a number of instances a small part of the nucleus is seen to separate off and to lie as a distinct body, *Nebenkern*, alongside the nucleus; this body has a colorable portion which is comparable to the "centrosoma." For an account of the scattered observations on the *Nebenkern*, together with the relation of these bodies to Gaule's so-called cytozoa, see G. Platner, **34**,

[1] The history and significance of the spheres of attraction as here presented cannot, by any means, be regarded as final. The observations are few, and in *most* cases the exact history of the spheres of attraction has received no attention from investigators whatsoever.

for additional observations see Prenant, **35**, and Platner, **34a.**

The sphere of attraction divides, as does also its central body, and its two parts move to opposite sides of the nucleus. There thus appear two opposite accumulations of clear protoplasm, from each of which as a centre, astral rays or radiating lines are formed in the cell-body. Meanwhile, within the nucleus, changes go on; the threads of the intranuclear network radiate out from the the pole where the sphere of attraction lies before its division, and the chromatic substance forms a number of distinct grains. When the sphere of attraction divides and its halves go asunder, the nuclear substance preserves its radiating relation to each sphere, and as the membrane of the nucleus disappears during these changes, the final result of the transformation of the nucleus is a spindle-shaped body, the points of which rest just within the clear centre of each astral system, so that the spindle stretches from one protoplasmic mass to the other. The spindle consists of fine threads extending from pole to pole and having almost no affinity for the dyes of the histologist, a peculiarity which causes them to be known as the achromatic threads. These threads are probably always compounded of a considerable number of exceedingly fine fibrillæ, see Rabl, **38**, 21-22. The colorable substance forms a number of separate grains, each of which is united with one of the achromatic threads, and all of which lie at the same level in the centre of the spindle; when the spindle is seen from the side, the chromatine grains appear to constitute a central band or disc (Strassburger's *Kernplatte*) but when the spindle is seen endwise, the separate grains are at once recognized. The shape of the grains is variable; some authors, without sufficient observational proof, have advanced the opinion that the grains are *always* V-shaped. The spindle together with the polar accumulations of protoplasm and the two accompanying radiations constitute a so-called *amphiastere.*

The domain of the radiation extends, the two protoplasmatic centres move further apart, the nuclear spindle elongates correspondingly, and the chromatic grains of the *Kernplatte* divide. Flemming maintains that the division is always lengthwise of the V-shaped grain, but this has been controverted by Carnoy. How the division occurs in the mammalian ovum is unknown. By division, however it is effected, the number of chromatine grains is doubled; they form two sets; one set moves toward one pole, the other towards the other pole; the grains of each set keep at the same level as they move, until they reach the end of the spindle, where they appear as a polar disc (Carnoy's couronne polaire). Next the achromatic threads of the spindle break through and are apparently drawn in towards each polar crown. There are now two nuclear masses, each near but not at the centre of a radiation, and each consisting of chromatine and achromatic substance, each mass develops into a complete membranate nucleus, but the steps of this process have yet to be followed in detail in the vertebrate ovum.

The signs of division of the protoplasm usually become visible about the time the polar crowns are formed, but when the ovum contains much deutoplasm the division may be retarded. In the plane which passes through the equator of the nuclear spindle, there appears a furrow on the surface of the ovum, which gradually spreads and deepens until it is a complete fissure around the cell, it cuts in deeper until at last only a thin stalk connects the two halves of the cell, and thereupon the stalk breaks and the cell is divided. There next ensues a pause, during which the astral rays of the protoplasm disappears in the daughter cells, and the daughter nuclei assume each the form of an ordinary resting membranate nucleus.

The external appearances of segmentation in the living ovum vary, of course, especially according to the amount and distribution of the yolk material. The appearances in holoblastic ova with very little yolk are well exemplified by *Limax campestris*. Mark's description, **32**, is, nearly in his own words, as follows:

"In Limax, after impregnation, the region of the segmentation nucleus remains more clear, but all that can be distinguished is a more or less circular ill-defined area, which is less opaque than the surrounding portions of the vitellus. After a few moments, this area grows less distinct. It finally appears elongated. Very soon this lengthening results in two light spots which are inconspicuous at first, but which increase in size and distinctness, and presently become oval. If the outline of the egg be carefully watched, it is now seen to lengthen gradually in a direction corresponding to the line which joins the spots. As the latter enlarge, the lengthening of the ovum increases, though not very conspicuously. Soon a slight flattening of the surface appears just under the polar globules, the flattening changes to a depression (Fig. 1) which grows deeper and becomes angular. A little later the furrow is seen to have extended around on the sides of the yolk as a shallow depression, reaching something more than half way toward the vegetable or inferior pole, and in four or five minutes after its appearance the depression extends completely around the yolk. This annular constriction now deepens on all sides, but most rapidly at the animal pole; as it deepens it becomes narrower, almost a fissure. By the further deepening of the constriction on all sides there are formed two equal masses, connected by only a slender thread of protoplasm, situated nearer the vegetative than the animal pole, and which soon becomes more attenuated and finally parts. The first cleavage is now accomplished. Both segments undergo changes of form, they approach and flatten out against each other, and after a certain time themselves divide.

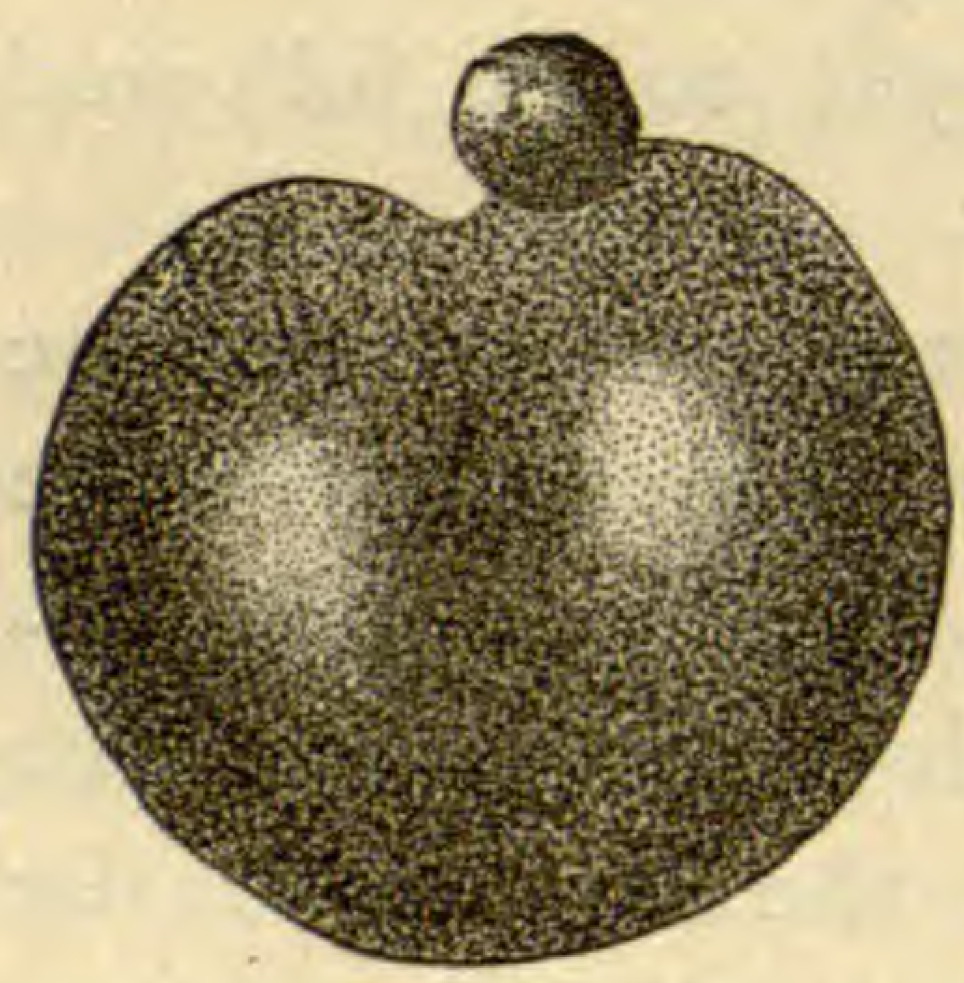


Fig. 1. Ovum of Limax campestris, during the first cleavage. Magnified 200 diameters. The envelopes are not drawn in. (After E. L. Mark.)

Primitive type of segmentation. In the lower animals there is not found that excessive amount of deutoplasm in the ovum which is so characteristic of the vertebrates, and in their ova we have what is undoubtedly the earlier and more primitive type of segmentation. In these cases the cleavage extends as in the egg of Limax, (see above) through the whole of the dividing cell. The two cells first produced are almost if not quite alike, and each of them produces two cells which are also very similar to one another; then comes a division of the four cells into eight, four of which resemble one another and differ from the remaining cells which are also similar among themselves. Four of the cells are derived chiefly from the substance of the animal pole of the ovum and are very protoplasmic; and the other four cells are constituted out of the substance of the vegetable pole and accordingly contain most of the deutoplasm of the ovum. The eight cells form an irregular spheroid, in the centre of which there is a space between the cells; this space is known as the segmentation cavity.

The four cells of the animal pole progress in their divisions more rapidly than the four of the vegetable pole, but the latter when the yolk matter is at a minimum, as, for instance, in echinoderms, do not lag much. From their unequal rates of division the two sets of cells come to differ more and more in size, those of the animal pole being much the smaller. The division of the cells take place so that the cells form a continuous layer of epithelium, one cell thick, stretching around the enlarged central segmentation cavity, (Fig. 2) and, the latter being an outside view of an Amphioxus blastula, *cf. infra;* the epithelium consists of a larger area of the small cells of the animal pole, and a small area of the large cells of the vegetable pole. This stage of segmentation is known as the blastula stage; the small cells are destined to form the *ectoderm* of the embryo; the large cells the *entoderm;* the central space is the *segmentation-cavity;* the line along which the two parts of the epithelium (ectoderm and entoderm) join is known as the *ectental line.*

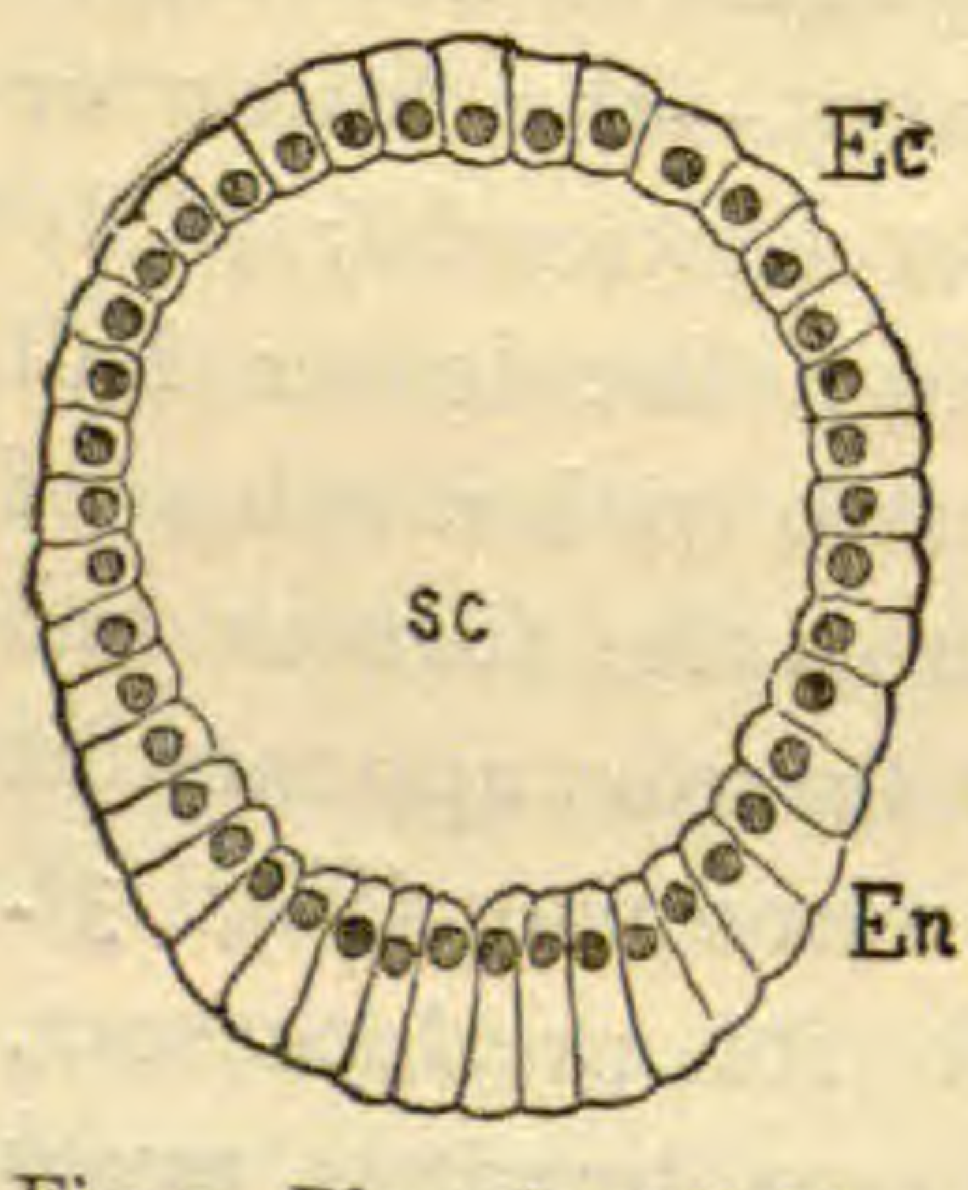


Fig. 2. Blastula of Echinocardium cordatum 20 hours after impregnation *Ec*, ectoderm; *en*, entoderm; *sc*, segmentation cavity. After Selenka.

Vertebrate type of segmentation. In the vertebrates we find that segmentation also results in two epithelia, one ectoderm and one entoderm, joined at their edges, and surrounding a segmentation-cavity, but the resemblance to the typical blastula is masked by changes in both ectoderm and entoderm; the vertebrate ectoderm when first fully differentiated consists of several layers of cells, and not merely of a single layer of cells as in the primitive type of segmentation; the entoderm contains a very large amount of nutritive material (deutoplasm) and is represented either by a mass of large cells (marsipobranchs, ganoids, amphibians) or a mass of protoplasm, not divided into cells, or but partially divided into cells, and containing an enormous quantity of deutoplasm (sauropsidans and monotremes). In the higher mammals there are further modifications as described below.

The more primitive form among vertebrates is, I think, presumably, that in which the entoderm consists of separate cells, for this mode of segmentation is the one which most resembles that of invertebrates, and it occurs in the lowest vertebrates, and in ova which are not excessively charged with yolk.

In the *primitive form of vertebrate segmentation*, which is preserved in the marsipobranchs, ganoids and amphibians, there is a well marked difference between the cells of the two poles. The following account refers especially to the frog's egg, and is an adaption of Balfour's summary (Comp. Embryl. I., 78, 79). The first formed furrow is vertical; it commences in the upper half of the ovum which corresponds to the animal pole and is characterized by the black pigment—the lower or vegetable pole being whitish. The first furrow extends rapidly through the upper, then more slowly through the lower half of the ovum, so that the divergence in the two polar rates of development is indicated already. As soon as the furrow has cleft the egg into halves, a second vertical furrow appears at right angles to the first and behaves in the same way (Fig. 3). The next furrow is at right angles to both its predecessors, and therefore parallel to the equator of the egg, but it is *much nearer the animal than the vegetative pole.* It extends rapidly around the egg and divides each of the four previous segments into two parts; *one larger with a great deal of yolk, and the other smaller with very little yolk.* The eight segments or cells

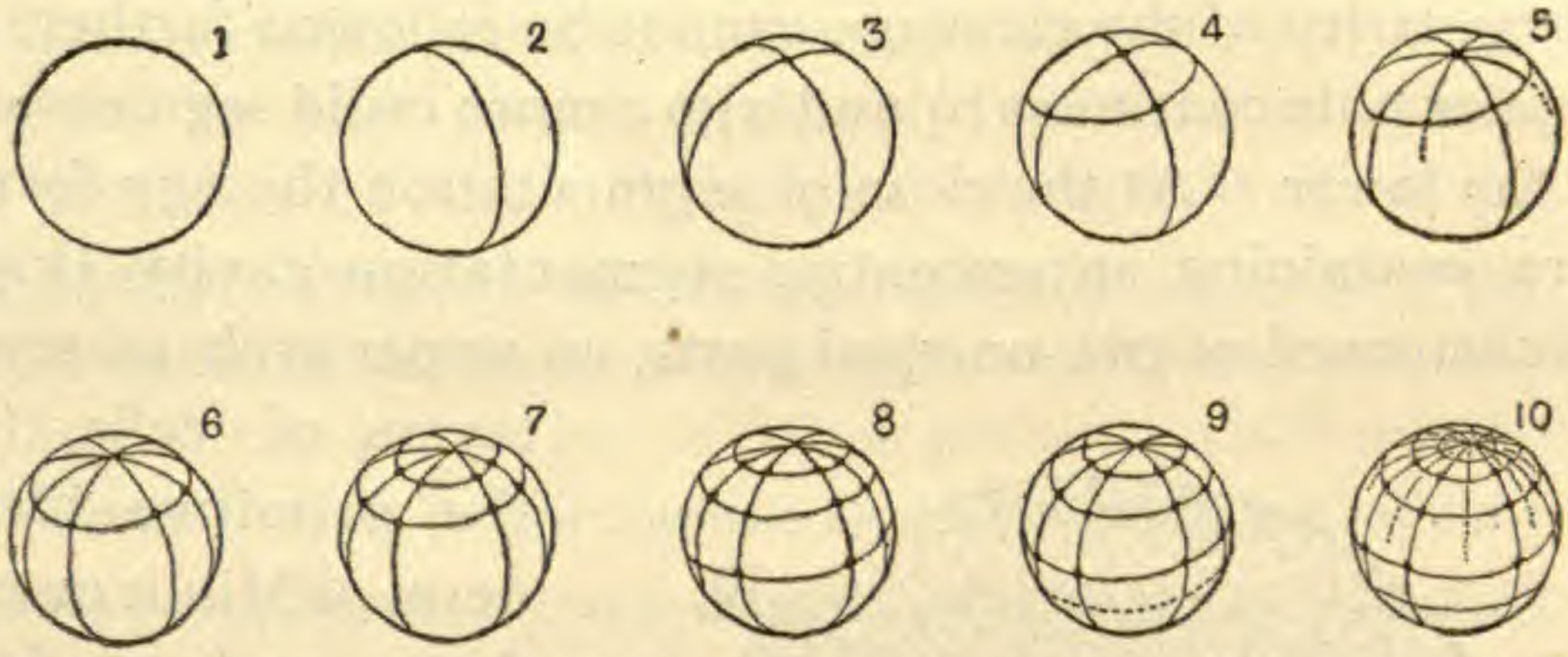


Fig. 3. Segmentation of the egg of the common frog; diagrams slightly modified from Ecker.

have a small segmentation cavity in the centre between them. This cavity increases in size in subsequent stages, its roof being formed by the small cells further divided, and its floor by the large cells, also multiplied by division, though to a less extent than the small cells. All the developmental processes progress more rapidly at the animal pole. After the equatorial furrow, there follows two vertical or meridional furrows which begin at the animal pole and divide each of its four cells into two, making eight small cells. After a short period these furrows extend to the lower pole and divide each of the large cells into two (Fig. 3, 5). The so-called *meridional* cleavages after the first and second are not truly meridional cleavages since they do not pass through the pole of the ovum, but through the poles of the cells, (blastomeres) which they divide; see Rauber, Morph. Jahrb. viii, 287.

A pause now ensues, after which the eight upper cells become divided by a furrow parallel to the equator and *somewhat later* a similar furrow divides the eight lower segments. Each of the small cells is now again divided by a vertical furrow, which later divides also the corresponding large cell. The segmentation cavity is, therefore, now bounded by 32 small and 32 large cells. After this the upper cells (ectoderm) gain more and more in number beyond the lower cells (entoderm). After the 64 segments are formed, two equatorial furrows appear in the upper pole before a fresh furrow arises in the lower, making 128 ectodermal cells against only 32 entodermal.

The regularity of the cleavage cannot be followed further, but the upper pole continues to undergo a more rapid segmentation than the lower. At the close of segmentation the egg forms a sphere, containing an excentric segmentation cavity (Fig. 4, *s. c.*) composed of two unequal parts, an upper arch of several layers of cells, (*Bl.*) the primitive blastoderm of Minot or ectoderm, and a lower mass (*Yolk*) of large cells rich in protoplasm. At the edge of the mass of large cells (*k w*) there is a gradual passage in size to the cells of the blastoderm, and it appears that the small cells receive additions at the expense of the large ones; this zone corresponds to the so-called germinal wall of large vertebrate ova, and also to what we have defined as the ectental line.

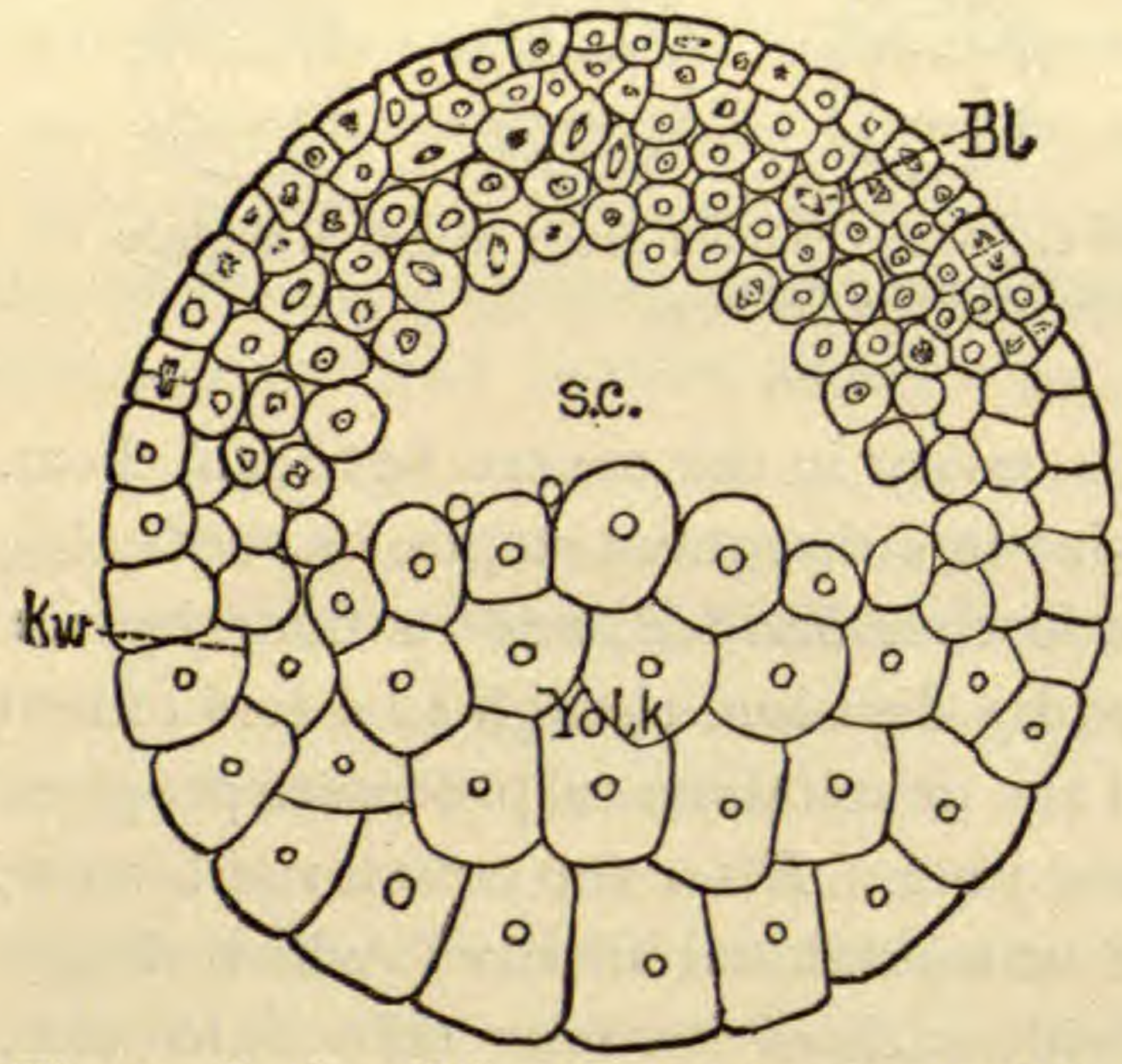


Fig. 4. Section of the segmental ovum axoloth, after Belloni, *Bl.* blastoderm; *s. c.* segmentation cavity; Yolk, yolk or entoderm; *k. w.* (keim wall) germinal wall.

The *secondary type of vertebrate segmentation* differs from the primary principally in the retarded development of the entoderm, due, apparently, to the increase of the yolk-matter. The yolk granules are, as already mentioned, found to be situated not quite exclusively, though almost so, in those parts of the ovum out of which the entodermal cells are formed. Hence, when there is a great deal of yolk the anlage of the entoderm becomes bulky, and when it segments the entodermal cells it produces are correspondingly big, as we have seen is the case in Amphibian ova. On the other hand, when the amount of yolk is small, as in the primitive type of segmentation, *e. g.* echinoderms, the entodermal cells are small. In the reverse case when the amount of yolk is exceedingly great, as in selachians, reptiles and birds, the yolk may not divide into cells as fast as the nuclei multiply, so that it seems that the presence of the deutoplasm, though it does not affect the nuclear divisions markedly, certainly impedes very much the division of the protoplasm, and consequently in these ova we find at certain stages of development a multinucleate yolk. The impediment is not encountered by the protoplasm of the animal pole, hence we see the animal pole segmenting while the yolk does not; in this case the segmentation appears confined to one portion of the ovum, and accordingly such ova are termed *meroblastic* in contradiction to the *holoblastic* ova, in which the first cleavage furrows divide the whole ovum; but the difference, it must be expressly remembered, is one of degree not of kind.

The best known example of a vertebrate meroblastic ovum is, undoubtedly, the hen's egg. The so-called yolk or "yellow" is the ovum; the white and the shell are both adventitious envelopes added by the oviduct as the ovum passes down after leaving the ovary. The segmentation begins while the ovum is passing down through the lower part of the oviduct, and shortly before the formation of the shell commences. If an ovum from the upper part of the oviduct be examined, it is found to be surrounded with more or less white (albumen). Its animal pole is represented by a whitish disk from 2.5—3.5 mm. in diameter and 0.30—0.35 mm. in thickness; this disc is known by many names— formative yolk, germinal disc, cicatricula, (Narbe, Hahnentritt, Keimscheibe, stratum s. discus proligerus). The animal pole consists chiefly of protoplasm and is peculiar only in its small size compared with the whole ovum; it contains, when the ovum leaves the ovary, the egg-cell nucleus; the ovum then matures; impregnation occursand finally segmentation begins. Viewing the ovum from above, we see the first furrow appear as a groove running across the germinal disc, though not for its whole width, and dividing it into halves; this furrow is developed in accompaniment with the division of the segmentation nucleus. The primary furrow is succeeded by a second furrow nearly at right angles to the first; the surface of the germinal disc is cut up into four segments or quadrants, (Fig. 5, A.) which are not, however, separated from the underlying substance. The number of radiating furrows increases from four, to seven or nine, when there arises a series of irregular cross furrows, by which the central portion of each segment is cut off from the peripheral portion giving rise to the appearance illustrated by Fig. 5, C; there are now a number of small central segments surrounded by large, wedge-shaped external segments. Division of the segments proceeds rapidly by means of furrows running in va-

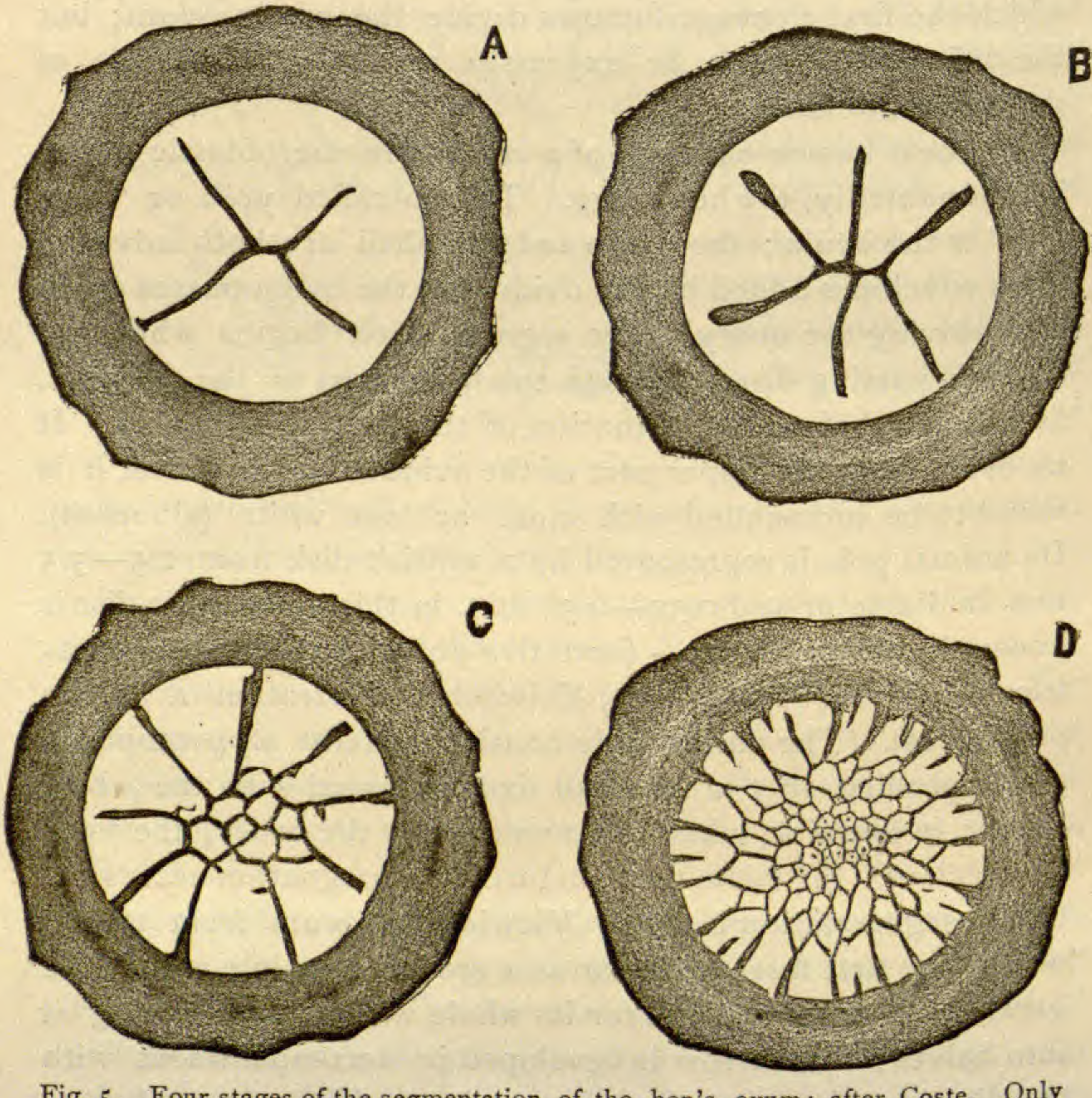


Fig. 5. Four stages of the segmentation of the hen's ovum; after Coste. Only the germinal disc seen from above and part of the surrounding yellow yolk are represented.

rious directions. Not only are the small central segments divided into still smaller ones, (Fig. 5, D.) but their number is increased also by the addition of cells cleft off from the central ends of the large peripheral segments, which are themselves subdivided by additional radiating furrows (Fig. 5, D.). Sections of the hardened germinal disc show that segmentation is not confined to the surface, but extends through the protoplasmic mass of the animal pole, there being deep seated cleavage in planes parallel to the surface of the ovum. According to Duval, **19**, when the first few, small central cells are separated off there is a small space between them and the underlying egg substance (see Figs. 2, 3, 4, 5 and 6 of his Plate I.) and this space he calls the segmentation cavity; but in this, I think, he is in error, for the cells formed below this space are incorporated in the ectoderm or primitive blastoderm; the cells referred to are those marked *im*, in Fig. 8 of Duval's Pl. I. The true segmentation cavity, as we have seen, is bounded on one side by entoderm. This fundamental characteristic Duval has entirely overlooked. From the processes described, there results a disc of cells, which receives peripheral additions; the border from which these additions come is known as the *segmenting zone*. The whole mass of cells derived from the germinal disc represents the ectoderm, and the segmenting zone may be homologized with the cells around the edge of the primitive blastoderm of the frog (Fig. 4, *k w*). A section through the segmented germinal disc shows the following relations: The blastoderm is a disc of cells; its upper layer is epithelioid, its lower layers consists of rounded cells more or less irregularly disposed; at its edge it merges into the yolk which continues to produce cells; between the blastoderm and the yolk is a fissure—the segmentation cavity; the yolk under the fissure contains a few nuclei, which have each a little protoplasm about them, but do not form parts of discrete cells.

In reptiles, the process of segmentation is very similar to that in birds. Our knowledge is based principally upon observations upon the eggs of the European lizards (*Lacerta agilis* and *viridis*) which have been studied by Kupffer and Benecke,

30, Balfour, **2**, Sarasin, **41**, Weldon, **49**, and Hofmann Archives ne'erlandaises xvi, 1881) Hofmann gives a resumé) in Broun's Thierreich vi. Abth. iii. p. 1877-1881. The process is more irregular, and small cells are budded off singly and in scattered clusters from the larger segments. At the close of segmentation the germinal disc is converted into a membrane consisting of several layers of cells and parted from the underlying yolk by a thin space—the segmentation cavity; at its edge this membrane, the primitive blastoderm, is united with the yolk, it being immediately surrounded by a segmentating zone, from which it receives accretions. The layer of the yolk immediately under the segmentation cavity contains scattered nuclei, lying singly or in clusters; each nucleus is surrounded by protoplasm; the nuclei are not all alike; some are very large round with very distinct nuclear threads; others are small and often bizarre in shape; probably the latter are budded off from the former.

In Elasmobranchs, the germinal disc is thicker, and consequently the mass of cells resulting from its segmentation cuts in quite deeply into the yolk, Balfour, Comp. Embryol. i, fig. 46, Rückert, **40**, 28. As segmentation progresses, the cells spread out into a layer, which shows the same essential relations as have been described in birds and reptiles. There is the several-layered primitive blastoderm with its edges connected with the yolk and itself overlying the segmentation cavity, the lower floor of which is formed by the multinucleate yolk the representative of the cellular yolk mass of the frog (Fig. 4, *Yolk*). The nuclei are confined to the layer immediately under the segmentation cavity, and this layer corresponds to the sub-germinal plate in teleost ova. Of the yolk-nuclei some are large, others are small as in reptiles; they are the *Parablast-kerne* of His, the *Merocyten-kerne* of Rückert.

In bony fishes, also, we find the same type, but modified somewhat. The process of segmentation has been very carefully studied by C. O. Whitman, **1**, to whom I am indebted for the accompanying semi-diagrammatic figure of the segmented ovum of a flounder. The ovum is surrounded by a vitelline membrane, *z*, from which it has slightly withdrawn, notably at the upper pole, where lies the thick cap of cells constituting the blastoderm, *Bl.*; in the stage represented, the outer layer of cells is just beginning to assume an epithelioid character; underneath the blastoderm is the well-marked segmentation cavity, *s. c.*; everywhere at the edge of the blastoderm lies the segmenting zone, *k. w.*, a ring of granular protoplasm with rapidly dividing nuclei; the cells resulting from these divisions are added to the edge of the blastoderm, which thus enlarges peripherally. The protoplasm of the segmenting zone is prolonged inwards forming the floor of the segmentation cavity; this sheet of protoplasm *s. g.*, is known as the *sub-germinal plate*. The segmenting zone is, of course, the homologue of the similar zone in amniote ova, or the so-called germinal wall, but it is quite sharply defined against the yolk and therein differs from the wall in the chick, because in the latter the germinal merges gradually into the yolk. The process of segmentation differs from that in elasmobranchs and sauropsida, in that the cleavage of the germinal disc is strikingly regular, and further in that the whole width and thickness of the germinal disc is involved in the segmentation from the very start. The segmentation in teleosts is further interesting as affording proof that all the nuclei as shown by Whitman's investigations, arise from the segmentation nucleus.

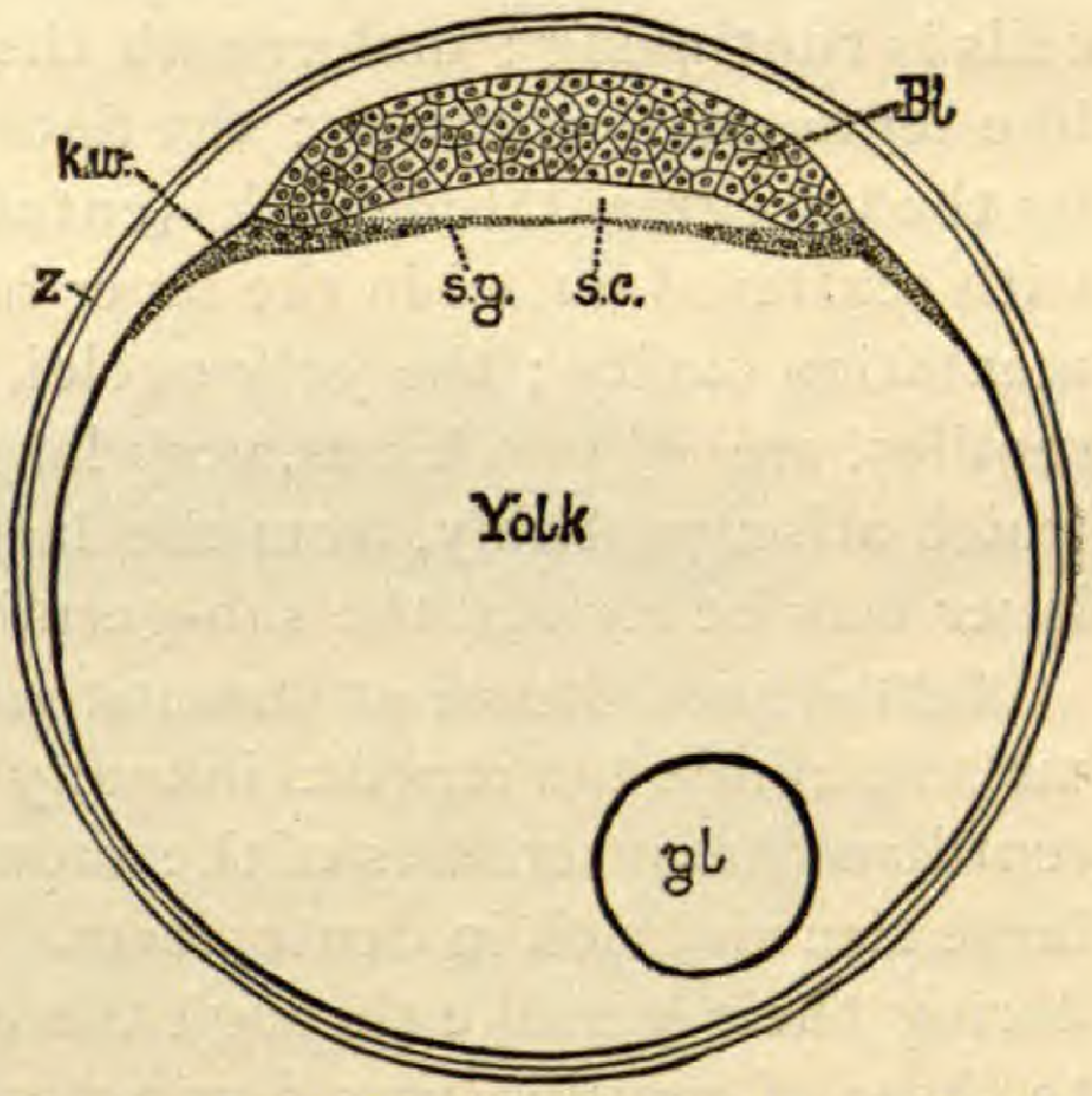


Fig. 6. Ovum of a flounder in transverse vertical section; semi-diagrammatic figure by Dr. C. O. Whitman. *z.* vitelline membrane (or zona); *k.w.* segmenting zone (keim wall); *Bl.* blastoderm or primitive ectoderm; *s. c.* segmentation cavity; *s. g.* sub-germinal plate, *gl.* oil globule of yolk.

To summarize: In vertebrate ova with a large yolk which does not divide into cells until segmentation is considerably advanced, the substance of the animal pole segments completely and produces several layers of cells (the uppermost becoming epithelioid), which are the ectoderm or primitive blastoderm ; the edge of the blastoderm touches the yolk and is surrounded by a nucleated zone in which the production of cells is continuing ; underneath the blastoderm is the fissure-like segmentation cavity ; the floor of this cavity is formed by the unsegmentated yolk (entoderm) which is furnished with scattered nuclei in the layer immediately under the segmentation cavity ; the yolk nuclei, at least in selachians and reptiles, are of two kinds, very large ones and smaller ones, which arise, probably, from the large nuclei ; the nucleated layer may be termed the sub-germinal plate.

Modified segmentation of placental mammals. The lowest mammals resemble the reptiles in many respects ; amongst other reptilian characteristics of the monotremes, we find ova of large size and rich in deutoplasm. That these ova segment during their passage through the oviduct, in similar manner to those of reptiles, was first ascertained by direct observation by Caldwell in 1884, **16.**

In marsupials and the placental mammalia the amount of yolk substance is greatly reduced and the ovum is of small size. It is, therefore, holoblastic, that is to say, the cleavage planes cut through the entire cell, as in the primitive type of segmentation, but the arrangement of the cells at the close of segmentation appears to be a direct inheritance from the reptilian ancestors of the mammals.

The segmentation of the mammalian ovum was first clearly recognized by Bischoff, though it had been previously seen and misinterpreted by Barry, **5, 6, 7 ;** very beautiful figures of segmentation in the rabbit have been given by Coste, **17.** More recently, observations have been published by Hensen on the rabbit, **24,** van Beneden on the rab-

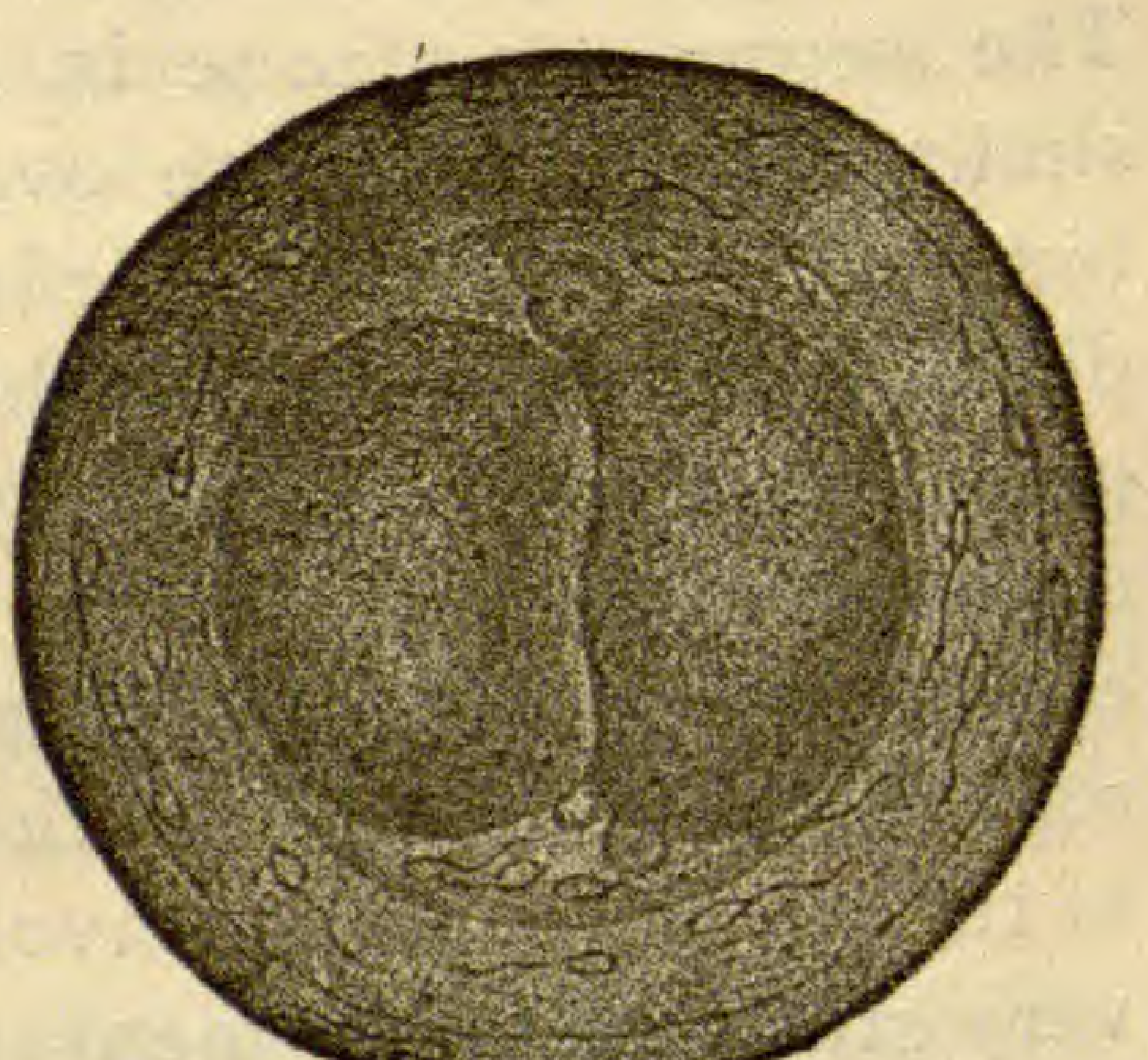


Fig 7. Ovum of a rabbit of twenty-four hours; after Coste. The first cleavage has been completed; the two cells are appressed; above the cells lie the polar globules; numerous spermatoza lie in and within the zona pellucida.

PLATE XVII.

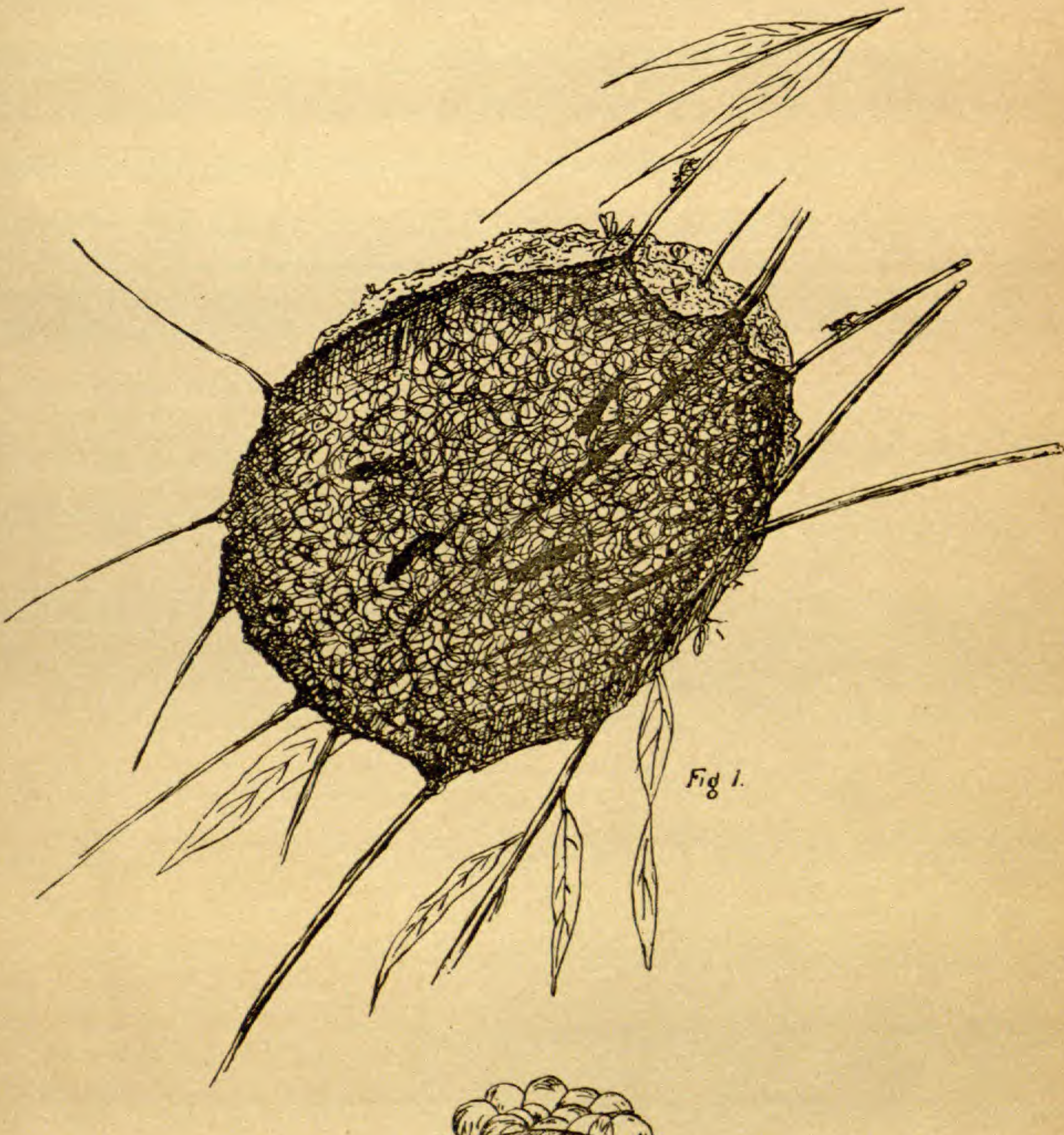


Fig 1.

Fig 2.

Nest of Arboreal Batrachian.

bit, **8, 9, 10,** Kupffer on rodents, **29,** Selenka on rodents, **44, 45, 46,** and oppossums, **47,** van Beneden and Julin on bats, **13,** Heape on moles, **23,** Tafani on white mice, **48.**

The ovum, when discharged from the ovary, is surrounded by the corona radiata, which is lost when impregnation takes place. Segmentation begins when the ovum is one-half to two-thirds of the way through the oviduct. The ovum spends about 70 hours in the oviduct in the rabbit, and about eight days in the dog. The first cleavage plane passes through the axis of the ovum which is marked by the polar globules. When first formed, the two segmentation spheres are oval and entirely separated from one another, but subsequently they flatten against one another and become appressed—a remarkable phenomenon of which we possess no explanation whatever. The second cleavage plane is also meridional.

The ovum next divides into eight and then into twelve segments, of which four are larger than the rest.

The succeeding cleavages have never been followed accurately, but from Heape's observations on the mole, **23,** 166, we know that the divisions progress with great irregularity, and is probable that the commonly assumed regularity of mammalian segmentation does not exist in nature. After a time (in the rabbit about 70 hours) there is reached the stage termed *Metagastrula* by van Beneden, **10,** 153-160, in accordance with his view of the homologies of this stage. The metagastrula consists of a single layer of cuboidal hyaline cells lying close against the zona pellucida (Fig. 8) *en;* the space within this layer contains an inner

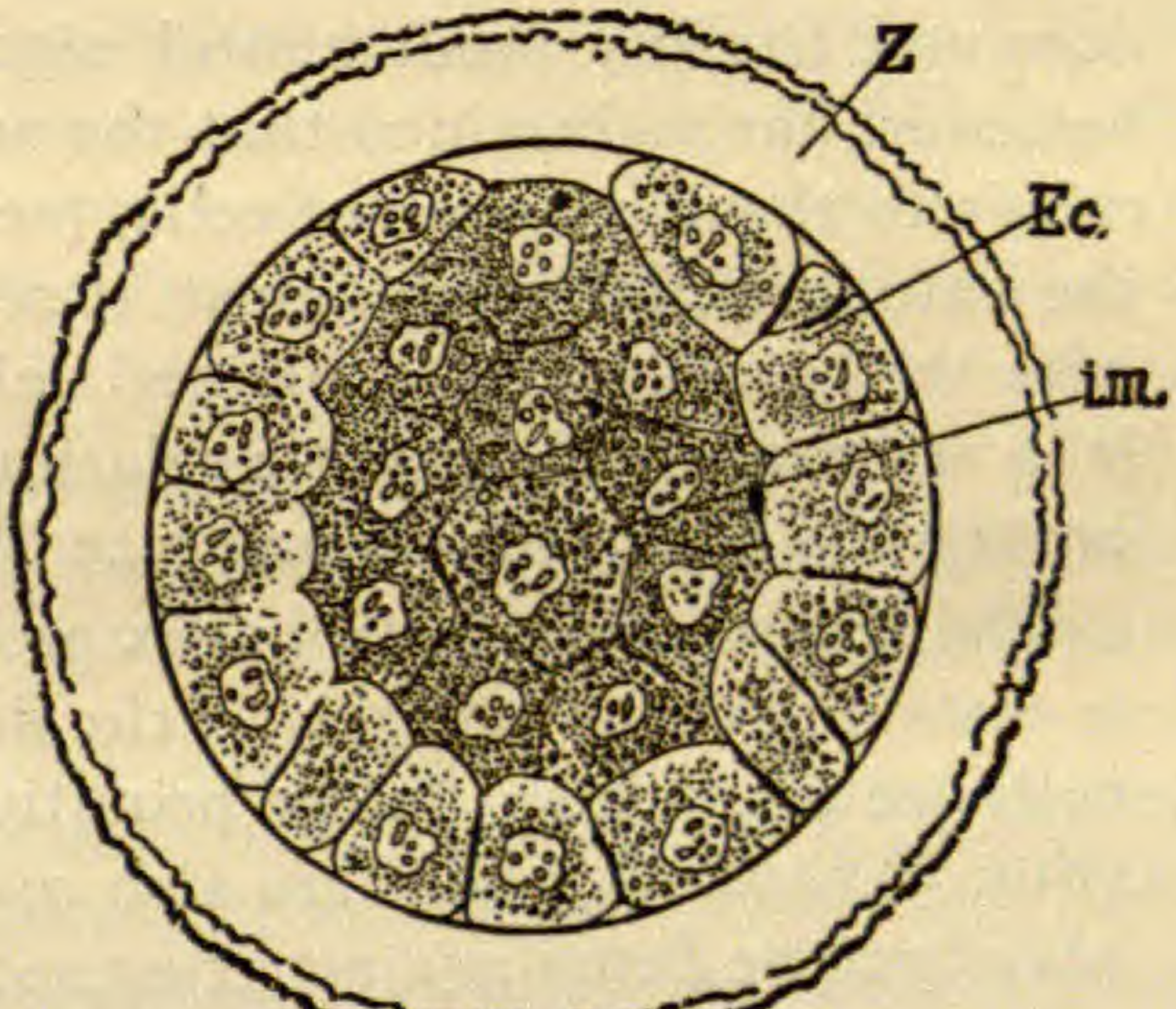


Fig. 8. Rabbit's ovum of about 70 hours; after E. van Beneden. *z.* Zona pellucida; *en.* [ento-derm; *i. m.* inner mass of granular cells.

mass of cells, *im*, which are rounded or polyzonal and densely granular. At one point the outer layer is interrupted and the space is filled by *one* of the granular segments of the inner mass (Fig. 8). The nuclei of all the cells are somewhat nodulated, and have several highly refractible granules each. The granules in the bodies of the cells of the outer layer are somewhat concentrated around the nucleus, leaving the cortices of the cells clear, van Beneden, **9,** 28-29, has observed that sometimes (21 oval out of 29) the first two segmentation spheres are of unequal size in the rabbit, and similar variability occurs in the mloe, Heape, **23,** 165 ; Tafani, on the other hand, expressly denies its occurence in white mice. It is, I think, very improbable that this difference, which sometimes occurs and sometimes does not, has any fundamental significance ; van Beneden, however, has maintained that the small cell gives rise in the rabbit to the inner mass of cells, (see below) which he terms the entoderm, but which must, it seem to me, be homologized with the ectoderm, as explained below. That van Beneden is in error, as to the genetic relation of the small cell to the inner mass has been demonstrated by Heape, **23,** 166.

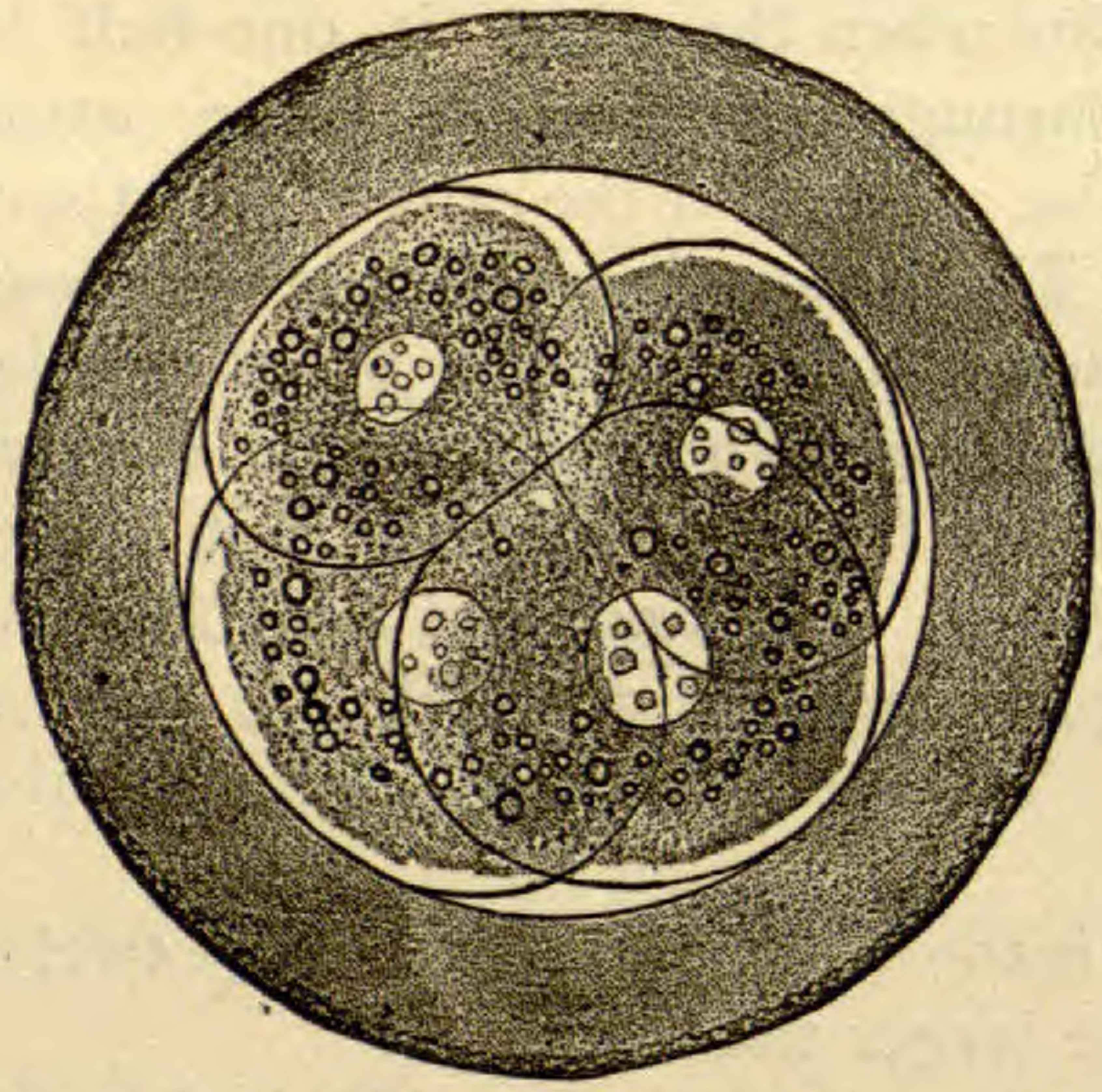


Fig. 9. Ovum of a bat, Vespertilio murina, with four segmentation spheres; after van Beneden and Julin.

The second cleavage plane is probably also meridional, and is certainly at right angles to the first, so that four similar cells are produced as in the primitive type of segmentation,[1] (Fig. 9) those four cells are also rounded at first, and probably become fitted against one another so as to produce the

[1] The distinction here made between "primitive type of segmentation" an "primitive type of *vertebrate* segmentation" should be borne in mind by the reader.

disposition observed by Tafani 1889, **48**, 116, in mice ova at this stage; Tafani describes each cell as having the form of a three-sided pyramid with the apex at the centre of the ovum and a convex base forming part of the external surface of the yolk. That the two first cleavage planes are meridional is rendered probable by the arrangement in the four cell stage observed by Selenka in the Virginian oppossum. (Fig. 10.)

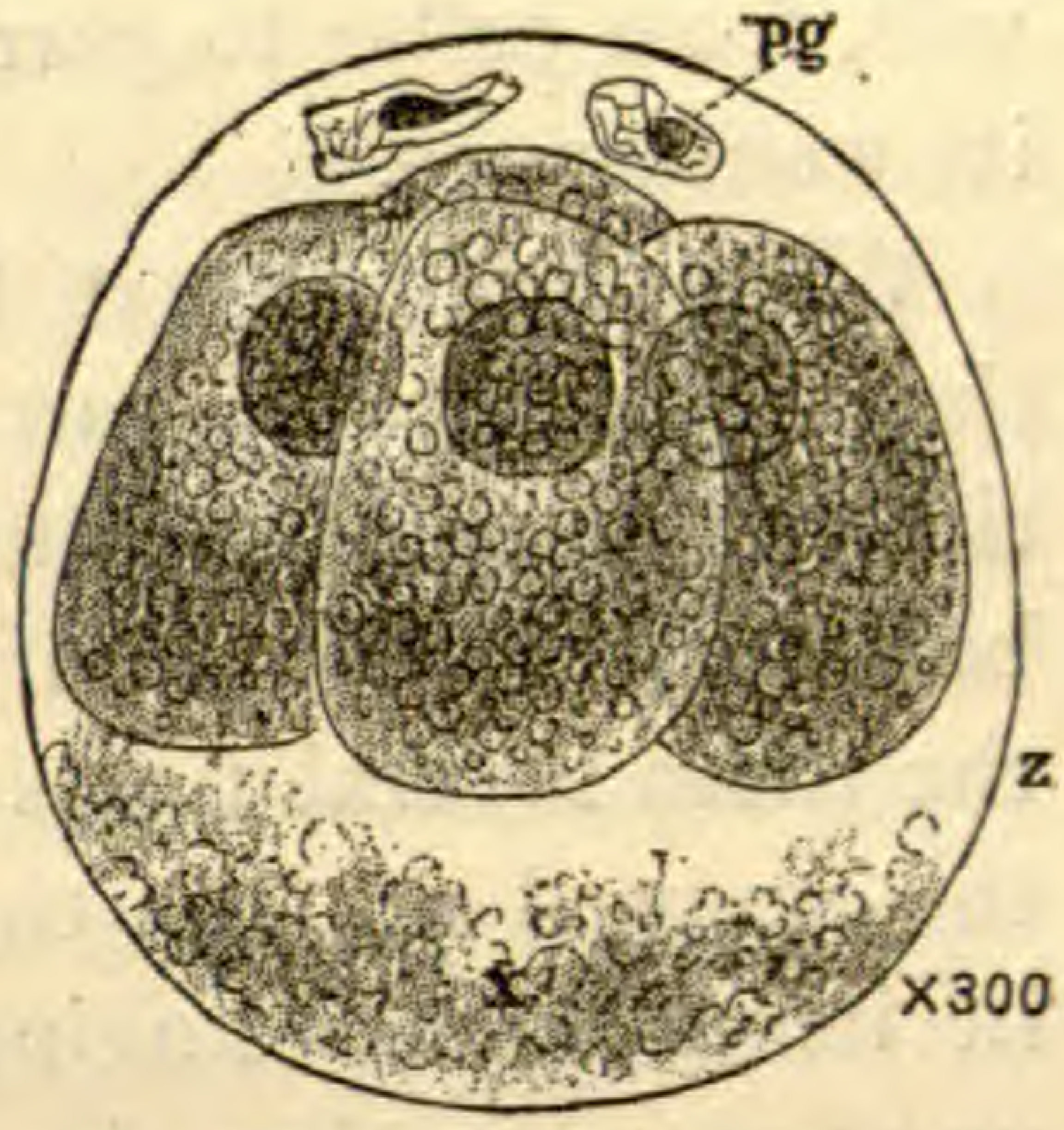


Fig. 10. Ovum of Virginian oppossum with four segments; after Selenka.

(To be continued.)

THE SONG OF THE SINGING MOUSE.

BY. WM. T. DAVIS.

IN the daily papers and in scientific journals references to singing mice are not uncommon, some relating to wild species, but generally to the house mouse. The authors of these notices usually refer to the mice as singing from happy choice, as if they greatly enjoyed their own music, and in captivity, they have been reported as singing when food was given them, or when turning the wheel, as expressive of delight and high spirits. In some cases a mouse may be able to sing at will, but I think, from the descriptions I have read, that it is generally involuntary, as it certainly was in the individual that came under my own observation.

Several years ago, in November, I heard a strange noise near some water pipes in a store room, and at first thought that one of them had broken, and that a little stream was gurgling between the walls. However, later on, this gurgling noise was found to be produced by a mouse, which ran from behind various boxes as they were, in turn, removed, keeping up a constant song. A trap was set, and after a few days the mouse was captured. In the meantime, it was heard at intervals, from cellar to garret, as this tell-tale song gave notice of its wanderings.

When removing it from the trap to the cage, and many times afterward, it ran about a small room, and the most noticeable feature on these occasions was the unvaried song, it being especially loud if I caused the mouse to scamper around the room several times without stopping. When gnawing on the exposed wood in the cage, when eating, or when disturbed in its nest, this singing was also particularly loud; in fact, upon any exertion, the song was produced, varying in volume in proportion to the amount of exercise.

On Thanksgiving day, eleven days after her capture, my mouse had two young, poor, miserable, little creatures, but, nevertheless, able to squeak and make considerable noise. It was just previous to, and for some time after the birth of these young, that *Mus* sang most continuously.

The young grew apace, and on December 14th, one was looking out of the nest, while the mother kept up a constant singing, probably being much excited thereby. At this stage the baby mice were funny little bodies, sparsely covered with hair and the dimensions of a respectable peanut. On the 19th, both of the young mice were out of the nest, and one was quite helpless, laying on his back kicking and panting after he had tumbled about the cage. I was afraid he would be unable to get into the nest again, so I rendered some assistance. However, in about fifteen minutes he was out as before, tumbling about in just the same rough manner, the mother all the while keeping up a constant singing, and alternately running in and out of the nest. After a time she picked up the little mouse by the side of the neck, carried it across the cage and put it in the nest, and I did not see it again. The other baby mouse was quite able to care for itself.

On December 21st the mother mouse ate about half of one of her offspring, commencing at the head. The one devoured was the most backward of the two, and I found the lively fellow, on this occasion, at the other end of the cage, the most distant point from his mother. I have had a full-grown *Hes-*

peromys mouse eat a large portion of one of the same species, though there was plenty of food in the cage at the time; and, as with this *Mus*, it started its cannibalistic operations with the head of its companion.

These two mice were not very good specimens as mice go. The mother was small and thin and her offspring, at first, equally miserable in appearance; but an abundant food supply finally bettered their condition. Fourteen more young, divided into four litters, were born to this musical rodent in the course of the year and seven months of her captivity, and the incidents detailed in the account of the first were repeated with slight variations. One morning it was discovered that the singer had devoured her spouse, though, be it said in her favor, he may have died first. The family was thus broken up, and the probable cause, in consequence, transferred to a bottle of alcohol, where she at present remains.

As I have said, it was the time at which the mouse was the weakest, when made to exercise greatly and breath fast, that the singing was chiefly noticeable, and I think a few quotations from some other notes on the subject will tend in the same direction. Mr. Wm. H. Edwards, in the AMERICAN NATURALIST, Vol. III., p. 551, says: "The captive seemed pleased with his quarters, and soon manifested his content at the quality and regularity of his rations by singing his unvarying tune at all hours." When ejected from his bed "he would manifest his displeasure by flying across the cage into the wheel, which he would make spin, emitting all the while his peculiar note with great shrillness and rapidity."

The Rev. Samuel Lockwood, in his note on "A Singing Hesperomys," printed in the AMERICAN NATURALIST, says: "A very noticeable fact was that a great deal of the little creature's song was poured forth while at play—that is, while in actual activity, and take the wheel-play, for instance, when really in quite violent exercise. A thing, too, which much surprised me was that often when eating she sang and eat at the same time, literally in the same breath." Mr. Lockwood thought that this last might be suggestive of a physiological difficulty, but he nevertheless gives reasons, under four heads, to disprove the disease theory, and says in the fourth that "she can sing and eat at the same time."

From the facts given above it will be observed how the circumstances under which these mice sang agreed: when ejected from bed, when eating or gnawing, and, as I have shown, when forced to run rapidly about a room, in which act there could be no pleasure. Neither was it happy feelings that prompted the song when I meddled with her babies, when she cowered at the other end of the cage, evincing all the anxiety that is usually shown by animals under such circumstances. In birds we know the cause of song for rivalry or for pleasure, but we always hear quite other notes than those expressive of pleasure, when we look at their precious eggs.

EDITOR'S TABLE.

EDITORS: E. D. COPE AND J. S. KINGSLEY.

As suggestions looking to the adoption of some flower as emblematic of our country are now being made, we present some opinions on the topic. The conditions to be satisfied are: 1st, that the flower shall be conspicuous; 2d, that it shall be available for architectural carving; and 3d, that it shall be characteristically American. These conditions exclude many plants that have been named. Propositions in favor of introduced plants, such as the Convolvulus, are out of the question. Members of the Compositæ are mostly undistinguishable in sculpture, and such forms as the golden-rod, which has met with much favor, are unavailable for architecture. The mountain laurel (Rhododendron), is objectionable, since the genus is widely distributed in other regions; and the same objection holds true of the Magnolias. The Indian Corn and the Sweet Gum (Liquidambar) are both destitute of conspicuous flowers. We wish to call attention to two species which satisfy all the conditions. These are the *Kalmia latifolia* ("laurel"), and the *Liriodendron tulipifera* ("tulip-tree"). Both are of wide distribution; both are conspicuous in various ways, and both belong to genera exclusively North American. Both lend themselves well to the sculptor's art. Between them there is little choice, but we rather lean to the tulip-tree, which, besides its conspicuous flowers and very characteristic leaves, is one of the monarchs of our woods. It thus well represents our characteristic richness in forests, and expresses, figuratively, the strength and greatness of our country.

The scientific editor of the *New York Tribune* will be probably on hand at the Toronto meeting of the American Association for the Advancement of Science, to misrepresent the science of the United States. According to this luminary, the only important scientific meeting held in America up to 1884, was that of the British Association at Montreal that year. As Toronto is not on American soil, he will probably find this year's meeting the next most important. The left-handed compliments paid by this gentlemen to American science will, perhaps, suggest to the readers of his articles that the mind of their author acts inversely as the square of the distance of its objects. We wish we could find an integration of the matter of these articles at all correspondent to the dissipation of energy wasted in writing them.

RECENT LITERATURE.

SCUDDER'S MESOZOIC COCKROACHES.[1]—On comparing mesozoic with palæozoic cockroaches the author finds the fundamental distinction is in the change which the principal nervures of the upper wings have undergone, by the basal or total amalgamation of some of them—a change which reaches its culmination in living species. In the basis of these differences he divides the mesozoic cockroaches into three groups: *a*, those in which only the mediastinal and scapular veins are amalgamated; *b*, those in which the externomedian is united with one of the veins on either side of it; *c*, those in which either

[1] A Review of Mesozoic Cockroaches. By Samuel H. Scudder. Extract from the Memoirs of the Boston Society of Natural History. 1886.

the mediastinal, scapular, and externomedian veins are all united, or there are two lines of union, one between the mediastinal and scapular, and the other between the externomedian and internomedian veins. There are fifty species (28 sp. nov.) figured and described in detail. These are referred to seventeen species, four of which are new.

LYDEKKER'S FAUNA OF THE KARNUL CAVES.[1]—This quarto, of 57 pages and 5 plates, belongs to the series of Palæontologia Indica. The author describes remains of 42 mammals, 8 birds, 5 reptiles, 1 toad, and 9 mollusks. Of the larger mammals no complete skulls were found; only detached teeth, fragments of jaws, and more or less imperfect limb bones. Of the smaller mammals skulls were found in some instances. The remarkable feature in the mammalian remains is the occurrence of a *Cynocephalus*, which may be identical with a living African species; of *Hyæna crocuta*; of a small equus, indistinguishable from *E. asinus*; and of a *Manis*, apparently identical with the existing West African species, *M. gigantea*. The author considers the occurrence of these forms extremely important in supplementing the evidence afforded by the Siwalik fauna as to the probable derivation of many of the existing Ethiopian mammals from those of the later tertiaries of India.

BRANNER'S CRETACEOUS AND TERTIARY GEOLOGY OF THE SERGIPE-ALAGÔAS BASIN OF BRAZIL.[2]—The author states that the importance of this region is due to (1) The representation of a geological range unusual in Brazil: (2) The rich fossiliferous nature of many of its beds; (3) The accessibility of good exposure across the entire section. He is of the opinion that the key to future successful geologic work in Brazil lies in the careful study and comprehension of some such typical region as that comprised in the provinces of Sergipe and Alagôas. Although much of this paper is of a statistical nature, it will be found extremely interesting by the general reader as well as by the special student.

[1] The Fauna of the Karnul Caves. By R. Lydekker, B. A., F. G. S., etc. Extract Memoirs of the Geol. Survey of India, Vol. IV., Part II. 1886.

[2] The Cretaceous and Tertiary Geology of the Sergipe-Alagôas Basin of Brazil. By John C. Branner, Ph. D. Extract from Trans. Am. Philosoph. Soc., Vol. XVI., 1889.

HULL'S GEOLOGICAL AGE OF THE NORTH ATLANTIC OCEAN.[1]—A quarto of 12 pages illustrated by 3 sketch maps and several sectional drawings. The author opposes the doctrine of the permanency of oceans and continents, held by Dana, Le Conte and Dr. Wallace, and cites facts derived from observations in the region of the North Atlantic to uphold Lyell's views of the repeated interchange of oceans and continents. He refers the date of the oceanic condition of the Atlantic area, and of the continental conditions of Eastern America and Western Europe to the close of the Palæozoic epoch.

BOULENGER'S REPTILES AND BATRACHIANS OF THE SOLOMON ISLANDS.[2]—The position of this group of islands, on the limits of two great zoological districts, renders the study of its fauna of special interest, as it is the point where many of the Papuasian and Polynesian forms intermingle. The author gives a list of all the species hitherto found in the Solomon group, with notes on the general habitats. It includes nineteen reptiles and nine batrachians, some of which are restricted to these islands. The plates are admirable in every respect; the drawing is spirited, most of the batrachians especially so. The most remarkable discovery recorded is that of the genus Ceratobatrachus Boul, a form which represents in the Firmisternial Salientia the Hemiphractus of the Arciferous line. The parallel is shown in the mandibular teeth and the huge dermo-ossification of the head. This discovery nearly completes the parallels between the Arcifera and the Firmisternia.

BENNETT AND MURRAY'S CRYPTOGAMIC BOTANY.[3]—As stated in the Introduction, "No general hand-book of cryptogamic botany has appeared in the English language since the Rev. M. J. Berkley's in 1857." In this period, almost one-third of a century, since the preparation of that famous and

[1] On the Geological Age of the North Atlantic Ocean. By Edward Hull, LL.D., F.R.S., F.G.S., Director of the Geol. Sur. of Ireland. Extract from the Scientific Trans. Roy. Dublin Soc., Vol. III., 1885.

[2] On the Reptiles and Batrachians of the Solomon Islands. By G. A. Boulenger, F.Z.S. Extract from Trans. Zool. Soc., Vol. XII., 1886.

[3] *A Handbook of Cryptogamic Botany*. By Alfred W. Bennett, M.A., B.Sc., F.L.S., Lecturer on Botany at St. Thomas' Hospital; and George Murray, F.L.S., Senior Assistant, Department of Botany, British Museum, and Examiner in Botany, Glasgow University. With 378 Illustrations. London: Longmans, Guerny and Co.; and New York: 15 East 16th Street. 1889. All rights reserved. 12mo, pp. viii., 473.

useful book, cryptogamic botany "has gone through little less than a revolution." The present work is an attempt to bring within reach of botanists an acquaintance with the present state of our knowledge of this branch of science. How fully the authors have succeeded trial alone will tell. That they have made a useful book is evident at a mere glance.

The general plan of the work may be made out from the following general subdivisions of the subject, which correspond to unnumbered chapters in the book, viz.: Vascular Cryptogamia; Muscineæ; Characeæ; Algæ; Fungi; Mycetozoa; Protophyta. As will be seen, the work begins with the higher forms and passes to the lower, a plan defended by the authors by the statement that "to the general student 'from the known to the unknown' is a very sound principle." They say, however, that, "had our purpose been to construct, theoretically, a genealogical tree for the lower forms of vegetable life, the former course (commencing at the bottom) must necessarily have been pursued, and in the labor in favor of proceeding from the simple to the more complicated types." From which one would infer that this book is useful only to the general student. It will, on the contrary, prove a useful handbook for the laboratory student, in spite of its erroneous plan. Had our authors commenced with the lower plants, and worked up from them, they would have made their book still more useful, not only to the scientific student, but in according to our observation, to the "general student" as well.

Again, it is seen that there is here a partial "reversion to the time-honored division" of the lower plants, whereby the Algæ and the Fungi are recognized as natural groups. It is only a partial reversion, however, and botanists of the old school will scarcely recognize in the modern groups, the older ones of the same names. The Algæ suffer the loss of the Characeæ, the Protococcoideæ, the Diatomaceæ, and the Cyanophyceæ, while the Fungi lose the Myxomycetes, the Acvasieæ, and the Schizomycetes, and are augmented by having swallowed bodily the whole of the Lichens.

A feature of the work, which is to be especially commended, is the very general Anglicizing of terms; *e. g. sporange* for *sporangium; archegone* for *archegonium; antherid* for *antheridium*, etc., etc.

The amount of space assigned to each group is as follows: Vascular Cryptogamy, 122; Muscineæ, 40; Algæ (in the widest sense), 174; Fungi (in the widest sense), 110. Berkeley's proportions were better; he gave to each of his groups space as follows: Filicales, 58 pages; Muscales, 77; Fungales, 185; Algales, 156. It may be remarked also that Berkeley's order is the reverse of that adopted in the book under consideration.

There are many points which might be critically discussed in this book; naturally so, because its enforced brevity compels a summary treatment, in which the names of things are not fully given. But we have sufficiently indicated the general character of the work, which will unquestionably be very useful.—*Charles E. Bessey.*

BASTIN'S BOTANY.[1]—This book is a revised and enlarged edition of Professor Bastin's "Elements of Botany," which appeared a couple of years ago. The enlargement has greatly improved what was a good book to start with, and in the volume before us we have a nicely gotten up and useful work. Following in part the older ideas, toward which there is now an evident return among botanists, the author devotes thirteen chapters to Organography, which is, in fact, the organography of the flowering plants alone. The student will be likely (unless corrected by his teacher) to get somewhat warped notions as to the vegetative organs, and the organs of reproduction in the vegetable kingdom, from these 120 pages of introductory matter.

Then follow three chapters (aggregating about 100 pages) devoted to vegetable histology, in which the cell, plant tissues, and tissue systems are discussed. About 40 pages of Vegetable Physiology follow, and the remainder of the book is taken up with a brief survey of the vegetable kingdom, from the Myxomycetes to the Spermaphytes, and two brief chapters on the succession of vegetable life. There is also a glossary of about 30 pages, and a full index.—*Charles E. Bessey.*

DYER'S FOLK-LORE OF PLANTS.[2]—This is not a botanical book, unless we interpret liberally that very liberal definition of botany which declares it to include "every inquiry about

[1] *College Botany*, including Organography, Vegetable Histology, Vegetable Physiology, and Vegetable Taxonomy, with a brief account of the Succession of Plants in Geologic Time, and a glossary of Botanical Leaves. By Edson S. Bastin, A.M., F.R.M.S., Professor of Botany, Materia Medica and Microscopy in the Chicago College of Pharmacy. Chicago: G. P. Engelhard & Co., 1889. 8vo, pp. xvi. 451, with 579 Figures in the text.

[2] *The Folk-Lore of Plants.* By T. F. Thiselton Dyer. New York: D. Appleton & Company. 1889. 12mo, 328 pp.

every plant." The book before us is written in twenty-three chapters, devoted to such topics as Plant Worship, Plants in Witchcraft, Plants in Fairy-Lore, Love-Charms, Dream-Plants, Plant Language, Plants and their Legendery History, etc., etc. A few titles have a faint botanical color, as: Plants and the Weather, Plant Names, and Plants in Folk-Medicine, but it is very faint, indeed. Under the first, which certainly admits of at least a semi-scientific treatment, we have such rhymes as

> "Sow peas and beans in the wane of the moon.
> Who soweth them earlier, he soweth too soon.
> That they with the plant may rest and rise,
> And flourish with bearing, most plentiful wise."

And

> "Many haws
> Many snaws."

And again:

> "When the aspen leaves are no bigger than our nail,
> Is the time to look out for truff and peel."

In the chapter on plant names the treatment is better, but in that on Folk-Medicine we drop into poetry again, *e. g.:*

> "Eat an apple going to bed,
> Make the doctor beg his bread."

And

> "The fair maid who, the first of May,
> Goes to the fields at break of day,
> And washes in dew from the hawthorn tree.
> Will ever after handsome be."

Now, although this is not a botanical book, and while to a botanist many of its pages seem trash, yet for those for whom it was written the work is well done, and will be welcomed by many a reader.—*Charles E. Bessey.*

GEOLOGY AND PALÆONTOLOGY.

MARSH ON CRETACEOUS MAMMALIA.[1]—Professor O. C. Marsh has been successful in obtaining the teeth and bones of a number of species additional to the *Meniscoëssus conquistus* Cope, discovered by Wortman in 1882. The remains described have been found separate and fragmentary, and they indicate several species of small size belonging to the Multituberculata

[1] Discovery of Cretaceous Mammalia. By O. C. Marsh. *Amer. Journal Sci. Arts,* July and August Nos., 1889, pp. 81-177.

and to the Bunotheria. The former are typical members of the order, while though it is at yet difficult to locate the latter with certainty, they display no dental characters not found in the Creodonta. No Condylarthra have been as yet obtained, a fact which so far indicates the distinction between the faunæ of the Laramie and Puerco epochs. Apart from this, the fossils strongly resemble those of the Puerco, and detract nothing from the supposition which I have entertained that the latter fauna belongs to the Mesozoic series. It is needless to say that the position which I assumed in 1869, that the Laramie belongs to the Cretaceous system, and is not Cænozoic, is fully sustained.

The manner in which Professor Marsh has done this work requires notice. The most superficial knowledge of the subject would have shown him that the molar teeth which he has described as representing distinct genera belong mostly to different parts of the series of the same genus, and often species, and not unlikely, individuals. Thus, supposing superior anterior molars to be regarded as typical, we have the posterior and inferior molars, and even the premolars of the same genus described under separate generic names. In his first contribution nine generic names may be, with the greatest probability, referred to two genera. One of these is the genus Meniscoëssus, known since 1882, and the other is not shown to be distinct from Chirox or Polymastodon of the Puerco fauna. Of Bunotheria the three genera are proposed on teeth from different positions in the jaws of forms which may well belong to one genus, and no evidence is brought forward to show how they differ generically from the smaller species of Sarcothraustes of the Puerco. This is not the way to advance science.

Professor Marsh states that the genus Meniscoëssus was described from a tooth which he supposes to belong to a reptile. The fact is that was founded on the molar tooth of the mammal to which Professor Marsh now gives, among others, the name Selenacodon. (See AMERICAN NATURALIST, 1882, p. 830.)—*E. D. Cope.*

NOTES ON THE ORIGIN AND HISTORY OF THE GREAT LAKES OF NORTH AMERICA.[1]—*Discovery of the ancient course of the St. Lawrence River.* Previous investigations by the author showed that there was a former river draining the Erie basin and flowing into the extreme western end of Lake On-

[1] Abstract from the Proceedings of the American Association for the Advancement of Science, vol. xxxvii.

tario, and thence to the east of Oswego, but no further traceable, as the lake bottom rose to the northeast. Upon the southern side there was a series of escarpments (some now submerged), with vertical cliffs facing the old channel. By recent studies of the elevated beaches, it is demonstrated that the disappearance of this valley is due to subsequent warpings of the earth's crust, and that the valley of the St. Lawrence was one with that of Lake Ontario. Recent discoveries of a deep channel upon the northern side of Lake Ontario (a few miles east of Toronto), and of the absence of rocks to a great depth under the drift, far beneath the surface of Lake Huron, between Lake Ontario and the Georgian Bay—and in front of the Niagara escarpment, between these lakes—of a channel in Georgia Bay, at the foot of the escarpment, and of the channel across Lake Huron, also at the foot of a high submerged escarpment, show that the ancient St. Lawrence, during a period of high continental elevation, rose in Lake Michigan, flowed across Lake Huron, and down Georgian Bay and a channel, now filled with drift, to Lake Ontario ; thence by the present St. Lawrence valley to the sea, receiving on its way the ancient drainage of the Erie basin and other valleys.

Origin of the basins of the Great Lakes. The two questions involved are the "origin of the valleys" and the "cause of their being closed into water basins." The basins of Lakes Ontario and Huron are taken for consideration. The previous paper, upon the course of the ancient St. Lawrence, shows that the Huron and Ontario basins are sections of the former great St. Lawrence valley, which was bounded, especially upon the southern side, by high and precipitous escarpments, some of which are submerged. Upon its northern side there were lesser vertical escarpments, now submerged, with walls facing the old valley. The valley was excavated when the continent was at a high altitude, for the eastern portion stood at least 1,200 feet higher than at present, as shown by the channels in the Lower St. Lawrence, in Hudson's Straits, and off the New York and Chesapeake Bays. The valley was obstructed in part by drift and in part by a north and northeastward differential elevation of the earth's surface, due to terrestrial movements. The measurable amount of warping defied investigation until recently, but it is now measured by the uplift of the beaches and sea cliffs. Only one other explanation of the origin of the basins need be considered—that of the "Erosion by Glaciers," (*a*) because the lake basins occur in glaciated regions ; (*b*) glaciers are considered (by some) to erode ; (*c*) supposed necessity, as the terrestrial warping was not known.

In reply: Living glaciers abrade but do not erode hard rocks, and both modern and extinct glaciers are known to have flowed over even loose moraines and gravels. Again, even although glaciers were capable of great plowing action, they did not affect the lake valleys, as the glaciation of the surface rocks shows the movement to have been at angles (from 15° to 90°) to the trend of the vertical escarpments against which the movement occurred. Also, the vertical faces of the escarpments are not smoothed off, as are the faces of the Alpine valleys down which the glaciers have passed. Lastly, the warping of the earth's surface in the lake region since the beach episode, after the deposit of the drift proper, is nearly enough to account for all rocky barriers which obstruct the old valley and form lake basins.

Establishment and dismemberment of Lake Warren. This is the first chapter in the history of the Great Lakes, and is subsequent to the deposit of the upper boulder clay, and therefore the lakes are all very new in point of geological time. By the warping movements of the earth's crust, as shown in the beaches—after the deposit of the later boulder clay—the lake region was reduced to sea level,and there were no Canadian highlands northward of the Great Lakes. During the subsequent elevations of the continent beaches were made around the rising islands. Thus, between Lakes Erie, Huron and Ontario a true beach was formed at 1,690 feet above the sea around a small island rising 30 feet higher. With the rising of the continent, Lake (or perhaps Gulf of) Warren—a name given to the sheet of water covering the basin of all the Great Lakes—was formed. A succession of beaches of this lake have been worked out in Canada, and from Lake Michigan to New York, extending over many hundreds—almost thousands—of miles. Everywhere the differential uplift has increased from almost zero, about the western end of the Erie basin, to three, five, and, in the higher beaches, more feet per mile. With the successive elevations of the land this lake became dismembered, as described in the succeeding papers, and the present lakes had their birth. The idea that these beaches in Ohio and Michigan were held in by glacial dams to the northward is disproven by the occurrence of open water and beaches to the north, which belong to the same series, and by the fact that outlets existed where glacial dams would be required.

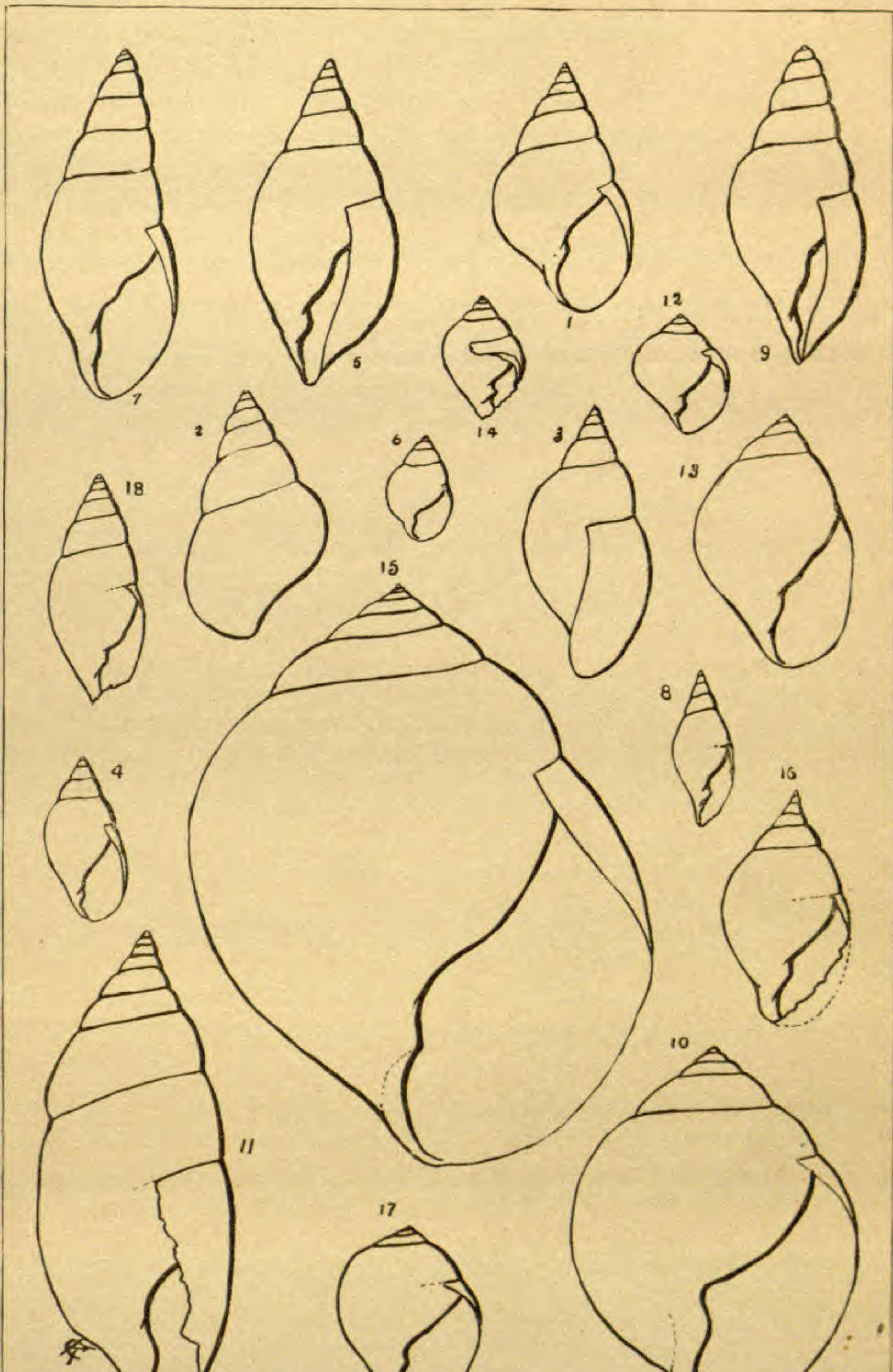
Discovery of the outlet of Huron-Michigan-Superior Lake into Lake Ontario, by the Trent Valley. With the continental elevation described in the last paper—owing to the land rising more rapidly to the northeast—Lake Warren became dismembered, and Huron, Michigan and Superior formed one lake ; the Erie basin was lifted out of the bed of Lake Warren and became drained, and Ontario remained a lake at a lower level. The outlet of the upper lake was southeast of Georgian Bay by way of the Trent valley into Lake Ontario, at about sixty miles west of the present outlet of this lake. The outlet of this upper lake was 26 feet deep where it connected with the Trent valley, and the channel was from one to two miles wide. This, for a few miles, is cut across a drift ridge to a depth of 500 feet. With the continued continental uplift to the northeast (which has raised the old beach at the outlet into the Trent valley, about 300 feet above the present surface of Lake Huron), the waters were backed southward and overflowed into the Erie basin, thus making the Erie outlet of the upper lakes to be of recent date. This is proven by the fact that the beach which marked the old surface plain of the upper Great Lake descends to the present water level at the southern end of Lake Huron.

Erie the youngest of all the Great Lakes. The Erie basin is very shallow, and upon the dismemberment of Lake Warren was drained by the newly constructed Niagara River (except, perhaps, a small lakelet southeast of Long Point). Subsequently the northeastward warping (very much less in amount than farther northward at the Trent outlet) eventually lifted up a rocky barrier and formed Erie into a lake in recent times, thus making Erie the youngest of all the lakes. The beaches about Cleveland are not those of separated Lake Erie, but belong to the older and original Lake Warren.

[NOTE.—To distinguish from the modern, the ancient valley of the St. Lawrence, above described, is named the "Laurentian," the ancient river from the Erie basin the Erigan, the Huron-Michigan-Superior Lake the Algonquin, as also the beach which marked its shores and the river which discharged its waters by the Trent valley. The expanded, but separate, Lake Ontario is named the Iroquois, as also its principal beach, now at 116 feet above its modern surface at the extreme western end of the lake, while at about 135 miles northeastward (near Trenton) its elevation is 435 feet.—*J. W. Spencer*, University of Georgia, Athens, Ga.]

KRAKATOA.—A period of five years has not been found too long in which to collect and collate the material necessary for a history of the gigantic eruption of 1883, which has been

PLATE XX.



Soleniscus.

made the subject of elaborate Reports by Dutch, German and English investigators.[1]

These Reports have been recently published and have been ably reviewed in recent issues of the *Contemporary* and *Edinburgh Reviews*.[2]

For a description of the physical characteristics of the great eruption the reader may consult these publications, but the scientific results as detailed in the several Reports may be briefly summarized. The process by which the eruption was brought about is considered to be typical of the physical action of volcanoes all over the world. Sea and surface water obtain access to the vent or to the heated rocks below it, and if brought suddenly into contact may give rise, by the development of steam, to earthquakes or eruptions of moderate strength, but it is to the slow percolation of water into rocks in a certain condition that the author of the English Report attributes the principal part in cataclysmal outbreaks. The water combines with the material of the rock, and by this combination the melting point of the rock is reduced; it only requires the subjection of the hydrated compound to such heat as would be supplied by the anhydrous lavas in a fluid condition to disengage steam and other gases in enormous quanities, and to produce outbursts proportionate to the pressure and the strength of the inclosing walls. If, while this process is going on; water in large quanities gains access to the surface of the heated mass, solidification might take place and the escape of gases through the crater would be temporarily checked. When at last the accumulated force bursts the newly-formed crust, this and other obstacles would be speedily removed by the tremendous violence of the blast, and the sides of the crater might either be blown away or fall into the seething lava. Such appears to have been the working of the final eruption of Krakatoa. The objection that water could not percolate to great depths, owing to the upward pressure of steam, already

[1] Krakatau. Par. M. Berbeck. Publié par ordre de Son Excellence le Gouverneur Général des Indes Néderlandaises. Batavia: 1884 and 1885. Paris: 1885 and 1886.

The Eruption of Krakatoa and Subsequent Phenomena. Report of a Committee appointed by the Royal Society 1888.

Untersuchungen über Dammerungserscheinungen zur Erklärung der nach dem Krakatau-Ausbruch beobachteten atmosphärisch-optischen Störung. Von J. Kiessling. Hamburg and Leipzig: 1888.

[2] *Contemporary Review*, November, 1888. New York; Leonard Scott Publishing Company.

Edinburgh Review, January, 1889. New York; Leonard Scott Publishing Co.

formed, is met by recent experiments which show that the capillary action continues in spite of such pressure.

The presence of volcanic cones and craters on the moon would seem to invalidate the "steam engine" theory as well as the hydrated lava theory of Professor Judd, unless the presence of water in large bodies is admitted, On both the earth and moon the expansion of fluid rock in the process of cooling would bring to bear an enormous pressure, resulting in outwellings of lava, and violent eruptions would be accounted for by the development of steam on a large scale. It is generally admitted that communication exists not unfrequently between reservoirs of molten rock at great distances from each other on lines of fissure. Heated rocks, subjected to the hydration and aeration of infiltrated water would probably occupy more space in a solid than in a pasty or liquid condition, and would melt at a lower temperature. Contraction by cooling of the solidified part of the globe, works in the opposite direction; but while this process is fairly regular and even, solidification may take place unequally, rapidly, and by local causes, such as cooling by extensive aqueous percolation. Other causes of periodic increases of pressure would be the shrinkage of the earth's crust upon the cooling interior, the percolation of water through fissures and the closure of these fissures by changes of level, so that steam developed at some miles below the surface would force the fluid lava through the nearest volcanic vent. As far as the argument from the moon is concerned, it can be readily disposed of by admitting the previous existence of water on its surface, which has been entirely absorbed by the rocky substance.

Among the attendant phenomena of the eruptions were the sea-waves. These caused greater destruction both to property and to human life than any other of the attendant phenomena. They are treated at great length by Captain Wharton in the English Report. Undulations were produced reaching as far as Havre, a distance of 10,780 miles from the original source of disturbance. The seismic flows and ebbs which thus covered a very large part of the globe were composed of long undulations, with periods of over an hour, and of shorter superposed irregular waves at brief intervals. The rate of propagation was in all cases less than theory would demand for the supposed depth of water. The average speed seems to have been something between 330 and 380 miles per hour. The mean depths deduced by the usual formula from this speed are less than those given by actual soundings. The cause of this discrepancy is not clear; but if the tide gauges can be relied upon, and the disturbances recorded are due to identical original waves, it seems probable that submarine elevations and ridges, hitherto unknown, retard the progress of the disturbance. The period of the long wave was originally about two hours, but at distant stations, such as Orange Bay and the ports of the English Channel, the period seems to have been reduced to about one fourth, and, throughout the course of the undulations, its original character appears to have undergone considerable modification. The cause of an undulation with a period of two hours remains a mystery, but of the correspondence between the water and air waves in point of time at starting there can be no question. An upheaval of the sea bottom must have been very slow to account for the length of the wave; no earthquake was observed, and the evidence generally is against earth disturbance as a cause. It is noted that the bulk of the fragments thrown out during the explosions must have fallen into the sea, and by their impact, almost coinciding with the violent evisceration of the crater, must have contributed to the rush of the destructive waves, and Captain Wharton calculates that a fiftieth part of the missing mass of Krakatoa, which was estimated to be at least 200,000,000,000 cubic feet, would, by dropping suddenly into the water, form a wave circle of 100 miles in circumference, 20 feet high, and 350 feet wide. But this is inadequate to account for the long wave; and he therefore holds that the destructive waves in the Strait of Sunda were mainly due to masses falling into the sea, or to sudden explosions under the sea, but that the long wave recorded by distant tide guages had its origin in upheaval of the bottom.

Another marked accompaniment of the explosion was the air wave. Reports from 47 stations representing the entire civilized world show that an air wave spread out from Krakatoa as a centre expanding in a circular form till half round the globe, concentrated again towards the Antipodes, whence it started afresh and travelled back to Krakatoa, occupying in the double journey 36 hours, rebounded and set off again on the same revolution, and repeated the movement at least three times sufficiently strongly to be recorded. Seven passages, going and returning were indicated by the diagrams at some stations. The whole process was almost exactly similar to the alternate expansions and contractions of a wave of water caused by dropping a stone at the centre of a circular pool. The barograms give tidings of atmospheric movements comparable to gigantic waves of sound, starting from a small area and encompassing the globe, several times in succession, completing each circuit in about 36 hours. The mean speed of propagation was about 700 miles an hour, less by 23 miles than the velocity of sound at zero Fahrenheit; the velocity, in fact, seems to have corresponded to that of sound in air at 20 or 30 degrees below zero.

Among other interesting observations noted in connection with this eruption are those relating to the propagation of sound. Authentic instances are recorded of sounds caused by the explosions being heard at distances of 1210, 1902, 2014, 2267, and 2968 miles, being quite the longest distances that sound has been known to travel. The English Report includes a number of interesting and instructive hypotheses. The concensus of opinion as to the red sunsets which formed so conspicuous a feature of the autumn evenings of 1883 is that they may be traced to Krakatoa. The general conclusions are admirably traced by Sir Robert Ball:

First of all it would be natural to ask whether the existence of volcanic dust in the air could have produced the optical effects that have been observed. This must be answered in the affirmative. Then it would be proper to inquire whether other volcanic outbreaks in other parts of the world, and on other occasions, had been known to have been followed by similar results. Here, again, we have page after page of carefully stated and striking facts which answer this question also in the affirmative. Next it would be right to see whether the sequence in which the phenomena were produced at different places in the autumn of 1883, tallied with the supposition that they all diverged from Krakatoa. The instances that could be produced in support of the affirmative number many hundreds, though it must be admitted that there are some few cases about which there are difficulties. Surely we have here what is practically a demonstration. It is certain that these optical phenomena existed. No cause can be assigned for them except the presence, at that particular time, of vast volumes of dust in the air. What brought that dust into the air except the explosion of Krakatoa? Most people find themselves unable to share the scruples of those who think there can be a doubt on the matter. Would another eruption of Krakatoa, followed by a repitition of all the optical phenomena, convince them that in this case, at all events, *post hoc* was *propter hoc.* Perhaps not, if they have already failed in being convinced by the fact that, when Krakatoa exploded two centuries ago, blood red skies appear to have been seen shortly afterwards as far away as Denmark.

ZOOLOGY.

UNSEASONABLE VISITORS.—Monmouth County, New Jersey, has had an open Winter, and with it some interesting phenomena. Among the fishing industries, crabbing is one, of which there are two seasons—the special and the general, the former being when the crabs are shedding their shells, and are known as shedders or soft-shells. In this condition they are considered a great luxury, and bring the highest prices. But the soft-shells only have a short season. The hard shells continue the year through, except in the winter, when they betake themselves to the mud. A shrewd fisherman found out that the crabs this Winter in Raritan Bay had not taken to the mud; so he continued to catch them, and owing to their good condition, and the unusual fact of getting them in the Winter, he got good prices. It was in vain that the man tried to keep his secret. It leaked out, and there was a rush which soon closed the business.

The common eel, also, in the Winter, hides in the mud; but the fishermen have continued to catch them in these parts this Winter.

In February, some men while clearing pine land with the grubbing hoe, at a depth of five or six inches, unearthed a nest of snapping turtles—*Chelydra serpentina*. There were four young ones, just out of their shells, the latter lying in the nest. They were soft, though frozen stiff. One told the other to handle them carefully, or the legs would break off. Taken to the house they soon thawed, and became very lively, but being kept through the night in a room without fire, they succumbed to the cold, and died. As these young reptiles usually do not appear until Summer, I was a little puzzled at this premature hatching. The fact too, that they could not endure the cold, after being once warmed, should have some significance.

About the middle of March we had our only real snowstorm, the fall being some six inches. It only lasted three or four days, but ere it had quite gone four snakes came out of the ground at Keyport. They varied in length from sixteen inches to two feet, and formed one company. My informant told me that he " went for them," but that the two largest got away into the bushes. From his description it is probable that they were garter snakes, but however innocent, or even useful, a snake in the popular creed is "a varmint with no right to live."

On the 22d of March a fine male specimen of the giant bug, *Belostoma grandis*, was also caught in Keyport. The *quid nuncs* of the town were greatly exercised over the "huge cockroach!" One man, however, who "knew it all," said he had "lots of them roaches, only not nigh so big, in their kitchen." In my experience, this is a very untimely occurence of this fine insect, and the specimen was in excellent condition. The bug is bred in the water, issuing thence in the imago state generally in the Summer, and flying in the night. I have received a number of specimens from Asbury Park, and Trenton, which had been killed by dashing against the electric lamps. —*Samuel Lockwood.*

THE POISONOUS ARACHNIDA OF RUSSIA.—At a recent meeting of the Dorpat Naturalists' Society, Professor Kobert spoke of the reputedly poisonous spiders of Russia. According to the observations of Dr. Walter, of Jena, *Galeodes araneoides* is not poisonous, and does not even possess poison-glands. *Trophosa singoriensis*, the Russian Tarantula, is not poisonous to warm blooded animals, although it is to lower animals. In the case of *Latrodectes* 13-*guttatus* not only the poison-glands but all parts of the body contain an unformed protoplasmic poisonous ferment, which has much the same physiological effect when injected into the circulation as cyanic acid and strychnine.

NEW ORGANS IN THE COCKROACH.—Mr. Edward A. Minchin describes (*Quar. Jour. Micros. Sci.*, December, 1888) an ectodermal organ in the cockroach, which may possibly be a stink-gland. It consists of a pair of involutions of the cuticle on the dorsal surface of the abdomen, between the fifth and sixth segments, and opening by means of two slits near the median line, which are usually covered by the posterior margin of the fifth segment. Internally each pouch is lined by a chiterious cuticle, bearing numerous branched hairs, and beneath them glandular epithelial cells.

ZOOLOGICAL NEWS—MOLLUSCA.—J. I. Peck (*J. H. U. Circ.*, No. 70) describes the anatomy of the Pteropod *Cymbulopsis calceola*, which he studied by means of serial sections.

In the same place, Mr. S. Watase records a remarkable phenomenon in the segmentation of the egg of *Loligo pealii*. He was successful in artificial impregnation and in tracing the histories of the various segmentation planes. The first plane is longitudinal, and for many stages an alternation of rest and activity on the opposite sides of this plane is noticeable. Thus at one time almost every nucleus on the left side shows distinct mitosis figures, while not a single nucleus of the right side exhibits such a feature. This was witnessed again and again, until the blastoderm contained 116 cells.

CRUSTACEA.—Professors W. K. Brooks and F. H. Herrick describe (*J. H. U. Circ.*, No. 70) some features in the development of the Peneid form *Sergestes hispidus*. It escapes from the egg as a protozoea, passes soon to the true zoea stage, and then to a mastigopus condition.

GENERAL.—Dr. H. V. Wilson gives an account (*J. H. U. Circ.*, No. 70) of the times of breeding of several marine forms at the Bahamas, which will prove of value to students visiting the West Indies.

WORMS.—Dr. Hurst records (*Notes from Leyden Museum*, January, 1889) the presence of *Arenicola cristata* (originally described by Stimpson from South Carolina) at Naples.

EMBRYOLOGY.

THE ORIGIN AND MEANING OF SEX.[1]—My hypothesis respecting the origin and meaning of sex may be stated provisionally as follows, pending a fuller sketch to be published in the immediate future.

1. Over-nutrition is regarded as the prime cause of the un-

[1] Seventeen paragraphs, or those numbered 1, 2, 8, 9, 12 to 18, 21, 22, and 25 to 28, of this article comprise all except 154 words, *verbatim et literatim*, of the first draft of a synopsis of the hypothesis here somewhat more fully presented. The Secretary of the Academy of Natural Sciences, of Philadelphia, advised the withdrawal of that first draft, which was offered for their *Proceedings*, on the ground that it was unwarrantably anticipated by the publication of the same matter in a supplementary notice, which was privately published by the author, with the same title, dated July 5, 1889, and which also forms part of the present article. This note is neccessary in order to correct any possible erroneous impression which may have arisen in the minds of those to whom copies of extras were sent of the first article, as to the latter's source, as it was printed, in advance of the issue of the signatures of the Academy's *Proceedings*, and bore the imprint of the latter.

equal growth of cells, or of individuals, if the latter are unicellular.

2. The differentiation of sexuality as a result of such unequal nutrition, through which a difference in potential of segmentational power was developed in consequence of physiological differentiation, accompanied by a great difference in size.

3. Over-nutrition in animals and plants has led to all the forms of sexual, asexual, and parthenogenetic reproduction.

4. The over-nutrition of ova, ovules, etc., through which they have grown beyond the average size of the other cells of the body of the parent, is proof that they have in some way lost the power to undergo spontaneous segmentation, except in the case of parthenogenesis, which will be dealt with more fully hereafter.

5. Over-nutrition of the male mother-cells, accompanied by an exaltation of segmentational power, has caused their products to become the smallest cells produced by the body, with a concomitant augmentation of latent segmentational power.

6. Ovum and spermatozoon are not homologous, but only sperm-mother-cells or groups of them and ova are homologous; the same law applies to the germ-cells of plants.

7. The production of the definitive sexual elements of the multicellular forms has proceeded *pari passu* with an extreme physiological differentiation of karyokinetic function in the two kinds, which stand in a reciprocal relation to each other, and which has been the cause of their reciprocal attraction for each other, leading to the act of fertilization.

8. The ability of such over-nourished cells to go on segmenting only as result of the union of such pairs of unequal dimensions, which stand to each other in a reciprocal relation of potentiality as respects segmentational power. The female cell has lost the power to spontaneously segment, whereas the male cell has acquired an exaltation of latent segmentational power.

9. The integration of such large masses of living matter as single units made it possible for the results of such segmentations to cohere, instead of falling apart. If, in fact, such prepatory accumulation of material had not occurred, rapid, simultaneous and successive segmentations would have been impossible, since *pari passu* with the differentiation of their segmentational function such germ-cells finally lose *in toto* the power to nourish themselves except when in a relation of continuity with the parent organism.

10. The aggregation of large masses of segmentable plasma has also enabled the products of such simultaneous and successive segmentations to cohere and remain a multicellular aggregate, and to thus lay the foundations and become the direct cause of all metazoan and metaphytic organization.

11. The over-nutrition of the female element and the augmentation of its mass has rendered possible complex series of simultaneous and successive segmentations, in planes of from one to three dimensions, and the development of embryos without need of other nutriment during the preliminary or larval stages of ontogeny, thus leading also to the evolution of all larval forms.

12. So long as living organisms remained unicellular they were enabled to vary and become adapted only within the narrow limits determined by their unicellular condition, yet we know how marked is variability, even in this low grade of development; proportionally far greater than in multicellular types.

13. The achievement of the multicellular condition, as I have supposed, produced new and more complex morphological relations leading to the manifold differentiation of physiological functions in relation to diversification of surroundings, thus introducing a new and most powerful cause or capacity for variations and adaptations under such diverse conditions.

14. It is thus seen that the evolution of sexuality is the indirect cause of variability, and that otherwise there could have been no such thing as a struggle for existence leading to natural selection amongst multicellular organisms—at least seeing that they must have been produced, according to this hypothesis, as a result of the development of sexuality.

15. Over-nourishment in the vegetable, then lead to the over-nourishment of the animal world and the over-production of germs or young in both, so that the rate of increase became augmented in a geometrical ratio, as supposed upon the Darwinian hypothesis, which, on the basis of the theory of the struggle for existence and the process of natural selection so evoked, accounts for the preservation of valuable or advantageous variations through survival and inheritance.

16. Over-nourishment, then, is, according to the present hypothesis, regarded as the primary cause of morphological differentiation under the stress of diverse conditions, as well as of the geometrical ratio of increase of such forms, and, consequently, of the struggle for existence.

17. The doctrine of over-nutrition consequently becomes

antecedent to that of Darwinism, since it accounts for the primary diversification of species on the basis of inequalities of cell-nutrition in all forms, thus seizing upon the diversification of the physiological powers of the primal forms of life as the first factors in biological evolution, and which gave the latter its first impulse and upon which all further impulses have been superimposed.

18. Sexuality is thus rendered the motive force of all biological development, but in a totally different sense from that hitherto held by any one else.

19. While sexuality thus viewed becomes the motive force of all biological evolution it also gives rise to the means of variability and a greatly augmented fertility of individuals, thus also leading to the struggle for existence and natural selection.

20. Sexuality is therefore found to transcend in importance the principle of natural selection itself, since over-nutrition only could have led to the over-production of germs and the consequent increase of individuals in a geometrical ratio, as assumed by the Darwinian hypothesis, and, since the vegetable world stands in an annectant relation between the not-living and animal world, it can be understood how the latter came to be over-nourished.

21. This hypothesis further assumes that, with the gradual circumscription and localization within more and more restricted limits, of the production of germ-cells, and *pari passu* with morphological differentiation, that the reproductive and recapitulative powers of the other cells of multicellular organisms became gradually less and less marked, owing to the gradually more intensified expression of the principle of the physiological division of labor in the evolution of organs with more and more definite functions.

22. It regards the hypothesis of the immortality and immutability of the *Keimplasma* as inadequate, and as absolutely disproved by the facts of morphological development alone.

23. The production of germ-cells has been localized more and more definitely as a result of the increasing morphological specialization of multicellular forms, so that the the hypothesis which assumes that the germ-plasma is precociously set aside in order to render it unmiscible with the somatic plasma, and therefore immortal, is based upon a fundamental error of interpretation of the facts of morphology.

24. The only cells in the multicellular forms which are ab-

solutely otherwise functionless are the germ-cells. They alone, therefore, can become the vehicles for the transmission of all the traits of the parent in higher forms, since they alone are otherwise functionally unoccupied, and are the only cells of the body which, by any stretch of the imagination, can be supposed, *a priori*, to possess the recapitulative power manifested in ontogeny.

25. It further assumes that the theory of the geometrical ratio of increase is qualified by the advent of multicellular forms as a direct result of the development of sexuality, and that, reckoning on the basis of cell generations, the ratio of increase in the animal and plant world is absolutely and relatively less than if living forms had remained unicellular.

26. It leads also to the assumption that biological evolution has been along definite lines, and not fortuitous or hap-hazard, as has been tacitly or avowedly assumed by some incautious but extreme partisans of the doctrine of natural selection.

27. This hypothesis is based on the assumption that the undifferentiated nucleated cell is the point of departure for all morphological and physiological differentiation, and that the first depends upon the character of the karyokinetic changes which go on within it, while the second depends upon the nature of its metabolism and the mechanical arrangement and constitution of the plasma through which such metabolism is manifested.

28. Upon this ground may be based a further development of hypothesis which gives a satisfactory explanation of parthenogenesis, pædogenesis, gemmation, temnogeny, metagenesis, and the recapitulative processes of ordinary sexual genesis.

29. In the production of female germs (ova, oospheres,) there occurs a prolonged process of intergration of plasma to increase the volume of the cell-body. In the production of male elements, (spermatozoa, antherozoids,) on the contrary, an actual process of elimination of plasma occurs, so as to reduce the cell-body to a minimum size and leave little remaining except the nucleus and its chromatin. The modes of production of the male and female elements therefore, stand in the most extreme contrast in respect to each other.

This hypothesis, founded upon data which have been hitherto apparently ignored, applies to both the animal and vegetable kingdoms, sex having probably arisen simultaneously and independently in both, as soon as certain cells of coherent groups become over-nourished and incapable of further segmentation unless brought into contact and fused with the minute male elements, or one which, as we have seen, is the product of an exalted segmentational power which is transferred to the female element in the act of fertilization. Both kinds of sexual products were probably at first, and still continue to be, dehisced from the parent organisms as useless products of over-nutrition, after further recapitulative growth in the form of new axes or of individuals, growing in organic union, as in colonial organisms, became impossible, due to crowding, the culmination of seasonal growth or the morphological specialization leading to definite or constant formal individuality.

All the facts which I have been able to gather lead to the conclusion that there is a relation between the difference in size of the male and female elements as to the number and rapidity of the subsequent segmentations of the resulting oösperm or oösphere. If the elements are alike there will be comparatively few segmentations; if greatly unlike, many successive segmentations seem possible.

The foregoing hypothesis affords clews to the reasons for variations in the fertility of species, the origin of viviparity and placentation, the infertility of irrelated forms, the origin of food yolk in ova and of pelagic eggs, the evolution of primary and secondary sexual characters, the interrelations of plants and animals, and a consistent and simple theory of inheritance, which is in harmony with all the facts of reproduction in plants and animals.

This hypothesis also discloses some of the apparent reasons why there is so frequently a great difference in the size of the sexes, as in fishes, where the male is smallest, and especially in those arthropodous forms, in which the males are microscopic and attached to or parasitic on the females, as in some Copepoda and Cirripedia. The extraordinary feeding and nursing habits of social Hymenoptera, efficient in determining the sex or neutrality of offspring, also acquire a new significance.

The first steps by which the over-growth of the sexual elements through over-nourishment is seen in the most primitive of all known non-parasitic, free-swimming, multicellular forms, namely, *Volvox*. Its life history proves that the multicellular condition can be, and probably was, attained directly by the over-growth and subsequent segmentation of a single cell in three planes, simultaneously and successively, with but little coherence, forming a delicate blastula, the cells of which are separated from each other by interspaces, and joined together by very slender protoplasmic bonds. Certain cells of this blastula-like organism grow directly into germs with exaggerated dimensions. The wall of the *Volvox* blastula is probably ectodermic and entodermic in its homologies, gastrulation is still to occur, but it is interesting to observe that already the germs are produced in a little more than one hemisphere only, which probably corresponds to the ectodermic portion of a Cœlenterate, while the empty, anterior, directive, and sensory pole is homologous with the entoderm of the latter. The tendency of the germ-cells to originate from the ectoderm in some Cœlenerates, therefore, may have an ancestral significance.

The over-growth of Protozoan or Protistan forms probably gave rise, through a series of segmentations, directly to such types as *Volvox*, and simulating the planula or blastula more or less closely. Gastrulation, under its various guises, as well as proliferation and delamination, also followed, with their consequences, which led to the direct development of the various forms of ciliated larvæ, at once ready to feed, undergo metamorphoses, and share in the struggle for existence.

This first larval development was probably rapid, and due to the same causes as are still seen to be operative in the development of ova, namely, rapid segmentation. The accumulation in the egg of a mass of plasma in excess of the average of its fellow cells or individuals, laid the foundation for the first and most primitive type of segmentation, namely, the holoblastic, before any yolk was added to the ovum, as is seen in the development of *Volvox*. This coherent aggregate was now an individual, ready to begin the struggle for existence, and with infinite capacity for variation, and with an augmented power of reproduction.

The ovum, according to this hypothesis, becomes the conservative factor in biological evolution in a new sense, while the male element imparts the power to undergo rapid segmentation, and to quickly achieve the larval state, when the interaction of the organism and the environment can be brought into play. The physiological activities of such plasmic aggregates as an oösperm are at first almost wholly karyokinetic, and but slightly metabolic; this renders possible the later and immediately subsequent anabolism through which further growth and power is acquired. In the vegetable world there has, from the first, been a tendency to form plates, filaments, and later columns of cell aggregates, instead of the blastula form of animal types. Sexuality, or the development of male and female elements, therefore, has a meaning, fraught with consequences and promises which have culminated in the most wonderful morphological and adaptive specialization, and probably in definite ways, which might have been predicted had all the conditions been known.

N. B.—Finally, it is necessary to point out here that these views have little in common with those urged by Geddes. While a preponderance of anabolic activity may produce an ovum, as he supposes, how it is possible to conceive that processes of physiological disintegration or katabolism, such as are witnessed in the breaking down of protoplasm into simpler compounds, could result in the production of male-cells, I utterly fail to comprehend. That growth is accompanied by katabolism there is no doubt, but to assume that the tremendous energy with which karyokinesis manifests itself in spermatogenesis is merely an exhibition of preponderent katabolism, which must result in the enfeeblement of the cells so produced, stands in such obvious contradiction to all that we know of the male-cells, that such an erroneous view must be unhesitatingly pronounced inadequate and unfounded. Anabolism and katabolism, or the molecular processes by which protoplasm is built up and torn down, cannot be tortured into an equivalency with the widely diverse modes of manifestation of karyokinetic activity in the morphologically homologous ovum and sperm mother-cells.

The fundamental error lies in confounding ordinary physiological processes with special modes of the manifestation of karyokinesis, and since there is no other known instance of katabolism resulting in the breaking up of cells by rapid cleavage into small cells, such as those produced from spermoblasts, it may well be doubted if the equivalency sought to be established is anything more than fanciful.—*John A. Ryder.*

PHYSIOLOGY.[1]

GASKELL'S WORK.—The most important recent work on the physiology of peripheral nerves, is that of Dr. W. H. Gaskell, of Cambridge, which has occupied him during the past ten years.[2] Begun as a contribution to cardiac physiology, it has extended itself much beyond this, and bids fair to alter fundamentally our conceptions of the morphological and

[1] This department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] Gaskell's chief articles are published as follows—
Phil. Trans. 1882. p. 993.
Journal of Physiology. Vol. IV. p. 43.
" " Vol. V. p. 362.
" " Vol. VII. p. 1.
Medico-Chirurgical Transactions. Vol. LXXI. (Contains a summary of results up to the receipt of the Marshall Hall Prize.)
Journal of Physiology. Vol. X. p. 153.

physiological natures of peripheral nerves. For this work the author received last year the Marshall Hall prize. An abstract of the results follows.

Gaskell began his work by the study of the innervation of the frog's heart. He found that the vagus not only inhibits but also accelerates the rate of the contractions. This led to the discovery that the vagus in the frog is in reality the vago-sympathetic, *i. e.* the nerve trunk consists in part of vagus fibres, in part of sympathetic fibres, the two uniting early in their course; the vagus fibres proper are inhibitory, the sympathetic fibres cause acceleration. Taking into account not only the primary effects of the stimulation of these fibres, but also the after effects, Gaskell came to the conclusion that "the process of inhibition is bound up with changes in the muscle of a beneficial nature to the further action of that muscle, while the action of the augmentor nerve resembles rather the action of a motor nerve, and causes an exhaustion of the muscular activity." He concluded, therefore, that "inhibition of contraction is the symptom of the action of an *anabolic* nerve *i. e.* a nerve which brings about constructive metabolism, just as much as contraction or augmentation of contraction is the symptom of the action of a *katabolic* nerve *i. e.* a nerve which causes a destructive metabolism." He further studied the nerve supply of the rest of the vascular system, and came to the conclusion that all tissues are supplied with two sets of nerve fibres, one anabolic in nature, the other katabolic.

In the study of the nerves of the tortoise's heart, he found that the sympathetic, or katabolic, fibres were all non-medullated, while the vagus, or anabolic, fibres were medullated. So here was a morphological difference bound up with a physiological difference, and the question arose, does this distinction hold good throughout the entire course

The efferent nerves of the body can be divided into groups according to their function. If this division be not purely artificial, the members of the different groups should agree with one another morphologically as well as physiologically. Gaskell made the following classification of efferent nerves, and studied the different groups with great care.

EFFERENT NERVES:

1. Nerves of the vascular muscles.
   (a) Vaso-motor, *i. e.* vaso-constrictors, accelerators and augmentors of the heart.

(b) Vaso-inhibitory , *i. e.* vaso-dilators and inhibitors of the heart.

2. Nerves of the visceral muscles.
   (a) Viscero-motor.
   (b) Viscero-inhibitory.
3. Glandular nerves.

He found that the "vaso-motor nerves for all parts of the body can be traced as bundles of the finest medullated fibres in the anterior roots of all the spinal nerves between the 10th and 25th, inclusive, along the corresponding *ramus visceralis* (white *ramus communicans*) to the ganglia of the lateral chain (main sympathetic chain) where they become non-medullated and are thence distributed to their destination either directly or after communication with other ganglia." The viscero-motor nerves are also fine medullated fibres which become non-medullated in the chain of sympathetic ganglia. As to the vaso-inhibitory fibres, these too start from the spinal cord as fine medullated fibres, becoming non-medullated in the collateral or terminal ganglia; the difference between the vaso-motor and vaso-inhibitory fibres lies therefore in the place where they lose their medulla, the former becoming non-medullated in the proximal ganglia, the latter in the distal ganglia. The viscero-inhibitory fibres agree with the vaso inhibitory just as the viscero-motor agree with the vaso-motor. The conclusion arrived at from this work is that "the vascular and visceral muscles are throughout supplied by two kinds of nerve fibres of opposite function, the one motor and the other inhibitory; and that further these two kinds of nerve fibres reach the muscle by separate, distinct anatomical paths, the difference of path consisting in a difference of origin from the central nervous system combined with the fact that the inhibitory nerves lose their medulla in more distant ganglia than the corresponding motor nerves." Moreover, the investigation of the course of the efferent nerves led Gaskell to regard the sympathetic and homologous ganglia as the motor or efferent ganglia of these visceral fibres; so that instead of the old conception of two nervous systems which interchange fibres with each other, he would substitute the following definition of the nerve belonging to a spinal segment— "A spinal nerve is composed of anterior and posterior roots both ganglionated, the ganglion of the afferent root always being stationary, while that of the efferent root is vagrant and has traveled away to various distances from the central nervous system," these vagrant ganglia being the ganglia of the sympathetic system.

The results of Gaskell's latest work concern the relation between the spinal and cranial nerves. In order to make a comparison between these two, it is necessary to have a clear idea of a complete spinal nerve. According to Gaskell such a nerve consists of— 1. A posterior root composed of afferent fibres, both somatic and splanchnic, the ganglion of which root is stationary in position, and is always situated near the entrance of the fibres into the central nervous system. 2. An anterior root composed of (1) efferent, non-ganglionated, splanchnic and somatic fibres, and (2) efferent, ganglionated, splanchnic fibres, characterized by the fineness of their calibre, the ganglion of which is vagrant and has traveled to a variable distance from the central nervous system. The cranial nerves are then considered seriatim.

The optic and olfactory nerves do not conform to the type of a segmental nerve and are not discussed.

The IIId nerve is efferent in function. It consists of large and small fibres ; as it approaches the oculomotor ganglion the large fibres pass off to supply the eye muscles and the small fibres form a separate group and pass into this ganglion, which is therefore considered a typical motor ganglion. The IVth nerve is also efferent in function, and consists of a large fibred and a small fibred portion, but no ganglion cells have been found along its course. As to the afferent fibres of these nerves—both the IIId and IVth possess within themselves degenerated structures which appear to Gaskell to have been originally the nerve cells and nerve fibres corresponding to the cells and fibres of the stationary ganglion on the posterior root of a spinal nerve. These two nerves, then, form the primary segmental nerves of the first and second segments, the function of the degenerated sensory elements being performed by the *ramus ophthalmicus profundus* of the Vth.

The VIth is purely motor; it contains somatic fibres, while the so-called motor part of the Vth contains splanchnic efferent fibres, but no somatic ones ; therefore, taking these two nerves together, we have a complete segmental nerve, as far as efferent fibres are concerned. Here, again, we find that the roots of the motor part of the Vth contain within themselves the remains of nerve fibres and ganglia which would correspond to the afferent fibres and posterior ganglion. The *ramus maxillaris superior* of the Vth, which with the *ramus ophthal-*

miçus profundus originates in more posterior segments, has replaced the lost sensory elements of the original nerve of the third or mandibular segment.

The VIIth nerve is a splanchnic efferent nerve consisting of both large and small fibres, the small fibres passing into the geniculate ganglion, which would therefore be the ganglion of the anterior root. As to the somatic efferent fibres, Gaskell has not been able as yet to find these. In this nerve, too, the degenerate remains of the sensory fibres and ganglion are found.

The VIIIth nerve is dismissed from consideration, since it is a nerve of special sense, and this might possibly justify its claim to an independent position. Summing up, then, we find that "in the group of motor cranial nerves, formed by the IIId, IVth, VIth and motor part of the Vth, and VIIth nerves, we have at least four fully formed segmental nerves which for some reason or other have lost a certain portion of their original components."

"In the group of nerves which arise from the medulla oblongata we find all the components which make up a fully formed spinal nerve, or rather group of nerves; here, however, there is no sign of any degeneration of any special group of fibres, but rather a dislocation and scattering of the different components, so that the cranial nerves of this group form parts of a number of segmental nerves instead of each one forming a single nerve." Both the IXth and Xth are purely splanchnic nerves. Each possesses two ganglia: the *ganglion jugulare* and *ganglion petrosum* on the one hand, and the *ganglion jugulare* and *ganglion trunci vagi* on the other. Gaskell considers that the two jugular ganglia represent the stationary afferent ganglia of the IXth and Xth nerves, while the *ganglion petrosum glossopharyngei* and the *ganglion trunci vagi* represent the vagrant efferent ganglia. The spinal accessory consists of large and small fibres. The large ones arise in all the roots of the nerve, the small fibres are confined to the medullary and upper cervical roots, and pass into the *ganglion trunci vagi.* All the fibres are splanchic efferent fibres. The hypoglossus is a purely somatic motor nerve. It represents the separated somatic efferent fibres of this region.

The origin of the fibres of the cranial nerves as well as the structure and function of their peripheral nerve fibres, goes to prove the spinal nature of the cranial nerves, for the groups of cells, which give origin to the cranial nerves, are the direct continuation of the corresponding cell-groups found in the spinal region.

Having homologized the spinal and cranial nerves, Gaskell formulates a theory of the origin of the central nervous system of vertebrates, to explain the degeneration in the anterior groups of cranial nerves. The central nervous system of the vertebrate, considered anatomically and morphologically, suggests two modes of origin which are apparently antagonistic to each other. The segmental arrangement of the nerves and the cells, from which they arise, points to the conclusion that the nervous tissue of the animal, from which the vertebrate arose, was arranged in a distinctly segmental manner. On the other hand the evidence of embryology points to the fact that the formation is tubular. Any theory must then take both these into account. Schwalbe concludes that the evidence points to the origin of the spinal cord from a bilateral chain of ganglia connected together by means of transverse and longitudinal commissures. Gaskell adopts Schwalbe's view, with the addition to this system of another system of higher function, *i. e.*, the cerebrum, cerebellum, etc., connected with the spinal system through the pyramidal tracts, the direct cerebellar tracts and others. This system is not represented in the spinal cord, and does not give rise to any outgoing nerves except nerves of special sense. Beside the nervous structures of the cord, we have the supporting structures; both of these arise from the medullary tube. As to the connection between these two structures, Gaskell holds that both phylogenetically and ontogenetically the evidence points to the fact that "the central nervous system of the higher vertebrate has been formed by the spreading and increase of nervous material over the walls of an originally non-nervous tube, the cellular elements of which tube, whatever may have been its original function, have been utilized as supporting structures or have undergone gelatinous degeneration. Tailwards this tube emerges free from the encasing mass of nervous matter as the neurenteric canal and its walls are continuous with those of the alimentary canal. Headwards this tube passes into the third ventricle and has apparently no anterior opening." The spinal system of vertebrates corresponds to the infra-œsophageal ganglia and ventral chain of invertebrates, while the crura cerebri, peduncles of the cerebellum and other tracts extrinsic to the level of the ventral ganglion chain form the œsophageal collar, the system of higher function corresponding to the supra-œsophageal ganglia. It follows necessarily that the tube around which the nervous matter has been formed, *i. e.*, the central canal and ventricles, represents part or the whole of the alimentary canal of the vertebrate ancestor. The author believes that he has found in the infundibular region the remains of the terminal œsophageal tube. In the light of this view we have sufficient reason for the degeneration of certain components of the foremost group of nerves, for with the loss of function of the invertebrate alimentary canal, and mouth parts in connection with it, the sensory parts of the nerves supplying that region degenerated.—*Leah Goff.*

ARCHÆOLOGY AND ANTHROPOLOGY.[1]

ANTHROPOMETRY AS APPLIED TO THE DETERMINATION OF THE ATTRIBUTES OR POWERS OF THE MIND OF MAN.—This is a problem. My only purpose is to consider its feasibility. Its benefits will be apparent. Can it be done?

It will not do, in this age of science, to determine on the entrance to the consideration of a given subject that its discovery or elucidation is impossible because of its extent, distance, mystery, or difficulty. These may be a bar to its discovery, but not to its consideration or attempted discovery.

The scientific discoveries made within the last few years are sufficient answer to this. What question presents greater apparent difficulties—impossibilities that the knowledge that the composition of the flame of the sun or the fixed stars—yet the solar and stellar spectrum has resolved these into their original elements, and we know them as well as we do that of the candle or the coal, which burn before our eyes.

Professor Langley has just informed us that the greater part of the sun's rays are not luminous, and that those which are, are really blue, and not white.

Who could have foreseen that when Galvani, of Bologna, in dissecting a frog (what nonsense, for a great philosopher to fool away his time dissecting frogs!), should have touched with a wire a given nerve, and that the twitch it made in response to his touch should have since then run through a million

[1] This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

miles of wire, over the land like the network of the fowler, and through the sea like the seine of the fisherman, until with its sudden cession, the trade, commerce, and government of the world would come to a standstill?

Professor Bell, one of our countrymen, has taken one of these wires—it may be a thousand miles long—and put on it at one end a patent mouth and at the other a patent ear, which can speak and hear with as much distinctness as if they were both attached to the same head.

The latest invention is a machine, about the size of a small sewing machine, into which one may speak in his natural voice, then boxing up his speech, may, after a thousand years of time, or at a thousand miles distance, by the simple turning of a crank, unwind the same speech in the same tone and voice as it was spoken.

Surely, there is much new under the sun.

After this preamble upon the possibilities of science, let us see if we may not measure and record in figures the attributes of man's mind.

Man holds communication with the outside world through his five senses. The action of either of those produce a sensation. Sensation produces perception, and perception intelligence. If we can measure the sensation we are on the road to measuring the perception, and so on, to the understanding and intelligence, and possibly the mind in its more subtle and abstruse operations.

What a conquest of science if we could be able to measure the sensations produced upon the mind, and passing through the upward scale, to calculate the mental force expended, say by Webster in his great constitutional arguments, or by determining the vividness and depth of perception, and so of understanding; to be able to calculate, by mathematical formulas, the reserve mental power necessary to make such arguments.

Decision requires an entire mental operation. It pre-supposes choice; choice, discrimination; discrimination, impression or sensibility; and this, sensation, which is obtained through one of the organs of sense. The operation of this organ, say of sight, can be easily measured, and one step accomplished. Is it not possible to continue it further?

The higher and more complex operations of the human mind may not now be measured. But why not the lower and simpler? When thus measured in different individuals may not their differences denote their differences in mental calibre?

One child knows a letter or figure, remembers it, understands it, on seeing it once; another requires twenty times; while the learned pig can only spell or count on being shown the same letter or figure, a hundred, maybe a thousand times.

Animals can be taught many mental operations. I recall the performing elephants, dogs, bears, monkeys, birds, even the fly and the flea, while Sir John Lubbock has ascertained the sensibility of the ant in the matter of sight, hearing, smell, and has shown that he can receive impressions through these senses which lead up to perception, understanding and decision. Sir John discovers that the ant has a goverment, and consequently a governor. He will emigrate to any other country, can organize an army, make raids, fight battles, take prisoners whom he enslaves. It is highly interesting to count the needed sensations, impressions, and perceptions required to perform all these mental operations.

The same system by which this can be measured or counted in our experiment with the animal can be applied to man.

What are school examinations or college commencements but tests by measurement or counting of the mental capabilities of the students? They may be only for comparison one with another; but that comparison is made by measurement more or less indefinite. At West Point and Annapolis the comparison is made with an absolute standard, in which 1000 is perfection. The system may be anomalous, for unblacked shoes and unkempt hair may so reduce it as to defeat his promotion.

Color blindness and astigmatism are measured by the oculist. They may be diseases or caused by defective mechanism, but these are only determined by measuring the sensations produced in the mind.

The measurement of a mental sensation is something accomplished, and I would pursue the same line of investigation to its end. Examine the candidate for the *truthfulness*, the *fidelity* of his sensation. First as to his sense of color. The question is, what sensation is produced upon his mind by the sight of a strand of worsted of a given color? Does green give the proper sensation, or purple, or red? This is a test of the *correctness* of the impression as to color. The operation is done leisurely. Rapidity is not now required. It is *accuracy* which is now being tested. As his examination progresses mark on the chart his successes or his failures. The fault in his sense of color may result from a species of disease. But now we test his sensation as to size, form, etc., which is not affected by disease, but it is a question purely of truthfulness of sensation or impression. Show him a yard stick, and let him mark the middle of it—divide it into feet or inches. Let him do it slowly but correctly. Compare two lengths—draw parallel lines, some true and some untrue—try him with angles, right, and other than right. Invent methods to test the correctness of his impression on his mind as derived from the operation on the sense of sight.

As a second lesson or course give him the chalk and let him make on the board the lines which he has just tried. Let him make a straight line of certain length; an inch, a foot, a yard —a right angle, a square, a circle, parallel lines, etc., etc.

Having exhausted correctness, test him for rapidity—have him do the same things and in addition to correctness, require rapidity.

To correctness and rapidity in such elementary matters let us add the test of power of observation, that is, the capacity to *see* things, to see them correctly, rapidly, and to note their number, position, quality, etc. This is only to note the sensation obtained from a larger view than the sticks and lines first shown. It is still the mental impression derived from the operation of the sense of sight.

March the candidates or class into a room, stay five minutes, and out again—then describe every article seen; try one minute; try unfamiliar rooms; try a picture; conduct them past an open door at a slow pace, and then ask them to tell every article seen in the room.

All these tests can be registered for each candidate, and the result will be his mental capacity in each of these regards, correctly expressed in figures.

Then try him with the sense of hearing, of touch, possibly of smell. You will say this will sharpen his senses. I prefer to say it will sharpen his *wits*—that it educates him, it causes him to correctly note the impression of the object as presented to the senses and as correctly to report or carry it to his mind. All this is but that mental quality called attention. After attention, memory. Thus we may measure by Anthropometry the mental qualities of sensation, impression, attention, and memory.

These are the faculties by which the mind of man receives its communications from the world. By their means it obtains the raw material to be worked up in the laboratory of thought.

MEASUREMENT OF MAN'S REASON.

How many are twice two? Twice ten? Easy enough to tell. How many are twice 17.648? Seven times that? Twelve times that? The mental operations required are those we have just been measuring, and we who have perceived in them the highest grade will succeed here the best. First attention to impression and sensation, then correctness, and finally, rapidity. All these tests to be recorded. Thus we may progress through mathematics, logic, philosophy, and so on to the end, practicing continually our first and fundamental rules of Attention, and Correctness of Impression, or Sensation.

The thoughtful man can follow this system out in detail, can perceive how it can be accomplished. I can see how, by the introduction of some such system, not only the average mental capacity or power of a nation or a people might be measured, the result announced in figures, and a comparison made with other nations; also that its use might tend to increase that capacity and power.

Such are the higher uses of Anthropometry. The human mental capacity *to understand* things is nearly allied to its capacity to *see* things. If one can be done I should not despair of the other. Whatever can be done with either must be by experiment directed by observation, Experiments must be repeated and the observations recorded. This means counting and measuring; and this applied to man is the Science of Anthropometry.

These are some of the possibilities of Anthropometry, but they are as yet far beyond the scientists of the United States.

We must content ourselves for the present with obtaining full, complete, and reliable tables of measurements of the physical peculiarities of the various races which inhabit our country. This should be our immediate contribution to the world's science.

MICROSCOPY.[1]

THE RETINA OF THE BIRD. — Cajal[2] recommends the method of Golgi for the study of the retina. He proceeds as follows:

[1] Edited by C. O. Whitman, Clark University, Worcester.

[2] Anat. Anz., iv., No. 4, Feb., 1889, p. 112.

The fresh retina is left for two or three days in a mixture consisting of

Bichromate of potassium (3 %) - -	4 parts
Osmic acid (1 %), - - - - -	1 part.

It is next placed in nitrate of silver solution (¾%) 24-30 hours. The sections are cleared in oil of cloves and mounted in damar.

CELL DIVISION.—Rabl[1] recommends the following method of preparation for the study of the caryokinetic phases in Triton.

The larvæ are treated with chloride of platinum ($\frac{1}{10}$ - $\frac{1}{8}$ %) 24 hours, then thoroughly washed in water, and slowly hardened in alcohol. The floor of the mouth and the gills are then cut out, stained in Delafield's hæmatoxylin, or Czokor's alum cochineal, *and examined in methyl alcohol.* In media of higher refractive index the finer details are not seen. The preparations last only for a few days.

DEMONSTRATION OF THE TONOPLAST.–Professor Vries[2] has shown that the vacuoles of plant cells represent organs with distinct and very resistant walls. In harmony with its function the wall is called the tonoplast. Aleuron granules are tonoplasts with their contents in a dried condition. The demonstration of the tonoplasts is accomplished by a 10% solution of nitric acid reddened with eosin. The method may prove useful in the case of animal as well as plant cells.

THE PRESERVATION OF ACTINIÆ.[3]—The preservation of Actiniæ in a suitable condition for future study is a matter of some difficulty, and has greatly hindered a thorough study of the group. The great difficulty experienced in killing the animals sufficiently rapidly to prevent contraction is the main obstacle, and the method of first producing torpor by the use of chloroform or nicotine, as practiced by the Hertwigs ('79), is tedious and not always successful. I was in hopes that good results might be obtained by the use of cocaine, but my experiments with it gave negative results. The success of any method depends greatly on the character of the form under

[1] Anat. Anz., iv., 1, Jan. 10, 1889, p. 30.

[2] Hugo de Vries, *Intracellular Pangenesis*, 1889, p. 150.

[3] J. Playfair McMurrich, Actiniaria of the Bahamas, Journ. Morph., iii., 1, p. 2, 1889.

treatment. Methods which will give good results with the Zoantbidæ, for instance, will yield failure quite as often as success with more contractile forms. For a collector who cannot give the time required for the proper carrying on of the narcotizing methods, my experience has led me to advise the following method of procedure. After the general characteristics —the coloration, presence or absence of tubercles, the dimensions, and such easily observable features—have been carefully noted with as much detail as possible, the animal is placed in a jar just wide enough to allow its complete expansion, and with just enough water to cover it when fully expanded. When this condition is reached, a glass syringe is filled with Perenyi's fluid, and this is suddenly and rapidly injected into the interior of the animal, the nozzle of the syringe having been quickly inserted into its mouth. At the same time, if possible, a quantity of the same fluid is poured over the animal, so that it is bathed without and within with a tolerably strong mixture of Perenyi's fluid. It is left to the action of the fluid for about half an hour, and is then to be treated successively with 50, 70 and 90 per cent. alcohol, care being taken to inject a considerable quantity of the spirits into the interior at each change.

Although considerable contraction usually results from this process, and although the color is, as a rule, almost destroyed, yet I think the distortion is less than that resulting from most other methods, and there is the great advantage that the parts are preserved in a satisfactory manner for future histological study. Dissection is possible, owing to the absence of the excessive brittleness which results from the use of chromic acid, encrusting or attached calcareous particles are dissolved, and sectioning of entire small forms may be practiced without the danger of ruining the knife, and lastly, there is no unpleasant precipitation of crystals as occurs from the use of corrosive sublimate when the subsequent washing has not been sufficiently prolonged.

THE PREPARATION OF BONE AND TEETH WITH THEIR SOFT PARTS.[1]—Dr. L. A. Weil takes only fresh, or nearly fresh teeth, and in order to allow reagents and stains to penetrate into the pulp cavity, divides the tooth immediately after extraction with a fret-saw, below the neck, into two or three

[1] *Internat. Monatschr. f. Anat. u. Physiol.*, v., 1888, Heft 1, *Journal Roy. Mc. Soc.*, 1888, Dec., p. 1042.

pieces, "allowing water to trickle over it the while." The pieces are then laid in concentrated sublimate solution for some time to fix the soft parts. After this they are washed in running water for about one hour, then placed in 30 per cent. spirit, which in twelve hours is changed to 50 per cent., again, after a similar period, to 70 per cent. Then, in order to remove the black sublimate precipitate, the teeth are laid for twelve hours in 90 per cent. spirit, to which 1.520 per cent. tincture of iodine has been added. The iodine is afterward removed by immersion in absolute alcohol until the teeth become white.

For staining, alcohol, or an aqueous solution of borax carmine, gave the best results. From the absolute alcohol the teeth are removed to running water from fifteen to thirty minutes, and then placed in the stain. In the aqueous solution of borax carmine they remain one or two, in the alcoholic two or three days. They are then transferred to acidulated 70 per cent. alcohol (alcohol 100 ccm., acid. muriat., 1.0) in which they remain, the aqueous ones stained at least twelve, the alcohol-stained ones twenty-four to thirty-six hours. This done they are immersed for about fifteen minutes in 90 per cent. alcohol, and then for half an hour in absolute alcohol, after which they are transferred to some etherial oil for twelve or more hours.

The oil is then quickly washed off the objects with pure xylol, and then they are placed for at least twenty-four hours in pure chloroform. After this they are passed into a solution of balsam in chloroform. The balsam is prepared by drying in a water bath, heated gradually up to 90°, for eight hours or more, until when cold the mass will crack like glass on being punctured. Of this balsam so much is added to the chloroform as to make a thin solution in which, as before mentioned, the teeth lie for twenty-four hours. After this time as much balsam is added to the solution as will dissolve. When no more balsam will dissolve, the teeth and a sufficiency of the balsam are poured into a vessel and heated up to 90° in a water bath, until the mass when cold should be as hard as glass. When the balsam is sufficiently set the teeth are carefully picked out, placed in a vice, and their discs are cut from them with a fret saw, water being allowed to trickle over them the while, and then they are ground in the usual way. The preparations are mounted in chloroform balsam.

MINERALOGY AND PETROGRAPHY.[1]

PETROGRAPHICAL NEWS.—Dr. G. H. Williams[2] has identified upon the island of Fernando de Noronha, the following rock types: hornblende-trachyte, trachyte glass, hornblende-andesite, phonolite, nepheline rocks, augitite, limburgite and basaltic bombs and tuffs. In the phonolites, ægerine occurs both in porphyritic crystals and in the groundmass. In the crystals of the groundmass the inclination of the axis of greatest elasticity to the vertical axis is 7° 42′—16°. Their pleochroism is B = green, A = green, C = yellow. Among the nepheline rocks are basanites, dolerites and basalts. In the dolerites are brownish-red augite crystals which are distinctly pleochroic in reddish-brown and greenish-yellow tints. They are zonarly developed with the exterior zones more highly colored than the interior ones.—A recent article by E. S. Dana[3] in the petrography of the Sandwich Islands is so full of interesting statements that a brief review of it is very unsatisfactory. The lavas of Mauna Loa and of Kelauea are of the same general character. They are basalts and olivine-basalts in numerous varieties. A fine-grained clinkstone-like basalt from Loa is remarkable for the beautiful feather-like groupings of augite microlites discovered in all specimens examined. Many of the augite microlites are intergrown with lath-shaped crystals of plagioclase, the two minerals radiating from a common center, and the latter often capping the tufts of the former. The olivine-basalt from the same crater contains many crystals of olivine in peculiar forms, some of which are slender acicular crystals elongated in the direction of their *c* axes. They often possess an unusually deep green color, when they show strong pleochroism. In the Mt. Loa lava streams are caverns from whose walls delicate stalactites of lava project. These are described by the author in great detail and are pictured with great minuteness. The stalactites are often solid throughout and possess a concentric structure. They are crystalline, except on the outside, where they are covered with a thin coating of glass, transversely marked with fine flowage lines. Frequently a large portion of the volume of a stalactite consists of cavities, whose walls are lined with large rhombic scales of clear plagioclase, needles of augite and octhedra

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Am. Jour. Sci.* March, 1889, p. 178.

[3] Ib. June, 1889, p. 441.

of magnetite. The lavas of the island of Maui and of Ohua are also principally olivine-basalts, in which augite is often zonally grown around olivine crystals. In the western portion of Maui is a whitish-gray compact rock, composed almost exclusively of plagioclase, with a very little altered hornblende, brolite and magnetite. Since it contains 61.63% of SiO_2 it is probably to be referred to the andesites.—An interesting communication by Rutley on the possible origin of epidosites appears in the Quarterly Journal of the Geological Society.[1] Altered felsites with a perlitic structure occur near the Hereford Beacon, Malvern Hills. The rock is gray in color, and is traversed by a delicate network of quartz veins containing epidote grains and curved lines of epidote, which by their green color and strong double refraction mark out the direction of formerly existing perlitic cracks.[2] The epidote is thought to have originated from the feldspar of the felsites, either directly or indirectly through the interposition of kaolin by the action of solutions of carbonates of calcium and iron, which would naturally circulate most readily through the perlitic cracks. By a continuation of this process epidosites might arise through the entire change of the material of the felsite into epidote and quartz.—The ejectamenta thrown out by Vulcano have recently been studied by Johnston-Lavis.[3] The most abundant products of this volcano are bombs whose surfaces are broken by fissures, and pieces of foreign rocks. The material of the bombs is obsidian, containing as inclusions pieces of basic rocks, and minerals resulting from these by alteration. The ashes accompanying these bombs consist of fragments of basic and acid glassy rocks, which the author believes to have been broken from the sides of the volcanic vent. The existence of pyrites in the material of the bombs, as well as the presence in it of olivine and augite with perfectly sharp angles, leads to the conclusion that the temperature of the lava from which the bombs were formed was low.—The obermittweide conglomerate from a point in the Mittweide valley, twenty-five miles south of Chemnitz, has been subjected to investigation by Bonney,[4] who finds the matrix to have been derived largely from the detritus of a biotite granite, and to have undergone

[1] November, 1888. p. 740.

[2] AM. NAT., 1887, p. 1112, where it is stated that the author regarded the mineral filling the cracks as topaz.

[3] Nature, p. 111.

[4] Quart. Jour. Geol. Soc., 1888, No. 173, p. 25

such alteration that it may now be regarded as crystalline. It consists of quartz, two micas, and a little feldspar. The constituents exhibit a slight tendency to parallelism, but show little evidence of squeezing.—The same writer[1] announces the discovery of a variety of picrite, known as scyelite, on the island of Sark in the British Channel. It is composed of serpentinized olivine, altered augite and bleached mica, some of which exhibits a banded twinned structure, one set of bands extinguishing parallel to the cleavage of the mineral, and the second band 18° to this cleavage. The rock was not found in place.—Joly[2] has discovered the presence of iolite in a feldspathic substance associated with beryl in the granite of Glencullen Co., Dublin, Ireland.—Upon treating the quartz-porphyry from Teplitz with hydrofluoric and sulphuric acids, von Foullon[3] obtained in the residue little grains of corundum.

MISCELLANEOUS.—In a little pamphlet entitled "Ueber das Verhalten der Silicate beim Uebergange aus dem gluthflüssigen in den festen Aggregatzustand," Nies[4] discusses the occurrence of crystals of silicates in lava streams, describes the action of water, metals, and alloys in passing from the solid to the liquid state, calls attention to the contraction forms in eruptive rocks, and concludes that silicates probably expand upon their crystallization from a molten magma, and do not contract as has been generally stated, but that not enough facts are known to warrant a positive statement on either side. The apparent contraction is due to the fact that the specific gravities of crystallized and amorphous bodies have been taken while both were cold, and, therefore, that they can not be regarded as criteria upon which to base conclusions as to the relations of the substances in the two different conditions at a high temperature. Their different relations at a higher temperature are due to the more rapid expansion of crystalline substances than of amorphous ones.—An interesting contribution to the study of morphotropism has recently been made by Dufet,[5] who has carefully investigated the mixed crystals produced upon the evaporation of a solution of zinc and magnesium sulphates. As a result of his measurements of certain

[1] Geol. Magazine, March, 1889, p. 109.

[2] Geological Magazine, 1888, p. 517.

[3] Verh. I. k. k. geol. Reichsanst. 1888. No. 8, p ,

[4] Stuttgart. 1888. Schweizerbartsche Verlagshandl.

[5] Bull. Soc. Franç. I Min. xii. p. 22.

interfacial angles he concludes that the values of these are the means of the values of those of the two simple sulphates, calculated in the proportions of their molecular combinations. The author proposes to study other mixed salts in the same way. McMahon[1] makes use of a thin quartz wedge for the determination of the strength of the double refraction of minerals in their rock sections. The quartz wedge is inserted between the crossed nicols of a microscope at an angle of 45° to their planes of polarization, and the point is noted at which there is no double refraction apparent when the object under investigation is placed on the microscope stage. This point of no double refraction is indicated by a dark line crossing the field. Its position varies with the strength of the double refraction of the mineral, so that by comparing its distance from the end of the quartz wedge with the distance observed in the case of minerals of known strength a ready means is afforded for a rapid determination of its double refraction.

Heririg[2] mentions the existence of a grotto in the Waschgang Mine at Döllach in Corinthia, whose walls are covered with well formed ice crystals, some measuring as much as 200 mm. in diameter.—Fulgurite glass from lightning tubes in a glaucophane epidote schist, in which occur yellow garnets, sphene, and occasionally diallage, is described by Rutley from the top of Monte Viso. The interesting fact in connection with this fulgurite is the existence in the tubes of a vesicular glass in which gas bubbles, and globulites and microlites are scattered.

In an article entitled the "Physics of Metamorphism," Harker[4] calls attention to the influence of pressure in effecting changes in the character of rock masses, and divides metamorphism into hydrothermal dynamo, and plutonic metamorphism, the meaning of each of which terms he explains in some detail In a red copper slag from the Canton Copper Works, Baltimore, Messrs. Jarman and McCaleb[5] have discovered cuprite in little octahedral crystals.

MINERALOGICAL NEWS.—Much additional[6] knowledge in regard to the sulphates occurring near Copiapo, Chili, has

[1] Geological Magazine 1888, p. 548.

[2] Zeits. f. Kryst. xiv. p. 237.

[3] Quart. Jour. Geol. Soc., Feb. 1889, p. 60, and Geol. Mag., 1889, p. 42.

[4] Quart. Jour. Geol. Soc., 1889, p. 15.

[5] Amer. Chem. Jour. Vol. II., p. 30.

[6] AMERICAN NATURALIST, 1888, pp. 930 and 1022.

been gathered by Luck,[1] who has made an extensive crystallographic and chemical study of them. *Coquimbite* is declared to be rhombohedrally hemihedral with $a : c = 1 : 1.5613$. Its hardness is 2—2.5 and specific gravity = 2.079—2.114. *Copiapite* has been determined to be monoclinic with $a : b : c = .4791 : 1 : .9759$ and $\beta = 71° 56'$. The mineral cleaves parallel to $\infty P \infty'$ and $\frac{4}{9} P\overline{\infty}$. Its hardness is 2.5 and specific gravity 2.103. Analysis yielded:

SO_3	Fe_2O_3	Ae_2O_3	CaO	H_2O
38.91	30.11	tr.		30.74,

corresponding to $Fe_4 (HO)_2 (SO_4)_5 + 18$ Aq. *Stypticite* occurs in radially fibrous aggregates of a yellowish-green color. Its hardness is 2.5 and specific gravity 1.857. Its crystalization is probably monoclinic. Its composition was found to correspond to $Fe_2 (OH)_2 (SO_4)_2 + 9$ Aq. Upon alteration it gives rise to a grayish-yellow substance what is probably identical with *fibro ferrite*. Tabular crystals of *römerite* and found to be triclinic with $a : b : c = .9681 : 1 : 2.6329$ and $\alpha = 116° 2' : \beta = 94° 41' : \gamma = 80° 8'$. Its cleavage is basic, hardness 3 and specific gravity 2.102. An analysis of pure material leads Linck to regard the mineral as $Fe (Fe Al)_2 (SO_4)_4 + 15$ Aq. Chilian *halotrichite* yielded on analysis:

SO_3	Ae_2O_3	Fe_2O_3	FeO	CaO	MgO	H_2O
33.98	10.43	.95	5.55	.69	.78	46.94

Among these sulphates is one occuring in reddish-violet, tabular crystals, in habit resembling gypsum crystals. It is monoclinic with $a : b : c = .3942 : 1 : .4060$. $\beta = 77° 58'$. Most of the crystals are elongated in the direction of the clino diagonal. The plane of the optical axes is in $\infty P \infty'$ and the first bisected is inclined to c in the obtuse angle β. The the double refraction is negative, hardness 2.5, specific gravity 2.1155. Its composition is

SO_3	Fe_2O_3	Al_2O_3	CaO	MgO	H_2O
39.83	27.66	tr.	.40	tr.	31.35

corresponding to $Fe_2 (SO_4)_3 + 10$ Aq. The author calls the mineral *quenstedite*.—Some interesting pyrite crystals are described by Mr. W. B. Smith[2] from the mines in Gilpin and Summit counties, Colorado. The crystals from the Saratoga mine in the former county are remarkable for the large num-

[1] Zeits J. Kryst. xv. p. 1.

[2] Proc. Colorado Scient. Soc. 1887, pp. 155 and 17

ber of forms occuring upon them. Interpenetrating crystals with the twinning axis normal to ∞O, consist of modified cubes, which are brought into such a position by twinning that the striations on parallel cubic faces cross each other at right angles. Other crystals contain on their cubic faces striations that appear to be discontinuous. The crystals are probably contact tronis with $\infty O \infty$ the composition face. The crystals from Summit county occur in almost ideal perfection in a mass of kaolin in the vicinity of Monte Zuma. *Alabandite* from the Queen of the West mine in Summit county, *manganite* from Devil's Head, Douglas county, crystals of *dioptase* ($\infty P2$ and $-2R$) from near Riverside, P.O., Arizona, and *garnets* from Chaffee county, Col., are also described by the same mineralogist. Repeated trillings of *vanadinite* from the Alice mine, Yuma county, Arizona, consist of crystals united by their prismatic faces and therefore resembling simple crystals. These groups of three crystals sometimes enclose a hollow triangular space running longitudinally through the center of the group. In a lot of *wulfenite* crystals from the Red Cloud mine in Yuma county were found a few tronis with the composition plane ∞P. They produce elbow shaped forms with the two limbs bent at right angles to each other. Fine *quartz* and *epidote* crystals, all of the latter of which are twinned parallel to ∞P occur in pockets in a peculiar rock composed of epidote, calcite and pyroxene, overlying a stratum of limestone at Calumet, Col. Some new facts are stated regarding the *phenacite* from Mt. Antero, and a new locality for the mineral is mentioned as existing half a mile distant from the locality already known. In the second place, the phenacites have a rhombohedral habit in consequence of the development of a rhombohedron of the third order. The pocket in which these crystals are found contains also many Baveno twins of white microline upon which most of the phenacite was implanted.—The *feldspar* of the nepheline and lencite basamites of Kilimandjaro examined by Fletcher a year or so ago[1] has been re-examined by Hyland[2]. The fresh mineral is pearl-gray in color, with a light vitreous lustre. Crystals containing the faces oP, $\infty P \breve{\infty}$ are twinned parallel to $\infty P \bar{\infty}$, with this face also as the combination plane. In some of these an interior, twinned nucleus is surrounded by a zone of untwinned material, which can be removed from the former by

[1] AMERICAN NATURALIST, 1888, p. 930.

[2] Geological Magazine, April, 1889, p. 160.

mechanical means so as to leave a kernel with the shape of a Carlsbad twin. The cleavage of the mineral parallel to oP and ∞ P' ∞ are inclined to each other at an angle of 90° 3'. Between crossed nicols plates cut parallel to oP show twinning lamellæ of variable breadth extinguishing at 1°—3½°. Sections parallel to ∞ P ∞ possess an extinction of 5°—6°. A chemical examination of purified material gave:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O	Sp. Gr.
61.35	23.10	3.02	5.34	7.11	.09	2.63

Its composition corresponds to $An_1\ Or_{2.1}\ Ab_{4.02}$. Since the mineral is undoubtedly triclinic Hyland would call it *soda microcline* as suggested by Brögger.—Intermingled with a few notes on new occurrences of minerals in Pennsylvania and New Jersey, Mr. Eyerman[1] records the analysis of *calamine* from Friedensville, N. J., and of *apophyllite* from St. Peter's, Chester Co., Pa., as follows:

	SiO_2	Fe_2O_3	QnO	CaO	K_2O	H_2O
Calamine,	24.32	2.12	65.05			7.86
Apophyllite,	51.63			25.42	6.25	16.58

—The same writer[2] describes large crystals of *pyrite, chalcopyrite, apophyllite, stilbite, garnet* and smaller crystals of *calcite, orthoclase, pyroxene, aragonite*, masses of *pyrallolite* and *erythrite* and needles of *byssolite* in calcite, all from the shafts of a magnetic mine at French Creek, Pa. The stilbite gave on analysis:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	H_2O
58.00	13.40	tr.	7.80	1.40	1.03	tr.	18.30

—Abnormally developed crystals of *pyrite* from these mines are mentioned by Mr. Penfield[3] as being lengthened in the direction of one of their axes as to present tetragonal symmetry with all the planes terminating at the extremity of the extended axis curved. The crystals are either simple octahedra or octahedra in combination with pyrotoid faces. It is thought that the abnormality may be due to the development of the planes of the form ³⁄₂ O.—Crystals of *gypsum* from the salt marshes of Batz, Loire-Infèrieur, France, are so associated

[1] Notes on Geology and Mineralogy, Proc. Acad. Nat. Sci., Phila. Feb. 26, 1889, p. 32-35.

[2] On the Mineralogy of the French Creek Mines in Pennsylvania. Read before the N. Y. Acad. of Sciences, Jan. 14, 1889.

[3] *Amer. Jour. Science*, March, 1889, p. 209.

with iron pyrites and organic calcium carbonate, as to leave no doubt[1] that they have been produced by the action of these two substances upon each other.—Messrs. Clark and Catlett[2] have discovered small quantities of platinum in a mass of sulphide of nickel, iron and copper from the copper mines at Sudbury, Ontario. The principal sulphide in the mass is the rare mineral *polydymite* $(NiFe_4)S_5$.—Mallard[3] has measured the index of refraction for yellow light in the rare mineral *sellaite* from the vicinity of Montiers, and finds $\varepsilon = 1.389$ and $\omega = 1.379$.—Cruciform twins of *thenardite* from Borax Lake, Cal., are stated by Mr. Ayres[4] to have $P\breve{\infty}$ as their twinning plane.—Jannash and Calb[5] have analyzed a large number of specimens of tourmaline, and have reached the same conclusion with reference to the composition of the mineral as was reached by Riggs[6] about a year ago.

PSYCHOLOGY.

THE SENSE OF SMELL IN DOGS.—Under this title Dr. George J. Romanes read a paper at the meeting of the Lumean Society of London, December 16, 1886. After preliminary observations on the faculties of special sense generally, and in particular that of smell, as enormously developed in Carnivora and Ruminantia, the author related his own experiments with a setter bitch. His conclusions are that in the case of this animal she distinguished his trail from that of all others by the peculiar smell of his boots, and not by the peculiar smell of his feet. "No doubt the smell which she recognized as belonging distinctively to my trail, was communicated to my boots by the exudations of my feet; but these exudations required to be combined with shoe leather before they were recognized by her. Moreover, it may be inferred that if I had always been accustomed to hunt without boots or stockings she would have learned to associate with me a trail made by my bare feet. The experiments further show that although a few square millimetres of the surface of

[1] Bull. d. l. Soc. Franc. O. Min., xi., p. 295.
[2] *Amer. Jour. Sci.*, May, 1889, p. 372.
[3] Bull. Soc. Franc. d. Min., xl., p. 302.
[4] *Amer. Jour. Science*, March, 1889, p. 235.
[5] Ber. d. deutsch. Chem. Ges., 1889, p. 216.
AMERICAN NATURALIST, 1888, p. 250.

one boot is amply sufficient to make a trail which the animal can recognize as mine, the scent is not able to penetrate a single layer of brown paper. Furthermore, it would appear that in following a trail this bitch is ready at any moment to be guided by inference as well as by perception, and that the act of inference is instantaneous. Lastly, the experiments show that not only the feet (as these effect the boots) but likewise the whole body of a man exhales a peculiar or individual odor, which a dog can recognize as that of his master amid a crowd of other persons; that the individual quality of this odor can be recognized at great distances to windward, or, in calm weather, at great distances in any direction; and that this odor is not overcome by anise seed."—*Zool., Anz.*, No. 242.

MIND AND CONSCIOUSNESS.—*To the Editor of the Open Court:* You and Mr. Hegeler have expressed the desire (in a letter, December 31, 1887), to know how it happened that in my friendly contention with Professor Cope I have used "consciousness" and "mind" synonymously. I did so partly out of courtesy to my adversary, who habitually makes use of the phrase "mind or consciousness," and partly to carry on the discussion as much as possible on the basis given by himself.

Allow me, however, to indicate as briefly as possible how I myself distinguish "consciousness" from "mind." "Consciousness" is that state of our being in which we are aware of what is usually classified as sensations, perceptions, emotions, thoughts and volitions. When we are thoroughly asleep or in a swoon we are not aware of such affections, and are consequently not conscious.

Consciousness, of course, can be only a *present* phenomenon, a manifestation taking place within us *at the very moment.* When we are conscious of something that has occurred in the past, this retrospective consciousness takes place likewise only in the moment of present awareness. The same holds good with prospective consciousness. We foresee the future only as content of our present consciousness.

I have called this one, all-comprising moment of conscious realization "the mental presence," and have repeatedly pointed out that its contents vanish from moment to moment into nothingness, and are as constantly reconstituted under kaleidoscopic changes, from a persistent vital matrix. Consciousness is always the effect or outcome of some underlying *activity*, never itself the manifesting substrate.

The underlying vital matrix is perceived by us as the nerve-system of organic beings. And *all* the functional activities of this nerve-system contribute toward the production of the mental presence, though many phases of it may remain unconscious; and this not only from their not attaining a sufficient degree of intensity, but also by dint of normal disposition (see "Space and Touch," *Mind*, No. XL.).

When the term consciousness is used collectively for a series of mental states which we experience during an hour or a lifetime, it does not denote an actual phenomenon or veritable existent, but stands merely as a general name, in the same way as "animal" or "plant."

The term "mind" signifies to most persons some active immaterial agent within us, capable of producing or manifesting conscious states. As I do not believe in such an agent, I can rightly speak of mind only adjectively, as when I say: "mental states," and then "mental" is really synonymous with "conscious." Or I can speak of it, at most, as an attribute of our being, as when I say, "our mentality," which is not synonymous with our "consciousness," as it includes also the unconscious working of the brain toward the production of consciousness.

We can, moreover, not well avoid using the term "mental" as an opposite to "physical." This distinction is felt by every one to be legitimate. Yet it is incontestable that everything physical—all matter and all motion—is realized by us solely as perception of our own. We become aware of it as a peculiar kind of conscious event within our own mental presence. A physical fact is, consequently, itself of mental consistency, for it forms part of our own consciousness. And the only essential difference between it and other constituents of our consciousness lies in the fact of its being aroused in us through compulsory sense-stimulation, while other conscious states arise in us without any compulsory influence working upon us from outside our own being.

To become, however, fully alive to the radical contrast obtaining between what we call a "physical" and what we call a "mental" fact, we need only realize that mental facts, as such, are entirely imperceptible through sensory channels, while it is the very characteristic of physical facts to be thus perceptible. I can touch your physical being, hear your voice, and see your body move and gesticulate; but I cannot touch, hear or see any of your sensations, perceptions, emotions, thoughts or volitions. These are inwardly or retrospectively realized by yourself alone.

The distinction here established is essential. It excludes, first of all, the possibility of our entire being consisting of mind stuff, as believed by Idealists of all shades. And it excludes also the possibility of anything mental being in the remotest degree akin to physical forces, as taught by materialistic thinkers, for no one can deny that we give the name of "force" only to that which is capable of affecting our senses in some way or other, and this is exactly the kind of effect that nothing purely mental can produce.

Yours, very truly,

EDMUND MONTGOMERY.

The Open Court.

GEOGRAPHY AND TRAVEL.

ASIA.—FORMOSA.—Mr. G. Taylor, an Englishman in the Chinese Lighthouse Service, gives in the April issue of the *Proceedings of the Royal Geographical Society* a most interesting account of the natives of Formosa. There was considerable difficulty in establishing a lighthouse at the southern end of the island, among wild natives inimical to Chinese rule, but at last the ground for its erection was fairly bought, and this commencement without bloodshed led to future amicable relations. The Chinamen has ousted the natives from the fertile and highly cultivated plains of the west and north, and even in the south the Chinese squatter has fixed himself upon all the streams, so that the really wild natives have had to retreat to the mountains, especially as many of the native races adopt Chinese customs, settle down, and cultivate the ground.

Formosa possesses only two harbors worthy of the name, viz., Keelong in the north, and Takowin in the west. The first of these can be entered by larger vessels, but the second has the advantage of being more entirely land-locked. The entire island is densely wooded.

There is little doubt that the original settlers were Malay, but physiognomy differs greatly in the same tribe. At present there are four principal races who have preceded the Chinese, viz., the Paiwans, Tipuns, Amias, and Pepohoans.

The Paiwans seem to have been the first settlers, and some are still head hunters, no youth among the wild tribes finding favor with a girl unless he can show a head as a trophy. The Paiwans are a tall, fine-limbed active race of mountaineers, and the women, although small, are symmetrically formed. Their dress consists of nothing but two aprons, one in front and one in rear. Drunkenness is the prevailing vice of the tribe, and has already sapped the power of Paiwan rule in South Formosa.

The Tipuns seem to have come from the north, perhaps from Japan. They must have had considerable civilization when they came, as they were the ruling people in South and East Formosa before the advent of the Chinese. In person they are rather shorter than the Paiwans, less angular, and more inclined to become fleshy. They wear leggings, waist cloths, and long overcoats of buff skin, are an agricultural people, can work in iron and silver, and often intermarry with the Chinese. They have a language of their own, but also speak the tongue of the Paiwans, with whom they are to a considerable extent merged. Pilam, where they first landed, was once the capital, and Tipun headmen were sent to the Paiwan villages. But afterwards the Southern Paiwans, led by some exiled chiefs of the Tipuns, rebelled, and established their independence.

The Amias hold among the natives a lower rank, though they are more muscular and hirsute. They divide time into years, and hold their new year at the end of harvest. There is a tradition among them that they once had written characters, but no traces of these exist.

The Pepohoans seem to be a mixed people, and have a higher civilization than the other tribes. Chinese stories make fun of their simplicity, but intercourse with the Chinaman has given them his astuteness.

The young men of the Formosan natives live in a separate house called a padangkan, as in some African tribes. When a young man has obtained the consent of a girl, he leaves at the door of the parents a bucket of water and some wood. If they agree to the match, the wood and water are taken in, but if not, the lover has still undisturbed possession of his lady love if he can induce her to elope with him.

The Paiwans bury their dead in a spot near his dwelling; the grave is lined with stone, the clothes, arms and ornaments of the deceased are buried with him, and the corpse is placed sitting, facing the nearest high mountain. The grave is then filled up and turfed over. The Tipuns have similar burial customs, but bury within their dwellings. Among the

Tipuns tattooing is practiced upon wrists, etc., but it is a privilege of nobility.

The Amias bury in waste ground, the corpse facing the west; they erect a wooden slab over the spot, and each mourner throws a handful of earth at the grave, and spits at it, repeating a formula telling the dead man that he has been properly treated, and had better stay quietly where he is, or, should he come back, he will be stoned and spit upon.

All the natives are full of superstitions about goblins, etc. They believe that thunder is made by the male divinity throwing things about, and that the lightning is caused by the female uncovering herself. A female uncovers herself if she is evincing the utmost scorn. Some of their stories are about animals assuming human forms.

The Koahuts (a tribe of Paiwans) build neat houses of bamboo covered with straw. The southern Paiwans of Tierasock construct huts of sun-dried bricks, and cover them with thatch. The coast Paiwans are cleanly; they wash and scrub all utensils with sand every morning, and they eat their food with spoons made from a pearly shell. The Tipuns and Amias are scarcely so well housed, nor are they as clean. A Tipun chooses a tree as the centre of his house, and builds around it an irregular hut with partitions. The Tipuns have no tables or spoons; they squat on a billet of wood and dip their hands into a common dish. But the wild Paiwans of the mountains live in a hole dug upon a hillside, and fronted with slabs of slate. When it becomes too filthy to be longer endurable they dig a new hole.

The irrigation practiced by the Chinese has doubtless injured various creeks and harbors, but the island seems to be rising. Anping was an island at the time of the Dutch, but is now joined to the mainland; and an anchor has at another spot been found several feet below ground.

It does not seem that any of the tribes now practice cannabalism, but the coast Paiwans accuse their brethren of the hills, and tell a story of a chief of the Diaramocks who served up his son as a choice morsel to the ambitious chief Tokotok, who aimed to unite all Formosans under his sway.

AFRICA.—THE ZAMBEZI-CONGO REGION.—Rev. F. S. Arnot (*Proc. Geog. Soc., London*, 1889. 11) gives an account of his journey from Natal in search of an elevated spot upon the water-parting between the Zambezi and the Congo, suitable for the establishment of a mission. He traversed the Kaohavi and the district of the Bamangwak, but was turned back by Liwanika, chief of the Barotse. He then retreated toward Benguela, but set out again and reached the country of the Gavenganze. Ascending plateux of 4000 to 6000 feet he arrived at Kwanza, and soon after discovered that the great depression Kifumadji, which Cameron believed to be a lake, has no water (save Lake Dilolo) except in the wet season. Then leaving the Upper Zambezi on the right, the traveller entered a mountainous country, where Mount Kaomba form a water-parting between the Congo and the Zambezi. He was favorably received by Msidi, chief of the Gavenganze, and lived there some years before his return. Ivens and Capello had previously visited Msidi. Mr. Arnot says that Livingstone's Leeba is the true source of the Zambezi.

MR. SELOUS' JOURNEY IN THE ZAMBEZI COUNTRY.—F. C. Selous sends an account of his recent and somewhat unfortunate journeys in Africa, accompanied by a sketch map, to the *Proceedings of the Geographical Society*, London. It was Mr. Selous' intention to explore the Kafukwe, an important tributary of the Zambezi from the north, and at first all went well. Monze, the Mashona chief, had seen no white man since Livingstone passed thirty-five years since, and spoke of that event as though it had been last year. With the Mashakalumbwe, a people on the Kafukwe who have no firearms and wear no clothes, but who never go out without a bundle of long, barbed throwing javelins, Mr. Selous had great difficulty, and narrowly escaped with his life. These people, aided by some Marotse, or inhabitants of the Barotse valley, attacked the camp in the night, and by a volley killed twelve and wounded five of his escort. Mr. Selous escaped, and, after having his rifle stolen, and after enduring great hardships, fell in with the remnant of his party. The Barotse valley is a hot-bed of fever, and no white man can hope to escape death if he continues in this part of Africa.

EUROPE.—THE CAUSSES OF THE SOUTH OF FRANCE.—E. A. Martel contributes to a recent issue of the *Revue de Geographie* an article upon the *Causses* of the South of France, a region almost unknown ten years ago, and not rightly known till now. These Causses are calcareous plateaux, not dissimilar in their nature to the mesas of the Colorado region, and evidently formed as a sediment at the bottom of the secondary sea. These Causses, the highest portion of which rise 1,200 metres above the sea, have, in the course of time become furrowed by canons 400-500 m. in depth. There are four principal Causses and numerous smaller ones. These four, commencing at the North, are: the Causse Sauveterre, which is the least sterile of all; the Causse Mejean, the most arid, elevated and isolated, having an area of 400 sq. kil., and united to another Causse only by an isthmus, which is, in some cases, not more than 10 m. wide; the Causse Noir, which is the smallest and most picturesque of the large Causses; and the Causse Larzac, largest of all, with an area of 1,400-1,500 sq. kil. All these Causses are bare, dreary, monotonous deserts, without water and almost without inhabitants. The rivers that separate them have no above-ground affluents, but are fed by powerful springs and streams that flow from the junction of the limestone with the clay beneath, at the level of the bottom of the gorges. The rains penetrate the limestone at apertures which are called *avens*, sink until they reach the bed of clay and have underground courses sometimes of considerable length. Exploration of the caverns is, however, very difficult, and, indeed, impossible, except to those provided with proper apparatus. M. Martel traced the course of a stream, the disappearance of which had long been a problem to the natives, and discovered two caverns, one of which, Dargilan, has a length of 2800 m. with many large halls, one 190 m. long, and is, in many respects, a rival to the celebrated Grotto of Adelsberg, especially as it has the finest stalactites in Europe.

The finest gorge is that of the Tarn, which for 80 kilo. flows in the depths of a cañon, the walls of which have a mean height of 500 m. One of the greatest wonders of the region is Montpellier-le Vieux, a promontory of triangular shape upon the Causse Noir, above the valley of the Doubré which is here 400 m. deep. At this spot 1000 hectares are covered with what seems like the ruins of a city with its streets, squares, monuments, etc. M. Martel's description recalls the Garden of the Gods and other spots in Colorado.

BOTANY.[1]

THE FLORA OF THE UPPER NIOBRARA.—In the northwestern part of Nebraska there are conditions which have given rise to a flora which possesses unusual interest to the student of botanical geography. Here a spur of the Rocky Mountains extends eastward between the headwaters of the Niobrara River on the south and the White River on the north. This extension of elevated land bears the local name of Pine Ridge. It rises above the great plain as a series of higher and higher ridges and points, until at its culmination it is fully twelve or fifteen hundred feet above the general level to the north and the south. Its southern slopes are less abrupt, but upon its northerly side it is often very abrupt and broken, and here there are multitudes of picturesque and fantastically shaped buttes.

Both the Niobrara and the White Rivers, in this region, run through rather broad flood plains, but their tributaries are all cañon streams, often with high rocky precipices along their banks. Here and there fine springs burst from the sides of the cañons, and give rise to clear, cold streams of pure water. These are more numerous upon the northerly side than upon the south. The elevation of the summit of the ridge is nearly five thousand feet above the sea. The tunnel of an extension of the Chicago, Burlington & Quincy Railway passes through the ridge at a measured elevation of four thousand five hundred feet, and there are numerous points within a short distance which rise fully three or four hundred feet above it.

The vegetation of this region presents an interesting mingling of the Rocky Mountain and the eastern floras. Its most striking feature is the abundance of pine trees. These are all of the Rocky Mountain variety of the Great Yellow Pine of the Pacific Coast. *Pinus ponderosa* var. *scopulorum*. They attain a height of from fifty to eighty or ninety feet, and have often a diameter of from fifteen to twenty-five or more inches. They occur in heavy masses in the cañons, and in more scattered growths upon the slopes and hilltops. So important are these pine forests that many saw mills have been erected near them, and large quantities of lumber have been cut for use in railroad construction and for other uses. Other trees occur only in the cañons. The most important of these are *Negundo aceroides*, *Prunus Americana*, *Prunus demissa*, *Fraxinus viridis*.

[1] This department is edited by Professor Charles E. Bessey, Lincoln, Neb.

Ulmus Americana, *Populus monilifera*. Occasionally one may find a tree of *Juniperus virginiana*, and on Crow Butte there are numerous specimens of *Juniperus communis* var. *alpina*. Of the lesser woody plants one finds *Celasteus scandeus* in abundance, though far out of its reputed range. *Vitis ripania* and *Ampelopsis quinquefolia* are common, as are, also, *Rhus glabra*. *R. toxicodendron* and *R. aromatica* var. *trilobata*. Here we find growing commonly the yellow flowered currant, *Ribes aureum*, the Buffalo Berry, *Shepherdia argentea*, and the Diamond Willow, *Salix cordata* var. *vestita*.

Of the herbaceous vegetation only the following need be enumerated: *Thermopsis rhombifolia; Lupinus plattensis; Latteyrus polymorphus; Potentilla auserina; Œnothera albicaulis; Gaura coccinea; Opuretia missousiensis; O. fragilis; Campanula rotundifolia; Asclepias speciosa; Gilia lineasis; Heliotropium convolvolaceum; Krynitzkia glomesata; Yucca augustifolia; Calochostus nuttallii; Stipa spartea; Buchloe dactyloides; Munsoa squanosa; Boutelona oligostachya.* In addition numerous species of *Astragolus*, *Estsgonum*, and of various mountain composites might be noted, but those already given are perhaps sufficiently characteristic.—*Charles E. Bessey.*

KELLERMANN AND SWINGLE'S KANSAS FUNGI.—Fascicle II. of this distribution has been received. It is fully as satisfactory as its predecessor. The numbers are as follows: No. 26. Æcidium callir hœs E. & K.; 27. Æ. grossulariæ Schum.; 28. Æ. penstemonis Schw.; 29. Æ. pustulatum Curt.; 30. Æ. tuberculatum E. & K.; 31. Cæoma nitens Schw.; 32. Cercospora althæina Sacc.; 33. C. diantheræ E. & K.; 34. C. Juglandis Kell. & Sw.; 35. C. polytæniæ E. & K.; 36. C. tuberosa E. & K.; 37. Dendryphium subsessile E. & E.; 38. Entyloma physalidis Cke.; 39. Fusicladium effusena Wint.; 40. Glorosporiam nervisequum Sacc.; 41. Peronospora androsaces Neissl.; 42. Phyllosticta ipomœas E. & K.; 43. Puccinia nigresceus Peck; 44. P. schedonnardi Kell. & Sw.; 45. P. silphii Schw.; 46. Ramularia urticæ Ces.; 47. Srptoria tenella Cke & Ell.; 48. Uromyces graminicola Burrill; 49 U. hyalinus Peck; 50. U. polygoni Fckl.

BAILLOU'S DICTIONNAIRE DE BOTANIQUE.—This work has now reached the 24th fascicle, the latter extending from *Lise* to *Meri*. Among the topics which have notable treatment, either by text or engravings are *Lycopodium*, *Magnolia*, *Marchantia* and *Melastoma*. The accompanying colored plate represents a twig bearing leaves, fruit and seed of *Theobroma cacao*, the chocolate tree of full size. The fascicles contain about 80 pages, and are of quarto size. Among the collaborators are Dr. Seynes, Nylander, Dutailly, Weddell, Durand, besides many other specialists.

LUERSSEN'S PTERIDOPHYTA.—In 1884 the first part of Luerssen's work on the Pteridophytes of Germany appeared, and recently part 14, which completes the volume, has come to hand. The work constitutes Vol. III. of the new edition of Rabenhorst's Kryptogamen-Flora von Deutschland, Oesterreich und der Schweiz. The treatment of the subject is eminently satisfactory, the text being full, and the illustrations numerous and of fine quality. Some estimate may be made of the fulness of the work when the reader learns that for the eighty-eight species described, we have here a volume of no less than 906 pages.

Luerssen's system is as follows:

CLASS I. FILICINAE Prantl.

Sub-Class I. Isosporeae Sachs.

Section I. Leptosporangiatæ, Goebel.

ORDER I. FILICES L.

Sub-Order I. Hymenophyllaceae Bory.
Family 1. *Hymenophylloideae* Pr.

Sub-Order II. Polypodiaceae Martius.
Family 1. *Polypodieae* Meth.
Family 2. *Aspleniaceae* Meth.
Family 3. *Aspidiaceae* Meth.

Sub-Order III. Osmundaceae Brongu.
Family 1. *Osmundaceae* Brongu.

Section II. Eusporangiatae Goebel.

ORDER II. OPHIOGLOSSACEAE R. Br.
Family 1. *Ophioglosseae* R. Br.

Sub-Class II. Heterosporeae Sachs.

ORDER III. HYDROPTERIDES Willd.
Family 1. *Salviniaceae* Bartl.
Family 2. *Marsiliaceae* Bartl.

CLASS II. EQUISETINAE Prantl.

ORDER IV. EQUISETACEAE Rich.
Family 1. *Equsietaceae* Rich.

CLASS III. LYCOPODINAE Prantl.

Sub-Class I. Isosporeae Prantl.

ORDER V. LYCOPODIACEAE Rich.
Family 1. *Lycopodiaceae.*

Sub-Class II. Heterosporeae Prantl.

ORDER VI. ISOÖTACEAS Bartl.
Family 1. *Isoötaceae* Bartl.

ORDER VII. SELAGINELLACEAE Meth.
Family 1. *Selaginellaceae* Meth.

Our familiar *Pteris aquilina* L. becomes under Luerssen's treatment, *Pteridium äquilinum* Kuhn. So too *Aspidium filix-femina* Sw., the *Asplenium filix formina* Beruh., of the ordinary manuals, becomes *Athyrium filix formina* Roth.—*Charles E. Bessey.*

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

PHILADELPHIA ACADEMY OF NATURAL SCIENCES.—April 24, 1888. Professor Ryder spoke of the displacement of the nucleus of tissue cells and in ova by a large amount of yolk matter.

May 1, 1888. Professor Leidy called attention to some *Menopon perale,* and also spoke of the parasites of the rock-fish.—Mr. Meehan exhibited specimens of the so-called navel orange.—Professor Wilson described some ærial roots in corn caused by abnormal watering of the plant. May 9, 1888. Professor Leidy spoke of the parasites of the pike and the pickerel.—Dr. Meyer described a tertiary barnacle, *Balanus concavus,* occurring in the neighborhood of Norfolk, Va. May 15, 1888. Dr. McCook read a description of four new species of orb-weaving spiders. He also made a communication on the color of spiders. May 29, 1888. Mr. Wilcox called attention to a number of shells beveled and perforated to permit a stick being thrust through for a handle.

June 5, 1888. Professor Heilprin called attention to a collection of specimens obtained from a deep boring at St. Augustine, Fla.—Dr. Chapman described the generative organs of a female spotted hyena from South Africa.—Mr. Meehan spoke of the importance of studying the companionship of plants, and announced the discovery of *Trientalis americana* in the vicinity of Philadelphia. June 12, 1888. Dr. McCook read a description of *Evatypus woodwardii*, a fossil spider. June 19, 1888. Professor Heilprin discussed the age of Laramie. June 26, 1888. Dr. McCook gave a résumé of a paper on the purse weed spiders.—Professor Ryder described the eggs of the sturgeon.

July 3, 1888. Dr. Koenig described some crystals of magapilite.—Mr. Meehan spoke of the so-called flowers of Hydrangea. July 10, 1888. A communication from Dr. Leidy on the fauna of Beach Haven, and on the embryology of *Lepas fascicularis*, was read.—The chairman exhibited a fine specimen of the snow plant.

August 7, 1888. Mr. Meehan spoke on the sexes of flowers.

September 4, 1888. Mr. Meehan and others discussed the polarity of the compass plant.

October 2, 1888. Professor Leidy called attention to the claw of a giant sloth found in the drift in Mills County, Ind., and exhibited a portion of a human skull having four true molars. October 9, 1888. Professor Heilprin made some remarks on the classification of the tertiary deposits. October 16, 1888. Mr. Redfield called attention to a probable hybrid Solanum.—Dr. Morris alluded to the effects of insect bites.—Dr. McCook read a paper on *Lycosa arenicola*. October 23, 1888. Professor Heilprin spoke of the physiography of the Bermuda Islands. October 30, 1888. Professor Heilprin discussed the Bermuda coral reefs.

November 6, 1888. Professor Heilprin described the fauna of Bermuda Islands. November 13, 1888. Professor Heilprin continued his remarks on the zoology of Bermudas. November 20, 1888. Professor Ryder presented the results of his study of the skeleton of living forms.—Dr. McCook described a case of double cocoonizing in *Argiope riparia*.—Dr. Rushenberger read a biographical notice of the late George W. Tryon.—Dr. Leidy read a communication on the zoology of Beach Haven.

December 4, 1888. Dr. Morris and others discussed the color of glass due to exposure to heat and air.—Mr. Ives described two new forms of star-fish.—Mr. Morris read a paper on subsidence. December 11, 1888. Dr. McCook read a paper on nomenclatures of spiders.—Professor Ryder gave the results of his study of *Mya arenaria*. He also exhibited and described a section of the skin of an elephant. Professor Leidy spoke of the embryology of Lepas. December 18, 1888. Mr. Pilsbry called attention to anomalies in *Helix bermudensis*.—Dr. Foote spoke of Threnardite.—Mr. Morris read a communication on colored glass.—Professor Heilprin summarized the observations made by the recent Greenland expedition.

January 1, 1889. Dr. Koenig exhibited and described a specimen of Anhydrite.—Dr. Leidy discussed the Gregarines. January 8, 1889. Professor Ryder made a communication on the axial skeleton.

February 12, 1889. Professor Ryder read a paper on the development of the calcified skeleton of Chelonians. February 19, 1889. Dr. Leidy described some teeth of a fossil horse from a limestone quarry in Florida.—Mr. Ives reported finding on the omentum of a monkey a number of Pentastomum.

March 5, 1889. Dr. Horn referred to the incrustation of fragments of wood by the mineral constituents of water or soil.—Dr. Leidy exhibited two spiders from Peru, and stated that the tooth of a fossil Llama, from Florida, had been received. March 12, 1889. Dr. Leidy read a paper on Cliona. March 19, 1889. Dr. Brinton exhibited a specimen of *Chrysosplemium americanum*.—Professor Ryder discussed the question of mammalian descent.—Dr. Rex exhibited a specimen of an undersized trichia from Montana.—Dr. Brewer exhibited specimens of yeast and described the development of its cells.—Mr. Wingate exhibited and described a new myxomycete.—Mr. Ives gave a résumé of a paper on "Variation of Color in Star-Fish." March 29, 1889. Dr. McCook explained the structure of spider webs.

April 2, 1889. Dr. Koenig described some Kansasite from Kansas.—Mr. Woolman called attention to the micro-geology of Atlantic City.—Professor Heilprin spoke of the geology of Bermuda and the structure of coral reefs.—Professor Ryder gave the development of vertebræ in certain lower forms.—A communication from Professor Wilson on the production of aerating organs on the roots of swamp and other plants was read. April 9, 1889. Mr. Meehan made a communication on dogwood.—Mr. Ryder spoke further of his studies of the vertebral column. April 16, 1889. Dr. Hartzell exhibited a section of skin mounted in monobromide of naphthaline.—Professor Ryder commented on the homologies of the jaw of Acanthias in mammalian dentition—Dr. Rex spoke of the interest attaching to common molds and mildew. April 23, 1889. Mr. Wilcox recounted his own explorations of Florida with reference to the geology of that State.—Professor Leidy spoke briefly of the palæontology of Florida.— Professor Heilprin gave a résumé of his study of the fauna of the Bermudas—Mr. Ives described the ophiurans. April 30, 1889. Professor Ryder resumed the report of his study of the development of the vertebral column with especial reference to its growth in the sharks.

May 7, 1889. An invitation from the University of Pennsylvania to remove the building to West Philadelphia was read.—Mr. Meehan referred to his former communication on the formation of species of dog-wood as affected by the principles of acceleration and retardation.—Professor Wilson spoke of the relation of various vegetable substances to electric filaments as bearing upon electric illuminations.—Mr. Redfield detailed the nature of botanical travel one hundred years ago. —Professor Dolly offered some remarks on Bahama plants.—Professor Rothrock described the sand dunes of Lewes, Del. May 14, 1889. Mr. Pilsbry spoke of the modifications of the odontophores in the Rhipidoglossa.—Mr. Ford referred to a new species of Helix from New Guinea, and to a group of fossil olives from Florida.—Mr. Wilcox described the habits of *Fasciolaria gigantea* from Florida. Mr. Campbell exhibited specimens of the genus Cypræa illustrating the convergence of species.—Professor Ryder gave the results of his studies into the structure of the transparent tissues surrounding the eye of the common shad. May 21, 1889. Professor Ryder gave the substance of a paper on Volvox.—Dr. Rex spoke of the development of a species of myxomycetes, *Clathroptychium rugulosum.*—Dr. Wingate exhibited specimens of the genus Physarum. May 28, 1889. The following resolution adopted: *Resolved*, That the Academy, in accordance with the recommendation of the Council, declines to accept the proposition made by the Provost of the University to move the institution to West Philadelphia.—Professor Ryder recounted recent investigations of heterocercous fishes.—Mr. Wilcox stated that eggs of Ampularia sent to Wagner Institute had all hatched out.

June 4, 1889. Professor Heilprin placed on record the finding of the first fossils in the limestone near Henderson Station.—Mr. Woolman exhibited a specimen of cretaceous limestone outcrop from the neighborhood of Clementown, N. J., full of *Trochosmilia atlantica.*—Professor Sharp described the extinct circular crater of St. Vincent.—Mr. Rand exhibited specimens of serpentine pseudomorph after asbestos, found near Radnor Station, and a variety of Iceland spar from Rossy Wene, N. J.—Mr. Jefferis exhibited a specimen of clinoclase from the Birmingham quarries. June 11, 1889. Dr. Horn exhibited a collection of beetles injurious to vegetation.—Dr. Skinner exhibited two rare papilios (*P. dasorada*) from Sikkim, India, and and an X butterfly from the Andaman Islands.—Dr. McCook made a communication in the sense of hearing of spiders. June 18, 1889. Professor Ryder described the larva of a species of salamander Amblystoma, which showed heterocercy. He also described the occurrence of hypertrophied hairs on the tips of the shoots of Ampelopsis.—Professor Sharp told of some carnivorous bats.—Dr. Rex exhibited a rare fructification of one of the black molds.—Dr. Hall called attention to aspergillus growth from a Brazil nut.—Mr. Wingate exhibited a box containing some enteridium.

Boston Society Natural History.—President, F. W. Putnam; Vice-Presidents, John Cummings, G. L. Goodale; Curator, Alpheus Hyatt; Honorary Secretary, J. C. White; Secretary, J. Walter Fewkes; Treasurer, Charles W. Scudder; Librarian, J. Walter Fewkes; and twenty-five Councilors.

The following papers were read: Mr. A. F. Foerste spoke of "The Palæontological Horizon of the Limestone Beds of Nahant."—Mr. J. E. Wolff read a paper on "Some Metamorphic Rocks in the Green Mountains.—Mr. A. F. Foerste then considered "The Fossils of the Clinton Group of Indiana and Tennesee."

Biological Society of Washington—The following communications were read: January 26, 1889. Dr. Cooper Curtice, Notes on the Sheep Tick, *Melophagus ovinus* Linn.—Dr. Geo. Vasey, New Species North American Gramineæ of the Last Twelve Years.—Mr. Th. Holm, Contributions to the Morphology of the Genus *Carex.*—Dr. C. Hart Merriam, A new species of Pika (*Lagomys*).

February 9. The following papers were read: Mr. B. F. Galloway, Diseases of the Sycamore.—Dr. Thomas Taylor, A new Freezing Microtome.—Mr. A. A. Crozier, Influence of Foreign Pollen on Fruit.—Mr. J. N. Rose, Geographical Distribution of the Umbelliferæ.—Dr. C. Hart Merriam, A New and Remarkable Vole from British Columbia.

February 23d. Mr. E. M. Hasbrouck, A New Maryland Yellow-throat.—Mr. M. B. Waite, Notes on *Melampsora hydrangeæ* Lusk. Notes the Seed Vessels of the Lop Seed *Phyrma leptostachya.*—Mr. Chas. D. Walcott, The Genus Olenoides of Meek.—Dr. R. L. Stejneger, Notes on Pallas' Cormorant.—Mr. F. V. Colville, The Fruit of *Stipa spartea.*—Dr. C. Hart Merriam, A New Marmot from the Sierra Nevada.

March 9.—Mr. Geo. B. Sudworth, Variations in the genus *Quercus.*—Mr. W. B. Barrows, Dangerous seed-planting by the Crow.—Dr. C. Hart Merriam, A new Ground Squirrel from the Southwest.—Mr. Chas. D. Walcott, The Genus *Olenellus* of Hall.

March 23. Dr. W. H. Seaman, Our Present Knowledge of the Rotifers.—Mr. C. L. Hopkins, A Point of Definition.—Mr. Geo. B. Sudworth, Variations in the genus *Quercus.*—Mr. W. H. Dall, Reproductive Organs in Certain forms of Gasteropoda.

April 20. Prof. Joseph F. James, The Effect of Rain on Earthworms.—Mr. F. W. True, The Occurrence of Sowerby's Whale on the Coast of New Jersey.—Mr. Theo. Holm, The Germination of Sarracenia, Rheum, Peltandra, Hemerocallis and Cyperus.—Dr. C. Hart Merriam, A new Vole from the Gulf of St. Lawrence.—Mr. Geo. B. Sudworth, The Influence of Odor in Attracting Insects.

May 4. Mr. W. T. Hornaday, Exhibition of a Specimen of the Black-footed Ferret (*Putorius nigripes*).—Mr. B. E. Fernow, Annual Ring-Growth.—Dr. Theobald Smith, Parasitic Protozoa (*Coccidia*) in the Renal Epithelium of a Mouse.—Dr. H. E. Van Deman, Tropical Fruit of the Lake Worth Region.—Dr. C. Hart Merriam, A new Spermophile from Arizona.

May 17. Dr. C. Hart Merriam, Two new Spermophiles from the Lower Colorado, with remarks on the Importance of the Type Locality in the Study of Species.—Dr. Cooper Curtice, How Entozoa Cause Disease.—Mr. Frederick W. True, Exhibition of a Skull of a Female Narwhal with two well developed Tusks.—Mr. L. O. Howard, Notes on Spider Bites.—

Mr. C. D. Walcott, Description of New Genera and Species of Lower Cambrian Fossils.

WICHITA ACADEMY OF SCIENCE.—On Saturday, April 6th, 1889, the Wichita Academy of Science was organized, having for its object "to promote the study of science and stimulate original investigation." The officers elected for the ensuing year are as follows:

President, J. M. Naylor, A.M.; 1st Vice-President, M. E. Crowell, A.B.; 2d Vice-President, W. A. Crusinberry, A.M.; Recording Secretary, J. S. Foote, M.D.; Corresponding Secretary, Fred L. Johnson, M.D.; Treasurer, F. J. Ford; Curator, E. L. Kemp, A.M.; Librarian, F. L. Hinsdale, M.D.

Regular meetings are to be held on the first Saturday of each month.

THE KENT SCIENTIFIC INSTITUTE, GRAND RAPIDS, MICH. —The following is the list of the officers for 1889:

President, E. S. Holmes; Vice-President, W. A. Greeson; Recording Secretary, C. W. Carman; Corresponding Secretary, E. S. Holmes; Treasurer, C. A. Whittemore; Director of the Museum, W. A. Greeson; Curator, C. W. Carman; Librarian, E. L. Moseley. Board of Directors: Wright L. Coffinberry, W. A. Greeson, Samuel L. Fuller, E. S. Holmes, J. W. Jones, C. A. Whittemore. Officers of the Board: Chairman, W. A. Greeson; Secretary, E. S. Holmes; Treasurer, C. A. Whittemore.

CHICAGO ACADEMY OF SCIENCES.—A regular meeting of the Academy was held in the Art Institute, Michigan Boulevard and Van Buren Street, March 12th, at 8 o'clock. The evening was devoted to a conversation on the "Great Glacial Moraine at Lombard, Illinois," as examined by the Academy, at the excursion in June, 1888.

NATURAL SCIENCE ASSOCIATION OF STATEN ISLAND.— Nov. 10th, 1888. This being the annual meeting, officers for the ensuing year were elected as follows: President, L. P. Gratacap; Treasurer, Samuel Henshaw; Recording Secretary, K. B. Newell; Corresponding Secretary, Arthur Hollick; Curator, W. T. Davis.

December 8th. Mr. L. P. Gratacap read the following paper upon the "Relation Between the Growth and Form of Leaves:"

It is obvious that the form of leaves must be the resultant of rates of growth in various directions. That a simple leaf with a single midrib will assume such a mature form as will express the equilibrium of the growing impulse along two axes, a longitudinal and a lateral one, and that as this ratio varies in favor of the first or the second, the leaf becomes ovate, circular, broadly elliptical, etc., or lanceolate, linear and elongated. And secondarily, in the case of the simple leaf, the point of intersection of the axis will modify the final form. If the lateral axis is developed at an early stage in the elongation of the midrib we have ovate leaves, if at a point half way along its length elliptical, if at the distal extremity obovate. And in leaves of a complex structure, whether palmate, pinnate or numerously veined with woody and rigid vascular fibres, we can resolve the entire form into a group of simple forms, wherein we may study the related rates of development in lamination (formation of parenchyma), and in vasculation (formation of ribs, veins, etc.). In other words, the rapid movement forward of rib cells would appear to interfere with or prevent the making of the leaf lamina, and their slow movement to assist it. In a leaf with several ribs, the slow progress of the rib-making permits the coalescence of the marginal tissues, and forms polygonal and crenate circular leaves, and also tends to introduce bifurcation and deliquesence of the original fibre bundles. In one, where the extension of the ribs is rapid, this coalescence is checked, and the leaf is sinuate, lobed, irregular and pinnatified.

It is thus apparent that a determination of the *actual* rate of growth in leaves may throw some light or be useful in assisting speculation as to the origin of leaf forms. And it is also apparent that there might be a condition of things exactly the reverse of our supposition given above, and yet produce the same result. That is, a linear leaf might be a, so to say, slowly made leaf as well as a quickly made leaf, if the movements of its parts maintain a ratio which gives extension in length and not in breadth. And in many cases of turgid and dense tissues in leaves this is probably so.

However the measurement of a number of leaf growths including those of Morning-glory, Musk-melon, Water-melon, Maples, *Magnolia*, Beach, Japanese Quince, Five Finger, etc., made this year on Staten Island, do seem to show that the elongated leaves grow much the more rapidly, that the palmate and pinnate leaves stand next in order, and the circular and transverse leaves last. [A diagram was here presented showing these results in part, with the rate per day of growth, also the slowly diminishing rate of growth of the leaf as it approached completion.]

Of course a number of considerations occur at once to modify the wholesale use of this conclusion. The relative size of the leaves compared should be similar, the condition of healthfulness of the plants alike, the nature of the plant tissue nearly the same, and the position and aspect of the leaves, as regards favorable or unfavorable conditions for growth, identical. The subject is suggestive, and carefully followed up might lead to interesting results.

Mr. Arthur Hollick showed fossil leaf impressions in ferruginous sandstone, found near Arrochar Station by Mr. Gilman S. Stanton. They are undoubtedly from the same formation as those from Tottenville (Cretaceous ?) described in the Proceedings of December 8, 1883, and like them, were not in place where found, but occurred in Drift rocks. The specimens are too fragmentary for determination, but the fact of their discovery at this new locality is a matter of interest and is therefore placed upon record.

Specimens of bowlder clay from the same locality were also shown. It has been lately utilized for brick making. There is a fine exposure of modified drift, overlaid by bowlder drift, where the railroad has been cut through.

Dr. A. L. Carroll noted the discovery on Staten Island recently of *Bothryocephalus latus*—the first reported occurrence of this parasitic worm in America.

Specimens of the "Large Mocker Nut," *Hicoria alba*, (L.) Britton, *var. maxima* (Nutt., Britton.), were presented—being an addition to the local flora. They were collected by Dr. Britton near Court House Station.

February 9, 1889. Mr. Chas. W. Leng read a paper upon "The Buprestidæ of Staten Island," illustrated by specimens of the species mentioned.

It is thought that the larvæ of many species take years to perfect their growth, and an instance is recorded of a *Buprestis* emerging from the wood of a desk that had been in use for twenty years. One of our commonest species. *Chrysobothris femorata* is, however, said by Packard to complete its transformations in twelve months, so the usual period is uncertain.

This insect is found every year in numbers on oaks and occasionally other trees. I took the greatest number about 1880, when Mr. Davis and I found a log near Silver Lake literally alive with them. They would take short flights and lighting on the log, hide in the crevices of its bark, which, by their color and deep-wrinkled furrows, they simulate to a degree. Many other species have this restless habit of flying from place to place, and on the wing look and buzz very like flies.

Two species of *Agrilus* are also abundant—*ruficollis* and *otiosus*—the first usually on wild blackberries and the second on a variety of young saplings. When the trees around Marling's Pond were cut down about three years ago, a growth of saplings sprang up on which the species of *Agrillus* were quite plentiful and besides many *otiosus* an occasional *bilineatus* or *interruptus* was found.

I have never found any of our other species in great numbers. Of the *Anthaxia* all my specimens have come from a clump of wild cherry in the Clove Valley. *Chalcophora* is said to breed in pine, but a good deal of beating has yielded little. The species have been found washed upon the beach and one specimen of *liberta* was taken by Mr. Davis flying at Watchogue. Two species of *Brachys* occur on the leaves of certain oaks, and I have found them in North Carolina in great numbers. Probably they will be found abundantly somewhere on Staten Island.

Chrysobothris azurea was a notable capture of 1886, and is everywhere counted a rare insect, but from May to July of that year it was plentiful on a species of dogwood in a thicket now burned over and turned into "Prohibition Park." The house, built, as I am told, for the dominie, stands just above where the first was taken. The beetles were very quick in their movements, and were captured by beating the trees over an umbrella, out of which they flew again as soon as they touched it. Several were observed resting on the main stems of the young trees with the anterior legs extended and the last ventral segment touching the bark and they were probably females depositing their eggs. None have been found since 1886, nor have I been able to find the larvæ in the few trees that are left.

Attention was called to the recent death of Mr. S. Elliot Lowell.

March 14, 1889.—Mr. L. P. Gratacap showed specimens of fossils from a drift bowlder and gave the following account of the same:

Mr. C. S. Egbert in excavating a foundation for a house at Fort Wadsworth station on the Rapid Transit Railroad, on the north side of the Fingerboard Road, and a few hundred feet northeast of the station, uncovered a bowlder of Oriskany Sandstone which upon examination by Mr. Wm. T. Davis proved to be of great interest. It was a compact mass of fossils representing over twenty species characteristic of that horizon, of which fourteen were new to our list previously published (Extra No. 6, March, 1887.) Amongst these were some of considerable rarity, and while many were in a fragmentary condition or preserved as impressions only, they were all unmistakably identified, and form a valuable addition to our palæontological possessions.

The list of new additions is as follows:

Pholidops arenaria, Hall.
Streptorhynchus hipparionyx, Vanuxem.
Strophodonta magnifica, Hall.
Chonetes campalnatus, Hall.
Leptæna nucleata, Hall.
Spirifera pyxidata, Hall.
Leptocœlia flabellites, Conrad.
Eatonia peculiaris, Conrad.
Rennsselaeria ovoides, Eaton.
Pterinea Gebhardi, Hall.
" *textile*, Hall,
Aviculopecten rectirostris, Hall.
Platyceras nodosum, Conrad.
Platyostoma ventricosum, Hall,

Mr. Arthur Hollick exhibited mounted specimens of new or noteworthy additions to the local flora and read the following memoranda in connection with them:

Since the fourth appendix to the Flora of Richmond County was published, about two years since, there have been many plants found which require recording. The full list, containing thirty-six species and varieties new in our Island's flora, will be published as usual in the *Bulletin of the Torrey Botanical Club*, as the fifth appendix. Reprints of the same will be distributed to all those desiring them. Memoranda in regard to some of the species have been published in our Proceedings, while others have not been recorded, although of considerably interest.

For several years specimens of a peculiar *Ranunculus* were collected in the Clove Lake Swamp. They were classed under the species *fascicularis*, the common Early Buttercup, although plainly not identical with it. The most remarkable characteristic of all the plants was a tendency to fasciation which showed itself year after year, and may be seen in all the specimens collected. The species has lately been determined to be *Ranunculus septentrionalis*, Poir. Thus far it has not been found in any other locality on the Island.

In studying the herbarium of the late Wm. H. Leggett many plants were noted as having been collected on Staten Island. Amongst the most interesting were several specimens of *Lechea racemulosa*, Lam, from Tottenville, mixed with and included under the name of *L. thymifolia*, Michx.

Trifolium hybridum, L., supposed to be a hybrid between the Red and White Clovers, is becoming more common, and may be now found along many of the streets of New Brighton, and also on the filled-in ground at St. George.

A species of Honeysuckle was admitted into the last appendix under the name of *Lonicera ciliata*, Muhl. A single bush in flower was found in some cedar woods just north of Garretsons. It was undoubtedly native where found. Since then, Mr. Wm. T. Davis has discovered the plant, in fruit, in a similar situation at New Brighton. With the material now in our possession we are enabled to determine it to be *L. xylosteum*, L, the European Fly Honeysuckle, which has somehow become established and thoroughly naturalized here, probably through the agency of birds.

On May 30, 1888, a single plant of *Cynoglossum officinale*, L., was found in a field near Richmond. The only other time that this plant was reported from the Island was in 1880, when a single specimen was found near Concord.

Amarantus hybridus, L., in every stage of hybridization between the green Pigweed and the red Prince's Feather is common along the streets and in waste places in New Brighton.

Thus far I have failed to find a Butternut tree growing here independent of cultivation, but in the Trans. N. Y. State Agri. Soc., for 1843, there is a list of the trees common on Staten Island, by Dr. Samuel Ackerly, and this tree is included in the list, under the name of *Juglans cathartica*, Michx. It is quite possible that at that time it may have been native here.

Mr. Wm. T. Davis has reported the discovery of several more trees *Betula nigra*, L., the Red or River Birch, near Richmond, Annadale and Old Place, but the total number of trees is so small that the speedy extermination of the species on the Island is certain.

Salix purpurea. L., the Basket Willow, has become established in several localities notably near Garretsons and Old Place. These trees no doubt originated from cuttings of cultivated trees which were thrown aside in rubbish heaps. At Garretsons their presence is easily accounted for by the old plantation belonging to the late John Reed, which has been cultivated for generations. No doubt at Old Place there was also a plantation, although no indication of it was noticed. A single isolated tree was found on a roadside near Woodrow.

A single tree of the Hemlock Spruce (*Tsuga Canadensis*, L.) was found near Old Place. It is a somewhat conspicuous object as it is the only large tree, and an evergreen at that, left standing in a recently cleared place of woodland, where all the surrounding hardwood trees have been cut down.

In the sandy soil at Mariners' Harbor, Watchogue and Kreischerville occurs abundantly a form of Cat Brier, which is clearly a variety of the common *Smilax glauca*, Walt. The leaves are narrow and elongated, often constricted in the middle so as to be almost fiddle-shaped, and the stem, especially at the base, is thickly beset with prickles. It agrees with the description of the so-called *S. spinulosa.* Smith.

Several of the plants admitted into our catalogue without having been personally seen have been discovered within the past two years. Amongst them may be mentioned *Lathyrus maritimus*, (L.) Bigel., the Beach Pea. This was admitted on the authority of a specimen in the herbarium of the late Dr. Samuel Elliot and it now turns up at New Dorp near the old race course.

Pycnanthemum incanum, (L), Mich., admitted on the same authority, grows on Ocean Terrace.

Salix tristis, Ait., the Dwarf Gray Willow, was credited to Staten Island about twenty years ago in the *Bulletin of the Torrey Botanical Club*. There is a small patch growing south of the railroad between Richmond Valley and Tottenville, within a few yards of the hybrid oaks described in our Proceedings for September and October, 1888, which is probably the same locality where it was originally found.

Sabbatia dodecandra, (L.) (*S. chloroides*, Pursh.,) was reported by Mr. E. M. Eadie from near Chelsea. It was found in the Autumn of 1887 growing abundantly on the salt meadow near Kreischerville.

Dr. N. L. Britton showed specimens of yellow gravel and kaolin and remarked upon a recent discovery of another exposure of the Cretaceous strata which are known to underlie a considerable portion of Southfield and Westfield. This new exposure is on the Fingerboard Road about a quarter of a mile east of Grassmere Station. A cutting in the north side of the road shows a section of glacial and modified drift, under which may be seen some of kaolin similar to that which is so extensively dug near Kreischerville. This is associated with a small amount of yellow gravel. He stated that it could not be positively determined whether the kaolin was exactly in place or had been ploughed up from below and enclosed in the moraine as at the Prince's Bay bluff, already described in the Proceedings, November 8th, 1884.

SCIENTIFIC NEWS.

Natural History at the Paris Exposition.—Although the Paris Exposition has no special biological department, it cannot be said that biology is entirely unrepresented. The Woods' and Forests' Building, in the Gardens of the Trocadero, is composed of trunks and branches of trees native to or naturalized in France, all labelled with their botanical and French names, and the gallery around its interior has a collection of the seeds, leaves, resins, etc., of those trees, as well as of the fungi and insects injurious to them. Around this building are planted examples of native and introduced trees. The exhibit of the Transvaal Republic, in the Invalides Gardens, has a series of the eggs of many South African birds; the Argentine Republic, besides an extensive collection of woods, including many Legumenosæ and Rubicæ, *Zuglans Australes*, species of Myrsine, and large sections of *Cedrela brasiliensis*, has a set of fishes, reptiles, etc., preserved in alcohol, and Gautemala puts forward a fine collection of insects, and quite a number of birds. Most of the exhibits of the smaller and less important countries devote, in fact, a considerable space to their minerals, plants and animals, and this is true not only with regard to America, Australia and Africa, but also, so far as regards minerals, of some European lands. The United States, important and extensive though it is, and varied though are its products, has nothing biological, and would have nothing mineral were it not for the enterprise of Dr. A. E. Foote, of Philadelphia, and of the exhibitor of the petrified trees of Arizona. Ethnography has not been neglected in the western or Industrial Arts wing, where Greeks are shown painting, pottery, Egyptians engaged in weaving and in agricultural work; and various semi-civilized or barbarous tribes occupied in their primitive methods of manufacture. Part of a hall in this wing of the main building is devoted to illustrations of the anthropology of criminality; and not far away from this a series of wax models, in a private exhibit, showing the effects of cutaneous and syphilitic diseases upon the person, is more pathological than pleasing or moral, but proves very attractive. As a parallel to the last-mentioned exhibit, the veterinary collection in one of the structures near the river may be noticed. Here also the monsters and malformations excite much more interest than anything normal. In the western gallery of the wing devoted to the Industrial or Liberal Arts is a miscellaneous geographical collection, which includes a rather extensive series of the results of the dredgings executed by the Travailleur and the Talisman in their various expeditions, together with the dredges used, and maps showing the course taken and the ocean depths. This collection contains many peculiar forms of fishes, including the renowned *Eurypharynx pelecanoides*, numerous crustaceans cirripeds, and pycnogonids, many echini, asteroids, crinoids and holothurians, and some gastropods lamellibra and brachiopods—all preserved in alcohol; also a dried collection of sponges and corals. Taken as a whole, the so-called "Liberal Arts" Department is the most unsatisfactory, most miscellaneous, and worst-arranged part of the entire Exposition. Perhaps, as time wears on, a catalogue may enable an enquiring visitor to see some order; but as it is, the various scholastic exhibits are an unexplained medley, and one is tempted to ask "Of what use are the few groups of historic, prehistoric and barbarous human beings, the meagre show of processes and results comprised under the head of 'Histoire de Travail,' and the very slim attempt at illustrating comparative anatomy, when within the bounds of the Exhibition itself—in the Trocadero Building—there is a first-rate ethnographical collection, and a splendid series of works illustrating French art in all its phases? Would it not have been far better to have rounded out these collections with judicious additions, than to have made a separate, iusufficient exhibit?"

In a corner of the centre gallery of the Liberal Arts wing may be found a cast of *Phenaeodus primævus* Cope, exhibited by its discoverer. If *P. primævus* could think, it would, like the Doge of Genoa at Versailles, be more surprised "to see itself there" than at anything else.

The aquarium in the Trocadero Gardens is well-stocked with a lively crowd of Cyprinidæ and Salmonidæ, including California salmon, but it has no marine animals.—*W. N. L.*

A course of six lectures on human embryology has lately been completed at Cornell University by Prof. Charles Sedgwick Minot, of Harvard Medical School; intended to supplement the practical course in chick development, given a year ago by Associate Professor Gage (who is in Europe this Spring). These lectures presented clearly the history of the ovum, karyokenisis, the germ layers, and the formation of certain organs, especially the heart. The closing discourse, on Theories of Heredity, was given on Thursday, the 9th of May, before a large audience of professors, trustees, advanced students and physicians.

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THE PALÆONTOLOGICAL EVIDENCE FOR THE TRANSMISSION OF ACQUIRED CHARACTERS.[1]

BY HENRY F. OSBORN.

AS a contribution to the present discussion upon the inheritance of acquired characters I offer an outline of the opinions prevailing among American naturalists of the so-called Neo-Lamarckian school, and especially desire to direct attention to the character of the evidence for these opinions. This evidence is of a different order from that discussed in Weissmann's Essays upon Heredity, and while it cannot be said to conclusively demonstrate the truth of the Lamarckian principle, it certainly admits of no other interpretation at present, and lends the support of direct observation to some of the weightiest theoretical difficulties in the pure selection principle.

1. I regard natural selection as a universal principle, explaining the "survival of the fittest" individuals and natural groups, and as the only explanation that can be offered of the origin of one class of useful and adaptive characters. I supplement this by the Lamarckian principle as explaining the "origin of the fittest" in so far as fitness includes those race variations which correspond to the modifications in the individual springing from internal reactions to the influences of environment.

[1] A paper presented to the British Association for the Advancement of Science, Newcastle, Sept. 11th, 1889. Section of Biology. Also read before the American Association for the Advancement of Science, Toronto, Sept. 2. Printed, not previously published.

There is naturally a diversity of opinion as to how far each of these principles is operative; not that they conflict.

2. If both principles operate upon the origin of the fittest we should find in every individual two classes of variation, both in respect to new characters and to modifications of the old:—First, chance variations, or those which, with Darwin and Weissmann, I attribute to the mixture of two diverse hereditary strains. These may or may not be useful; if useful they depend entirely upon selection for their preservation. Second, variations which follow from their incipient stages a certain definite direction towards adaptation. These are not useful at the start; thus while, as they accumulate, they favor the individual, they are not directly dependent upon selection for their preservation. These I attribute to the Lamarckian principle.

My present purpose is to show that variations of the second class are of an extent and importance not suspected previous to our recent palæontological discoveries, and that the Lamarckian principle offers the only adequate explanation for them.

3. The general theory as to the introduction and transmission of variations of the second class may be stated as based upon the data of palæontology — the evolution of the skeleton and teeth.

In the life of the individual, adaptation is increased by local and general metatrophic changes, of necessity correlated, which take place most rapidly in the regions of least perfect adaptation, since here the reactions are greatest. The main trend of variation is determined not by the transmission of the full adaptive modifications themselves, as Lamarck supposed, but of the disposition to adaptive atrophy or hypertrophy at certain points. The variations thus arising are accumulated by the selection of the individuals in which they are most marked, and by the extinction of inadaptive natural groups. Selection, in so far as it affects these variations, is not of single characters, but of the *ensemble* of characters.

The evidence is of a direct and indirect character. The direct evidence is that by actual observation in complete palæontological series, the origin of adaptive structures is found to conform strictly to the lines of use and disuse. The indirect proof is that the natural selection of chance variations is unsupported by observation and is inadequate to explain the variation phenomena of the second class.

4. I will first briefly consider the former. The distinctive feature of palæontological evidence is that it covers the entire pedigree of variations, the rise of useful structures not only from their minute, apparently useful condition, but from the period before they appear. The teeth of the mammalia render us the most direct service, as compared with the feet, since they furnish not only the most interesting correlations and readjustments, but the successive addition of new elements. With a few exceptions which need not be noted here, all the mammalia started with teeth of the simple conical type—like the simple cusps of reptiles. Practically every stage between this single cusp and the elaborate multicusped recent molars is now known. Every one of the six main cusps of the molar of *Hyracotherium*, for example, a type of an important central stage in the ungulate dentition, is first indicated at the first point of contact or extreme wear between the upper and lower molars; this point of wear is replaced by a minute tubercle, which grows into a prominent cusp. These are the laws of cusp development, as observed in every known phylum of mammalia:

I.—The primary cusps first appear as cuspules, or minute cones, at the first points of contact between the upper and lower molars in the vertical motions of the jaws.

II.—The modeling of cusps into new forms, and the acquisition of secondary position, is a concomitant of interference in the horizontal motions of the jaws.

5. The evidence, of which this is only a single illustration, has accumulated very slowly. The line of reasoning from this particular series of observations is as follows: 1. The new main variations, in the teeth and skeleton of every complete series, are observed to follow certain definite purposive lines. 2. By careful analysis of the reactions to environment which would occur in the individuals by the laws of growth, we observe that the race variations strictly conform to the line of these reactions. 3.

We further observe that no variations of this class occur without the antecedent operation of these reactions; the working hypothesis thus stands the test of prediction. 4. We accept this invariable sequence of race adaptation upon individual adaptation as proof of a causal relationship.

6. I admit that this proof may be invalidated in several ways: 1. By showing in more extended research that these observations of sequence are inaccurate or offset by others in which there is no such sequence. 2. By showing that the Lamarckian principle, while explaining some of the variations of this class, is directly contradictory to others. 3. By showing that all these phenomena may be explained equally well or better by natural selection. 4. By proving, independently, that the transmission of acquired characters never occurs.

I will now consider each of these cases:

First.—As regards these observations. They may be examined in detail in the studies of Cope, Wortman, or Ryder, and in a paper I presented to this Association last year. As the question of transmission has been generally assumed in the foregoing studies, I think it is now important to review the whole field, searching for facts which look against the Lamarckian principle, for as we have been hitherto studying with a *bias* in favor of it, some such adverse points may have been overlooked. At present, however, I can recall only a single adverse observation, that is, in the development of one of the upper cusps, the lower cusp which opposes it, and which is therefore supposed to stimulate this development, is found to recede. I have no doubt others will be found presenting similar difficulties.

Second.—As regards the Lamarckian principle. Several objections to the special application of this principle to the evolution of the teeth have been raised by Mr. E. B. Poulton:

A.—To the objection that the teeth are entirely formed before piercing the gum, and that use produces an actual loss of tissue as contrasted with the growth of bone, it may be said that by our theory it is not the growth itself, but the reactions which produce this growth in the living tissue, which we suppose to be transmitted.

B.—To the objection that this proves too much,—that the cusps thus formed would keep on growing, it may be said (*a*), that in the organism itself these reactions occur least in the best adapted structures. This proposition is difficult to demonstrate in the case of the teeth, but may be readily demonstrated in what are known as the phenomena of displacement in the carpals and tarsals where growth has a direct ratio to impact and strain. (*b*), In the organism itself growth does not take place beyond the limits of adaptation; there is, therefore, no ground for the supposition that overgrowth will take place by transmission. (*c*), Either by the selection or Lamarckian theory development is held in check by competition between the parts; there is a limit to the nutritive supply; in the teeth, as elsewhere, the hypertrophy of one part necessitates atrophy of another.

C.—A general objection of considerable force is that we find other adaptations, equally perfect, in which the Lamarckian principle does not apply; why then invoke it here? To this it may be said that there is no theoretical difficulty in supposing that while natural selection is operating directly upon variations of the first class, the Lamarckian principle is producing variations of the second class, and while selection does explain the former, it falls far short of explaining the latter.

D.—Finally, if Weissmann succeeds in invalidating the supposed proofs of the Lamarckian principle derived from pathology and mutilations, this will not affect the argument from palæontology and comparative anatomy, for these proofs involve two elements which are not in our theorem: (*a*), immediate transmission of characters; (*b*), transmission of characters impressed upon the organism and not self-acquired.

Third.—As regards the adequacy of the selection principle to explain these variation phenomena. It is not necessary to repeat here the well-known current theoretical objections to this principle, but simply to point out the bearing of this palæontological evidence. In Weissmann's variation theory the preponderating influence must be conservative; however it may explain progressive modification, or even correlation of old characters, it does not admit that the genesis of new characters should follow definite lines of adaptations which are not preëxistent in the germ plasma. We find that new characters of the second class do follow such purposive or directive lines, arising simultaneously in all parts of the organism, and first appearing in such minute form that we have no reason to suppose that they can be acted upon by selection. The old view of nature's choice between two single characters, one adaptive, the other not adaptive, must be abandoned, since the latter do not exist in the second class.

Fourth.—The most serious obstacle to the Lamarckian principle is the problem of transmission. How can peripheral influences be transmitted in the way we have outlined—now that we have such strong evidence for the continuity of the germ plasma? If acquired characters are not transmitted it is clear that the whole Lamarckian principle is undermined, and all these instances of sequence express no causal relationship. We are then, however, left without any adequate explanation of the laws of variations of the second class, and are thus driven to postulate some third, as yet unknown, factor in evolution to replace the Lamarckian principle.

METHODS AND MODELS IN GEOGRAPHIC TEACHING.[1]

BY WILLIAM M. DAVIS.

IN presenting to the Association certain considerations regarding methods of teaching geography, I venture to assume that your interests in educational matters extend so far down as to reach a subject which many scholars "finish" early in their course, and whose advanced study hardly receives its due place in our colleges; certainly it has suffered from neglect. My own practice in the way of teaching it has been with college students in the division of physical geography, and not feeling entirely satisfied with the system of study as presented in the text-books in current use, I have endeavored to discover and supply certain elements by which instruction in the subject might be advanced.

[1] A lecture delivered before the Scientific Association of Johns Hopkins University, on February 13, 1889.

The first element that should be supplied is one by which the conceptions which the teacher has in mind can be vividly transferred to the student. The teacher bases his mental pictures on something that he has seen, if he is so fortunate as to have traveled and brought home with him fresh memories of the morphology of the earth's surface; or if not an observer himself, he has at least had time to gain his geographic conceptions slowly, and with the aid of various descriptions and illustrations that he cannot present in their entirety to his class. How shall his ideas be passed on to his students? Maps and pictures are of value, but as a rule they are of low quality, except for the larger parts of the world. They present no sufficient expression of the forms of moderate size on which we live. Photographs are excellent as illustrations of actual landscapes, yet they are too often chosen with other than geographic reasons for the choice, and but few schools have them in sufficient variety. Moreover, all these aids lack one element of great value, namely, the third dimension that so strongly characterizes all geographic forms. I have therefore desired to use geographic models, which very easily give clear indication of the relief of a surface, and if without all its detail, still possess effective and suggestive form. Models are therefore to be taken as one of the means of improving the methods of illustrating what the teacher wishes to place before the class.

Again, physical geography as ordinarily defined is too largely merely descriptive, and not physical at all. Indeed, geography, which is supposed to treat of the form of the surface of the earth, neglects the form of the earth's surface to an unfortunate extent. We hear much about the connection between geography and history, for example; but what is this subject that is connected with history? Where is geography itself taught with the same thoroughness that characterizes the modern teaching of the biological sciences? We recognize of course the vital connection between geography and history, just as the botanist recognizes the connection between botany and medicine, but what botanist would be satisfied with stopping his teaching of his science or even of only its elements at the point that would suffice for the collector of medical herbs, or for the doctor of medicine? And why should the geographer be satisfied with so brief an outline of his science as will suffice for illustrating its connection with history? The subject deserves study for its own worthy self; it is in this line that the teacher of geography must wish to see it developed, and it is to this end that he must strive, just as his colleagues strive to advance the study of their respective sciences for their own sake, and not merely for the illustration of some other. For this reason I have endeavored to examine the forms of the land surface in detail, and to arrange them in their genetic relations, in order to come to a closer appreciation of the meaning of the form of the earth and its development. In this way, it seems to me, we may best study the fundamental material of geography. A year ago I had the pleasure of presenting some outline of a geographic classification at a meeting of the National Geographic Society in Washington, and now I would add thereto some account of certain geographic models,[1] designed as a means of illustrating this classification. Some of the models illustrate the development of plains and plateaus; some present the various forms of volcanic cones and lava flows; others indicate the changes in the features of a river as it grows old, or as it is embarrassed by glacial or volcanic accidents. You will perceive, in considering the use of these models, that it is essential that we should study the surface of the land by means of types, for it would be as impossible for a scholar to learn all the individual forms of the land as it would for the young botanist to learn all the individual plants of the world, especially if they were brought before him in the order of their occurrence over the world, and not in accordance with some well-tried system of logical and natural classification. Botanists and zoölogists believe that it is time enough for their scholars to study the complex congeries of forms that constitute the fauna or flora of a country when they have mastered the rudiments of the subject by careful study of a moderate number of typical examples of plants or animals; and, indeed, in the modern development of

[1] The originals of these models were designed by me for use in a course of lectures before the Teachers' School of Science in Boston in 1888; copies of them have been prepared by Mr. J. H. Emerton, Boston Society of Natural History.

the study of biology, one may see the strongest contrast with the older methods in this respect. I should be glad to see a similar change overtake the conservative science to which my studies are devoted.

In order to give specific illustration of the method of study by geographical types and the use of models, let me ask your consideration of that large group of land-forms that may be included in the category of plains, plateaus, and other derivatives. There is a brief preliminary consideration.

Any mass of land constituting a single geographic individual or a natural group of such individuals, must, as soon as it is exposed to the destructive forces of the atmosphere, begin its long sequence of development; and if no change of level happen to it, it must at length be worn down smooth and low to a featureless plain. When this work begins, with every mark of immaturity in its small accomplishment, we may regard the individual as young; that is, but little advanced in the long cycle of systematic change through which it is destined to pass. When much more work has been accomplished, and the variety of form resulting is at its greatest, the individual may be called mature; and finally, when the features of maturity weaken as the relief is reduced and intensity of form is lost, we find a resemblance to organic decay, and are warranted in the use of such a term as old age.[1]

But you may say that all this is geology, not geography. Geological processes are indeed at work in carrying the geographic individual through its successive forms, but we are not concerned with the processes, only with the results. In organic growth, the process is chemical; but for all that, biology is not chemistry. Moreover, if the several forms assumed by a geographic individual are geological affairs, we might expect to find them treated in the standard works on that science, but, except in brief outline, nowhere do they appear in such books. Geology is quite enough occupied with matters of underground structure,

[1] The example of a form in its "old age," as that term is employed by Chamberlin and Salisbury (Sixth Ann. U. S. Geological Survey), would in the above scheme be called "mature," for it still possesses abundant relief, and is by no means a featureless base-level plain.

with questions of constructive and destructive processes, and with composition and fossil contents of rock's to be awake to another large question. The study of the form of the earth's surface, even though recognizing that the form changes, is geography. But after all, geography and geology are one science, treating of the earth, and it is needless for us to embarrass our work by attempting unnecessary subdivision and limitation of the fields that the two branches shall occupy. Let each one take whatever will aid its attainment of the desired end. If we can understand geographical morphology better by some consideration of geological structure, let it be introduced, just as chemistry is introduced into physiology, or physics into meteorology. Surely geologists have employed geographical methods freely enough to warrant our reversing the relation. If some consideration of geological processes will serve our purpose and give better appreciation of the sequence of forms that geographical individuals pass through, then call freely on geology for such consideration and use it to the best advantage. Do not hamper our endeavor to understand the form of the earth's surface by any arbitrary limitation of the means that we shall employ to the end. It is plainly apparent that geology and geography are parts of one great subject, as ancient and modern history are, and they must not be considered independently. Indeed, it is only in this close relation that a satisfactory definition of the two terrestrial sciences is obtained. Mackinder has concisely said that geology is the study of the past considered in the light of the present, and geography is the study of the present considered in the light of the past. I can quote no better indication of the close connection of the two divisions of the world's history. Without going further into abstract considerations, we may now turn to our concrete examples.

The so-called "valley" of the Red River of the North in Minnesota and Dakota is a broad plain of exceedingly level surface. It is so truly level that it illustrates the curvature of the earth, in the same way that it is seen at sea; for in crossing the plain first a distant tree-top is seen above the horizon, then a house-top, and at last the body of the house rises into full view; just as the upper and lower sails and the hull of a ship are brought into sight in sailing towards it on the ocean. This broad plain is a lake bottom, whence the water in which its fine sediments were laid down has been drained away, and drained away by so curious a process that if, in teaching modern history, it were noted that some existing form of government were as curiously related to the past, no teacher would hesitate to make reference to it. The northern barrier that held the waters of the lake was the southward front-slope of a great sheet of ice that for a time obstructed the open northward drainage; and in the lake thus created fine sediments were spread out so plentifully that they buried the former surface of the land, and so evenly that when the waters were drained away as the ice melted a dead-level plain was revealed.

The plain stands well above sea-level, and hence must suffer change as destructive processes attack it. Why then is it so smooth? Manifestly because it is young. There has not yet been time for streams to channel it. It is extremely immature, truly infantile in its appearance, with scarcely a sign of the variety of features that will be developed in its later history. Does not this consideration lend additional interest to the study of so simple and monotonous a district as the plain of the Red River of the North? Is there not a keener appreciation of its peculiarities gained by looking at them in the light of their development, instead of describing them simply as absolute forms, not otherwise considered.

The Red River plain has, however, begun its development. The Red River itself has incised a narrow, steep-sided trench twenty or forty feet deep in the surface of the plain, and the few side branches of the river have narrower and shallower channels. These trenches and channels are simply young valleys, and they are growing so rapidly that their increase in length and width is noticeable even in the past few years of settlement. But still the streams have barely made a beginning of the great work of carrying away all the material of the plain above base-level, this being their manifest future task. So little has been done as yet in the way of preparing drainage-channels that the rain which falls here is greatly delayed in reaching a stream-course by which it may flow to its goal, the sea, and so much of it stands about idly, instead of quickly running off, that it is in good part evaporated and carried away through the air. Evidently we have here to do with a geographic individual that is just entering its career, that still retains its embryonic characteristics, so little has it advanced in its life-history.

Can we not foretell something of the future history of this plain? As the rivers carve their trenches deeper and deeper, and the enclosing slopes are wasted away and widen out, and the little side-gullies eat backwards and increase in length till they become ravines and the ravines grow into valleys, then the inter-stream surface, at first smooth and unbroken, is traversed in all directions by branching water-courses; the rainfall is much more quickly led into the streams,—everything marks a more advanced stage, all of whose features are indicated in one of the models of the plain and plateau series. But we can not only predict the future of the Red River plains; we can find examples of other plains, born at an earlier time, that are now in the advanced stage that the Red River plains have yet to reach. Look at the coastal plains of the Carolinas. They are the old bottom of the Atlantic, laid bare by a relative uplift of continent. They are well drained; many streams run across them and many branches give ready discharge to the rainfall; the channels are deeper below the general level of the country than are those of the Red River plains, and the inter-stream surface is much more broken; yet still enough of it remains to make it clear the present form is developed from an originally level, unbroken plain; and a close comparison will leave no doubt that the coastal plains of the Carolinas differ from the Red River plains chiefly in being farther advanced in their cycle of development. They are closely related individuals, but they differ somewhat in age. They are like the egg of a caterpillar and the caterpillar itself; not very similar at first, and not like what they will come to be later on, but closely comparable for all that; their differences only manifest their relationship; what one is, the other will be; what the other is the first has been. Thus we can introduce into geography the element of growth, that is, systematic change, and greatly to the enlivenment of the study. It is often the reproach of geography that it does not deal with things having life; but this is true only if we do not take heed of the kind of life that it may consider. One may say that the changes here discussed are so slow that we need not take account of them; but this is predetermining what we shall and what we shall not study; let us rather see if the consideration of slow geographic life does not impart new meaning to an old study; let us question if this new meaning is not nearer the truth that we are striving for; then we shall be better in a position to judge if slowness of change is a reason for its neglect. No one makes objection to teaching a young scholar about the growth of an oak tree from an acorn, though it is safe to say that no scholar comes to the belief of the growth of an oak from witnessing it; he is convinced of a change that he cannot wait to see, partly by comparison with trees of a faster growth, and partly by seeing oaks of different sizes, and being led to make reasonable generalizations on his observations. It is the same with our understanding of geographic growth; we cannot see much of it, not even the oldest of us, and yet, after the conception is once gained, it becomes so vivid that one can hardly help expecting to find that a change is perceptible on returning after a time to some familiar locality. One may see a sand-bank washed away by a heavy rain, and from this to the washing down of the largest mountain there is only a difference of degree, not of kind. A scholar may easily comprehend the change of form indicated by the differences between the two plains already described, and unless his natural intelligence is obstructed, he can then grasp the idea of geographic growth.

Let us next look at West Virginia, typified in the second model of the series; here the inter-stream hills are so high that they almost merit the name of mountains; the stream branches have become so numerous that no part of the original level upland surface remains; every part has an immediate slope to a stream, and the drainage system is advanced to its highest development. Indeed, we need some aid here from geology to be sure that we are dealing with an individual of the same kind as those already considered, so little likeness is there between this one and the others. But the aid from geology is conclusive; for West Virginia and a large area around it is made up of horizontal layers of bedded rocks that once were at the bottom of the sea, and that still retain the essentially horizontal attitude in which they were laid down: the whole mass of horizontal layers has simply been raised with respect to the surface of its parent ocean.[1] This elevation is so long ago that the immaturity such as still characterizes the Red River plains is here long past; the adolescence seen in the Carolina plains is also long ago lived through. In West Virginia we have maturity; there can be no greater variety of form than is here presented. The relief of the surface is at its highest value, for while the inter-stream hills have not lost much of their original height, the valleys have been sunk about as low as they can be, and hence there is the greatest possible difference of altitude between hill-top and valley-bottom. The streams have become very numerous, and can hardly be more so; every part of the surface is intersected by them. There is no room for more.

From this time on the form of the surface becomes less pronounced. As the destructive changes progress further, the valleys can deepen but little, although the hill-tops must be reduced, and the valley-slopes must widen out, and all the topographic expression must weaken as old age is approached. This is the character of central Kentucky, and appears in the third model of the set. Excepting where the valleys are enclosed in especially hard rocks, they are wide open, and the variable height of the intervening hills makes it clear that they retain no longer all of the height that they once possessed. They are weakening, passing into forms of less and less emphasis, losing variety, becoming old and feeble.

In the next stage, we may expect to find the valleys so far widened that they should form broad plains, smoothly rolling, essentially a low-land of faint relief, but occasionally diversified

[1] In speaking here of relative changes of level between land and sea, I do not wish to raise the question as to how the level was changed; except to say that the teachings of Suess and Penck in this matter seem to me to go too far in excluding unknown possibilities of broad changes of level, without folding, in the crust of the earth, and without local changes of gravity, on which these authors depend.

with hills of moderate height; and thus the very opposite of the Caroline plains, where the surface is an upland, with occasional valleys. Such an old plain may be seen about the head-waters of the Missouri, in eastern Montana; the general surface is extremely monotonous, gently rolling, and one roll like the next, so that one may easily lose his way in the absence of landmarks. But here and there over the plain mesas of considerable elevation still remain, the reason for their endurance being seen in the layer of hard lava that protects them, and retards their destruction, while the rest of the country not thus protected has wasted away more rapidly. These lava-caps are old flows from once active volcanoes; the lava at the time of eruption undoubtedly ran down from its vents to the lowest ground that it could find; and yet it now occupies the highest ground, in virtue of its obstinate refusal to waste away. Every such lava-cap is an outspoken witness to the greater mass of material over the whole country when the eruption took place, and the destruction of this greater mass must have progressed through the several stages illustrated by the present condition of the Red River plains, the Carolina plains, the mountains of West Virginia, and the hills of central Kentucky, before it could have reached a surface of faint relief. It requires great faith in the evidence here adduced to believe that so stupendous a piece of work has really been accomplished. It is well nigh incredible, and the observer on the ground is fully justified in doubting it as long as he can; but it cannot be doubted when the evidence is once well seized. It is by no means unparalleled, and much nearer home we may find examples as extraordinary, and as far from easy belief, but as necessary to the convictions of the well-ordered geographer.

Such a plain as that of the upper Missouri may be called a base-level plain, because it has been worn down to the controlling level of drainage, or to what is called the base-level of the region; this being in distinction to a constructional or new plain, whose smoothness is due to the short time that its original form has been exposed to developing agencies. A base-level plain represents the ultimate stage in the sequence of a simple cycle of development.

Certain elements of importance yet remain to be considered. If the plain be raised to a moderate height over sea-level, it can never acquire great intensity of relief; for the streams are then allowed but a small depth to which they can cut. If, on the other hand, the elevation is great, and rapid enough to be for the most part acquired before the destructive processes have made great headway, then the vertical element is strong, the topographic relief is intense. Our coastal plain is an example of a region of mild form; it has but slight elevation, and hence however long the rivers flow across it they can never cut out deep valleys. The plateaus of Utah and adjacent parts of the west are of another sort; here the elevation is excessive, and the depth of cutting allowed to the rivers is correspondingly great. Marvelously have they taken advantage of their opportuity. The valley cut by the Colorado and its tributaries is in some places a mile deep, and yet, when we see the enormous mass of land still lying on either side of the valley above base-level, and waiting to be carried down to the ocean, we cannot doubt that the time thus far employed in doing so great a piece of work is a small part of the whole cycle of growth. The upper plateau surface is still broadly level, except for certain irregularities to be referred to later on; the valley is narrow even to notoriety, and must therefore be called young. It is a case of precocious adolescence. Intensity or faintness of relief are therefore variations on the general scheme, and it is my intention that these variations shall also be represented by models when new members are added to complete the present series: a young plateau of intense relief, a middle-aged plain of mild relief, will thus become definitely intelligible terms to our mind. Along with this, it must be perceived that two mature plains need not be of the same age, if measured in years: for the development of maturity in a high plateau requires more time than in a lowland.

There is another element of variation that must be considered. Sometimes the simple cycle of development that has been described is interrupted: the land does not lie quiet long enough to pass through a complete series of changes without disturbance. Indeed, this interruption is, except in very young plains, the rule and not the exception; and several of the examples already given illustrate it. The coastal plain of the Carolinas has suffered a moderate depression since its valleys were defined pretty much in their present form, and their lower courses are thereby slightly submerged. Thus arise the estuaries that characterize our Atlantic coast, and these are presented in the fourth model. The old base-level plain of the upper Missouri no longer stands at the low level in which it was worn down, but has been elevated a thousand feet or more, and hence all its rivers that had settled down to a quiet old age of little work, have been rejuvenated, and are now beginning a second cycle of life. They run swiftly, in well-defined, narrow valleys, even though the enclosing rocks are soft; and they are sometimes interrupted by waterfalls, even when their volume is as large as that of the Missouri above Fort Benton. Manifestly, therefore, the elevation of the old plain is relatively recent; very little advance has yet been made in the development of its second cycle. The same kind of complexity appears in the high plateaus of Utah and Colorado: the high-level surface in which the cañons are cut is not an original surface of construction, but is a surface of considerable irregularity, as has already been mentioned; part of the irregularity is due to great fractures which have broken the country into massive blocks and lifted them a little unevenly, and part is due to the incomplete base leveling of the region during a previous cycle of development, when the elevation was less than now. The combination of old and new forms thus explained is the subject of the fifth model. A wonderful addition is made to our appreciation of a country when all these factors in its history are recognized as contributing essentially to its topography.

Is it not worth while to try to acquire the broader comprehension of geography that comes from understanding its meaning? Can we not make immediate practical use of such terms as infantile, young, adolescent, mature or middle-aged, old, and very old? Do they not recall all the significance of certain selected or idealized typical examples that have been studied, being in this like the terms that the botanist employs to so great advantage? No botanist would admit the superiority of paraphrases over terms; compactness, accuracy, and intelligibility would all be sacrificed if terms were given up. And yet nearly all geographers employ paraphrases instead of terms. Let us take an example to illustrate this from the description of certain counties in Missouri in one of the geological reports on that state, to which as in other states we must generally go for the best geographic materials.

The region is one of horizontal structure, and therefore comes under the general heading now considered. Of Miller county it is said: [1] "Near the Osage and its larger tributaries, the country is generally very broken and rocky, excepting immediately in the valleys; but farther back the slopes usually become more gentle, with fewer exposures of rock, until we reach the higher districts, more remote from the streams, where the surface is comparatively level, or but slightly undulating." Again, of Morgan county: "The surface of the elevated region near the middle of the county is beautiful, comparatively level or undulating prairie land. South of this the slopes are first gentle, near the head branches of the Gravois, but as we descend these the face of the country becomes more hilly, and almost everywhere near that and the main creeks, as well as their principal tributaries, and especially near the Osage, it is very broken and rocky. North of the main divide, the high, nearly level prairie land extends, with a slight descent, for some distance northward between the streams flowing in that direction, but near most of the larger streams the surface is more or less broken, and sometimes rocky, but generally not so much so as on the south side."

What is meant by this? Manifestly, the country is an adolescent plain of moderate intensity of development and apparently of simple history. The horizontal attitude of the rocks and the level surface of the uplands show us that the region belongs to the family of plains or plateaus; the irregular courses of the streams and the steepness of their banks decide with equal clearness that the development of the plain has not advanced very far.

Now in the same report the writer says that there are oak trees

[1] Reports on the Geological Survey of the State of Missouri, 1855–1871, (1873); the above extracts being from county reports by Meek, pp. 112, 135, 136.

in the forests. Why does he not say that there are tall vegetable growths, of irregular bifurcations, bearing green appendages at the attenuated extremities, these appendages being strongly scalloped in outline, and so on. He also speaks of pines. Why not of other vegetable growths, with straight vertical axes, from which lateral arms spread out with some regularity, bearing long slender spicules on their minuter divisions. Instead of this, he says oak and pine. This is not because all oaks and all pines are of precisely one pattern. Their variations are infinite, but for all that they vary only througn a moderate range, and can all be brought under typical forms. They may be young or old, large or small, well grown or deformed, living or dead, but they are still oaks or pines. How well it is, therefore, that they should be known by a definite term or name. How well it would be if geographic forms were equally well named; and why should they not be? The many plains that we have described do not differ more greatly among themselves than the oaks or the pines; they deserve recognition as constituting a family, naturally related, not by inherittance from descent, as with the trees, but by similarity of the physical processes under which they have been developed. The natural association of their features deserves just such recognition as is implied by giving them names, distinctive and well defined.

Do we not gain a better understanding of the earth's surface, of the primary object of geographical study, by thus looking at the meaning of land form, as well as at the form itself? Is not the possibility of accurate description greatly increased thereby, and does not the description when made carry more of the desired meaning than ordinary geographical narration, in which there is no definite standard recognized for comparison? The reason of this is not far to seek. Our conception of the unknown is based on the conception of the known, either by likeness or contrast. Ordinary geographic description has not sufficient accuracy, because its terms are vague; they do not bring up to the mind the recollection of any well-defined type or standard. Plain, rolling country, hilly country, broken country, have no precise meaning; they "denote" but do not "connote." But when we examine a series of geographic forms related by community of structure, though contrasted in age, and give to every one a name, such as a young plain, a mature or middle-aged plain, these terms bring certain well-marked conceptions before us, conceptions that have been elaborated in our study of the type or standard of reference, and we readily form a mental picture in which all the many essential features of the region described are clearly appreciated. An adolescent plain, for example, is a surface of broad even uplands, here and there trenched across by streams which follow valleys of moderate width; the general continuity of level from one inter-stream surface to another comes to mind; the relative scarcity of the smaller stream channels; the relation of the region to its fellows of greater or less age.

It is immaterial what names are used for the present in describing plains and plateaus, for none as yet are authoritatively accepted by geographers, but it would be to our common advantage if experiment were made on the use of a larger set of terms than is now commonly employed. The important point is that terms based on natural relationship should be used, and that they should be familiarized by the study of type forms. Experiment will alone decide what term shall be finally adopted. My own experience with students of undergraduate age has shown me that the idea as here outlined is a valuable one, and that the terms here employed are suggestive and satisfactory. I am very desirous of hearing the experience of others in the same experimental line.

A few words may be said as to the method of using the models, a method that seems to me adapted to young as well as to more advanced scholars. A series of models is laid out on the tables of a room which, in the schools of the future, may, I trust, be called the geographic laboratory. The students are seated near them, and each one is asked to describe what he sees; to note if he can recognize any features of the miniature landscape that are already familiar to him from his own observation. He is then told to try to draw a map of the surface represented, or a part of it if the whole is somewhat complicated. More or less aid must be give here, as so many students are untrained in the simplest delineation. When the map is drawn, show the class a map of some actual region of the same kind as that typified in the model; ask them to notice how far the features that they have drawn from the model are features on the actual map; let them search for additional features, generally small ones that may appear on the map, but which are not shown on the model.

Next produce the second model, and go through the same process, but without any suggestion that the first and second models are related. Finally, ask if any one perceives a connection or relation between the two regions thus considered. Few can fail to see it, and when perceived it should be described by every member of the class for himself. I have great faith in the scholar's own careful expression, both in drawing and in writing, of what he has himself seen or thought. Note here that the scholar need not discover how the change from one form to the next has been produced, he need only recognize it; then the teacher may supplement the recognition as far as he wishes with simple geological explanation of processes. This need not go far, and merely opens the way to further study of geology. The word geology need not be mentioned.

If the class be somewhat mature, the teacher may, before bringing out the third model, ask for predictions of the form of the future stages of the region; or, if this seem venturesome, the simpler inductive method may be still followed. At last the models showing complications and interruptions in a single cycle of change may be introduced, all the examples being illustrated by maps of actual relations, as well as by models, views, descriptions, and in every other way that the ingenuity of the teacher devises.

When thus familiarized with the general conception of geographic change, let the scholars attempt to make full statement of all they have learned from the work so far concerning geographical relationships. The brighter ones will here manifest some perception of the generalizations that may be based on the facts thus far presented, and from this time on geographic form has a new and a fuller meaning to them. Additional examples of the various stages of development may be introduced at the discretion of the teacher; and if time allow they can be best taken from books of travel and exploration, reports of state and government surveys, and the like, in order to give some freshness and reality to the study. It is apparent enough that, in its fully expanded form, it will take a long time for the better geographical teaching to enter the larger public schools, but in schools where teachers are numerous enough to give every scholar a good share of personal attention, I do not despair of seeing geographical laboratories and a rational inductive method of instruction employed.

Comparisons have already been made between the methods employed in teaching biology some forty or fifty years ago and during the last decade. It seems to me that physical geography is still in the undeveloped condition that biology has outgrown. Our text-books of physical geography attempt to describe the whole earth, just as the old natural histories tried to describe the whole animal and vegetable kingdoms. Since the publication of Huxley and Martin's Biology, this plan has been abandoned in the better schools, and the pupil now studies the few typical forms that give him a knowledge of the great resemblances of animals, and does not dwell on their minute differences. He learns a good deal about a few animals instead of a very little about a great many. I should like to see the same change introduced into the teaching of physical geography. It is impossible for a scholar to learn anything definite about the form of the earth's surface if he attempts to study all the continents. He might as well attempt to learn about the distribution of forests instead of studying the structure of plants in his botany lessons. Something of the grosser continental forms should of course be considered, just as it is interesting to know something of the distribution of forested and of desert region; the general distribution of land and water, its relation to climate, history, and so on,—all this is of great interest; so are the generalizations concerning evolution and the speculations concerning migrations in which the biologist may indulge, but they do not form the chief matter of our best elementary methods, for they cannot be sufficiently original with the ordinary student. When a boy grows up and travels over the country, he never sees the grosser continental forms; they are too large. He sees only small forms, corresponding to the individual plants of the forest. Why not then instruct him in such a way that he shall appreciate these small forms, these geographic individuals, just as he is taught to understand something of botanical individuals? Let him understand that there is a geographic morphology, perhaps not so precise as that of the organic world, but none the less interesting; let him feel that these geographic forms are the results of definite orderly processes, working systematically, and carrying the geographic individual through a determinate sequence of changes, nearly as definite as that passed through by any animal or plant in its life-development, but more complicated from the combination of the records of several cycles of life often being found in one individual. Let him learn that every feature of a geographical individual is significant and expressive, full of meaning to those who look at it aright. Do not hesitate to call on geologic processes when they are needed to aid his understanding; do not postpone the few necessary and simple geological conceptions until he reaches a geological course of study. Do not be discouraged because the earth's surface contains many complicated individuals; there are many simple ones also, which a student may appreciate and enjoy, and from which, when thus understood, he may form a juster idea of unseen regions. Of course there are many complicated forms that he will not easily comprehend; but so there are plants of difficult analysis, yet this is not held to be an excuse for giving up the teaching of systematic botany. Few scholars may be able to analyze all the compositæ, or to recognize all the species of oaks, even if they have learned their lessons well in school, and yet we do not doubt that there is profit in the teaching of systematic botany. So there may be in teaching the elements of systematic geography. Let the scholar learn a few simple forms well, as he surely can without difficulty; he will recognize these when he sees them, and, finding meaning in their form, he will be convinced that there is meaning also in the more complicated forms that his slight study has not deciphered. He may even come to conceive that he has not "finished" geography, and that it is capable of advanced study for its own sake.

Cambridge, Mass., February, 1889.

A NEW CATTLE-PEST.

BY S. W. WILLISTON.

ON October 5, 1887, I received from Professor Cope specimens of a fly taken from the cattle of Mr. Thomas Sharpless, of West Chester, Pa., with the information, shortly afterwards, that the flies had been observed during the year at that place in small swarms, resting on the horns of the cattle, near the base, when not feeding, having the appearance, at a short distance, of small patches of foreign matter. The horns were merely a resting-place, to which the flies quickly returned when disturbed or driven away, the individual flies feeding upon the blood of the animals, concealed in the hair along the flanks. The flies, I was also told, were observed the same year on the land of Mr. George Pim, of Marshallton, Chester county.

I am thus particular in giving the facts as told to me, for this is the first record, of which I am aware, of the introduction from Europe of a cattle pest that bids fair to extend itself over the whole United States, and be as troublesome as its nearly related pest, the well-known stable-fly, or cattle-fly, also European originally, *Stomoxys calcitrans*, Linn.

I had never seen or heard of the fly before, and for that reason immediately reached the conclusion that it was an introduced species. A careful search of the literature, however, gave but slight clue to its identity, though it was immediately seen to be a member of the genus *Hæmatobia*, which, by Schiner, was looked upon as forming a division of the genus *Stomoxys*. In the early spring of the following year specimens of the same fly were sent me by Professor Riley, from, I believe, somewhere in New York and New Jersey, and more recently Mr. Howard reports it from Delaware and Virginia. Not knowing what else to call the insect, I gave it the provisional name *H. cornicola*. The examination, for the first time the past spring, of male specimens, sent me by Mr. Howard, led me to suspect that the species was identical with *H. serrata* Robineau Desvoidy, from the south of France, and in a late number of Entomologica Americana the fly was described under the name of *cornicola*, as a doubtful synonym of *serrata.* Since the publication I have learned that the fly had been positively identified as *H. serrata* for Prof. Lintner by Mr. Kowarz, of Bohemia, whose authority on the subject is the best. The fly will thus be known as *Hæmatobia serrata* Rob. Desv., and in the vernacular the name used by Mr. Howard, in "Insect Life," of Horn-fly, seems the most appropriate.

So much for a brief history of the actual and probable pest in our own country, and this history, brief as it is, seems fuller than that of it in its own home, for I can find but very little in reference to it. Desvoidy described it in 1830, and Macquart gave an equally brief description of it in 1838. Rondani separated the species into another genus, which he called *Lyperosia*, in 1856, and Robineau Desvoidy, about the same time, gave it the name *Priophora.* It may be that these names will obtain acceptance, one or the other (for they are not synonymous), for these species, but the characters are based upon minute differences of the bristle of the antennæ or a secondary sexual character, and the time is not yet when we may accept them. It is much to be desired that the name of a common pest may remain unchanged, but so long as we know so little of its allies it is impossible to preclude change in the nomenclature.

The fly belongs to the family Muscidæ, and in the group Stomoxyinæ, which some excellent entomologists deem equivalent in rank to the Muscidæ (or Muscinæ). It will be distinguished from the common cattle-fly by its smaller size, and more especially by its long palpi, and has for its immediate allies some of the most vexatious of flies indigenous to Europe, Asia, Africa, Australia, North and South America. Two of these are well-known to all, either by repute or experience,—the cattle-fly and the tsetse-fly. *Stomoxys calcitrans* was doubtless originally European, but its spread has been almost coëxtensive and contemporaneous with man. In the United States it reaches from the Atlantic to the Pacific, a torment to both domestic and wild animals, and I have seen specimens from Rio de Janeiro. The tsetse-fly, (*Glossina*, of Africa), of which several species are known, has been, perhaps, the most famous of all for its poisonous effects upon horses and dogs, though only annoying to man. Very recently another species of the tsetse-fly has been discovered in Australia, with similar "poisonous and pestilential" habits. A genus allied to *Stomoxys* is ascribed to South America, though I know nothing further concerning it.

Among the diptera we have a number of families of widely different structure and habits that subsist, either wholly or in part, upon the blood of mammals, including the mosquitoes (Culicidæ), with about one hundred and fifty known species, scattered over a large part of the world, the Simuliidæ, with the Buffalo gnat, and about sixty other widely-distributed species, the horse-flies (Tabanidæ), with over thirteen hundred known species, the score or two of species of Stomoxyinæ, and a few species of Chironomidæ and Leptidæ. In all these flies it is the female only that draws blood, and they all seem to have the ability to emit a poisonous saliva into the wound they make, in some of a more irritating nature than others. The males, in general, are harmless, lounging fellows, with a proboscis weaker than in the female, used in sipping nectar from flowers, or the sweet sap of plants. They are not so commonly found as the females, and of the tsetse-fly are still unknown. *Hæmatobia serrata* has habits very similar to those of *Stomoxys*, as stated in Insect Life. The eggs are deposited in fresh cow manure, and only twelve days are required for the insect to acquire its adult condition. What its future in America will be one cannot say; there can be but little doubt, however, that it will soon spread over the entire United States.

It is very probable that the largest number of cosmopolitan insects are found among the Diptera. Reasons therefor we can readily find; they furnish the greater number of our domestic pests, and their eggs or larvæ are constantly mingled with our food material, or common objects of commerce. Indeed, the wonder is not that there are so many species that follow man in his colonizations and migrations, but that the number is so few. *Musca domestica*, that inseparable companion of man, is believed to occur everywhere about his dwellings; even on the uninhabited plains of America it abounds, as Professor Snow has observed, and as I can corroborate. Rather interestingly, too, like other domestic animals, it seems subject to modifications of climate and environment to such an extent that several varieties have been described from the different countries it inhabits. Almost equally widely distributed are the other plagues of the housewife,—the blue-bottles, *Calliphora vomitoria*, *C. erythrocephala*, *Lucilia cæsar*, and *L. cornicina*,—all of which have distributed themselves from Europe throughout the length and breadth of North America, and some even into South America.[1] In fact, little as we know about the Muscinæ of our country, nearly a score of species are known to be identical with European ones.

But we have no right to say that all such species are importations; some, perhaps many, of them undoubtedly are, but assuredly not all of them are. And even those whose original habitats have been extended through commerce, we may as rightly believe to have been *exported*, in many instances, as *imported*. Commerce with America far antedates the systematic or even superficial study of insects, and the dissemination of insects would as likely be to as from Europe. The Colorado beetle is a striking instance coming within our own observation. The Hessian fly is another that stands almost on the border line of history, and though, as Professor Riley shows, we have every reason to believe that it was originally an European insect, yet had reliable evidences of its occurrence in North America extended back a few years earlier we should never have known whether we had Europe to thank for the pest, or Europe us, as she has more recently for the phylloxera and grape-vine fungus, or whether, indeed, there should be no exchange of thanks at all, the insects being "at home" in both continents. The screw-worm fly, *Lucillia macellaria*, occurs from Canada to Patagonia; will it become naturalized in Europe?

The distribution of many species in both Europe and North America opens up a number of interesting questions about which

[1] *Calliphora vomitoria* has been accredited to South America, but in the examination of considerable material from Brazil I have not found either of the Luciliæ, though a closely allied South American species appears to take their place.

opinions will differ. Doubtless other orders have many such cases, but my studies enable me to speak of the two-winged flies only. In but a very few families of flies, in reality I may say in but one or two, do we have even a tolerable knowledge of the North American fauna. In quite a number, however, our knowledge is sufficient to base fairly good conclusions as regards distribution, and these conclusions lead me to the belief that almost invariably species of flies common to the two continents have an unusually wide distribution in this country. Ten per cent. of our species of Syrphidæ, a family of flies that comes rarely into direct relation with man's economy, are common to the two continents. Of the thirty species thus known very nearly all are found from the Atlantic to the Pacific, forming very nearly a half of the species that are known to occur across the United States. In the family of Tabanidæ, or horse-flies, not a single one of the hundred and fifty species is known to be common to the two continents, and very few species in the United States have a wide distribution. Among the Asilidæ, a large family of predaceous flies, one species, and one only, is known to extend into the two continents, and this one species is one of the four or five that are found on the Pacific and Atlantic coasts. In numerous other cases I have observed similar facts, and always confidently expect to find such species reappearing in the Western fauna. What conclusions may we draw from such facts? That their distribution has been due to commerce? Or, that they are indigenous throughout their extended habitats, persistent forms that have survived unchanged from preglacial times? Among the desmids, out of about three hundred species accredited to the United States, only about one-third are said to be peculiar to our fauna, the others common to all parts of the world, though chiefly European. As among other insects, I have found species of flies occurring only in the White Mountains and the Pacific fauna, which indicates the persistency of their types from different geological and climatic conditions. The circumpolar habitat of many such species may, as Osten Sacken suggests, account for their occurrence on the two sides of the continent, as well as in Europe, but it is purely gratuitous to say that it will account for all, and the notable case brought forward by the same author of *Catabomba pyrastri* is a pertinent one. This European species occurs in abundance in the western United States and in Chili, but has never been found east of the Missouri river. So, too, I doubt not that the European *Eristalis tenax* was at home, at least for awhile, on the Pacific coast before it suddenly spread eastward about 1870.

On the other hand many species that we should naturally expect to find on the two continents are yet confined to the one. Some, if not many, of these have failed to migrate simply because a good opportunity has never occurred, and our *Hæmatobia* is evidently of this class. But for others other explanations must be sought for. As the black rat and the Norway will not abound in the same region, so it is not unreasonable to suppose that the incompatibility, if one may so put it, of many species will prevent their living in common. Again, too, possibly the numerous parasites of insects may find an adaptabilty to newly introduced forms that may not only keep them in check, but actually keep them from obtaining a foothold. More potent causes undoubtedly are the climatic conditions and food supplies. As before intimated, those families of flies having the widest range of distribution for their species have generally the largest number of "foreign" species, while those in which the habitats are restricted have but few such species. A possible explanation for the latter is that a greater struggle for existence has weeded out the poorly favored ones and adapted the remainder more closely to the immediate environments. Certain it is that many of those families that are confessedly difficult to the systematist are the ones having fewer "foreign" species.

However, the very extensive family of parasitic Tachinidæ have remarkably extended habitats for their species, while I do not recall a single species common to the two continents, though a number reach through the two Americas. This non-identity of forms may be more apparent than real, yet it is very singular that none have been recognized, while in the related family of Anthomyidæ nearly a third of the recognizable hundred or so species are "European," and the family has, if anything, been less studied than the Tachinidæ. Professor Riley has proposed the feasibility of introducing the European Tachinid parasite of the asparagus beetle, but my opinion is that such an attempt would fail, though it would certainly be very interesting. The difficulty in the way of the insect host may be the cause of such non-importation, but it hardly seems so, for many species are parasitic upon numerous forms, and American parasites allied to the European ones have, in not a few instances, adapted themselves to European insects that have been introduced into, or at least occur in, this country.

In the parasitic family of bot-flies it is probable that all the species common to the two countries (eight) have been introduced with the domestic animals, with the exception of the circumpolar reindeer bot-fly. They all occur from the Atlantic to the Pacific,—that is, those of the United States,—and not a single species of their respective genera (leaving out the doubtful case of *Hypoderma bonassi*) is indigeneous. In the genera *Cuterebra* and *Cephenomyia* not a single species is known to occur outside of North America. Among the mosquitoes three or four species, from among about forty, are recorded as common to the two continents.

New Haven, Conn.

EXPLANATION OF PLATE.

FIG. 1. *Hæmatobia serrata* R. Desv., female.

FIG. 2. Head of male.

FIG. 3. Head of female.

FIG. 4. Hind foot of male.

PLATE XXI.

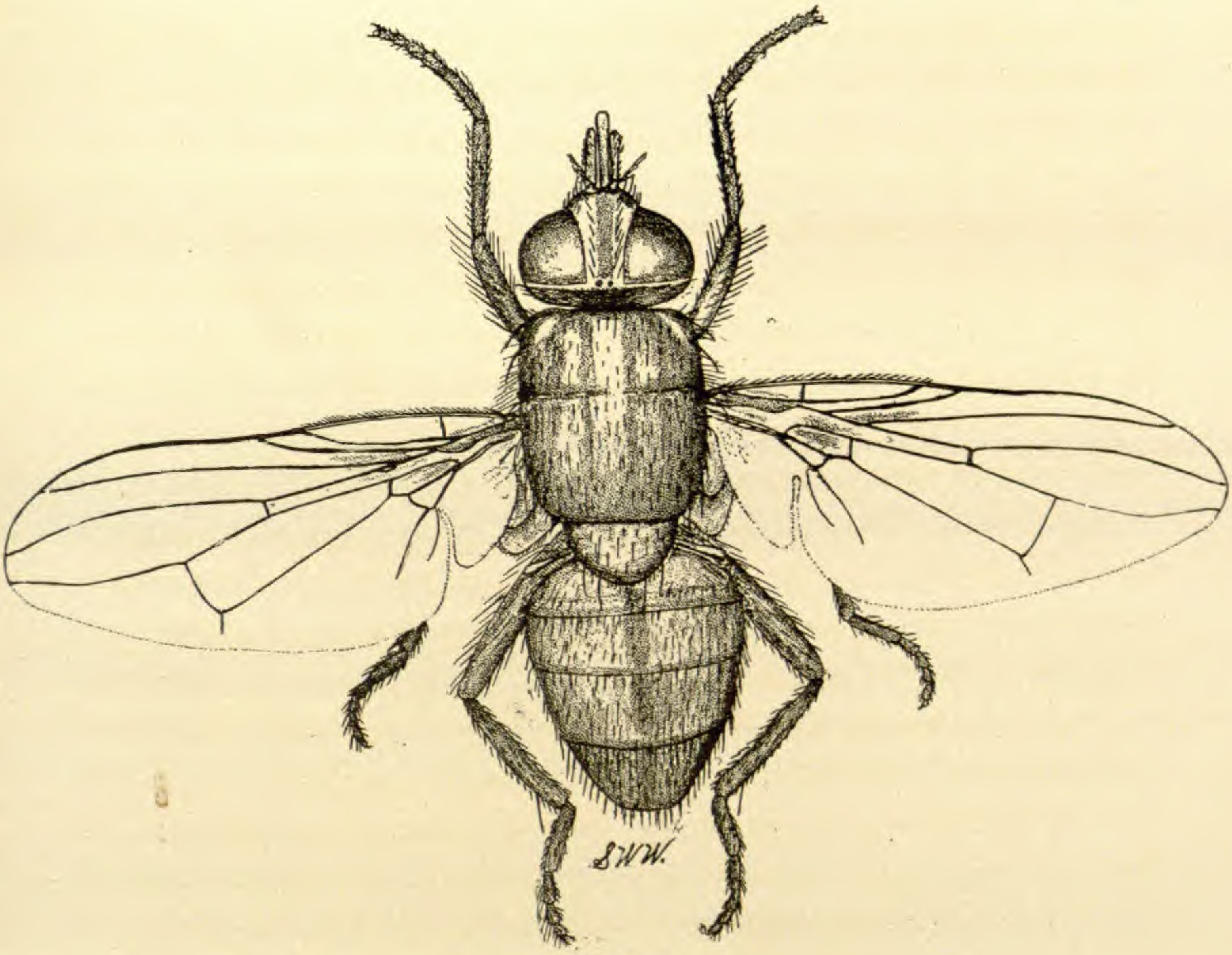
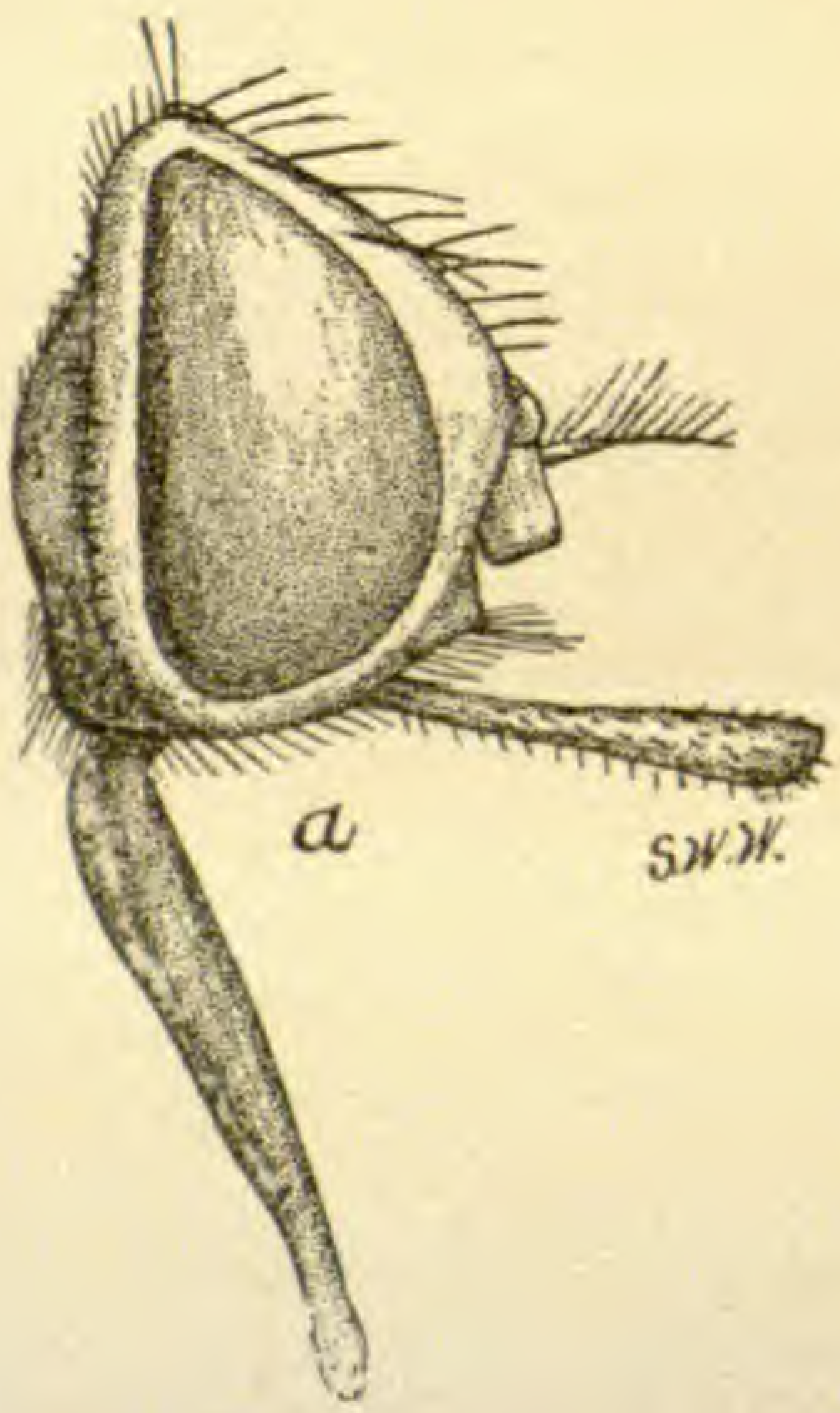


FIG. 1.



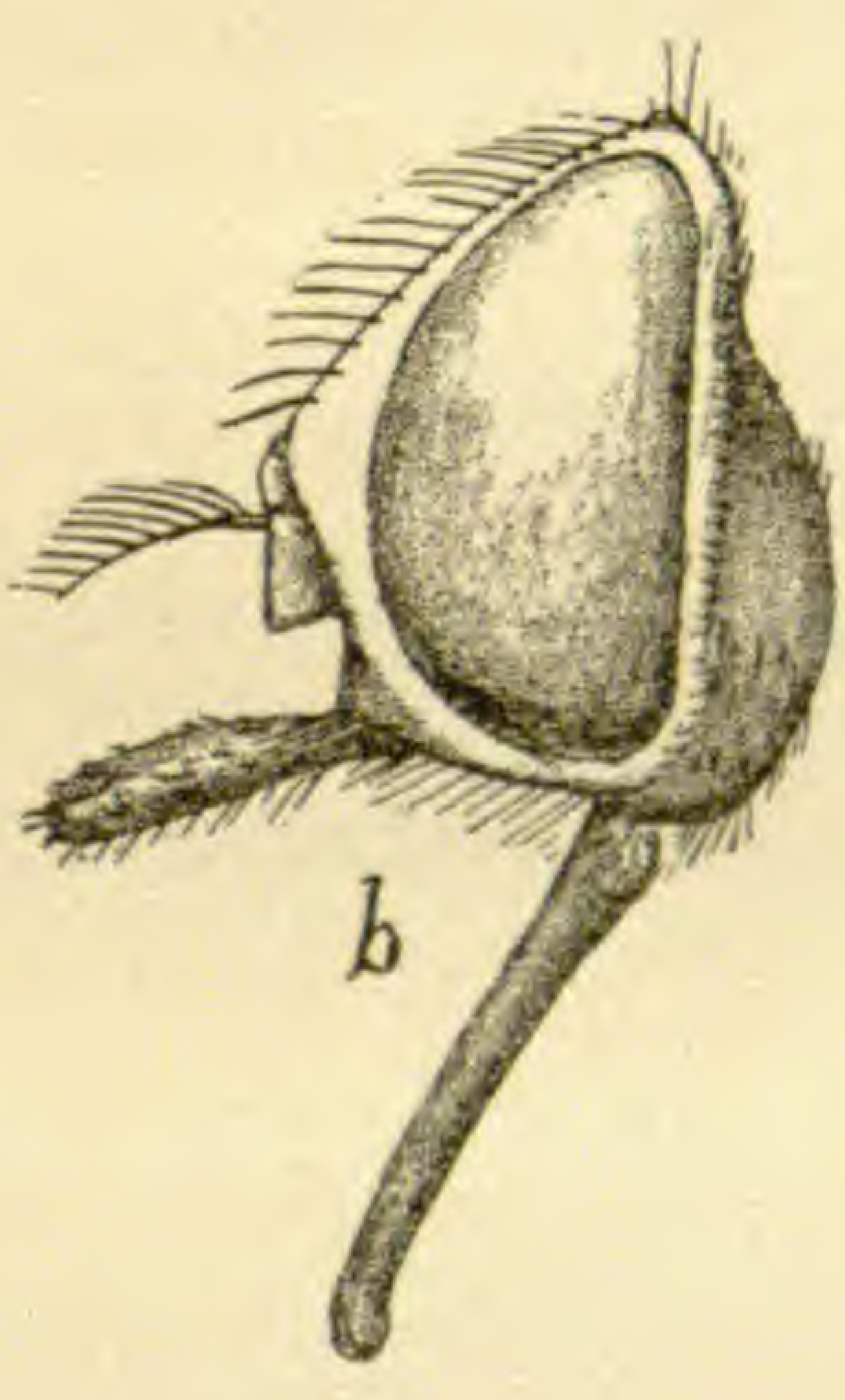


FIG. 2. FIG. 4. FIG. 3.

ON A FEW CALIFORNIAN MEDUSÆ.

BY J. WALTER FEWKES.

VERY little is known of the different genera and species of Medusæ which live in the waters contiguous to the coast of Southern California. There is every reason to believe that this fauna is very rich, and extremely interesting and instructive so far as its geographical distribution is concerned. The animals of this group from the west coast are represented by genera and species widely different from those found on the Atlantic seaboard. The coast of California, washed as it is by the largest ocean of the globe, is bathed by great oceanic currents, bringing with them their quota of oceanic and pelagic life. We should naturally expect there forms of medusan life of strange appearance to one who has always studied similar animals from the Atlantic.

A few attempts have been made to use the dip-net in the Pacific coast, but we cannot say that more than a beginning has been made, and it may rightly be concluded that an abundant harvest awaits the collector of pelagic animals who first carries on continued work in these waters.

In the present paper I have attempted to consider a few representatives of the group of Medusæ which were captured in a trip across Santa Barbara Channel in the spring of 1887. No accounts[1] of several of these Medusæ have ever been published, although some of them are very different from those which are found in the waters of the Atlantic. Our work on these animals may serve as an introduction, or to call attention, to a line of

[1] I refer simply to the floating medusan life, not to the fixed hydroids. There are several elaborate papers on the Hydroidea of the coast of California, which give a very good idea of the general facies of this group from this locality. This paper deals only with the floating Medusæ, and only makes casual mention of one or wo fixed hydroids, of which little or nothing is known.

investigation which is destined to reveal a rich harvest to any one who may take up the study of these facinating animals. There is no subject which would more richly repay observation than that of the Medusæ of California. I have here pointed out the most important general structural features of these genera, and have introduced a few comparisons with similar genera from the Atlantic, with which students of zoölogy are more familiar.

Of the group called Acraspeda, or Discophorous Medusæ, a species of Pelagia is one of the largest and most striking of those which make their way into the Santa Barbara Channel. Compared with the Pelagia of the Atlantic and Mediterranean Sea, *Pelagia noctiluca*, the Pacific Ocean representative, *P. panopyra*, is a veritable giant. Specimens were captured which had the "tentacles" of the mouth over four feet in length, and the dimensions of the body in proportion. The Atlantic Ocean Pelagia is commonly not more than a fifth of the size of this form.

The first figure gives a representation of the general form of this Pelagia as it was observed floating near the surface of the water in mid-channel. The umbrella, which forms the upper portion or body, is over two feet in diameter, and from the center of the under side there hang down four long, frilled, flexible tentacles, which form the lips of the mouth, or oral aperture. There are eight "sense-bodies" arranged at regular intervals around the margin of the umbrella, alternately with which arise the tentacles, or the long, thread-like structures conspicuously shown in the figure. This Medusa, from its very large size, is one of the most striking, and seems to be common at certain seasons of the year, according to reports given to me by the fishermen, but I was able to collect only a half dozen good specimens. The examples captured had a beautiful pink color, which was especially brilliant on the tentacles and exterior of the umbrella.

The genus of Acraspeda called Aurelia, represented on the Atlantic coast by the well-known *A. flavidula*, is also found in the Pacific, and is represented on the coast of California

PLATE XXII.

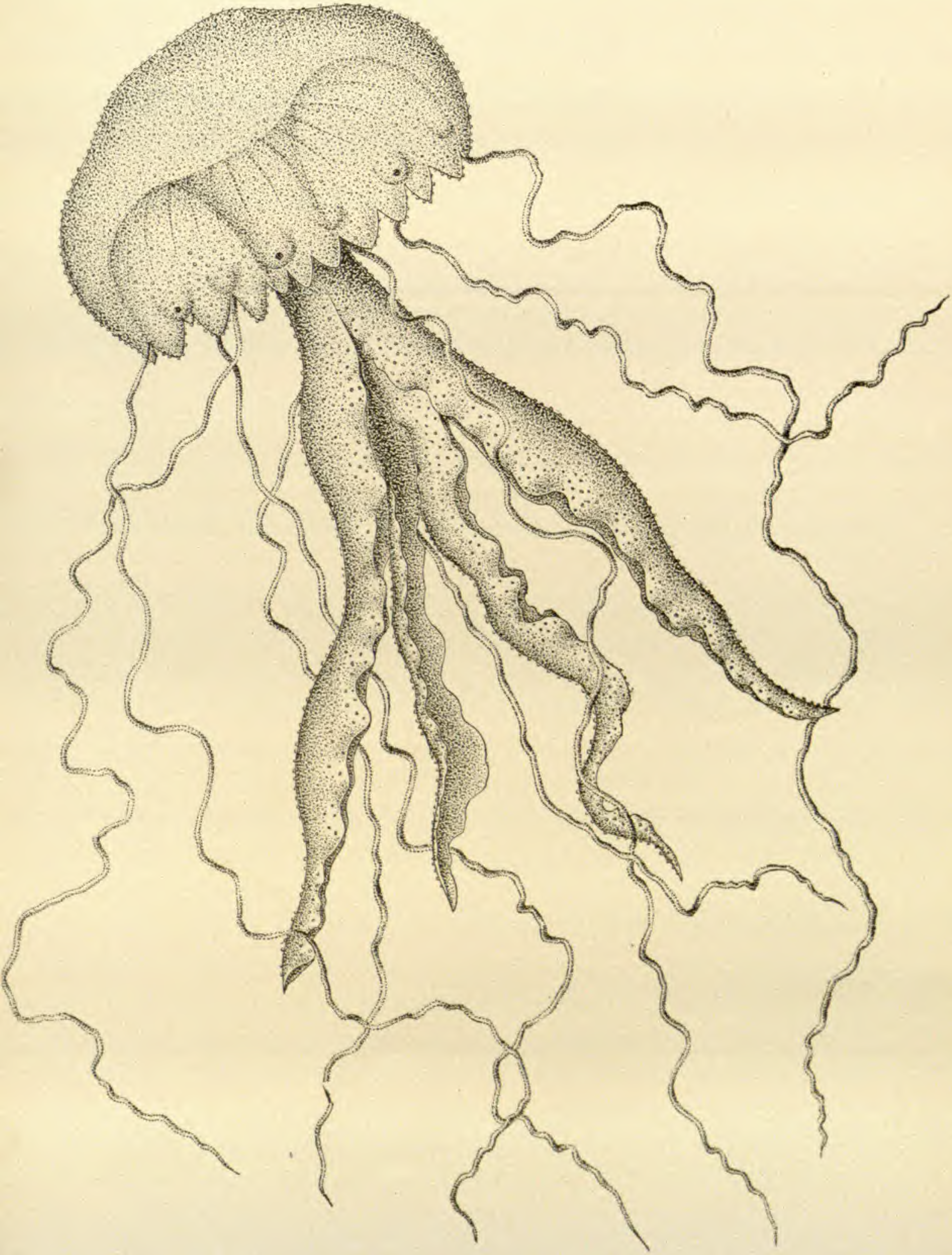


FIG. 1.—*Pelagia panopyra.*

by a beautiful species, *Aurelia labiata.* This species, like the Atlantic, has eight sense-bodies on the bell-margin, between which there are numerous short tentacles as represented in Fig. 2. The color is more pinkish than that of *flavidula*, but the specimens observed are smaller. It was met with but once in my surface fishing in the Santa Barbara Channel, but north of Santa Barbara, at Monterey, it was found several times, and according to trustworthy reports this jelly-fish is very common, in certain months of the year, along the west coast of the United States.

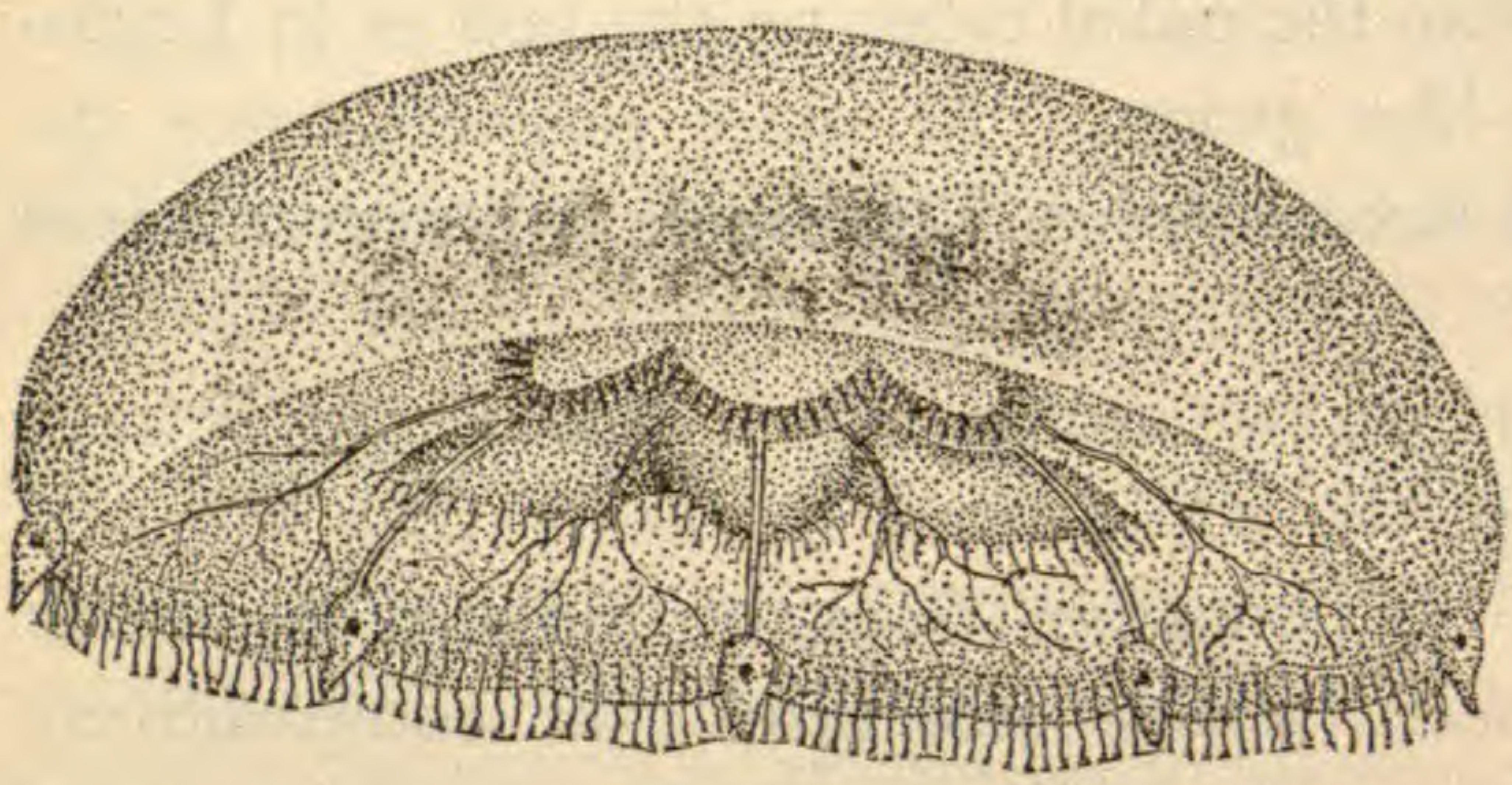


FIG. 2.—*Aurelia labiata.*

One of the most beautiful, conspicuous and abundant jelly-fishes found in the Santa Barbara Channel in the Spring months is a genus Polyorchis, represented by a single species, *Polyorchis penicillata* (A. Ag.) This Medusa is common in all stages of growth, and often swarms in the waters about the landing places. It is easily recognized by the peculiar character of the radial chymiferous tubes, which are four in number, and from their sides there arise lateral branches as shown in the figure. The ovaries hang from the upper portion of the manubrium from a gelatinous elevation or extension of the bell which bears the proboscis. This position of these organs is peculiar, for while Polyorchis belongs to the so-called Tubularian hydroids, in none of which these otocysts are situated on the bell margin, the position of the sexual bodies is exceptional. In the majority of the Tubularian or Anthomedusan hydroids the sexual bodies arise from the proboscis itself, but here these bodies hang from a gelatinous extension of the bell, or, more exactly, form the radial tubes which cross this prominence. Practically, therefore, we have here a Medusa which has characters of hydroids like Sarsia and those like Oceania, representatives of two groups, for while otocysts are wanting on the bell margin, as in Anthomedusæ, the sexual bodies hang from the radial tubes on the bell as in Leptomedusæ or Oceania-like genera. In most respects, save the simple position of the sexual bodies, Polyorchis is however a true Tubularian.

The youngest form of Polyorchis which was found betrays clearly the affinities of the adult, since it shows that the side branches from the radial tubes are in reality structures of comparatively later growth in the development of the Medusa. The accompanying figure represents an undeveloped or young individual of Polyorchis before the side branches of the tubes had formed, and before the tentacles had reached any considerable length. Like the younger forms of many young Medusæ of widely different genera we find clusters of small bodies superficially resembling nematocysts strewn over the external surface of the bell. The immature Medusa has no apical prominence on its bell, and in general its umbrella is more elongated, with a longer vertical diameter, than the adult. All stages of growth between the young represented in Fig. 4 and the adult can be easily collected.

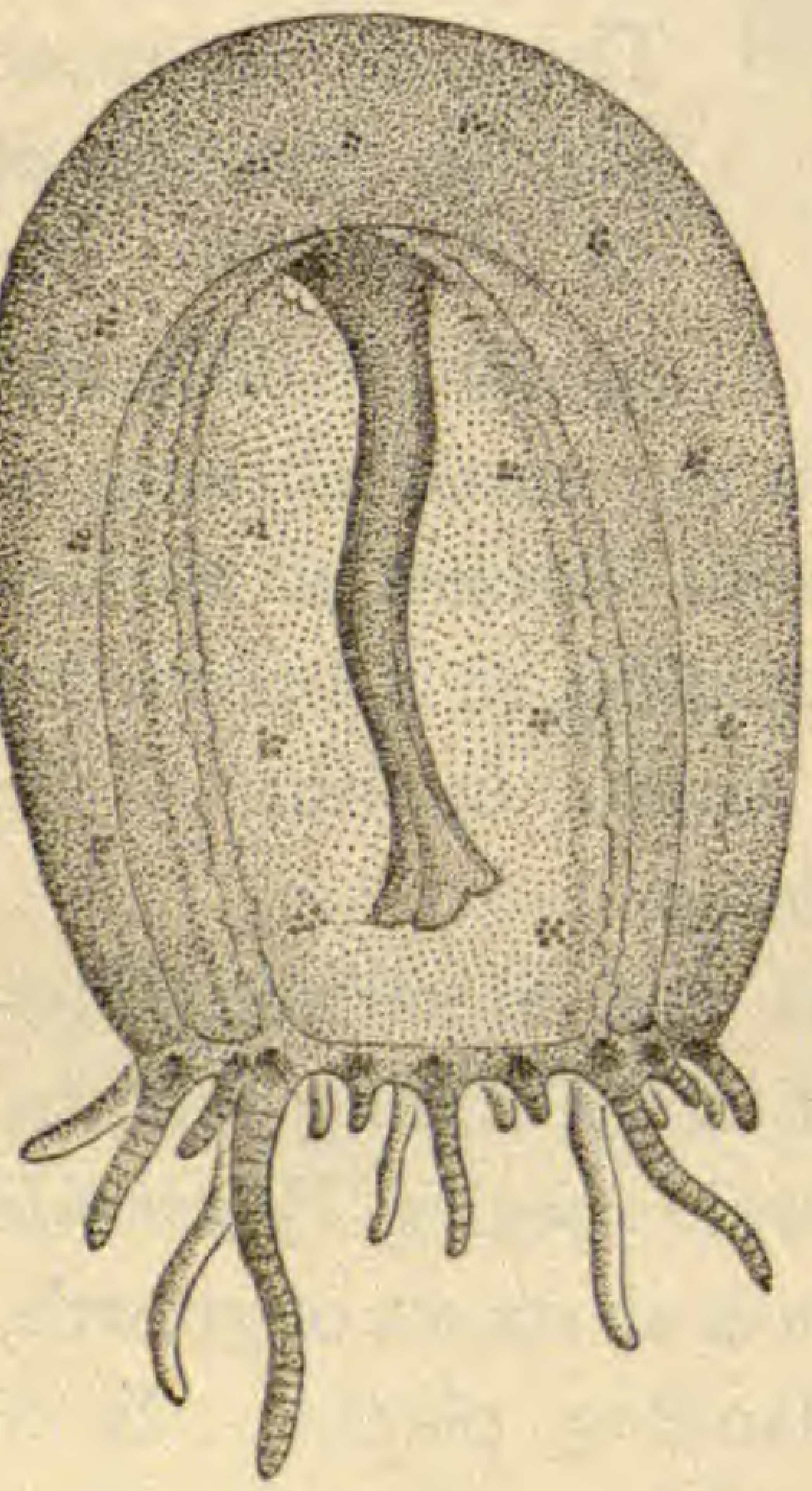


FIG. 4.
YOUNG POLYORCHIS.

There is another very curious Medusa likewise belonging to the Anthomedusæ, which is found in the vicinity of the Island of Santa Cruz.[1] This Medusa is so remarkable that a figure of it is introduced for comparison with related representatives from the Atlantic coast.

One of the most interesting genera of Tubularian Medusæ

[1] The island of Santa Cruz is the nearest of the Santa Barbara islands to the city of the same name.

PLATE XXIII.

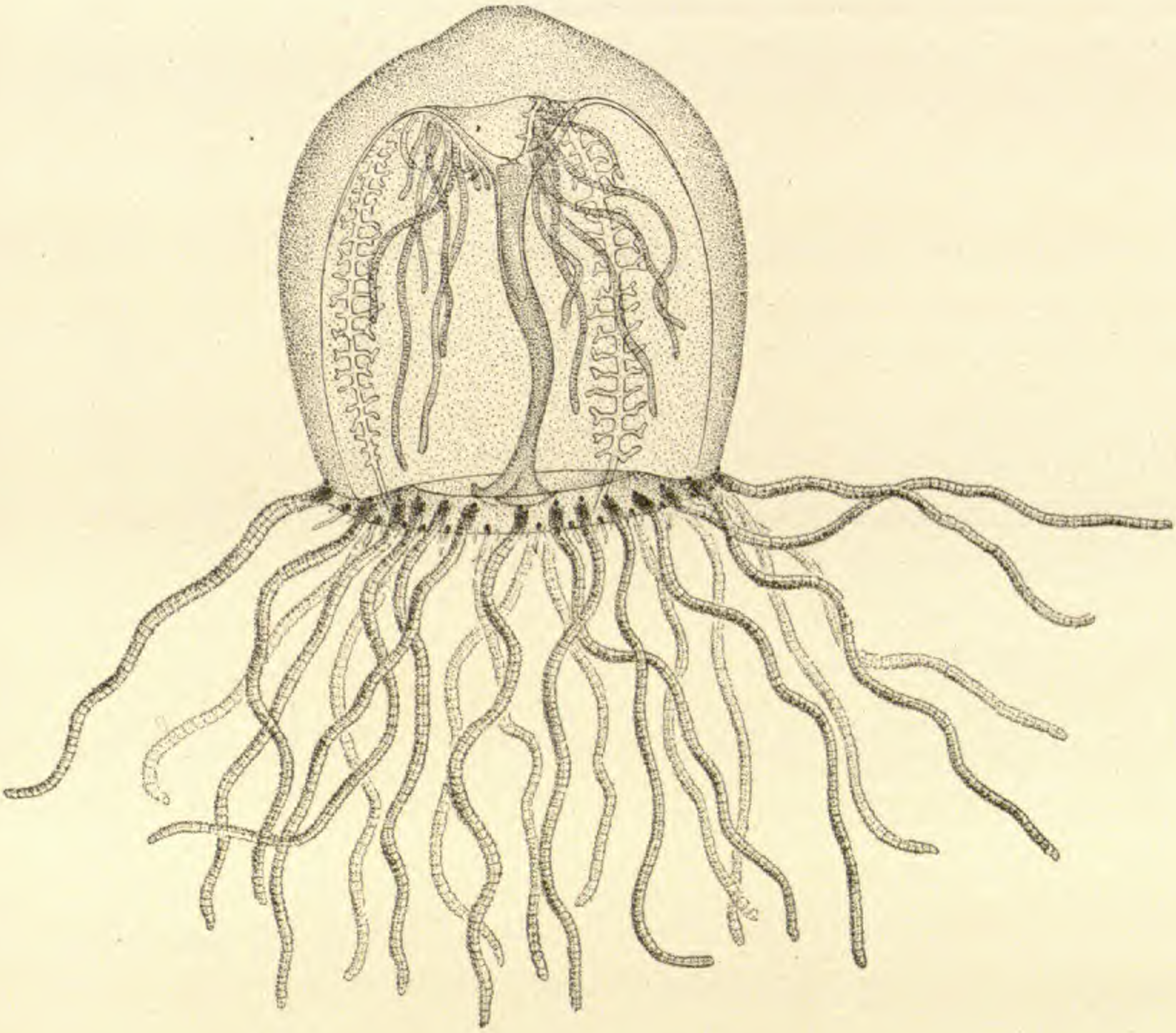


Fig. 3.—*Polyorchis penicillata.*

found in the waters of the Atlantic is a strange genus called Dipurena. This jelly-fish is remarkable from the fact that while its bell resembles closely that of Sarsia, the Medusa of Syncoryne, the form of the tentacles is very different. While Sarsia has long, highly-flexible tentacles, Dipurena has, in the same position, arranged at regular intervals on the bell, nine stiff club-shaped appendages, enlarged at their tips into clavate organs of unknown function.[1] The form of the bell, the structure of the tentacles and the proboscis of Dipurena have been figured in my paper on the "Jelly-fishes of Narragansett Bay," to which the reader is referred for a knowledge of the peculiarities of this most interesting animal. The points with which we have at present to deal are the following: Dipurena has a hemispherical bell, four simple radial chymiferous tubes, and four stiff tentacles which are enlarged at their extremities into club-shaped bodies resembling small dumb-bells. The length of the proboscis is very much longer than the height of the bell cavity, and through its walls the ova can sometimes be seen in packets occupying two regions. The mouth is simple, resembling that of Sarsia, and at the base of the stiff tentacles on the bell margin there are simple pigment spots or ocelli. Dipurena is rare on the coast of New England, but it seems to be more common in the Gulf Stream, and occurs in numbers in Floridan waters and on the Carolina coast.

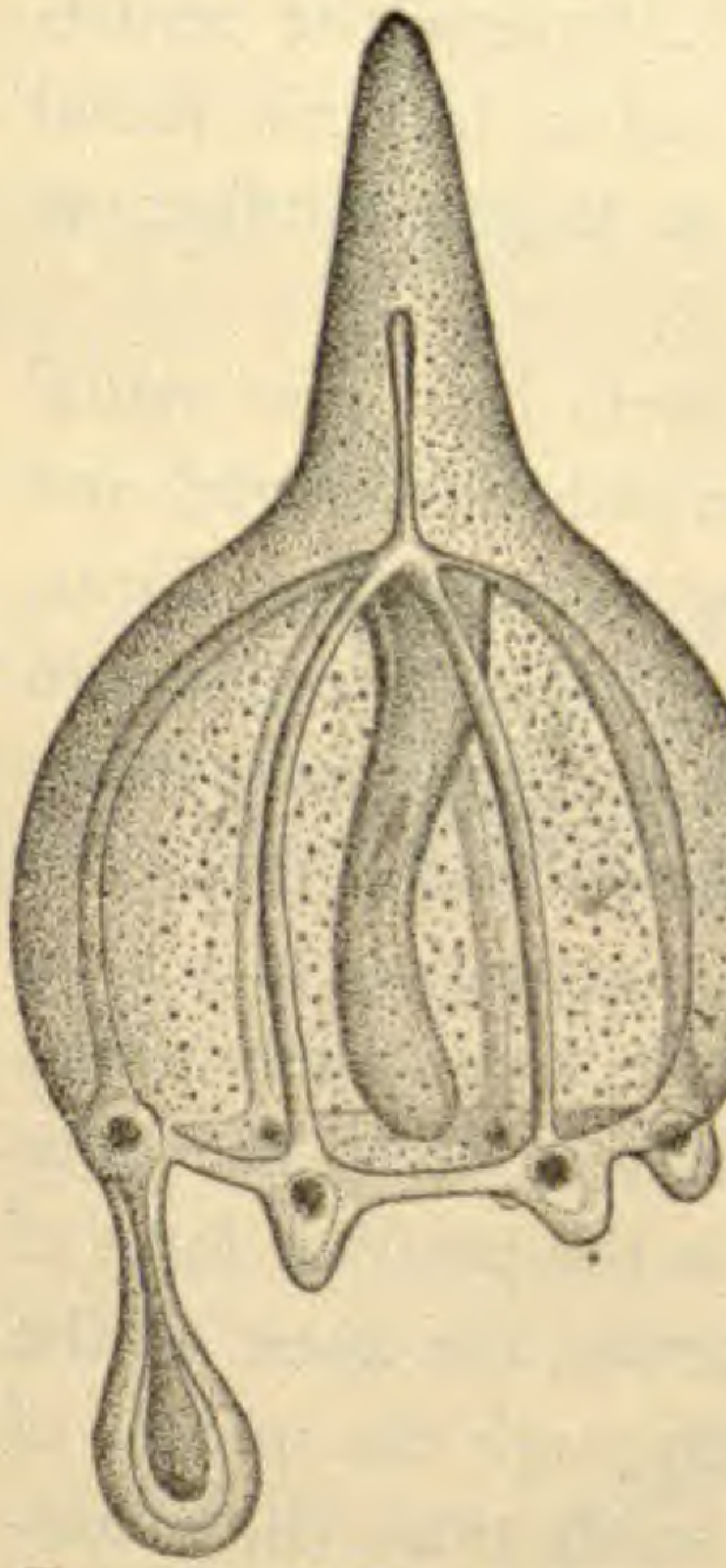


FIG. 5.—MICROCAMPANA.

Under the lofty cliffs of the island of Santa Cruz, opposite Santa Barbara, a Medusa with certain of the characters of Dipurena was taken in the Spring of 1887. There are features of this Medusa which stamp it as a most characteristic one, and

[1] It seems highly improbable that the function of these clavate appendages is the same as that of the long flexible appendages or tentacles of Sarsia.

as highly exceptional, differing from any which has yet been described. I suggest for it the name Microcampana, the structure of which is indicated below. Microcampana has *six* radial chymiferous tubes instead of four, eight or a larger number, as ordinarily occurs among its nearest allies.

Among Hydromedusæ the majority of genera have four radial tubes, but there are several, as Melicertum, which have eight, and still others, Zygodactyla, which have more than eight. Four, however, is the normal number in the majority of genera, and there are only two or three which have six. Microcampana is therefore in the first place exceptional in the number of radial tubes. It has, moreover, a single club-shaped tentacle, resembling, it is true, that of Steenstrupia in the fact that it is single, but closely allied to those of Dipurena in anatomical characters. It is the only known genus which approaches Dipurena in the peculiar form of the tentacles. Unlike the last-mentioned genus, the apex of the bell is prolonged into a conical projection, through the middle of which, at least in its basal region, passes a small tube, the homologue of which is found in several genera where it is often the remnant of a former connection with the hydroid from which the Medusa has been formed by gemmation. The conical projection at the apex of the bell is exactly reproduced in two Atlantic genera, Stomatoca and Dinematella, neither of which, however, has less than two tentacles. To recapitulate, then, we have these extraordinary features in Microcampana, which are found in combination in none of the known Hydromedusæ which have yet been described: there are *six radial chymiferous tubes, a single tentacle, which is inflexible, and enlarged at its tip into a dumb-bell-shaped structure,* and an apical projection on the bell penetrated by a median canal originating from the common junction of the four radial tubes, and terminating blindly in the substance of the projection.

It is probable that the size of this Medusa (it is barely an eighth of an inch in diameter), and the existence of but a single tentacle, are indications of immaturity. It may later be found that other tentacles are developed, and new affinities be sought for it. To this conclusion, the fact that a remnant of what may be a former

PLATE XXIV.

Fig. 6.—*Steenstrupia californica.*

connection with the hydroid, seen in the apical projection, adds some weight. Even if it is an immature Medusa, the character of the tentacles, so like those of Dipurena, is exceptional. The specimen cannot be confounded with Dipurena on account of the greater number of radial tubes.

It may be urged with some weight that we are dealing with an abnormal specimen, and that the extra tube is an abnormality. Granting that such is the case, the apical projection remains as a feature not possessed by any of the species of Dipurena, and ordinarily the apical projection is a late formation on the bell of a Medusa as shown in the development of Stomatoca and Dinematella.

Microcampana is not the only unitentacular Medusa found in the prolific waters of our Pacific coast. A second genus, known from the Atlantic for many years, is also represented in the Santa Barbara Channel.

A bizarre genus of Hydromedusæ, found on the Atlantic coast, is known as Hybocodon, the "hunchback" Medusa. The same, or a very similar, genus from Europe is called Steenstrupia. There genera are remarkable from the fact that they have but one long, flexible tentacle. One of the most interesting features of this Medusa is that the young arise as buds from near the attachment of this tentacle to the bell margin. It is a true Tubularian, with the peculiarities of that group, but has three of the tentacles so reduced as to be wholly wanting, while the fourth is very much prolonged and is highly flexible, armed with ferules of powerful "stinging cells,"—nematocysts. The young, with the bells in process of formation, each with its own tentacle more or less completely developed, and clustered at the base of the long tentacle of the parent, can be seen in my figure. When sufficiently developed these budding individuals probably break their connection with the mother, and from the bases of their tentacles in turn they develop new broods.

Among the many other Hydromedusæ which live in the Californian waters, one of the most beautiful is closely allied to Sarsia, a genus abundant at times in Massachusetts Bay. This beautiful animal has received the name *Sarsia rosaria*, and is the free gonophore of a form of hydroid called Syncoryne. The simple structure of this Sarsia can be seen in the two cuts, the smaller of which represents the young, the larger the adult form of the same jelly-fish. They were found very abundant near Monterey and Santa Cruz, and several specimens were taken from the Santa Barbara Channel, where, however, they were not found as abundantly as in the former locality. The species is readily distinguished from the Atlantic representative by its greater size and by the color, while the proboscis is much shorter than that of *Sarsia mirabilis*, so abundant at times on the coast of New England.[1] As is well known, the Anthomedusan and Leptomedusan groups of Hydromedusæ are supposed to arise as buds from fixed hydroids, excepting perhaps the somewhat doubtful case of the Lizzia recorded from Scotland, of Claparede. In genera where we have young Medusæ budding from Medusæ among these groups, as in Lizzia, Sarsia, and others, it is not impossible that a direct development in which no fixed stage is found, direct development not unlike that of Cunina, may exist, but such a form of development has yet to be described. The genus Sarsia has a development of young by the budding of new individuals from the proboscis of the parent *S. prolifera*, and from a fixed hydroid Syncoryne.

The piles of the wharf at Santa Barbara are peopled by a beautiful pale pink hydroid, belonging to the genus Syncoryne, which may possibly be the hydroid of the Sarsia just described. These hydroids are found in clusters with a common basal connection, each head rising from a single stem as shown in the figure given here. On a single magnified head we detect the club-shaped tentacles and the ovate "buds," which are Medusæ in all stages of

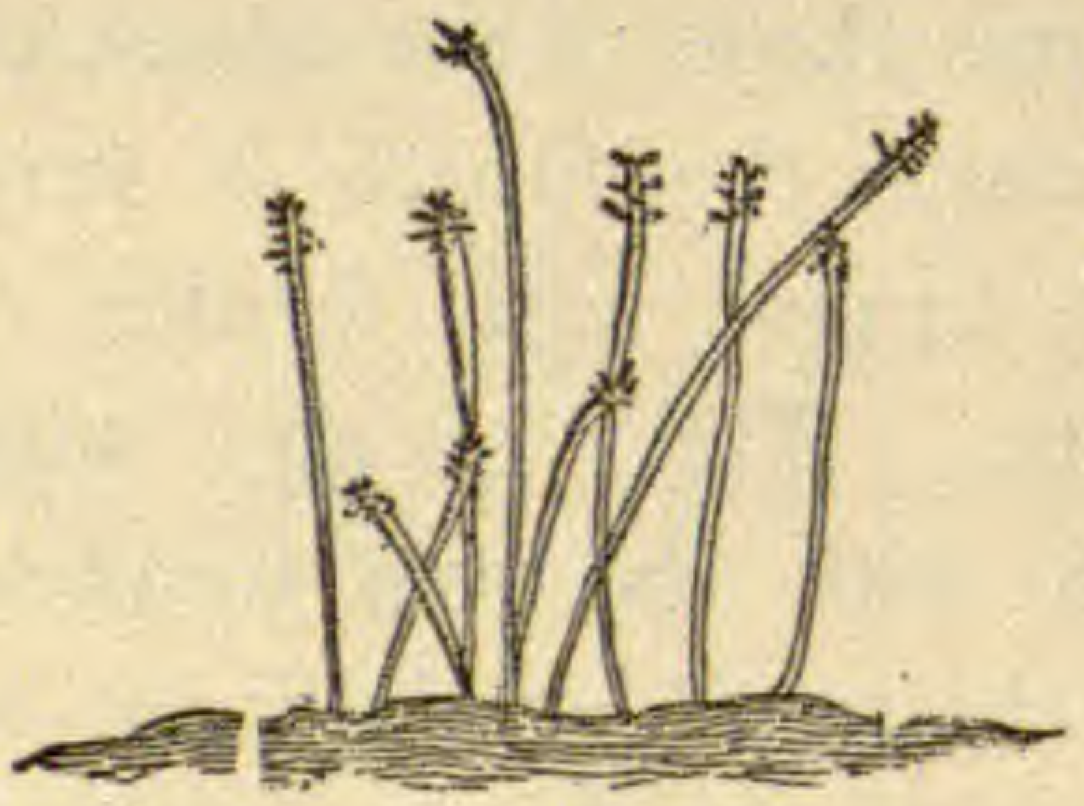


FIG. 8.—CLUSTER OF SYNCORYNE HYDROIDS.

[1] The hydroid Acaulis, found at Grand Manan and Eastport, Maine, is a most interesting genus of free hydroids with Medusa buds. This genus, which might be mistaken for the head of a Monocaulis, is probably an interesting connecting link between the Siphonophora and the fixed hydroid or its homologue the budding Cunina.

PLATE XXV.

FIG 7.—ADULT AND YOUNG OF (*Sarsia*) *Syncoryne rosaria.*

development. I have not been able to trace these "buds" into

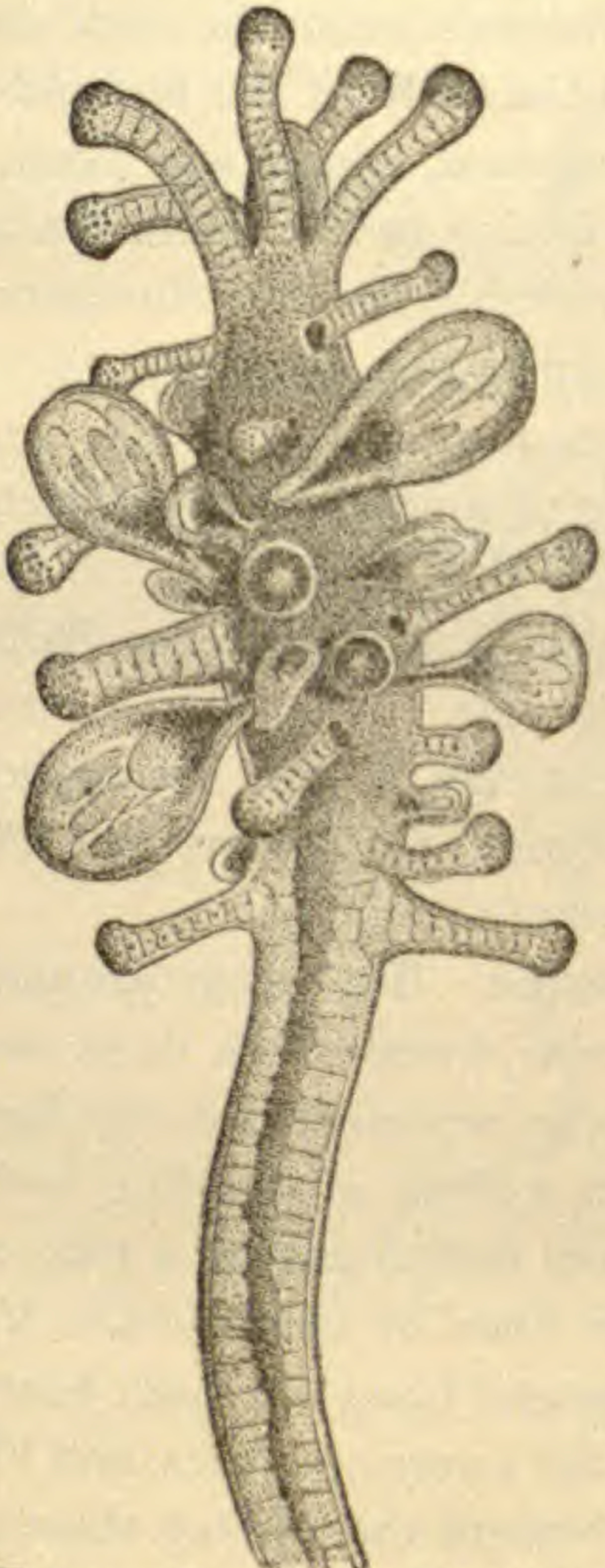


FIG. 9.—ENLARGED HEAD OF A SINGLE SYNCORYNE.

FIG. 10 *a*.

a young Sarsia, but from what is known of the hydroid of the Atlantic Sarsia, it seems highly probable that this hydroid is the young of the Pacific Coast Sarsia.

FIG. 10.

Associated with the preceding hydroid on the piles of the wharf at Santa Barbara, there is another hydroid not yet determined, figures of which are given herewith. These hydroids belong to the second group of Hydroidea, or the Campanularians, and are found in clusters, as shown in the first figure. The larger cut represents a single head, very much magnified, with the tentacles partially retracted. Along the sides of the body clusters of unicellular algæ are seen, which sometimes occur in such numbers as to almost completely conceal the body of the hydroid.

There is another curious Hydromedusa, which was taken in the skimming nets used in pelagic fishing in the Santa Barbara Channel. The genus Willia is remarkable for the bifurcation of the radial chymiferous tubes, as shown in the cut.

This interesting genus, never before recorded from the waters of California, is related to the young of a genus Proboscidactyla, and the Medusa figured may belong to this genus.

One of the most interesting Medusæ from the Santa Barbara Channel is a little-known genus, Athorybia. Athorybia is a member of the group of Siphonophora known as the Physophoræ, although it bears little superficial likeness to Agalma and Physalia, two of the best-known members of the group.

The anatomy of Athorybia is simple. The most prominent structure is an oval float of pink color, from which there hangs a tube-like or trumpet-shaped body, as represented in my figure. At the base of the float there arises a circle of leaf-like bodies, transparent, gelatinous, penetrated from end to end by a tube, and crossed in their exterior by motor lines of lasso-cells. Very flexible bright pink bodies called tasters hang out from beneath the flat leaves, or, as they are called, the covering-scales, and long, highly flexible tentacles extend far beyond the tips of these and other organs of the body. Each tentacle bears a tentacular knot, as it is called, which are lateral branches, enlarged at one end, and with the termination divided into three divisions. The main body of the knob at the end of the lateral branches is composed of a spirally-coiled structure, covered by batteries of stinging cells, and partially enclosed in a covering-sac or involucrum, which is extended on one side into a conical projection or apex, as represented on the figure. There is but one kind of these structures along the tentacles of Athorybia, but in the neighboring genus Diplorybia from Florida there are two kinds of these structures.

The interpretation of the function of the organs of Athorybia described above, is in certain respects not difficult. The large

PLATE XXVI.

FIG. 12.—*Athorybia californica.*

oval body above is a float, the flask-shaped or trumpet-like organ the polypite, whose inner wall serves as a digestive organ, and whose terminal opening is a mouth for the capture of food. The leaf-like covering-scales, sheltering beneath themselves the other organs or zoöids, often keep up a flapping movement, by means of which the Athorybia is propelled from place to place. The function of the tentacles and tentacular knobs is probably the capture and retention of the prey. No sexual bodies were observed, from which we may readily conclude that the specimens which were captured were immature.

One of the most interesting of all the surface animals of the ocean is a beautiful genus called Velella, which receives its name from its fancied resemblance to a "little sail-boat." This genus is often so common in the Mediterranean Sea that the surface of the water appears to be almost covered with them, and after favorable winds they are sometimes accumulated in great masses along the shores and in the small bays and harbors of the Italian coast. In Florida, likewise, a similar animal occurs in great numbers, and stragglers often make their way even to the New England coast, where they are often stranded on our Southern beaches.

A Californian species of Velella, found along the west coast of the United States, occurs in the waters of the Santa Barbara Channel, and although often very abundant, is at times rather rare. Its bright blue color and its strange form make it a noteworthy Medusa.

In the accompanying cut there is shown a view of this Californian Velella, as seen from above, looking down upon it as it floats on the surface of the sea. The diagonal oval region, crossed by a thin triangular plate, the edges of which are seen in the figure, is the float, which is composed of many concentric apartments, each opening exteriorly by a small orifice, and all communicating with each other. The larger oval is the body of the Medusa, and as it floats on the surface of the water this portion, which is flat, forms the great mass of the animal. Through its walls, which are of bluish color, the tentacles can be seen, but the feeding-polyp, which lies in the centre of the under-side, is hidden by the oval float in the middle of the body.

Of all the Medusæ considered, Velella is the only one which floats on the surface of the sea, the whole upper surface of the body, or that shown in the figure, being exposed to the air. From this fact, as well as from certain rhythmical motions made by Velella, it is not improbable that the respiration is in part aerial in this Medusa, as has been already pointed out by Dr. Carl Chun. To facilitate this mode of respiration, and to bring the air into the interior of the body, there are tubes, called tracheæ, communicating with the cavity of the float, through which air is taken in and gas expelled by the movements of the body. At the same time there is also an abundant opportunity for aerial respiration through those parts of the body which are always exposed to the air.

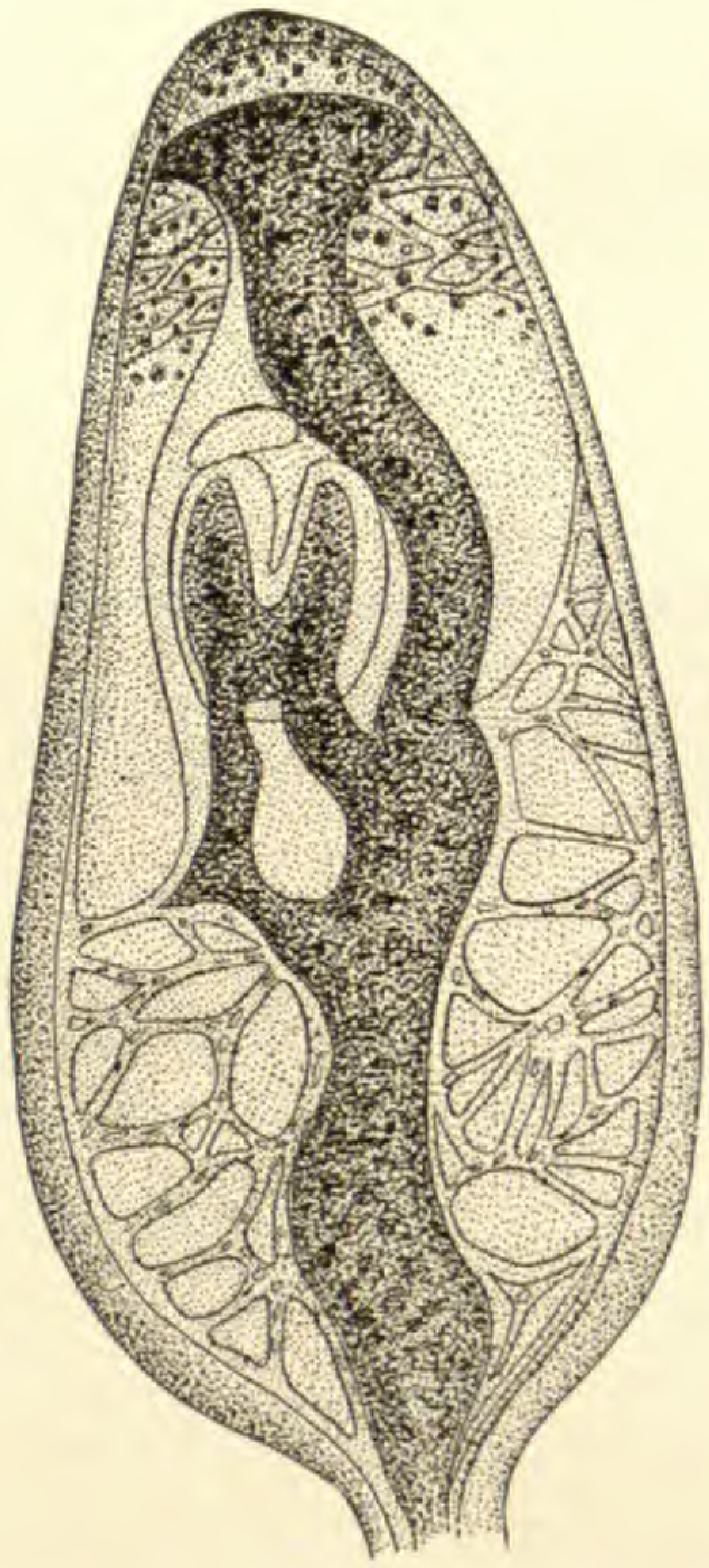
NOTES ON THE HABITS OF SOME AMBLYSTOMAS.

BY O. P. HAY.

MY observations on the habits of the Amblystomas have been made almost wholly on the three species, *A. microstomum, A. tigrinum, and A. punctatum.* These species have received respectively the vernacular names, small-mouthed salamander, tiger salamander, and spotted salamander. All three are quite abundant about Indianapolis, the *microstomum* most of all; and it is this that I have been enabled to study most carefully. Unless otherwise noted, my remarks will refer to this species. It will be most convenient perhaps to begin with the life of the individual; first of all with those events which make provision for the life of the individual.

The eggs of the small-mouthed salamander are laid very early in the spring, as soon as the thick ice of the winter is gone, or even before it is gone. During the present year I found eggs of this species at noon of March 3. They had probably been laid during the preceding night. They were attached singly

PLATE XXVII.



GONOSAC OF ATRACTYLOIDES.

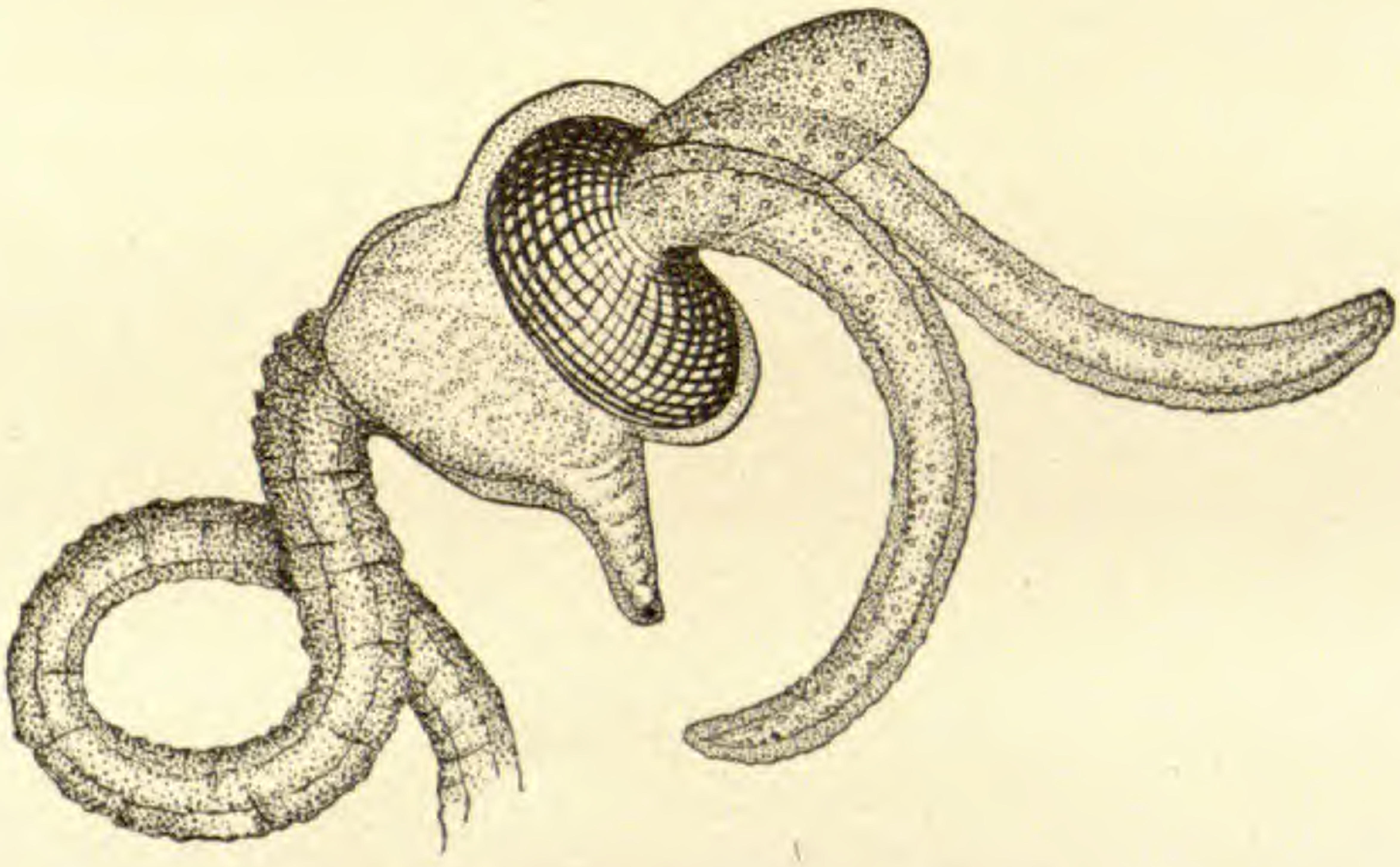


FIG. 12 *a.—Athorybia californica.*

and in bunches of various sizes to blades of dead grass and to sticks under water. I have also seen them strung along on the bottoms of shallow ditches, as if they had been deposited by the female while crawling about. I have reason to suspect that eggs had been laid in the same ponds at an earlier date. It is also certain that oviposition continued at least as late as March 22.

The eggs are quite small, the diameter being about 2 mm. Each egg is surrounded with a capsule of a clear gelatinous substance, by which it adheres to other eggs and to objects in the water. This mass of gelatinous matter has a diameter of from 6 to 9 mm. It is made up of two principal layers separated from each other by a very thin layer, and from the yolk by apparently two other very thin layers.

How the eggs are fertilized by the male I have not observed; but it is probably much as in the case of *A. punctatum*. Some eggs strewed by a female over a brick in an aquarium failed to develop, doubtless because they were not fertilized. All the eggs found on the third of March had begun segmentation, and it was not long before the outlines of the embryo became visible. The changes passed through by the embryo cannot be here detailed. Very early cilia are developed on the outer surface, and the embryo begins slowly to revolve within the gelatinous envelope. When it is 8 mm. long it lies coiled within the envelope, and may be seen to possess short buds to represent the gills and the "balancers." About the 28th of March, some of the eggs were so far advanced that on being handled the tadpoles slipped out of the gelatine, and swam about in the water. Already, however, there were more advanced larvæ swimming about in the pond, which I could not distinguish as different. The eggs from which the latter originated may have been laid earlier; but it seems quite certain that some eggs develop more rapidly than others. Many of the eggs which I had more particularly under observation did not hatch until April 10th. At the time of escape from the egg the young are about 10 mm. in length. They are of a bright olive-green color, with indications of squarish blotches along the back. There is a broad fin running along the back and around the end of the tail to the vent. Three little gills stand out on each side of the neck, and on these may be seen a few rudiments of lateral filaments. The fore-legs exist as the merest little buds. The head is rounded in front, and the mouth is below, features due to the yet persisting cranial flexure. It is doubtful if the mouth is yet perforated. The heart may be seen beating at a lively rate, and the blood coursing through the gills. During the earliest period of its free life, currents of water are directed over the gills and the body by the action of the cilia; but soon currents may be seen to enter by the nostrils and to make their exit through the gill slits. After this the ciliary action becomes feebler, and at length ceases. When the larvæ have attained a length of about 12 mm. [one-half inch] the lateral filaments of the gills have become distinct, and may be seen arranged in two rows on the under side of the main stem. There are four to six filaments in each row. The mouth is now nearly terminal, and microscopic sections reveal the existence of premaxillary, vomerine, dentary, and splenial teeth. Nothing was found in the stomach of this sectioned specimen, but it may have been an unsuccessful hunter. Toward the last of April, the larvæ have reached a length of from 15 to 18 mm. The anterior limbs are conspicuous, and show each two short toes. The posterior limbs are present as elongated processes. The so called "balancers" have shrunken somewhat, and give evidences that they will soon be lost. The tadpoles are more inclined to lie at the bottom of the water when resting than to cling to the sides of the vessel.

From the time of hatching up to this stage the "balancers" are conspicuous organs. They are attached just behind the mouth on each side, and resemble a base ball bat. They are said by Professor S. F. Clark[1] to function as supports for the larvæ when they fall to the bottom of the pond during the period while the fore-legs are still undeveloped. I doubt if they are of much use in this way. In the aquarium they spend much of their time sticking to the walls, and it is by means of these organs that they suspend themselves. They are by no means "suckers," and it is doubtful if they secrete a sticky fluid, as the

[1] Studies from Biolog. Lab. Johns Hopkins University, No. II., 1880.

PLATE XXVIII.

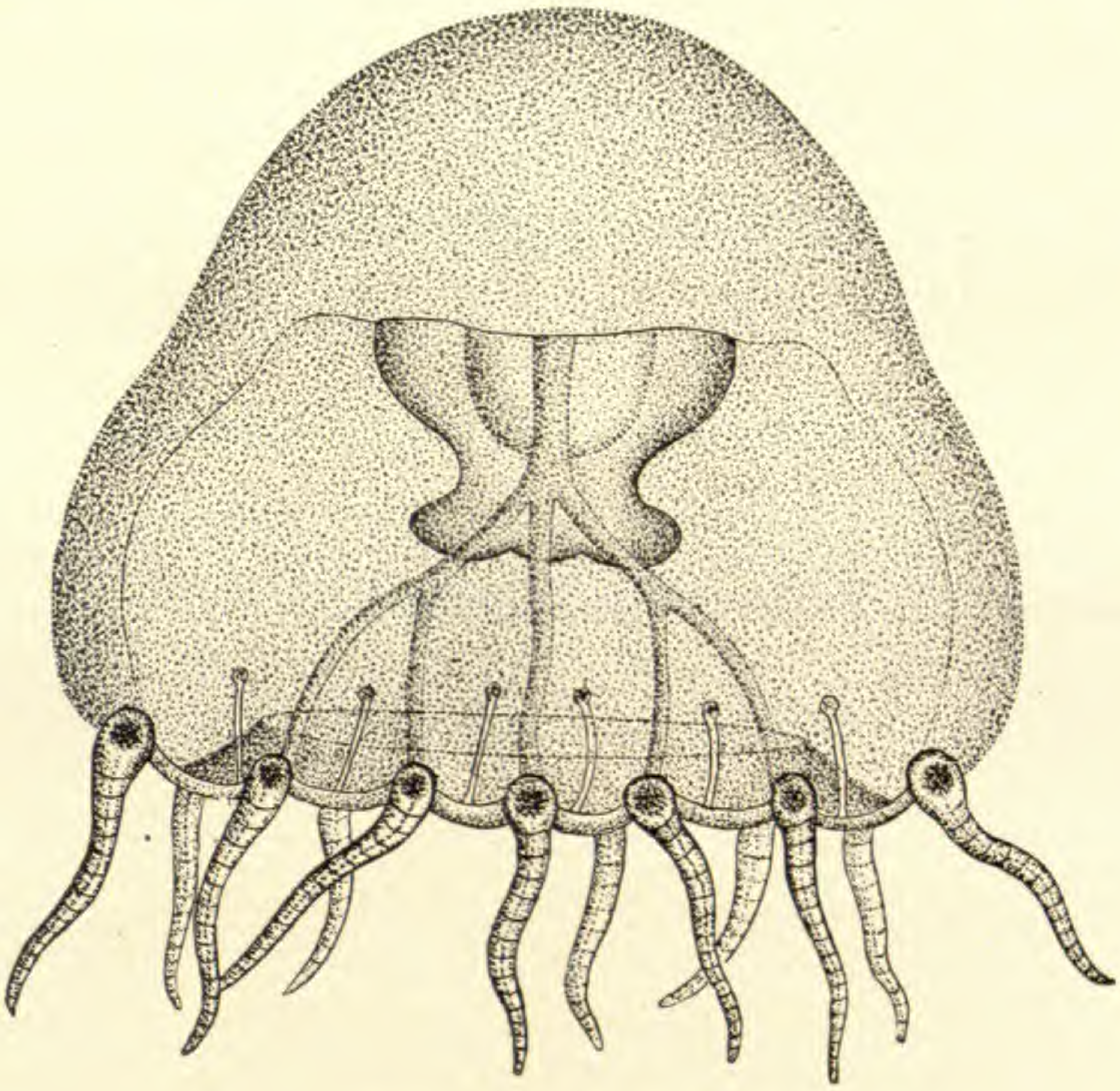


FIG. 11.—WILLIA.

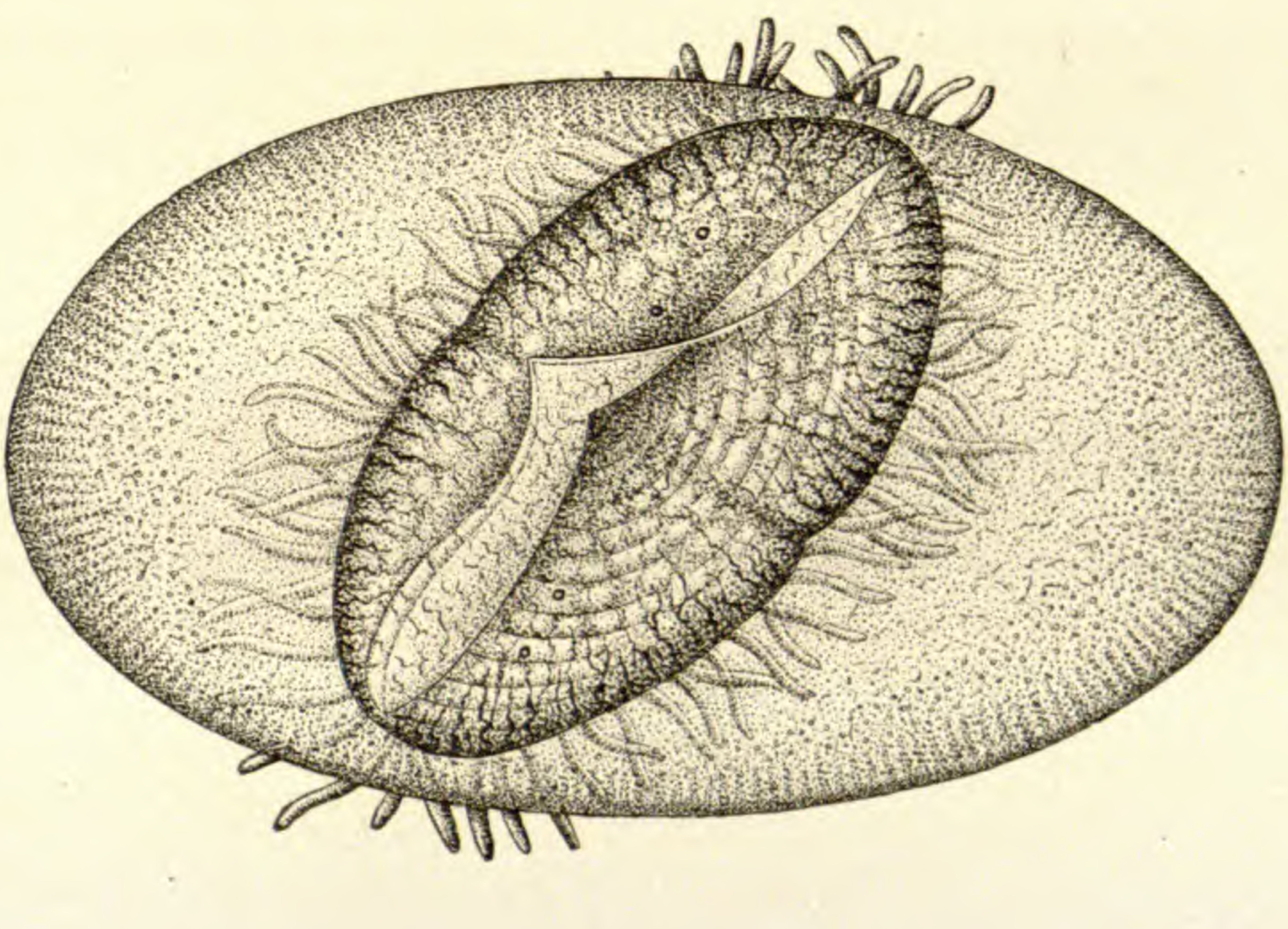


FIG 13.—*Velella meridionalis.*

organs of adhesion of the frog are said to do. In microscopic sections the epidermal cells near the tip of the organ appear each to project into a point, so that the whole surface is roughened somewhat. Since all objects in the water soon become covered with a thin layer of slime, the holders will adhere to this with sufficient force to suspend a little creature which is of nearly the same specific gravity as the water. When they are put into a clean glass or tin vessel, it is with great difficulty that they can succeed in attaching themselves to the perpendicular side. After making many unsuccessful efforts they sink to the bottom seemingly exhausted, and lie quite as often on their sides as on their bellies. When the holders have been lost, I have observed the larvæ to suspend themselves to the walls by means of their toes, or by a single toe.

While they are adhering to objects by means of the holders one may, under a lens, and with the point of a fine forceps, loose one holder and allow the tadpole to hang by the other alone. One may then touch the forceps to the adhering holder, and succeed in dragging the little animal hither and thither through the water.

Larvæ of the length of 15 mm. had their intestines filled with the remains of small animals. These consisted mostly of entomostracous crustaceans, such as *Daphniidæ*, *Cyclops*, and the like; but there were also found portions of the young of *Crangonyx* and *Asellus*, and of the larva of some beetle. The ponds which harbor these amphibians literally swarm with minute animal life, and the tadpoles are active, hungry, and fierce.

When the tadpoles have become about 25 mm. long, they may occasionally be seen to come to the surface for air. This shows that the lungs are becoming functional. A bubble of air is expelled by the mouth just as, or before, the tadpole reaches the surface; a portion of fresh air is probably inhaled; and the tadpole hastens to the bottom, as if alarmed at having exposed itself.

The changes from this time on until near the time of metamorphosis consist principally in increase in size and further development of the limbs. A tadpole two inches long and full-grown may be briefly described. Those who are familiar with figures of the axolotl will need little additional description. The body is catfish-shaped. A high membranous fin begins on the back just behind the head, and continues around the tail to the vent. Fore limbs with four fingers each, and hinder limbs with five toes each, are present. On each side of the head are three gills, of which the upper is the longest, and the lowest the shortest. The main stem of each gill bears on its lower edge a fringe of filaments in which the blood is brought into close contact with the water. The upper surfaces of the head and body are olive, mottled and speckled with black; the whole lower surface is white.

Reference has been made to the food of the tadpoles in their native haunts. Last season I obtained a large number of the young of *A. microstomum* and kept them for some time in a glass jar. Soon I found that their gills were disappearing, from which circumstance I concluded that they were transforming. Soon, however, it was also seen that some of them were also losing their legs; whereupon I began to watch proceedings a little more closely. One was seen to seize another by a leg, and a struggle followed for the possession of the member. It was plain that they were devouring one another alive. Not knowing what else to do I procured some slender angle-worms, and breaking them in pieces threw them into the water. Soon a tadpole approched a section of the worm and began to show interest in it. Presently with a sudden leap he seized the morsel and shook it violently, as if he expected resistance. By sudden snaps and gulps the worm was soon worked down the tadpole's throat. A tadpole would in this way swallow a piece of worm of nearly his own diameter and an inch or more in length. After this my specimens were abundantly supplied with this diet, the cannibalism ceased, and the larvæ increased rapidly in size. When they are not supplied with food they are able to endure hunger for a long period, but they do not grow. If one wishes to rear them in aquaria, one may easily strain out the Entomostraca of pond water, and thus furnish them with acceptable food. On the bottom of an aquarium in which a number of freshly-captured nearly-grown larvæ had been kept for a few days, were found numbers of the shells of a small species of *Planorbis* or related genus of mollusks.

Toward the last of May my specimens began to undergo their metamorphosis. The gills began to suffer absorption and the broad tail fin to disappear. They came oftener to the surface for air, and they spent a good deal of their time floating on the water. When the tadpole took in air, he would float horizontally. As the oxygen of the inhaled air was converted into carbonic acid, and this in its turn given off into the surrounding water, the little animal's body grew heavier and he began slowly to sink, the tail going down first. To counteract this a few feeble movements would be made, but still down he would go. At last by a strong effort the animal would bring his head to the surface, take in air, and then quickly regain the horizontal position.

At this time the young showed also a strong inclination to leave the water. They would crawl up on sticks and stones and remain there. When in a glass vessel they would sometimes be found climbing up the perpendicular side, two or three inches above the water.

The time of completing the change is about the first of June, although some specimens may have completed it sooner. As it progresses, the tail becomes more terete and the whole body slenderer and less bulky. The general color above becomes black, while here and there white specks appear; and the animals are soon small models of the full-grown adults.

When my specimens had transformed, about fifty of them were put into a box in which was a sod about a foot square. Into this they immediately disappeared, and burrowed through and through it. When it was allowed to become dry, they would be found under it, where a little moisture remained. When it was thoroughly wet, they would appear at the surface among the grass blades and roots. At length it was allowed to become thoroughly dry, and the salamanders perished. Doubtless, however, many of them had escaped by crawling up the sides of the box.

During the last spring many specimens of the small-mouthed salamander were taken about Irvington, Ind., and several of *A. punctatum*, which latter had not before been seen here. They were taken during March in ponds about which were pieces of fallen timber. On turning over a small log or a rail which lay partly in and partly out of the water, one or more salamanders could often be found. In such situations they could obtain suitable food, and at night go forth to deposit their eggs. A little later, in the first days of April, they had left these situations, and one could be found only occasionally and away from the water. Later, none of either species could be found anywhere. The summer seems thus to be spent away from the water, burrowing about in the earth. Specimens of *microstomum* kept in the aquarium appeared, as warm weather came on, to be driven by an intense desire to leave the water. Occasionally one would swim about as if frantic; and so many were found dead that they were at length transferred into a box partially filled with earth. In this they remained quiet, at least during the daytime. The Amblystomas seem to be able to endure a good deal of drought, if necessary. A gentleman informed me that he had seen a specimen of the tiger salamander crawling about in a cornfield on a hot day in midsummer. On the other hand, this species seems to be capable of living all summer in the water.

During the winter, no doubt, many of these Amblystomas hide away under sticks and stones, and in the earth away from the water. I believe, however, that most of them betake themselves to the vicinity of the ponds, and remain either close about their borders or in them. I have several times received examples of both *A. microstomum* and *A. tigrinum* that had been taken in January and the early part of February from under the ice of ponds where boys were skating. On one occasion some of these were put into a tank of water; and this having frozen, they remained under the ice two or three days without injury. Some of these same specimens, which species I do not know, laid eggs on January 15.

Early in April of the present year, about thirty specimens of the small-mouthed salamader and eight or ten of the spotted salamander were put into a dry-goods box partly filled with earth. In order to separate the two species, a piece of bagging was tacked across the box. The box stood at least fourteen inches, and the bagging a foot, above the dirt. Every now and then a spotted fellow would be found on the wrong side of the wall.

Fearful lest some of them might escape, wire netting was laid over the box in such a way that it was thought that none could get out. Toward the last of June the dirt was carefully examined, and all of both species but eight specimens were gone. This will illustrate their ability to climb. They rely especially on climbing up the corners. I have watched them climb up the corners of a zinc box six inches high. They brace themselves on each side by pressing their feet against the walls. The tail is also brought into service, but when this was loosened the animal did not fall.

Mention has been made of the food of the older larvæ. The adults of the three species mentioned in this paper feed greedily on earthworms. When a worm is brought near the snout of a salamander, the latter may quietly observe it awhile; or if the worm is crawling away, he may follow it for awhile. Soon, however, there is a sudden forward movement, the jaws open, the broad tongue is protruded; and if the aim has been faulty, the jaws come together with a snap. If the worm has been caught, it is shaken as a dog shakes a snake; the part secured is held fast for awhile; then another quick snap is made and a little more of the worm is taken in. In this way a worm several inches long may be swallowed. It is amusing to watch two large salamanders try to swallow the same worm, one at each end.

It is probable that earthworms furnish the bulk of the diet of the Amblystomas; but they are ready to eat almost anything of an animal nature. A year ago I put a tiger salamander, eight inches long, into a large case with glass sides, where I could watch him. It was occasionally convenient to put other things into the same receptacle; and among them was a full-grown tree-frog, *Hyla versicolor*. Up to this time the salamander had not, so far as I knew, eaten anything for months. A few months afterward the salamander was found holding the frog by the foot, which on examination proved to be somewhat injured. During the day the frog kept out of the way of his persecutor; but next morning it was missing, while the salamander lay in his box of sand blinking serenely, and showing a stomach that protruded like that of the proverbial alderman. A cricket-frog and a large caterpillar had previously disappeared somewhat mysteriously, and now their fate was explained. I have fed this specimen insects, fresh beef, and tadpoles. Once it swallowed a mass of three or four grape skins; but since he seemed to regard himself as no prodigal son in dire extremities, he refused to accept any more such favors. He swallowed with ease a half-grown wood-frog. A smaller frog had lain about and become dry and stiff. It was offered to the salamander, who began to swallow it but soon rejected it. A freshly-killed mouse was offered him and eagerly seized by the nose. He slowly swallowed it as far as the fore-legs. Then a lack of confidence in himself seemed to seize him, he grew uneasy, dragged the mouse about, and at length succeeded in getting it out of his mouth. The mouse's head was covered with a sticky fluid, the secretion, no doubt, of the numerous glands that fill the tongue of the salamander. Dr. Robert Wiedersheim states that he found a shrew in the stomach of a specimen of *A. tigrinum* that he dissected. One day my large salamander seized a good-sized spotted salamander by the tail, and only with difficulty was he made to release his hold. The amphibians appear to swallow one another without much regard either to relative size or to the ties of consanguinity.

Reptiles at all periods of life, and amphibians after they have lost their gills, have been generally supposed to be wholly air-breathers; unless the skin may take some part in aerating the blood. Recently, however, the Profs. Gage [*Amer. Nat.*, XX., 233] have shown that the soft-shelled turtle enjoys an aquatic pharyngeal respiration, the mouth being filled and emptied by movements of the hyoidean apparatus. More recently [*Science*, VII., 395] they inform us that the newt, *Diemyctylus viridescens*, while under the water, both draws in and expels this element by the mouth. In this process the walls of the mouth ánd pharynx serve as a place of exchange between the oxygen of the water and the gases of the blood. The same authors have observed water to be taken into the mouth-cavity of *Cryptobranchus alleghaniensis*, and expelled, partly at least, through the gill-slit. This pharyngeal respiration may be readily observed in the three species of Amblystoma under consideration. In all of them, by the dilation of the hyobranchial apparatus, streams of water are drawn in through the nostrils, and this water is then expelled at intervals by the mouth. By keeping the salamander in a glass vessel containing water that has in it fine floating particles, and using a lens, one may readily see all the phenomena mentioned. The animal will remain under the water several minutes, sometimes a quarter of an hour, breathing in this way. Then will occur motions indicating uneasiness; large bubbles of air may escape from the mouth, and the animal will come to the surface and take in fresh air. It may remain there for some time, or may again go to the bottom and stir about as if trying to conceal itself. The expulsion of the water through the mouth occurs in *microstomum* every eight to twelve seconds; in *tigrinum*, every five or six seconds; and in *punctatum*, every four or five seconds. It is probably due to this pharyngeal respiration that they are able to remain imprisoned for so long under the ice of ponds.

The Amblystomas shed the epidermal layer of the skin at frequent intervals. Whether this occurs oftener when they are in the water than in the earth, I do not know. The large specimen of *A. tigrinum* kept by me seemed to prefer to enter the water when about to exuviate. For some weeks during the past summer while he was confined to the water, he shed his skin about every week. The skin comes off in one almost untorn piece, and floats about in the water like a shadow of the original. It seems never to be swallowed, as it is said to be in the case of the newt.

The popular notion about these animals is that they are very poisonous. On the contrary they are perfectly harmless. Never but once have I succeeded in getting one of these animals even to attempt to bite. Once my large *tigrinum*, thinking that something was being offered him to eat, seized my little finger. His teeth could scarcely be felt. Even if they should penetrate the skin, there is no poison secreted that could enter the blood.

These animals are not averse to being handled. I have thought that the small-mouthed salamander likes to be rubbed along the back with the finger or a straw. When thus rubbed, I have seen it lift its tail high in the air and wave it to and fro in a ludicrous way.

All the tailed salamanders seem to dislike greatly to be turned over on their backs. They struggle violently to regain their normal position. While thus fastidious about being "right side up," some, at least, of the Amblystomas show extremely little intelligence in avoiding falls. They will crawl right off the hand or the table regardless of consequences. Very seldom have I seen my large *tigrinum* hesitate to walk off the surface on which he was resting. Even then had he been touched he would have rushed insanely over. Prof. Samuel Garman has observed that the tail of *A. punctatum* is somewhat prehensile, and is employed to prevent itself from falling. I have observed something of the same kind in this species, but not in the others. It may be permitted to notice here the highly developed prehensile power in the tail of *Diemyctylus.* Its rough flat tail is always ready to catch on objects, if need be. I have kept it hanging for a quarter of an hour on a slender penstock.

I have heard *A. microstomum* make a variety of sounds. One is a low piping sound uttered apparently just as the animal comes to the surface and emits air from its lungs. It may be heard at a distance of at least three or four feet. It may not be produced voluntarily. Sometimes the animal will poke its head out of the water and make a low clucking sound, accompanying it with a sudden movement of the throat. It also often produces a grating noise, as if by grinding its teeth together. It may be made to produce this noise by teasing it.

RECENT LITERATURE.

The Requisite and Qualifying Conditions of Artesian Wells.[1]—Chamberlin.—The central purpose of this paper is to call into prominence the varied qualifying conditions that solicit consideration, and, if possible, stimulate and aid those special discriminative studies which lead to an intelligent confidence of success or a prudent withholding from failure. The author thinks it advisable to map off the face of the country into areas of (1) favorable, (2) doubtful, and (3) adverse probabilities. The areas of probable success would be the relatively low tracts, the areas of adverse probabilities, the relatively high regions, and the doubtful belts would be in between.

Ward's Synopsis of the Flora of the Laramie Group.[2]—In this book the author gives a condensed account of the Laramie Group, together with a series of illustrations of fossil plants obtained from the lower series in Colorado and Wyoming, and from typical Fort Union strata in the valleys of the Lower Yellowstone and the Upper Missouri.

Of the latter there are 131 Dicotyledons, 3 Monocotyledons, 3 Coniferæ, and 2 Cryptogams. The synopsis is in the form of tables, which show at a glance the distribution of Laramie, Senonian and Eocene plants, and will therefore be of great service to a palæobotanist.

Scudder's Insect Larva, Mormolucoides Articulatus, from the Connecticut River Rocks.[3] The presence of these insect remains in the Triassic shales at Turner's Falls, Mass., was first made known by Prof. Edward Hitchcock, in 1858, and they were then considered the larvæ of a neuropterous insect. Since that time various opinions have been advanced as to the affinities of these fossils. Recently Mr. Scudder has reviewed the whole subject, carefully examining hundreds

[1] The Requisite and Qualifying Conditions of Artesian Wells, by Thomas C. Chamberlin. Extract from the Fifth Annual Report U. S. Geol. Survey. 1885.

[2] Synopsis of the Flora of the Laramie Group, by Lester F. Ward. Extract from the Sixth Annual Report of U. S. Geol. Survey.

[3] The Oldest Known Insect-Larva, *Mormolucoides articulatus*, from the Connecticut River Rocks. Extract from the Memoirs of Boston Society of Natural History, Vol. III., No. 13.

of specimens, and he gives as a result that "we may look upon the Sialidæ as the group of insects to which Mormolucoides is most nearly allied." Sixteen specimens are figured to show the characteristic differentiation of the segments.

RECENT BOOKS AND PAMPHLETS.

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General Notes.

GEOGRAPHY AND TRAVEL.

Africa.—The Ports of German East Africa.—The coast of German East Africa has few good ports; the Bay of Mikindani is without shelter against the wind and ocean waves; that of Lindi is but the mouth of a river, rendered difficult by a dangerous bar; and those of Kisvara and Kilva-Kivindje are so shallow that ships cannot approach within two miles of the coast. The best port is Dares-Salam. Though the entrance is narrow, and full of reefs, there is at least sufficient depth and full shelter. Baganwyo owes its importance entirely to its proximity to Zanzibar, as the harbor is shallow, as is also that of Saadani. Pangani has a bar, and owes its prominence to the caravans that leave it.

The Boundaries of the Congo Free-State.—The boundaries of the Congo Free-State, as finally determined by the Berlin Conference, and by special agreements with France, are as follows:

(1). On the south. From the mouth of the river which falls into the ocean to the south of Kabinda Bay to the confluence of the Culacalla with the Luculla; then along the meridian of this point until the Luculla is again met with, and along the Luculla to its confluence with the Chiloanga. Along the latter river to its most northern source. From this point eastward an irregular line as far as Stanley-Pool; so arranged that the disputed villages and markets are parted between France and the Free State. The boundary then follows the centre line of Stanley-Pool and of the Congo as far as the confluence of that river with the Ubangi; then up the latter to 4° north latitude, and along this parallel to 30° east longitude.

(2). On the east. The meridian of 30° to 1° 20′ south latitude; then a straight line to the north end of Lake Tanganyika, along the centre of this lake; then a straight line to Lake Moero, in 8° 30′ south latitude; along the centre of Lake Moero, and along the line of the river to Lake Bangweolo.

(3). On the south. A line from the southern end of Lake Bangweolo to 24° east latitude, following the water-shed between the Congo and Zambezi. Along the water-shed of the Kasai, from 12° to 6° south latitude; along the latter parallel till the Quango is reached, and along that river until the parallel of Nokki. This parallel is followed until it crosses the meridian of the mouth of the Wango-Wango; then along the Congo from the confluence of the Wango-Wango to the ocean. The western or ocean frontage of the Free State is thus exceedingly short, reaching only from the mouth of the Congo to the south of Kabinda Bay. By royal decree the Free State was, on the first of August, 1888, divided into eleven districts, viz., Banana, Boma, Matadi, Cataracts, Stanley-Pool, Kasai, Equator, Ubangi and Welle, Arawimi and Welle, Stanley-Falls, and Lualaba.

Asia.—Another Russian Journey in Central Asia.—Another Russian traveler, M. Groubtchevsky, has been recently traveling in Central Asia. On his first journey he crossed the Pamir to the valley of the Aksu. At the junction of this river with the Istyk he was arrested by Chinese agents. Having got rid of these by presents, he followed up the Aksu and the Wakhan-daria, but soon met with a detachment of Afghan troops, sent on purpose to arrest Russians. These troops followed him, and camped near him; but in the night he assaulted them, took them prisoners, and made them conduct him to a pass in the mountains. Returning by another route, he traversed the Mustagh glaciers, and followed the course of the Yarkand-daria. Meeting an insurmountable obstacle, he was obliged to return, and direct his march to the north, passing by the peak of Tagharma. Here the food and strength of the Russians were exhausted, and a messenger was sent to Kashgar for supplies. The last news from the traveler announces his safe arrival in Ferghana.

Nepal.—Emil Schlagintweit informs us that the population of Nepal is about two millions. In the east the Tibetan race extends to the valley of Kosi; in the west the Hindu, somewhat mixed, extends to that of Gandach; and between them are located other peoples, coming from Central Asia. Among these tribes are the Leptcha, who are short, and have flat foreheads, pointed chins, and very long arms; the Limbu, who occupy the spurs of the Himalayas, and are neither Buddhists nor Brahmins; and the Hayu, who inhabit marshy spots at the foot of the mountains, and are even less civilized than the Limbu. The dominant people of Nepal is the Gurkha, who are Brahminists.

The Upper Yenesei.—M. Yatchevsky, one of the companions of Colonel Bobyr, notices the distribution of the glaciers in the mountains that separate Siberia from Mongolia. The limit of perpetual snow in this region is about 2,400 metres on the north, and 3,000 on the south side, but there are few glaciers properly so-called. That of Munho-Sardigh is like an Alpine glacier, but most of the others seem to be disappearing from the dryness of the climate. The region Sayan, watered by the sources of the Yenesei and its affluents, has no trace of a plateau, but is an Alpine country, a mountainous crest, with two rapid slopes.

E. Dulio's Journey from Shoa to Assab.—"Notes of a Journey from Shoa to Assab," by Emilio Dulio (*Cosmos*, Vol. IX., 1888), contains much valuable information upon the habits of the Abyssinians. While King Menelik was absent during his campaign against Harar, the news that he was dead was spread among the Mussulman population, whereupon the Azag Volde Tadik, Governor of the country during the King's absence, having heard of the conquest of Harar and the King's safety, imposed upon every Mussulman the payment of a heavy *tascar,—i.e.*, of funeral expenses for the King they had believed dead. The region of Bahadu Afar is still independent of Shoa. Some of the Afar women are of a most splendid type, while many of the men are, on the contrary, of feminine appearance. The men wear a long sash twisted two or three times round the body, and secured at the waist with the poignard; the women have a single piece of cotton from waist to ankle, secured upon the flank in a loose fashion, so that it often comes undone; in which case the girl takes it entirely off with a graceful and tempting smile, and readjusts it in the presence of male spectators. Married women wear for their principal adornment two anklets so heavy as to render their gait ungraceful. These anklets are the gift of the spouse, are secured by hammering on the occasion of marriage, and are not taken off unless the husband dies first.

South of Shoa the party traversed the plain of Cussurtu, visited the hot springs of Tiho, the mountain Aulia-hali, and the valleys of Galatu and Erole. Then descending into the valley of the Hawash, they came to the smaller branch of the river, and found it dry save here and there a stagnant puddle. Crossing the Hawash, the party reached Gambo-corria, a residence of the Sultan of Aussa. Sr. Dulio believes that the main Hawash can be made a means of communication with Shoa.

The Loess of Central Asia.—According to M. A. Krassnow, the Loess of the Thian-Chan is caused by the action of the rains upon the glacial mud, modified by the dryness of the atmosphere. M. Krassnow has discovered glaciers upon the upper courses of the rivers Zir-tass and Quelu. In the glacial period the glaciers of this region must have been almost equal to those of Europe, as the ice reached to

Lake Issyk-Kul, and covered the chains between it and China. The quality of the ice is different from that of the Alps, and the glacial flora is better preserved than in the latter. On the north-west slopes the plants are the same as those of Europe at similar heights, but upon the south-east slopes the steppe flora rises to 3,000 metres.

Europe.—The Abruzzi.—The part of Italy known as Abruzzo contains about 530 square leagues, and nearly a million inhabitants. It extends along the Adriatic for a length of 200 kilometres, from the river Tronto to the Trigno, is formed by the central group of the Apennines, and contains the highest peaks of that chain. Between the Tronto and the Gizio these mountains form a double line, separated by a series of the most picturesque valleys. The eastern crest is cut through by the Pescara, and is dominated by Il Gran Sasso d'Italia (2,916 metres), the highest mountain in peninsular Italy. Abruzzo is divided into three provinces, now named after their capitals, Christi, Teranco, and Aquila, but properly known as Abruzzo Citeriore, Abruzzo Ulteriore, and Abruzzo Ulteriore II. Among the high peaks of this region are those of Corvo (2626 m.), Malacosta (2,447 m.), Franco (2,135 m.), Scindarella (2,237 m.), Paganica (2,097 m.), Prena (2,566 m.), and Brancatello (2,387 m.). All these crests and peaks, with other lower ones, form an immense group, over which towers Il Gran Sasso.

The Population of Russia.—According to the "Annuaire Statistiquè Russe" for 1885, the present population of the Russian Empire is as follows:

Russia in Europe,	81,725,185
Government of the Vistula (Poland),	7,960,304
Caucasus,	7,284,547
Siberia,	4,313,680
Central Asia,	5,327,098
Grand Duchy of Finland,	2,176,421
Total,	108,787,235

This total comprises 54,063,353 males, and 53,883,042 females, besides 835,840 individuals (in Central Asia) whose sex is not stated. Leaving out Central Asia, the proportion of male to female births is as 106.3 to 100. The excess of births over deaths in Russia in Europe is 13.3 per 1,000 inhabitants; in Poland, 12.7 per 1,000.

The Soil of France.—Recent statistics relative to the present condition of the soil of France are not encouraging. Out of the fifty millions of hectares of cultivable surface, some four and a half millions, comprising the landes, marshes, heath, etc., are absolutely without culture; more than three and a half millions fallow; four millions are covered with natural, unirrigated pasture in plains, hillsides, etc.; and more than half the forests, comprising nearly five millions of hectares, are without roads, uncared for, and unexplored,—abandoned entirely to nature. Thus more than one-third of the cultivable area of France is practically uncultivated. More than this, the agricultural population, which in 1861 was 19,873,493, had in 1881 decreased to 18,249,209, and the rate of decrease seems to have accelerated since that date.

Geographical Notes.—Two German travelers, Dr. Humann and Professor Haufmann, have taken an archæological journey into the centre of Asia Minor, and have operated in the neighborhood of Aidin, on the site of the Acropolis of Thralles, one of the most renowned centres of antiquity.

Captain J. Jacobsen, already known for his travels in British Columbia, Alaska and Siberia, has, since the end of September, 1887, been exploring the East Indian Archipelago with his friend Kuhne, in the service of the ethnographical museum of Berlin. He has visited Flores, Wetter, Kiffer (a small populous island where the people call themselves Christians, and go regularly to church, and yet worship wooden images), Letti, Moa, Luang, and Babar. Herr Kuhne then explored Ceram, Goram, and Burru, and Captain Jacobsen, Timulant, Timoe, and other islands. The result was a considerable collection of ethnographical material.

Since the death of the illustrious general Prejevalsky, the Russian expedition has been under the direction of Colonel Pievtzov, already known from his geographical researches in Mongolia. A mining engineer, M. Bogdanovitch, accompanied him.

Colonel Bolcheff has published the most complete map of the Pamir that has yet been made. The names are in French, and the French Government has given an academical prize to its author.

The leveling of the southern part of the Siberian coast between Vladivostok and Ussuri has shown that there are no obstacles to the construction of a railroad. Moreover, the engineers have found that the flat and marshy lands to the south of Lake Hanka are of great fertility. Numerous colonists have already established themselves there.

The Chinese have recently sent a scientific expedition into Russia as a sort of response to the numerous expeditions which have visited China of recent years. The chief of the expedition is Miao, a high functionary in the finance department, and the secretary is a savant named Joney, who speaks Russian well. The visitors have been well received, especially at Irkutsk.

Among the very few lakes of South America is that of Tacarigua in northern Venezuela. This was visited by Humboldt, and was then 56 kilometres in length. In 1887 M. Hesse-Wartegg visited it and found that its length was diminished to 49 kilometres. The coasts resemble those of the Lake of Geneva, and its twenty-two islands recall those of lake Pazcuaro in Mexico.

The Pamues, a tribe living upon the lower part of the river Muni, have lately become threatening in their attitude toward the Europeans of the district belonging to Spain, between the Cameroons and the French colony on the Gaboon. As the Spaniards had no available force at hand, the French, who lay claim to part of that coast, had to be called in to protect life and property.

GEOLOGY AND PALÆONTOLOGY.

Contributions to the Knowledge of the Genus Pachyphyllum.—Up to 1870 the genus Pachyphyllum was not supposed by geologists to be represented in any of the American strata. But in 1870, Dr. White described a new species of coral from the Rockford shales, at Rockford and Hackberry, Iowa, as *Smithia woodmani* (Geol. Rep. Iowa, 1870, Vol. II., p. 188). This species was, however, afterwards shown to belong to the genus *Pachyphyllum*,[1] instead of the genus *Smithia*, to which it was at first referred. Again, in 1873, another new species of coral from the same beds was described by Hall and Whitfield,[2] as *Pachyphyllum solitarium*, intimating at the same time, however, that the specimen so referred differed from the generic description of *Pachyphyllum* in its being *solitary*. Since that time we have secured very large numbers of finely preserved specimens of this species, together with one new form from the same beds, as well as a

[1] 23d Ann. Rep. Board of Regents of New York State Cabinet, p. 231.

[2] 23d Ann. Rep. Board of Regents of New York State Cabinet, p. 232.

closely allied new species from the blue shales below the Devonian limestone at Independence, Iowa. A critical study of all these forms showed them to be generically distinct from Pachyphyllum, and to constitute a new and well-marked genus. We have also personally collected from these shales three new specimens of Pachyphyllum, all of which are described in this paper, thus making four species of this genus known to occur in American strata.

The occurrence of the American representative of this genus only in the Rockford shales of Iowa[3] (so far as known) is a fact worthy of note. This fact, together with many others now in our possession, tends to widen the breach between its supposed equivalents, the Chemung group of Hall and Whitfield,[4] and the Hamilton group of Dr. White.[5]

Pachyphyllum woodmani White,—Compare with description of Hall and Whitfield; (23 Ann. Rep. New York State Cabinet, p. 231.) Coral variable; growing in irregular, flat, convex, hemispheric, oblong or semi-circular masses, from single beds three to four mm. in height to corallums twenty-five and one-half centimetres in diameter. Cell walls, more or less strongly exsert, projecting from less than one mm. to more than eleven mm. above the intervening spaces; from three mm. to one centimeter in diameter (the latter dimension, however, is very unusual). Very often situated at one extremity of the area, and rising perpendicular or obliquely to, or even lying flat upon, the surface of the inner cellular space; wall thin or of moderate strength; central depressions very irregular, circular, oblong or ovate in outline, from one and one-half to five mm. in depth. Rays numbering from twenty-five to forty-one, about half of which extend to the elevation or columella in the centre, while the remainder terminate just within the inner wall. Entire cell from three mm. to about two centimetres in diameter, partially limited by a wall formed by the coalescing of the costæ from the adjoining cells. Intercostal and interseptal spaces divided by numerous thin partitions. Usually the great size to which the exsert portion of the cells sometimes attains is at the expense of vertical height; and likewise when a great height is attained, it is at heavy cost to diametrical proportions. In isolated cases the under surface and margin of the corallum exhibit small patches of epithecal crust; and in still more isolated examples, where the exsert portion of

[3] 23d Reg. Rep. New York State Cabinet, p. 236.

[4] Geol. of Iowa, 1870, Vol. I., p. 137.

[5] In some cases this genus is known to be represented in the Devonian limestone which immediately underlies these beds and, in one instance, adjacent to it.

the cell attains the greatest height, they are often annulated at the base and centre by epithecal rings; and budding often takes place slightly below the margin of the cell.

The usual method of growth of this species is by lateral budding almost from the beginning, but sometimes a single cell attains a height of from seven to twelve mm. before new cells are formed. This species, as well as all other species of this genus known to me, are, or were originally (with one known exception) attached to the surface of some shell or other species of corals. The delineation of this species is here based upon over two hundred finely preserved specimens. Its range is, so far as known to me, confined exclusively to the Rockford shales, except in some cases where it occurs in the limestone which immediately underlies them.

Pachyphyllum crassicostatum n. sp.—Coral, very coarse, growing in irregular, convex or slightly branching masses, from one and one-half to eleven centimetres in diameter; central depressions circular, from two to seven mm. in depth; wall very thick and strong. Entire cell from one and one-fifth to about two and one-fifth centimetres in diameter, usually limited by a wall formed by the uniting of the costæ of the adjoining cells; and again, this feature is not always well shown, owing to the great irregularity in growth of some specimens. Rays numbering from thirty-one to sixty, often only half of which extend to the elevated perpendicularly perforate columella in the centre, while the rest run out just within the inner wall. In large specimens the bottom of the cell is sometimes occupied by a well-defined, circular depression, instead of a columella. Rays and costæ continuous, passing down the outside of the cell wall and over the intercellular spaces. Intercostal and interseptal spaces divided by numerous thin, straight or convex transverse partitions.

The usual method of growth of this species is peculiar. Generally a large and very coarse curved cell will attain to the height (following the curvature of the specimen) of five and one-half centimetres or more before budding begins, which then takes place slightly below the margin of the cell, or some distance below. This description is from specimens from Owens' Grove, Cerro Gordo county, and Floyd, Floyd county, Iowa. Specimens of a variety of this species occur at Rockford and Hackberry; and differing from those from Owens' Grove and Floyd in the method of growth (which is generally by budding from the first) in that the coralla do not attain to so great a size, and the bottom of the cells never being occupied by a depression, as well as the (sometimes) slightly less coarse character of the specimens. This species is known to occur only in the Rockford shales at Owens' Grove, Hackberry and Rockford, Iowa.[6] Although this species is not uncommon at the former locality, yet less than a dozen specimens have been secured from the two latter places during the thirteen successive years that we have collected from these shales. This is a fine species, and cannot well be confounded with any other described in this country.

Pachyphyllum ordinatum n. sp.—Coral compound, growing in regular convex, hemispherical masses, ten centimetres in diameter; point of attachment small. Cell walls abruptly but usually slightly exsert; generally projecting only one and one-half mm. above the intervening spaces; central depressions circular, very regular, three mm. in diameter (rarely a few small young cells are present); entire cells, quite uniform in size and of moderate dimensions, partially limited by a wall formed by the uniting of the costæ from the adjoining cells. Number of rays, from twenty-seven to thirty-two, most of which extend to the slightly elevated centre. Rays and costæ continuous, passing down the outside of the cell wall and over the intercellular spaces. Rays and costæ in well-preserved specimens, slender; but in weathered specimens, strong and broadly rounded or angular. The surface of each cell of this species is slightly concave; sometimes the exsert portion of the cell (which always occupies the centre of the entire cell) is sunk below the outer wall of the cell. This species varies much from *P. woodmani* in its general aspect, the concave surface and greater regularity of the cells, as well as in several other important particulars. Position and locality: Rockford shales, Hackberry, Iowa.

Pachyphyllum crassum n. sp.—Coral usually growing in concave or convex hemispherical masses, from two centimetres to eight centimetres in diameter. Cells usually large, walls strongly exsert, often projecting four mm. above the intervening spaces; central depressions quite regular, from three to five mm. in depth; entire cell from two centimetres in length to one and one-third centimetres in width; when this size is attained, however, it is at the expense of the adjoining cells. At times the large exsert portions of the cells are so crowded together that their bases unite; as many as seven of these projections or elevated portions of the cells have been observed in an area two and one-half centimetres square. Rays numbering from twenty-six to forty-

[6] Since writing the above, a fine specimen has been secured by Mr. Guy Webster from the Devonian limestone which underlies the Rockford shales, one and one-half miles south of Rockford Grove, Floyd county: also numerous specimens have been secured by us from the same limestone at Floyd.

two, all of which appear to extend to the flattened or very slightly elevated centre. Rays and costæ continuous, passing down the outside of the cell wall and over the intercellular spaces. Rays and costæ down to the base of the cell walls alternating in size. The entire under surface of the corallum, except the point of attachment, covered by a strong, wrinkled, epithecal crust. This is a finely marked species, and differs in many important respects from its associate, *P. woodmani.* This species occurs in the Rockford shales, at both Rockford and Hackberry, Iowa.—*Clement L. Webster, Charles City, Iowa.*

On a Species of Plioplarchus from Oregon.—The genus Plioplarchus Cope was established[1] to receive two species of percid fishes, discovered by Dr. C. A. White in a stratum overlying the Laramie formation in Dakota. The writer has called attention to the existence of fishes in the shales near Van Horn's ranch, on the John Day River, Oregon,[2] and has suggested that these shales belong to the Amyzon beds. According to Condon, their position is below the John Day Miocene. Dr. Charles Bendire, U.S.A., obtained, among the collections from that region with which he has enriched science, some specimens of these fishes in a condition sufficiently good for identification. They include four individuals which belong to a single species of the genus Plioplarchus. They elucidate the characters of the genus as follows:

The vomer, premaxillary, and dentary bones carry teeth of small size in moderate numbers. An elevated supraoccipital crest. The lateral line is present, and the scales are feebly cetenoid. The ventral fins are sustained by a spine in front; the number of the rays cannot be made out. The character of the borders of the operculum and preoperculum cannot be determined, but no serrate edges are presented in any of the specimens. Tail furcate.

The specific characters are as follows: the mouth is small, and opens obliquely upwards. Premaxillary and dentary teeth in several rows. Size larger than that of the *P. whitei* Cope, and the scales are less numerous, and of larger size. The spinous rays are less numerous than in that species and the *P. sexspinosus.* Formula; D. xi.–?; A. vii–? 12; the soft anal rays at least twelve, possibly more. Scales in five or six rows above the vertebral column, and in ten or twelve below it. Radiating ridges of proximal portion, strong; disc and distal portion scarcely roughened. Caudal vertebræ, 15.

[1] *Amer. Journal Sci. Arts*, 1882; Tertiary Vertebrata, Cope (Vol. III. Report U. S. Geol. Surv. Terrs.) 1885, p. 727.

[2] Proceeds. Amer. Philos. Soc. 1880, p. 62.

The specimens are all too much injured to permit of complete measurements. The largest measures from the end of the muzzle to the base of the caudal fin 260 mm., and 90 mm. in depth at the vertical fins. The last dorsal spine measures 36 mm. A lateral dorsal scale is six mm. in length.

I propose that this species be called *Plioplarchus septemspinosus*.

The general agreement of this species with the two previously known species of the genus renders it highly improbable that they are widely removed from each other in geological age. Prof. Lesquereux has placed the shales at Van Horn's ranch in the upper Miocene, from the evidence of the numerous plant remains which occur there. As the shales are, according to Condon, below the John Day beds of the middle Miocene, they cannot be upper Miocene of the vertebrate scale. Plioplarchus has not been found in the Amyzon beds, and the plants of that horizon are, according to Lesquereux, different from those from Van Horn's ranch. The shale may then represent a horizon later than the Amyzon beds, but earlier than those of the John Day. In spite of the evidence of the plants, they may be even older than the Amyzon beds, since the bed of the Dakota *Plioplarchus whitei* is not distinguishable stratigraphically from the Laramie at its summit, according to Dr. White, a statement which I can confirm by personal observation.—E. D. COPE.

On a New Genus of Triassic Dinosauria.—In this journal for April, 1887, I described two species of Goniopodous Dinosauria, under the names of *Cœlurus longicollis* and *C. bauri*, from the Triassic formation of New Mexico. I subsequently discovered that they could not be referred to the genus Cœlurus, and placed them provisionally (Proceeds. Amer. Philos. Society, 1887, p. 221) in the Tanystrophæus of Von Meyer. I have recently learned that the reputed vertebræ of the latter genus possesses no complete neural canal, so that the position in the skeleton of these elements, on which the genus was founded, becomes problematical. It becomes evident that the Triassic species in question must be referred to a genus distinct from any hitherto known, differing from Cœlurus in the biconcave cervical vertebræ, and from Megadactylus in the simple femoral condyles, as well as in other points. I propose that it be called Cœlophysis, and the three species, *C. longicollis*, *C. bauri*, and *C. willistoni* respectively.—E. D. COPE.

The Ophitic Band of Andalucia.—M. Salvador Calderon contributes a study of the epigenic region of Andalucia and of the origin of its ophites to a recent issue of the *Bulletin* of the Geological

Society of France. An ophitic band extends in a W. N. W. to E. S. E. direction from the coast of the Province of Cadiz to the Sierra de Moron; here it bends to the east until it reaches Antiquera, where it again bends northwards, until it dies out in the Province of Jaen. The direction of the band is influenced by that of the cordillera, and its width in general diminishes as it recedes from the coast. Whoever traverses this region is struck by the difference between its orography and vegetation and those of the rest of Andalucia. This ophitic band is not confined to one geological stratum, but traverses Liassic, Neocomian, and lower Tertiary beds, so that the metamorphism has been effected by a similar series of causes acting upon different materials, and therefore producing different results. Throughout the band innumerable points of crystalline rocks exist, and have been designated ophites by Mr. Macpherson, who compares them with similar rocks in the Pyrenees. These ophites occur in masses of no great size and of circular form, and often in rounded hills, covered from the base to summit with many-sided fragments of the same rock. More than four hundred of these ophitic points are known at various levels, and many others must be hidden. Two theories have already been put forth with regard to the origin of ophitic rocks: that of a magma coming from the interior of the globe, and that of chemical deposition, without heat, in the depths of seas, where the débris of primordial rocks have accumulated. This latter theory is sustained by MM. Verlet d'Aoust and Dieulafait.

M. Calderon adds a third theory, which he believes to be the only one that will explain the phenomena to be found in Andalucia and in the Pyrenees. He maintains that ophites are the products of a vast metamorphism produced by orogenic movements upon argillaceous rocks impregnated with divers chemical elements. The relations which always exist between these ophites and the movements which have taken place in the formations in which they lie have long been known to geologists, but, taking the effect for the cause, they have believed that the ejaculation of igneous matter from the interior of the earth has been the cause of the movement of the strata, and also of the chemical transformations. For the region treated of no trace of those phenomena of contact which show the influence of matter in fusion, and no trace of vents of eruption, have been found. The ophitic rock has not penetrated the beds, and usually lies at the bottom of the folds. The clayey and marly beds, permeated with other minerals and with water, have brought together into the cul-de-sac formed by their folds all the conditions necessary for a chemical change, and denudation has in many cases afterwards brought them to the surface. M. Calderon concludes with these words: "I do not think that it will be too bold to conclude, as a general law, that *when a saliferous formation, rich in marls and clays, magnesia and gypsum, is exposed to tangential force, it must produce the epigenic phenomena known as ophitic, and give birth to true massive crystallized rocks in its anticlinals.*

Vertebrata of the Swift Current River.—No. III.—My second contribution to the knowledge of the fauna of the White River Miocene, as exhibited at the above locality, appeared in the NATURALIST of the present year, p. 151. The researches of Mr. T. C. Weston during the past season, under the direction of Dr. Selwyn, Chief of the Survey, have added a number of interesting points to our knowledge of the fauna, and the following new species:

Menodus selwynianus sp. nov.—Represented by a nasal process, which consists of the coössified nasal bones, of peculiar form. They are elongate as compared with their width, and are vaulted. The lateral borders are nearly parallel, and the extremity viewed from above is rounded. Owing to the thickness of the body, the profile descends abruptly at the extremity, and the convex surface is roughened as though for the attachment of some fixed body, tegumentary or muscular. From this tuberosity the surface descends steeply to a thin border. A short distance posterior to the extremity the lateral margins are decurved, forming the lateral walls of a deep longitudinal median gutter-like nasal meatus, which is deeper than in any other species. The horns are broken off, but the median inferior surface is so little recurved laterally, that it is evident that the former were not only small, but laterally placed. Length of fragment above, mm. 130; length of nasal border, 70; width at nasal notch, 80; do. near extremity, 65; depth at apical tuberosity, 26.

This species is dedicated to Dr. A. R. C. Selwyn, the accomplished director of the Survey of Canada.

Menodus syceras sp. nov.—This species belongs to the group with muzzle and horns of moderate length—the central group of Scott and Osborn. It differs from the two species of that group now known, the *M. proutii* Leidy, and the *M. tichoceras* S. and O., in the very close approximation of the basis of the horns, and the presence of a strong angle or ridge connecting them, so that the nasal bones are in a different plane from that of the front. The entire width of the skull at the basis of the horns is not greater than the length of each horn above the nasal notch. The horns are not long, and the section of their base is a longitudinal oval, flattened on the external side.

Summit subround. The nasal bones are flat, with broadly rounded extremity, and are much wider than long.

The width of the nasals at the base of the horns is 116 mm.; length of do. from do., 70; diameters of bases of horns; anteroposterior, 94; transverse, 67; length of horn from nasal notch, 160; width of muzzle at bases of horns inclusive, 160.

The nasal bones of three individuals present the characters above given. The close approximation of the bases of the horns does not exist in any other species known to me.

Elotherium coarctatum sp. nov.—Represented by a left mandibular ramus with condyle, which supports all of the molar teeth. The species differs from the *E. mortonii*, with which it agrees nearly in size, in having all the premolars in a series uninterrupted by diastemata, except a very short one between pm. iii. and iv. The second premolar is the most elevated, and the third and fourth are abruptly smaller. The fourth has one compressed grooved root. The molars are peculiar in having the two anterior cusps elevated above the three posterior ones, as in Mioclænus sp. The posterior, or fifth tubercle, is well developed, especially on the m. iii.

Length from condyle to edge of canine alveolus, 295 mm.; do. to last molar, 125; do. of true molar series, 67; do. of m. i., 22; width of do., 13; elevation of p. m. ii., 21; length of base of crown do., 28; depth of ramus at m. i., 55.—E. D. Cope.

Geological News.—General.—A geological map of the northern part of Tunis was recently presented by M. Rolland to the French Geological Society. According to a small transcript of the above in the Bulletin, by far the greater part of this region is Pleistocene or Pliocene; but there is a mass of Eocene between Bizerte and Cape Farina, and two others east of the Gulf of Tunis, besides a much larger mass west of Bizerte. Considerable areas of upper Cretaceous also exist west and southwest of Bizerte. On the edge of the Gulf of Tunis the Djebel Bou Kournine rises to a height of 689 metres, and is the first of a series of mountain masses which follow each other toward the south and southwest for 75 kilometres, and which culminate in the Djebel Zaghouan (1340 m.) These mountains are of coralligenous marble, compact, full of debris of encrinites, etc., but as a rule are without determinable fossils. A marly stratum upon which they rest has débris of belemnites. Some remains of ammonites that have been found in the marbles seem to prove that the latter are of Jurassic age.

M. Stuart Menteath has recently made before the French Geological

Society respecting the action of soft strata that have either naturally or artificially been deprived of their original support, some observations that seem to have an important bearing. The great open quarry of the Rio Tinto mines (near Huelva, Spain) is 400 m. long, 200 m. wide, and nearly 100 m. deep. On the southern side there is a mass of clayey schists deprived of support, and having normally a dip to the north. These schists are now taking on, at least near their surface, a dip to the south, and this dip extends at least five metres deep. At the bottom is a mass of solid ore, against which the lower beds of the schists are reduced to powder which is easily washed away by rains, and is expelled by the pressure of the upper layers. This removal causes the settling and gradual overthrow of the upper beds. Not many kilometres distant a similar phenomenon occurs, but here the agent is a torrent which has gradually scooped out a ravine. That which at Rio Tinto has taken place so rapidly that its progress can be noted from month to month, may easily have occurred more slowly in numerous places where the removal of material has been slow; and M. Menteath asks whether it has not often been the case that geologists have estimated the dip of the strata from this comparatively recent, yet in many cases extensive, reversing of the normal dip.

M. W. Kilian recently presented before the French Geological Society a geological description of the Montagne de Lure in the department of Basses Alpes. This work of 458 pages and 11 plates treats of the physical constitution of this mass; of its strata, which commence with the Trias and end with the Tertiary; of the dislocations which have given the chain its present relief; and of its palæontology, with a description of some interesting species found in it.

The new map of the geology of the environs of Paris, on a scale of 1-20,000, is the most complete yet made. The gypsose period is subdivided, and the Pleistocene deposits are carefully shown. Soundings taken in the bed of the Seine have proved that under the river exists a stratum of gravel 10 to 15 metres thick. The highest gravels of the terraces are at Lagny, 19 metres above the Marne, and at Poissy, 27 metres above the Seine. The surface of the chalk is not as much cut up by ravines as was supposed, but has uniform slopes consisting of two synclinal axes and an east and west anticlinal.

Carboniferous.—The Bulletin of the French Geological Society (Nov., 1888, to Jan., 1889) has a note by H. E. Sauvage upon the Palæoniscidæ of the Commentry coal-beds. These beds belong to the upper part of the coal measures. Some 400 specimens of fishes, most of them in an excellent state of preservation, have been furnished by these beds, and two species have previously been described by Brougniart and by Egerton. M. Sauvage mentions *Amblypterus fayoli, euryi, commentryi, renaulti, elaveris; Commentrya traquairi and C. brongniarti, Elaveria fayoli and E. gaudryi,* and *Comospoma typica,* and gives the leading characters and a side view of the head of each.

Mesozoic.—Numerous species of Jurassic polyzoa, found at Boulogne-sur-Mer, are described by M. H. E. Sauvage in the Bulletin de la Societe Geologique de France, 1889. Five of the species are new.

H. Larrazet describes some fragments of a Steneosaurus found at Parmilieu (Isère, France), in the compact lime-stones of the upper part of the Bathonian stage which furnishes Lyons with free-stone. These fragments present some peculiarities, but the material is not sufficient to warrant the foundation of a new species (Bull. de la Soc. Geol., 1889).

M. P. de Loriol has recently described two species of echini, one from the Senonian of Algiers, the other from the Cretaceous of Turkestan. The latter is made the type of a new genus.

M. Bertrand (Bull. Soc. Geol. France) contributes an interesting note relative to the horizontal folds or *plis couchés* of the region of Draguignan. Some of these folds are so acute that a portion of an older formation is completely enclosed by newer beds.

M. Jules Welsch notes the presence of Gault and Senonian beds in the high plateaux of Oran (Algeria), and remarks that the maximum invasion of the Cretaceous sea over the more ancient strata took place at the lower Senonian epoch.

The Cretaceous strata of a portion of Algeria, with the fossils contained in the different stages, are the subject of a long communication recently made to the French Geological Society. Albian (Gault), Cenomanian, and Senonian horizons are identified, and the Gault and Cenomanian are stated to be unconformable.

Coraster vilanovæ, a small echinid previously believed to belong to the Eocene, has recently been proved to be a Cretaceous species, and has been found in the Pyrenees at Alicante, and also at Tersakhan, near Askhabad (Turkestan).

The geological constitution of the environs de Puy (Haute Dome) from the Eocene to the Quaternary, forms the subject of a note presented on January 21, 1889, to the French Geological Society by M.

M. Boule. The considerable number of fossils favors identification of the beds. The author observes that the region is traversed by faults, a fact seemingly hitherto unperceived by geologists.

M. G. Cotteau, continuing his researches among the Eocene echini of France, has discovered many new species, and described several others which previously had been mentioned but not described. Most of the forms seem to have been local; those of the north of France and of the Paris basin are not the same as those of the southwest, and those of the Pyrenees and of the Mediterranean regions are again different.

M. Landesque (Bull. de la Soc. Geol., 1889), describes and illustrates the Tertiary strata of the Agenais and of Perigord (France). These strata, commencing with the upper Eocene, rest unconformably upon the Cretaceous, and their classification is by no means satisfactorily made out. The lowest bed is a more or less homogeneous mass of sand, colored by oxide of iron, and above this commence alternations of beds of sand and of calcareous clay, in the latter of which have been found six species of Palæotheria, two of Paloplotherium, *Pterodon dasyuroïdes*, an Hyænodon, *Xiphodon gracile*, and some crocodiles and chelonians. According to our author the white limestone of Perigord belongs only partially to the Eocene system, the two upper of the three beds of which it is composed belonging to the Miocene. The quadrupeds of the Miocene beds are much more numerous than those of the Eocene, and comprise species of Mustela, Hyænodon, Cynodon, Amphicyon, Lutra, *Cervus lamilloquensis* (nov. sp.), Palæochœrus, *Anthracotherium lamilloquense* (nov. sp.), Cainotherium, Amphitragulus, *Rhinoceros lamilloquensis* (nov. sp.), Theridomys, Arctomys, Erinaceus, Talpa, etc. There are also many undetermined crocodilians, some chelonians, and numerous *débris* of fishes, birds, batrachians, and snakes. These fossils have been found by M. Landesque at Lamilloque, Caillabet, and Comberatiere, especially at the former places.

M. Paul Gouret contributes to the *Bulletin de la Societe Geologique de France*, a geological study of the marine tertiary of Carry and Sausett (Bouches-du-Rhone, France). The locality is exceedingly rich in fossils, principally gastropods and lamellibranchs, but including some corals and echini.

M. Cotteau has lately presented to the French Geological Society a memoir of the Eocene echini of the province of Alicante (Spain). Seventy-five species, belonging to seven families, are described for the first time. This is a profusion of echinid species and genera in a limited area surpassing anything hitherto found. Some of the thirty-seven genera are very rare and four are new. These are Pygospatangus, among the Spatangidæ, Stomaporus among the Brissidæ, Microlampas (Cassibulidæ), and Radiocyphus (Diadematidæ).

BOTANY.

The Flora of Central Nebraska.—A botanical collecting field perhaps as interesting as any to be found in the United States is the sand hill region of Central Nebraska. Not particularly interesting from its rare or remarkable flora, perhaps, but from the general ignorance in regard to it. Year after year Eastern collectors have passed over this *arid region* on their road to the Rockies, preferring pleasanter collecting fields.

This summer, while on a collecting trip for the Department of Agriculture, in company with Lawrence Bruner, western entomological agent for the Department, I spent several days on the Dismal and Loup Rivers, in Thomas county, Nebraska. As this is in the very heart of the sand hill region, a few notes especially on the Dismal River trip may not be without interest.

We started for the Dismal River, of which we had heard much from the settlers, in the early morning of the 12th of July. We were accompanied by Mr. Wright, a farmer of the place (Thedford), and Mr. Harper, a sportsman. For several miles we drove up the valley of the Middle Loup River, here a stream about fifty feet wide, averaging three feet deep, and with a remarkably swift current (about eight miles an hour). In the valley the grass is very rank, composed chiefly of *Agropyrum glaucum* R. & S., *Kœleria cristata* Pers., *Elymus canadensis* L., *Panicum virgatum* L., etc., intermixed with sedges, and in places with rank growths of *Onoclea sensibilis* L., and *Aspidium thelypteris* (L.) Swartz.

We soon left the bottom lands, and began climbing the sand hills up over the divide. From all that I had heard of them I expected now a long, tedious ride, but not so. I was surprised at the great variety of flowers we found. We were kept constantly busy pointing out the different kinds and watching the flight of insects. At times we wearied our driver not a little by the frequency of our stops, although for a farmer he was quite a naturalist. The prairies were spotted with the great white flowers of *Argemone platyceras* Link and Otto, and here and there could be seen the beautiful blue spikes of *Pentstemon cœruleus* Nutt., peeping above the grass or over the edge of some "blow-out," which I notice that they frequent. *Erigeron strigosus* Muhl. dotted the prairie all over, frequently rendering them gray with its little white flowers. Then our common evening primrose, *Œnothera biennis* L., I was not sorry to see, for it was one of my friends, and how rarely beautiful it was, with its unusually large flowers all coming into bloom at so nearly the same time. Perhaps its beauty is somewhat due to the stunted condition it has here in the sand hills. Its relative, the morning primrose I call it, *Œnothera serrulata* Nutt., also added beauty to the prairies with its numerous large yellow flowers. *Haplopappus spinulosus* D. C., *Amorpha canescens* Nutt., *Petalostemon violaceus* Michx., *P. candidus* Michx., *P. villosus* Nutt., *Ceanothus ovatus* Desf., *Eriogonum annuum* Nutt., *Lithospermum hirtum* Lehm., etc., were among the showy flowers of the prairie. We frequently passed bunches of *cactus* of several kinds, but it was too late for their flowers. On one bunch, however, of the common *Opuntia missouriensis* D. C., I found the flowers yet nicely out. It may be of interest to mention that a bud of this particular specimen, after it had been in my press three weeks, when laid out in the sun one day for a few minutes blossomed out as nicely as if in its original sand hills. Fully a month after this, when I opened the package at home containing this, I found that while done up between papers with its flowers perfectly pressed, it had grown a joint fully 1½ inches long.

Our driver told us that we might look for antelope and deer on the divide, but although we saw numerous signs, perhaps fortunately for the scientific interest of our trip we could discover nothing more.

As we approached the divide the region became more hilly, and from here on till we reached the Dismal River grew constantly more undulating, until, with the sand and increasing heat, travel became very tedious. Mr. Bruner's hands, face, and neck were burned to a blister by the hot sun, and my own were no better, About two o'clock in the afternoon, much to our satisfaction, we suddenly emerged from the hills, and descended at first gradually, then abruptly, into the valley of the Dismal River, our destination. We had ridden some twenty miles through sand-hills, had seen but one house,—a deserted sod shanty,—and not a sign of water. We stopped on the bank of the river and began to prepare for dinner. Mr. Bruner and I, with the natural instinct of collectors, started on a trip of discovery to get water, while the others were building a fire. While looking around on the bank of the creek one of the botanical discoveries of the trip was made. The little *Azolla caroliniana* Willd. (compared with specimens from California distributed by the Department of Agriculture, and one from Florida, collected by Canby), was found in considerable quantity growing in compact patches on the soft, black mud at the edge of the water. Underwood gives us the range of this interesting little plant "from New York to Florida, Arizona and Oregon,"—on both sides of the continent,—and now we have it in the very centre, the Nebraska sand-hill region. Near by, in little stagnant pools, the three duckweeds, *Lemna minor* L., *L. trisulca* L., and *Spirodela polyrrhiza* (L.) Schleid, grew in abundance, while out in the swift stream at this particular point (very common all along, as I observed afterwards) great masses of *Ranunculus aquatilis* L. var. *stagnatilis* D. C., and *Potamogeton* sp., waved back and forth with the current. The profusion of the small white blossoms of the former, with the background of green readily seen beneath the water, gave a pleasing effect. A spring was soon found, and with water we returned to dinner.

The appearance of the Dismal River at this point is very striking. A half mile away one would never suspect the presence of more than a small "draw" at most, but soon one begins a rapid descent, and suddenly we look over a small bluff, and there below us a hundred feet spreads out the green valley of the Dismal River. A small valley, indeed, here only about seven hundred feet in width, but from its location the most interesting I have ever visited. Turn this way, and one sees only sand-hill after sand-hill, stretching away as far as the eye can reach, the air over them quivering with the heat of an almost tropical sun; face about, and there below is a green wooded belt, with underbrush in places forming almost a jungle, and, winding in and out, a clear, rippling stream. The coolness of the shaded valley seems to come rolling up in waves, enveloping the hot and tired collector as he gazes.

The bluffs on the south of the valley rise abruptly to the height of almost three hundred feet. At one time they were heavily wooded with the red cedar (*Juniperus virginiana* L.), of which a few remain, but settlers for miles around depend upon this for their fuel and post-wood. The brush from cut trees was thrown in rows, about a rod apart, extending up the bluffs, and a fire lately burned over great patches of this, doing much damage to standing trees, so that now from a distance the bluffs present a striking black and grayish-striped appearance.

After dinner we entered the wooded valley and began our search. Almost in the edge of the water near our stopping-place rank stems of *Glyceria arundinacea* Kunth., three feet high, and with a panicle about sixteen inches long, were gathered. This is not a rare species in many places, but has not been noted before for Nebraska. Near this, and still in the edge of the water, were *Glyceria nervata* Trin., and the common *Panicum virgatum* L. The trees commonly found growing in the valley were *Celtis occidentalis* L., *Prunus americana* Marshall, *Prunus demissa* Walpers, *Ulmus americana* (L.) Willd., *Cornus stolonifer* Michx., *Negundo aceroides* Mœnch., *Populus monolifera* Ait., *Salix longifolia* Muhl., *Rhus glabra* L., and in isolated patches or clumps *Shepherdia argentea* Nutt. The latter is found also on the edge of the bluffs above.

In the woods specimens of *Elymus striatus* Willd., *Agrostis exerata* Trin., and *Impatiens pallida* Nutt., were collected. The latter was very badly rusted (*Æcidium impatientis* Schw.). The rather rare grass *Oryzopsis micrantha* (Trin. and Rupr.), never before catalogued for Nebraska, grew in the edge of a pond, and near it, on wet, sandy soil, *Alopecurus geniculatus* L. var. aristulatus (Michx.) Torr.

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[To be Continued.]

ZOÖLOGY.

Professor H. Gadow on the Homologies of the Auditory Ossicles.—The homology of the auditory ossicles does not seem to be yet settled. The last contribution to the subject is that of Herr Hans Gadow, now Strickland curator and lecturer on the advanced morphology of the Vertebrata, at Cambridge, England. (Philo. Trans. Royal Society, London, 1888, Vol. 179, pp. 451–485.) Professor Gadow carries the history of the first and second visceral arches through the entire vertebrate series, and illustrates his memoir with four quarto plates, which give the results of his labors. The possession of an ample collection of rare Elasmobranch forms, especially Heptanchus, Hexanchus, Centrophorus, Myliobates, and Trygon, with several fresh examples of Sphenodon, motived the examination of the question. Professor Gadow finds that in the Notidanidæ the first and second arches do not articulate with each other, but that in all remaining Elasmobranches there is a suspensorial arrangement. In Centrophorus, Mustelus, and Acanthia there is no direct contact of the two arches; in Oxyrhinia and Sphyrna the hyoid and mandible have developed articular facets for contact, whilst the hyomandibular does not; but in Galeus, Scymnus, Cestracion, and Trygon the hyomandibular and mandible are in contact. In Trygon the former is also in contact with the quadrate portion of the first arch.

The Dipnoan and Batrachian series show the gradual and finally absolute estrangement of the hyomandibular-hyoid arch from the palato-quadrato-mandibular arch, leading to the loss of ligamentary connection, and to the final attachment of the hyoid to the cranium. The hyoid becomes completely separated from the hyomandibular, which would have aborted completely had it not assumed new—namely auditory—functions, by becoming connected with a tympanum, *i.e.*, a cavity formed out of the first visceral cleft. The hyomandibular, invested with this new function, breaks up into two or more pieces, as an ossicular chain. The old piscine ligamentous, or even cartilaginous, connection between hyomandibular and mandible is lost in the Salientia, and in the Urodela a piece of cartilage, comparable either with a symplectic or an opercular element, is also gradually lost. The tympanal end of the auditory chain or rod becomes connected with the cranium by a suprastapedial element, probably of periotic origin, while the quadrate becomes reduced to a small cartilage wedged between the elongated pterygoid and squamosal. This elongation of the pterygo-quadrate bar, transposing the masticatory joint outwards, away from the cranium, has caused, or at least facilitated, the separation of the hyoid from the hyomandibular. In the Chelonia the broad quadrate is fused with the skull. In the Trionychidæ and land tortoises (as shown by Peters) the quadrate forms a closed canal through which passes the columellar rod, but in other tortoises and turtles it forms an imperfect canal, open behind and below. In all chelonians the interfenestral apparatus consists of two pieces, and the hyoid is frequently either absent or is a mere bit of bone or cartilage attached to the basilingual plate. The pair of long bony bars which act as hyoid is really the third visceral or first branchial arch. In the Crocodilia the auditory apparatus is very complex. The air cavities of the os articulare are connected with the middle ear or tympanic cavity by the fibrous and partly cartilaginous siphonium. The air-cavities of the quadrate are also in direct communication with the tympanic cavity. The outer end of the columella proper possesses a concave facet, by which it articulates with the short basal stem of a trifid extra columellar cartilage or malleus. The lower process of this trifid malleus is connected with the mandible by a cartilaginous or partly ligamentous string, for the reception of which the quadrate forms a bony canal.

The whole string is originally cartilaginous. The hyoid arch has entirely disappeared as far as ceratohyal and stylohyal pieces are concerned.

In Sphenodonia the top end of the hyoid is fused with the extracolumella. In Gecko it is attached to the cranium, as in the Mammalia, but in most lizards the proximal portion of the hyoid is removed from the skull, and remains otherwise well developed. In the Ophidia and in birds, as in Crocodilia and Chelonia, the proximal part of the hyoid becomes reduced and lost. In Ophidia and in Chamæleo the extracolumella gains an attachment to the quadrate, squamosal or pterygoid, while its connection with the mandible and the tympanum is lost. The chamæleon has no tympanum, and those parts of the extracolumella which in other types would be attached to the tympanum, are here attached to and fused with the quadrate. In birds the arrangement of the auditory ossicular apparatus is very similar to that of the monitors. In the adult the whole hyoid bar is absent, with the exception of a small cartilage.

In mammals, as is well-known, the ossicles of the ear are usually four, although the small lenticular element which lies between stapes and incus frequently remains cartilaginous, and is occasionally absent. The hyoid has no connection with either mandible, palate, quadrate, or with the ossicular chain, but its upper end is fused with the cranium behind the tympanic ring. Many various views have been held respecting the origin of the auditory ossicles. Tindemann (1810) held that the entire ossicular chain of mammalia was equivalent to the columella of birds and reptiles, and that the quadrate equals the zygomatic process of the squamosal. Reichert (1837) derived the malleus from the articular element of the mandible, the incus from the quadrate, and the stapes from the end of the hyoid. Gegebaur agreed with Reichert as regards the malleus and incus, but derived the lenticulars and the stapes respectively from the symplectic and the hyomandibula. Peters (1867) held that all the ossicles were developed from Meckel's cartilage, and that the quadrate had become the tympanic bone. Huxley (1867) and Parker both held that the quadrate of birds and reptiles became the malleus of mammals, and that the incus and lenticular were derived from the hyomandibula. Huxley also held that the stapes is of hyomandibular origin, but Parker was inclined to derive this element from the auditory capsule. Parker's later view derived the malleus from the articulare, and the incus from the quadrate. Salensky (1880) held that the malleus and incus came from Meckel's cartilage; Fraser (1882) derived the malleus from the end of the mandibular cartilage, and the incus from the proximal end of the hyoid, whilst Albrecht (1883) traced all the ossicles to the hyomandibular, and held that the quadrate was present as the zygomatic process of the squamosal. Gradenigo (1887) agrees with Salensky with regard to the malleus and incus, but derives the stapes from the hyomandibular and periotic cartilage.

Prof. Gadow agrees with Peters in making the quadrate bone equal to the tympanic bone of the mammals, and states that no animal possesses both an os tympanicum and a distinct quadrate bone. The Salientia have indeed a tympanic ring, which Prof. Gadow, on Balfour's authority, derives from the metapterygoid region of the quadrate. He agrees with Albrecht in deriving the ossicles of the middle ear from the hyomandibular element of the second visceral arch. This last speaker upon the vexed question of the homologies of the suspensorium and ear bones therefore supports Albrecht in the main points of his thesis, but differs in regarding the tympanic bone rather than the zygomatic process as the representative in the Mammalia of the sauropsidan quadrate.

Prof. Lankester on Amphioxus.—E. R. Lankester contributes to the *Quarterly Journal of the Microscopical Society* (April 29, 1889) a number of valuable particulars concerning the anatomy of the lancelet, with special reference to numerical characters. In the living animal the atrial chamber projects between the lateral ridges or metapleura. Between these metapleura the ventral wall is in the living animal plaited into longitudinal folds, six or eight upon each side of the middle line; but when the generative products are full grown these folds disappear. A large drawing taken from life shows these folds. There are not any canals below these ventral plaitings, as was believed by Stieda, Rolph, and others. *Branchiostoma lanceolatum*, the species found at Naples, has on an average 61 myotomes; *B. elongatum*, from Peru, has 79; *B. bassanum*, from Bass's Straits, has 75–76; *B. belcheri*, from Borneo, 64–65; *B. caribbæum*, from Rio de Janeiro, 59–60; and *B. cultellum* has 52. The full number of myotomes is acquired at a very early period of life, even before the epipleural chamber is complete. The true mouth is the small median aperture concealed by the oral hood, which latter is really a preoral portion of the epipleural folds.

Twelve delicate tentacles project from the mouth into the pharynx. The atriopore seems to coincide with the thirty-sixth myotome, the anus with the fifty-first. The formula would, therefore, be 36–15–10–= 61. The number of dorsal fin rays is 250–260, although there are none over the last six myotomes; there are thus about five to a myotome; but there does not seem to be any fixed relation between the two numbers, especially as the ventral fin rays are proportionately less numerous,—thirty-four or rather more in twelve myotomes. The fin-rays lie in a compartmented lymph-space, which is antecedent to the rays and extends beyond them, both fore and aft. The cœlomic sacs, in which the reproductive cells develop, correspond to twenty-six myotomes. The pre-oral tentacles vary in number, but are always fewer in young examples. They are formed in pairs. After the larval phase is passed all relation is lost between the number of myotomes and that of the gill-slits, which latter numbered ninety-six in specimens a little under an inch in length, and one hundred and twenty-four in larger examples. Each primary gill-slit is borne upon a solid chitinous rod, and each becomes secondarily divided by the growth of a tongue in the direction of the length of the slit: these tongues are carried upon hollow chitinous rods.

The body contains three kinds of spaces, which are filled with lymph: (1) the atrial chamber, (2) the enteric spaces, (3)the hæmolymph cavities. An atrial cercum extends back to beyond the atriopore. The enteric cavity consists of atrium, intestine, and cæcum, the last given off as a diverticulum at the 28th or 29th myotome, and reaching forward to the 14th or 15th in adults. The vascular system seems to be in a state of degeneration. Certain of the vascular trunks are continuous with the lymph spaces, so that the vascular and lymphatic systems cannot be distinguished. The metapleural lymph canals disappear when the gonads are ripe, and it does not appear improbable that their lymph serves as a final supply of nutriment to the gonads.

Dr. Lankester has discovered two short, wide, brown funnels opposite to the 27th myotone; the wide end turned toward the atrium, the narrow directed to the dorso-pharyngeal cœlom, and thus serving to place the latter in communication with the former. Dr. Lankester's memoir is illustrated with five plates.

Note on Ammocoetes Branchialis (Linnæus).—Previous to the fall of 1885 we had no positive record of this species from localities other than from Central and Southern Indiana, and from Southern Wisconsin. On May 8, 1886, Professor S. A. Gage and myself discovered several specimens of this species in Cayuga Lake Inlet, five of which we captured.

One year ago Professor F. Star informed me that they were seen by him in the spring, in large numbers, in the small streams tributary to the Cedar River, Iowa.

This spring I collected about sixty specimens in a small brook from two to five feet wide, near Cedar Rapids, and many others were seen, all in a distance of about three-fourths of a mile.

In 1886 we compared the five specimens from Cayuga Lake Inlet with as many more specimens from Indiana, noting only this difference: in the Inlet specimens the extreme mandibulary cusps were larger than the inner ones, while in the specimens from Indiana all the cusps were subequal.

Dr. B. G. Wilder has kindly sent me twenty specimens from Ithaca, N. Y. These I have carefully compared with the specimens collected near Cedar Rapids, and am convinced that all are of the same species.

In most of the specimens the outer mandibular cusps are larger than the four others. In other specimens the cusps are subequal. The usual number of cusps is six. Occasionally a specimen is found with seven cusps, and rarely one with five.

There is no crest developed on the back of either sex during the breeding season, as is so characteristic of ***Petromyzon marinus***. About one-fifth distance from the vent to the end of the tail a small fin-like crest is developed on the male. There is also a similar crest on the female, which is larger, less firm, and more fin-like.

The dorsal fins on both males and females are situated on a small crest, which is more conspicuous on the males.

The number of muscular impressions between the last gill opening and the vent vary from sixty-five to sixty-eight.

A microscopical examination of the zoösperms shows those in both the specimens from Ithaca, N. Y., and Iowa, to be of apparently the same shape and size. The head is large and prismatic, with a long, slender tail, which usually has an enlargement near its posterior end. It is quite evident that this species is far more widely distributed in this country than was formerly supposed, and it will no doubt be found in all streams in the Mississippi Valley, at least north of the lower Ohio rivers.

Early in the spring they leave the larger streams, and ascend the smaller streams to deposit their eggs, which occupies from one to two weeks. They make their nests in the bed of the stream by excavating cavities from two to five inches in depth, and with the diameter from one and a half to twice the length of the animal.

The places selected for these nests are in the bed of the stream, where the current is quite swift and the bottom is covered with gravel.

During the spawning time from one to six have been seen in the same nest. In the ordinary season they may be found spawning between the middle of April and the middle of May (May 8, 1886, at Ithaca, N. Y.; April 20, 1889, Cedar Rapids, Iowa).

The length of all the specimens I have examined from New York and Iowa is between five and six and a-quarter inches.—S. E. MEEK, *Coe College, Cedar Rapids, Iowa, May 22, 1889.*

Zoological News.—Development of Millepora.—Mr. S. J. Hickson, on his recent trip to the Celebes, had an opportunity to study the development of the coral *Millepora plicata.* His account will be found in the *Philosophical Transactions,* Vol. 179 B. This species is hermaphrodite. The eggs and spermatozoa arise in the ectoderm, but before maturity they break through the supporting layer and enter the entoderm. The spermatozoa wander into the dactylozoids and there form sperm sacks. The eggs, after a peculiar history, form two polar globules, after which they are fertilized. The nucleus now divides into numerous portions, each of which becomes surrounded by a mass of protoplasm, giving rise to a morula. The next stage is the formation of a solid blastosphere, followed by the development of cilia. In some cases there was an appearance like the beginning of invagination. Ten ciliated embryos escaped through the mouth of the gastrozoids.

Rotifera.—E. F. Weber, under the title of "Notes on some Rotifers," has communicated to the *Archives de Biologie,* Sept. 1888, an extensive description of the anatomy of some species of these short-lived creatures, and of the male and female characters.

Echinodermata.—H. Bury (*Quart. Journal Micros. Soc.,* Apr. 1889), puts on record a number of facts in the embryology of that stage of the echinoderm larva which has been named the Dipleurula, with special reference to the development of the enterocœls and hydrocœls in the different orders. From his observations it appears that the Ophiurid Dipleurula develops two pairs of enterocœls metamerically arranged, and that the hydrocœl is formed later, evidently from the posterior enterocœl. The echinid larva develops two pairs of enterocœls and a waterpore as in the ophiceran, but the hydrocœl seems to arise from the anterior enterocœl, and retains connection with it. In the Asterid Dipleurula anterior and posterior enterocœls may be distinguished, but they are usually not separate, and the hydrocœl remains opens to the anterior enterocœl.

The crinoid Dipleurula develops only one anterior enterocœl, with which the hydrocœl is at first connected, but afterwards becomes separate. There are two posterior enterocœls. In the Holothurioidea there is no right anterior enterocœl, and the left is rudimentary; the hydrocœl, which is always on the left side, being connected with it. There are two posterior enterocœls.

The last portion of the paper treats of the development of the skeleton during this bilateral stage; it appears that many skeletal elements have their origin during this period.

Mollusca.—Paul Pelseneer has contributed to the *Archives de Biologie*, a dissertation upon the morphological value of the arms of the cephalopoda, and arrives at conclusions which differ widely from those most generally received. The problem to be solved is whether the arms are of pedal or cephalic origin,—whether they are or are not essentially appendages of the head. He endeavors to answer this question by an examination of the nervous system, which he illustrates in two plates. From this examination he deduces that the comparative anatomy of the nerves is contrary to the cerebral origin of the brachial ganglia, and in favor of their pedal nature. From a comparison of a walking gastropod with a walking cephalopod, it is evident that the arms of the latter stand in precisely the same relation to its head as does the foot of the former to its head. The only difference is that in the cephalopod adult some of the arms have assumed a position in advance of the mouth. But in the cephalopod embryo the mouth opens dorsally as in the gastropod, and is in advance of the arms. The entire vitelline sac was, according to Pelseneer, taken for the foot by Balfour and by Brooks, but the margins of the foot persist around this vitelline sac, and the arms represent the margins of almost all the foot. The swimming-lobes of Pteropoda and the Aplysiidæ correspond to the lateral borders of the foot in the gastropod, and may thus be compared with the arms of the Cephalopoda. Thus these arms are not merely the propodium, but represent the margin of almost the whole gastropod foot. The siphon (entonnoir) is the epipodium.

C. R. Keyes gives an annotated catalogue of the Mollusca of Iowa, in the Bulletin of the Essex Institute, Vol. XX., in which he enumerates 151 species now existing, and thirty-two from the loess of the state.

Arthropoda.—M. Nussbaum has seen two polar globules in the cirripede egg (*Zool. Anzeiger, 301*). The first is formed while the egg is in the ovary, the second after fertilization in the egg sac.

Vertebrata.—Dr. R. W. Shufeldt publishes (*Journal Comp. Med. and Surg.*, Apr. 1889), an account of the osteology of the hawk, *Circus hudsonius*.

Mr. S. Garman (Bulletin Essex Institute, XX.), has collated the references to the Batrachia in the various editions of Kalm's Travels in North America. The result is to overturn some of the nomenclature of our frogs and toads.

EMBRYOLOGY.

Homologues in Embryo Hemiptera of the Appendages to the First Abdominal Segment of other Insect Embryos.—While preparing a paper on the appendages of the first abdominal segment of the embryo *Blatta germanica* for the Proceedings of the Wisconsin Academy of Sciences, Arts and Letters, to be published during the coming summer, my attention was drawn to the Hemiptera, on which no observations have as yet been made in regard to appendages to the first abdominal segment. The pair of appendages which appear on this segment in embryo Orthoptera, Coleoptera and Trichoptera remain short, but become bulbous, and persist in some cases till the larva hatches. All investigators agree that in these three orders the curious appendages reach their greatest development during the revolution of the embryo. They have been regarded by Rathke, Ayers, and Graber as embryonic gills, by Patten and myself as glands.

The two species examined by me were *Cicada septemdecim* and *Nepa cinerea,* which represent two of the three large divisions of the Hemiptera.

In both cases the appendages persist as in the Orthoptera till after revolution, but instead of being *e*vaginated as in the insect embryos heretofore investigated, they are *in*vaginated. The shape of one of these appendages is bulbous, and its pyramidal cells are radially arranged with their broader basal ends turned inwards and their tapering outer ends terminating on the surface of the body. In *Cicada* there are few cells in the organ, in *Nepa* a much greater number.

In *Cicada* a glairy, much vacuolated mass is secreted by the tapering outer ends of the cells, and projects into the space between the body of the embryo and the egg envelopes. This space is filled with the coarsely granular secretion which before revolution filled the cavity of the amnion. The glairy secretion of the invaginated appendage stains pink in borax-carmine, and is distinctly marked off from the amniotic secretion.

In *Nepa* the secretion of the pyramidal cells differs from that in *Cicada* in a remarkable manner. The tapering ends of the cells are very delicate and transparent, and the secretion from the tip of each cell is not confluent with the secretion from the neighboring cells to form a glairy mass as in *Cicada*, but assumes the shape of a thread fully as long as the cell which secretes it, and protrudes into the space between the body wall and the egg envelopes. As the secretion of each cell remains thus independent, the secretion of the whole organ strikingly resembles a brush or a bundle of cilia.

I conclude that the *in*vaginated bulbous bodies in the first abdominal segment of Hemiptera are the homologues of the *e*vaginated bulbous appendages in other insect embryos from the following facts:

1. These organs in Hemiptera are two in number, and appear only in the first abdominal segment, in positions held by the evaginated appendages in other insect embryos.

2. They are ectodermic in their origin, like the appendages in other insects.

3. They have the same shape and cytological structure as the evaginated appendages of the first abdominal segment in Orthoptera and Coleoptera.

It is obvious that the invaginated appendages of the Hemiptera could never have functioned as gills, and their complete similarity in minute structure to the protruding bulb-shaped or even lamellar abdominal appendages of embryo beetles is strong evidence against Graber's and Ayer's supposition that these organs are respiratory in the forms heretofore studied.

On the other hand the supposition of Patten and myself that these organs are glandular, receives strong confirmation from my observations as briefly given above. My observations also make more plausible the supposition that the lung hooks of scorpions and spiders are the homologues of evaginated appendages.

I reserve a more complete and illustrated description of my results for future publication.—W. M. WHEELER, *Public Museum, Milwaukee.*

Observations on the Placentation of the Cat.—The following preliminary notes are offered in advance of the publication of an illustrated paper on the same subject.

The stages studied were from three days after impregnation to maturity.

All sections were cut with the embryo *in situ*. In the earliest stage examined little or no swelling was noticeable on the external surface of the uterine cornu. Sections through the cornu showed that the presence of the egg had induced very great changes in the mucosa; the most noticeable change being its increased thickness. In the stages immediately following the mucosa with its glands is turned inwards at both poles of the cavity, forming heavy lips around each pole of the latter. A little later the cavity containing the embryo becomes barrel-shaped, but remains so only a short time. The uterine glands become contorted, and extend peripherally almost to the annular muscular coat. The swelling of the cornu seems to be greatest on the side opposite the mesometrium. This is probably due to the fact that at that point there is least resistance. The spherical fœtal membranes touch the mucosa in an annulus about the embryonic or blastedermic vesicle, as they must necessarily do on account of the form of the latter and the tube in which it lies. The poles of the embryonic vesicle which do not come in close contact with the mucosa are, however, very small during the early stages.

The rapid growth of the embryonic vesicle seemingly expands the cavity of the cornu, and as the cornu does not become enlarged beyond each pole of the vesicle the mucosa must necessarily touch the chorion at all points except over a very small area at each pole.

In the succeeding stages the glands become very glassy in appearance, and contractile muscular bands were noticed about each gland, their function probably being to force out the "uterine milk," or secretion for the nourishment of the embryo at this stage.

Later, when the velli of the permanent chorion are developed, the glands cease their activity, and are transformed into crypts to receive the velli of the chorion. The glands at the poles remain unchanged. Their axial ends are turned towards the embryonic vesicle. They retain their contorted or spiral form and vascular appearance. The contact of the chorion and mucosa at this early stage determines the size and position of the placental zone. The placental zone increases its diameter and width slightly, but it does not increase in width as fast as the cavity containing the embryo elongates. It reaches its maximum width at a time when the embryonic vesicle is about one inch in diameter and almost spherical in form. The axial ends of all the uterine glands, in the cavity containing the embryo, beginning with the earliest stages, are pushed *from* the mesometrium, and on the side opposite the mesometrium they are much shorter. These facts can probably be explained as a result of the increase in size of the embryo, during which it meets with the least resistance at the free side of the cornu, the swelling consequently increasing more rapidly on that side, while the axial ends of the glands are drawn down from the mesometrium, and those on the free side of the cornu are compressed.

During the early stages the axis of the embryo lies transversely to the axis of the cornu, but when the uterine cornu reaches a diameter of about one and one-eighth inches the embryo changes its position, and remains with its axis parallel to the axis of the cornu; the ventral side of the embryo is toward the mesometrium. About this time the placental band or zone, at a point diametrically opposite the mesometrium, undergoes atrophy, which in the last stages almost severs the placental girdle as a groove in its inner face. In this attempt at a break in the continuity of the placental zone, the cat resembles the squirrel, in which, as Professor Ryder has shown, so much of the zone is atrophied that only a square piece of the original placenta remains.

The blood supply of the maternal portion of the placenta is very noticeable at this stage. The sides of the crypts are well supplied with very large capillaries, and supported on the inner ends of the crypt are large vessels carrying maternal blood, forming a vascular mesh-work through which the crypts open into the uterine cavity.

The peripheral ends of the uterine glands are not transformed into crypts, but seem to form a layer of spongy tissue, the decidua, and it is very probable that at parturition a portion of the degenerate epithelium of the crypts adheres to the muscular walls of the cornu, and reproduces the mucosa.

During the growth of the embryo the annular muscular band undergoes considerable change. Its fibres are turned from their normal direction, and run obliquely over the uterine dilatation. At the end of gestation the length of the uterine cornu is about twice that of the non-gravid uterus.

This study was conducted in the Biological Laboratory of the University of Pennsylvania, under the direction of Professor Ryder, to whom I would express my obligations for the valuable aid which he extended during its prosecution.—M. J. Greenman.

Mr. Hy. Orr (*Quart. Jour. Micr. Sci.*, Dec., 1888) gives some detailed observations on the development of *Amblystoma punctatum* (or *A. bicolor*) and of *Rana halecina* (or *R. palustris*), with special reference to the central nervous system, and with notes on the hypophysis, mouth and appendages, and skeleton of the head. The central nerve-system first appears as a transverse epiblastic thickening, continuous with paired elongated epiblastic dorsal thickenings. The first nerve-fibres of the brain appear on what was originally the internal surface of the primitive dorsal epiblastic thickenings. A subsequent development of nerve-fibres gives rise to a continuous ventral commissure and to the anterior and posterior commissures of the brain.

Mr. Orr considers the balancers of Amblystoma as external gills of the mandibular arch, which have become metamorphosed into embryonic organs of support.

PHYSIOLOGY.[1]

Heart-sounds.—The well known experiment of Ludwig and Dogiel, who, by excluding the blood from the heart and presumably throwing out of function the atrioventricular valves, still heard the first heart-sound, is interpreted as evidence of the preëminently muscular character of that sound. Krehl,[2] working in Ludwig's laboratory, finds yet stronger evidence of similar nature. Through the auricles he introduces a simple apparatus by which, at will, the atrioventricular valves may be held back against the cardiac walls, and thus thrown out of action or not interfered with. Observers, even physicians skilled in auscultation, are unable to perceive any differences, either in intensity or character, of the sound, whether the valves are in use or not. Bleeding the animal from the carotid does not interfere with the first sound until shortly before death, when the sound becomes feeble in accordance with the feeble beat of the heart. The experiments do not elucidate the question whether the heart-beat is a single twitch or a tetanus; if it be the former, the sound may easily be explained, as Ludwig himself has previously suggested, by the pulling or rubbing of the muscle fibres on each other. If the ventricular contractions be excluded, a distinct but feeble auricular sound is heard. This may doubtless explain the "galop-rhythm," which is characterized by the

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] Du Bois Reymond's *Archiv*, 1889, p. 253.

appearance of an extra sound preceding the recognized first sound, and is rightly regarded as indicative of some pathological condition.

Mechanism of Tricuspid Valve..—Krehl[3] publishes a careful and detailed account, illustrated by good figures, of the action of this valve during the whole cardiac cycle.

Innervation of Renal Blood Vessels.—J. Rose Bradford's work[4] adds to our knowledge, hitherto defective, of this subject. Roy's oncometer was used and the tracing of the volume of the kidney was compared with that of the general blood pressure. The main conclusions are as follows:

1. All renal vaso-motor fibres leave the spinal cord through the anterior roots, and although a few fibres may come out as high as the 4th dorsal, it is not until the 6th dorsal is reached that they are found in any abundance. From the 6th dorsal to the 13th dorsal they are abundant; below this they are found in rapidly diminishing numbers, so that but little vaso-motorial effect is seen to follow the excitation of the 3d and 4th lumbar nerves.

2. These renal vaso-motor fibres are of two kinds, vaso-constrictor and vaso-dilator. The former are, however, by far the best developed, so that unless special methods, such, for example, as slow stimulation, are used, it is rare to get clear evidence of vaso-dilatation on excitation of any given nerve.

3. The kidney vessels receive their nerves from all the spinal nerves included in this extensive series, but most of the renal vaso-motor fibres are found in the 11th, 12th, and 13th dorsal nerves.

4. No evidence has been obtained of the existence of any vaso-constrictor fibres for the kidney vessels in the vagus nerve. The splanchnic nerve contains not only vaso-constrictor but also vaso-dilator fibres for the vessels of the abdominal viscera, and for the renal vessels amongst the rest.

5. By reflex excitation of the renal nerves through the sciatic, intercostal or vagus, active renal contraction is obtained: through the depressor, active expansion, which is, however, usually neutralized and changed into passive contraction by the great dilatation elsewhere; through a posterior root, especially of the 11th, 12th, and 13th, active expansion, due to the stimulation of afferent visceral nerve fibres. Occasionally reflex excitation produces general dilatation, and then the

[3] Du Bois Reymond's *Archiv*, 1889, p. 289.

[4] *Journal of Physiology*, Vol. X., 1889, p. 358.

kidney (although its vessels share in the dilatation) undergoes passive shrinking. There is no evidence of decussation of vaso-motor fibres in the splanchnic, *i.e.*, the right splanchnic sends fibres to the right kidney only, not to the left.

Physiology of the Heart of the Snake.—In the Canadian *Record of Science*, Vol. II., No. 8, Oct. 1887, is given an account by T. Wesley Mills of a study of the heart of the snake, which closes with the following summary:

1. The investigations recorded in this paper were made in mid-winter, on fasting but not hibernating animals.

2. Comparison of the vagi showed that in every instance both nerves were efficient; but usually the right was the more so; in some cases the difference, if actual, was minimal.

3. Stimulation of the vagi leads to after increased force and frequency of beat, or the former only, and according to the law of inverse proportion previously announced by the writer.

4. The mode of arrest of the heart is identical with that noted in chelonians, fish, etc.; the same applies to the mode of recommencement.

5. During vagus arrest, the *sinus* and *auricles* are inexcitable.

6. There are certain peculiar cardiac effects not explicable by reference to the vagi nerves alone, but which put the sympathetic system of nerves in a new light.

7. Direct stimulation of the heart confirms results previously noted by the writer for other cold-blooded animals. Arrest is, in all the animals of this class yet examined, owing to stimulation of the terminals of the vagi within the heart's substance.

8. As regards independent cardiac rhythm, the results have been negative.

9. The heart of the snake, upon the whole, seems to lie physiologically between that of the frog and that of the chelonians. X.

ARCHÆOLOGY AND ETHNOLOGY.

Aboriginal remains near Old Chickasaw, Iowa. On the west side of the Little Cedar River, about one and one-half miles below Old Chickasaw, Iowa, are located ten mound-builder mounds.

The same locality, by disease, war, emigration, or other causes, may have been depopulated and again repeopled by other races, each of which in its turn may have erected mounds for burial purposes, religious purposes, points of observation, or for other uses. The word mound-builders, therefore, as generally used, is calculated to lead to error by the implication that the habit of mound building was peculiar to *one* prehistoric race. In this paper the term mound-builder is applied to that prehistoric race (doubtless represented by numerous tribes) which, in ancient times, prior to the advent of the red Indians,[1] occupied much of that region now comprised within the bounds of the United States.

The mounds near Old Chickasaw are situated upon the border of the first terrace of the stream, as shown in Fig. 1, and which rises from twenty to forty-five feet above the flood plain at its base. Back from the first terrace, two hundred and sixty yards, is a second terrace, which rises sixteen or eighteen feet above the first one.

The country back from this terrace increases gradually in height until within three-fourths of a mile it has attained an elevation varying from twenty feet to more than one hundred feet above the last bench.

About two hundred and sixty yards to the southwest from the mounds, a never-failing spring of water issues forth from the base of the second terrace, and a short distance below a second one rises from the same region.

This entire region was formerly occupied by a heavy growth of timber; but much of it has now been cleared away by the settlers in opening up farms. The limited view (owing to the presence of timber) obtained from the site of these mounds, although pleasing, is yet far inferior to the beautiful and extensive scene afforded from the elevated land back from the stream a short distance.

All the mounds of this series are circular, with oval tops, and have a diameter varying from twenty-two feet to fifty-one feet, and a height of from one and three-fourths feet to five feet.

The distance between the different mounds is variable, being from two feet to fifty feet.

The main line of mounds, as will be observed by referring to Fig. 1, runs north a few degrees east. The remaining mounds are located approximate to and run parallel with the main line. In the centre of the first mound examined (No. 3) three human skeletons were found.

These bodies, many of the bones of which were in a good state of preservation, had been placed on the original surface in a sitting posture, and the mound reared over them.

[1]In the light of recent discoveries, it is difficult to say what portion of the so-called "Mound-builder race" was not identical with the red Indians.

The first body sat facing the east, and the second one directly in front, with knees nearly touching, facing the first one.

A few inches to the north of No. 1 a third one had been placed, apparently facing the east. The crania of all three individuals showed an extremely low grade of mental development; the foreheads being, in one case, even lower than in the specimen found in the Floyd mound, which was figured and described by the writer in a paper on "Ancient Mounds at Floyd, Iowa," that appeared in a late number of the AMERICAN NATURALIST.

The upper anterior portion (back of the eyes) of one of the crania under consideration was quite narrow, but rather rapidly expanded postero-laterally. That portion of the frontal bone forming the upper part of the eye sockets attained a height of only from four to seven mm.; and then sloped abruptly backward, forming a slightly *concave* area back of and above the eyes. This cranium, as well as the others obtained from this mound, was smaller (the largest 6¼x5 in.), than the Neanderthal skull.

In Plate XXIX. is given a good representation of one of these strange crania.[2]

One of the individuals was apparently that of a woman in middle life, while the body on the left was that of an aged person.

The first one and one-half feet of material above the remains was a mixture of earth and ashes, made very hard, with a few small pieces of charcoal scattered through it.

The remaining three and one-half feet of material composing the mound was a yellow, clayey soil, unlike anything found on the surface in the vicinity.

Five feet below the surface of mound No. 4, and resting on the natural surface of the ground, were the remains of two persons which had been buried in a sitting position.

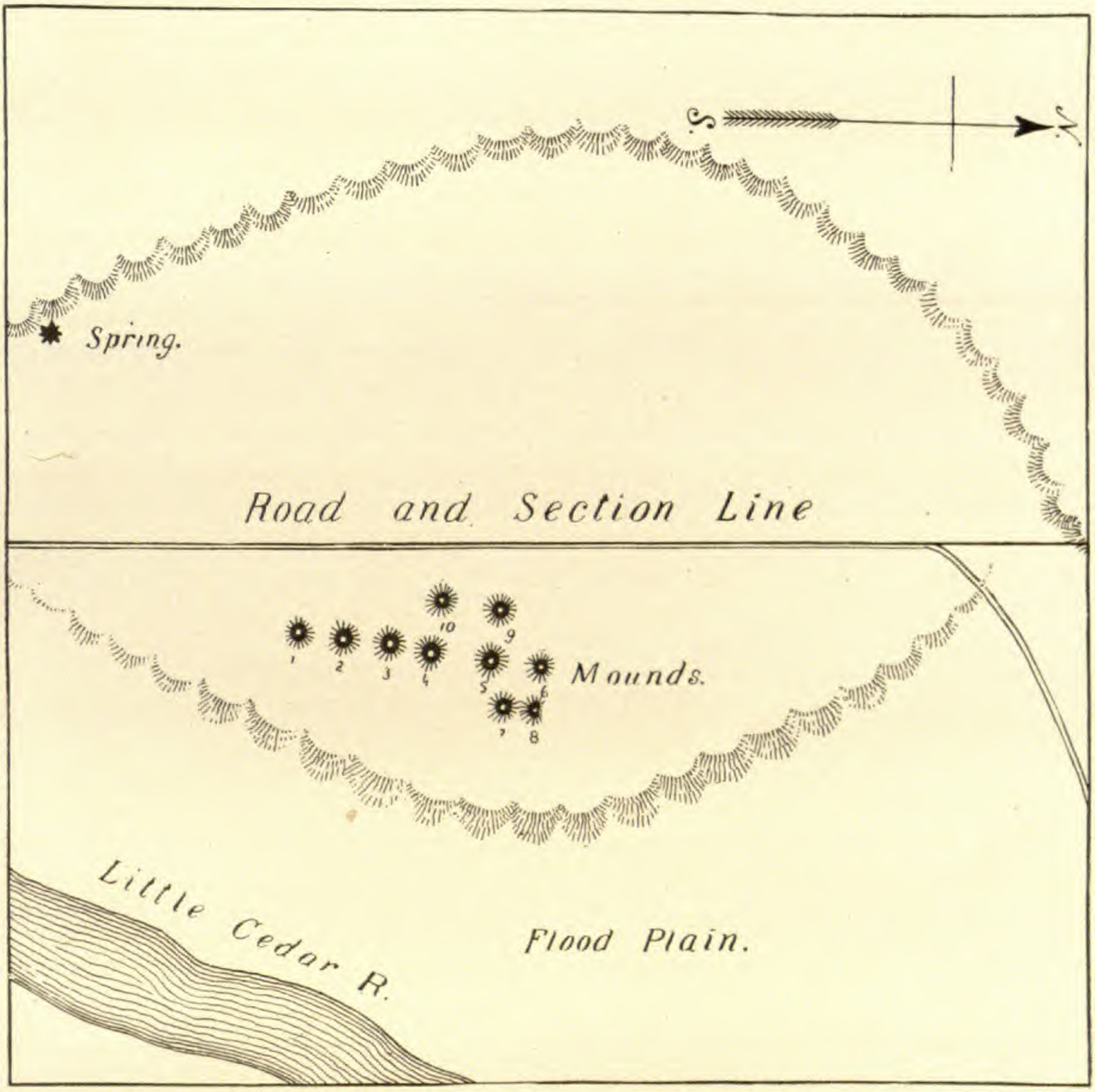
Some of the larger bones of the bodies were in a good state of preservation; the crania, however, were too badly crushed and decomposed to allow of a reconstruction of their parts.

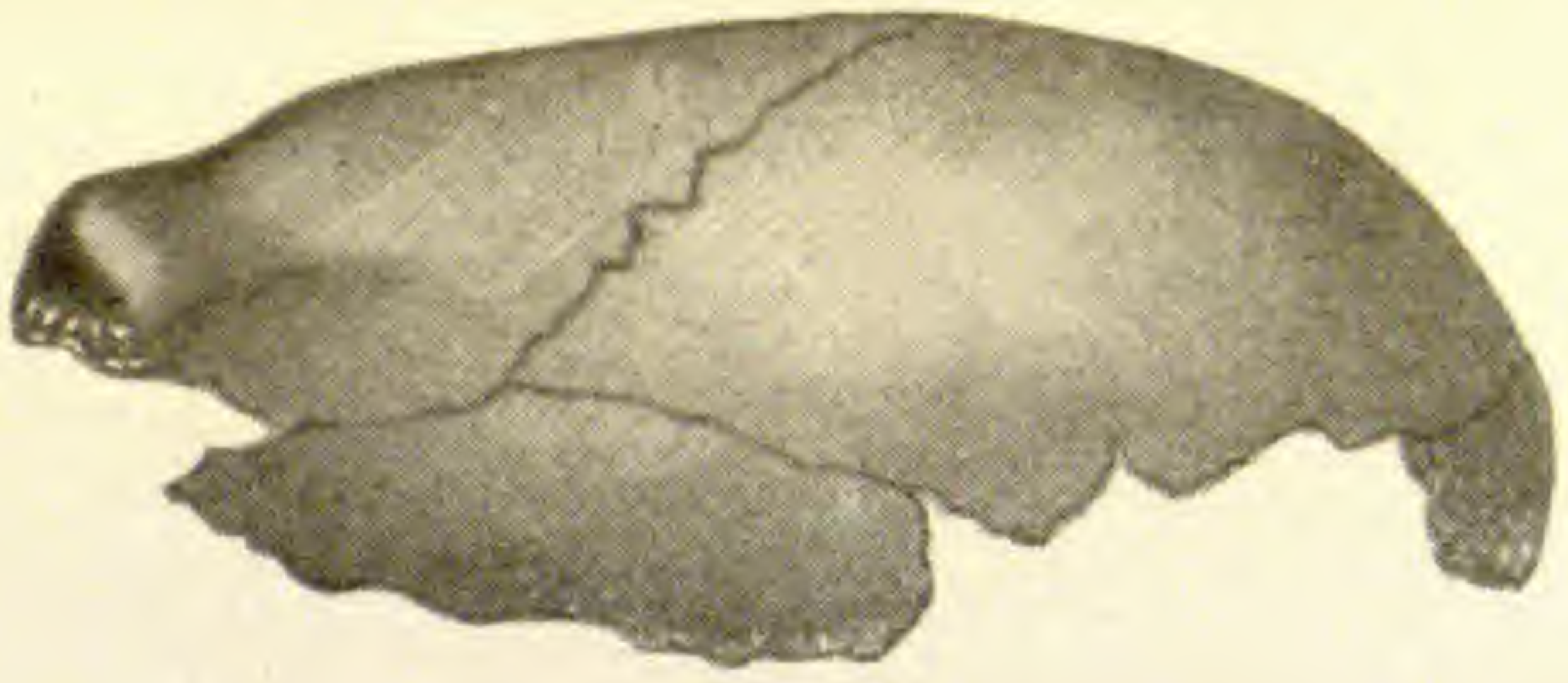
The structure and size of the bones of these individuals indicated persons of great muscular development, and showed them to have been at least six feet in height.

The first three and one-fourth feet of the mound above the remains was yellow earth and ashes, made very hard, probably by tramping and the use of water.

[2] This cut does not represent the most inferior cranium secured.

PLATE XXIX.





MOUNDS AND MOUND-BUILDER'S SKULL.

The remaining one and three-fourths feet of material was yellow earth, not packed.

Scattered through the mound were numerous pieces of oak charcoal.

In various parts of the mound were local deposits or "patches" of ashes, and underneath them thin, deeply-stained layers of ashes and earth, having the appearance of being stained by the decomposition of flesh.

In mound No. 9 were found the remains of four bodies.

The teeth and bones of two of these individuals showed them to have been well advanced in years, while the third body was that of a person of middle age, and the fourth that of a subject somewhat younger.

The lower jaw of one of these individuals was very large and strong, with the angles much straightened. All the teeth, with one exception, were well preserved, although much worn on the crowns.

One large molar, which was otherwise sound, had a decayed cavity in the cervix 3 mm. in diameter.

Although we have personally examined the teeth of many mound-builders, this is almost the first example of decayed teeth belonging to these people which has come under our observation. Another interesting and finely preserved lower jaw obtained from this mound had a breadth measuring, from exterior to exterior, at the angles, twelve and one-half centimeters.

This maxillary had apparently been fractured during life; and this may perhaps account, in part, for its great width.

The angle of the jaw was very low and much straightened.

At the time of death only the incisors and canines remained; all the other teeth had been lost, and the alveolar processes either wholly or in part absorbed.

All the bodies had been placed in a sitting posture in the centre of the mound, on a small hillock, one and one-half feet in height, composed of ashes and earth.

Although all the bodies had been buried in the flesh, still a portion of the skull of one individual had been much charred by fire before being in the mound.

The first one and one-fourth feet of material composing the mound was soft, yellow earth, similar to that constituting the other mounds; and the remaining one and three-fourths feet was of the same material, mixed with ashes, and made quite hard.

Disseminated through the mass were a few small pieces of charcoal.

In mound No. 10, which was about forty-five feet in diameter and three feet in height, were discovered the remains of three persons, the bones being in a better state of preservation than in any of the other mounds of the group explored.

First, there had been reared, from the ordinary black surface-soil of the vicinity, a small hillock, one foot in height; and on this were placed in a sitting posture, with the feet drawn under them, the three bodies.

One finely preserved lower jaw found in this mound was very massive and broad, and contained large, finely preserved teeth. The teeth in this specimen were all worn quite flat upon the crowns; and this remark applies to the incisors and canines, as well as cuspids and bicuspids.

In this case it is shown that the masticating surface of the upper jaw fitted perfectly that of the lower one.

The incisor teeth did not lap, but impinged on each other at their cutting edges, like the molars. This form of teeth is not peculiar to the mound-builders, however, but is characteristic of savage races generally.

The material composing this mound, although analogous to that of other mounds of the series, was not *packed* around the bodies.

It was plainly evident that much less care was exercised in this burial than in any of the others. Gathered facts, moreover, demonstrate that this mound, as well as some of the others, was erected long anterior to Nos. 3 and 4. Some years ago mound No. 2 was graded down by Mr. R. H. Gordon (on whose farm all the mounds are located) in making an excavation for a cellar.

The structure of the mound was similar to that of No. 4, although much smaller. On the original surface had been placed, in a sitting posture, one or two bodies.

The crania and many bones of the bodies are reported to have been in a good state of preservation.

Mound No. 1 is now twenty-two feet in diameter and one foot in height; but owing to the fact of its having been cultivated over for more than ten years, its original height has been somewhat reduced and its diameter slightly increased.

A few inches above the surface which environed the mound was discovered, upon exploration, a thick bed of charcoal, and a log over eight feet in length and twelve inches in diameter, which had been thoroughly burned.

This coal was mostly in a fine state of preservation. The wood used was of the same species of oak as now occupies the surface of the region. In this mound was observed scarcely a trace of ashes.

From all the evidence gained it was plain to be seen that this was not a place of sepulture; but, on the contrary, was a place where wood was burned for the purpose of obtaining ashes to aid in the construction of at least some of the burial mounds.

No fire had been used on any of the burial mounds examined, both the charcoal and ashes found in them having been brought in from some other place.

All the remains found in the mounds had been buried in the flesh, the earth in contact with the bodies being deeply stained by their decomposition.

As before stated, the earth from which the mounds were constructed was a yellow, clayey material, unlike that of the surface of the region, and had been brought in from some other place, at a greater or less distance from the mounds.

No relics of any description were found with the bodies exhumed, and as for field relics, none are reported from the region.

Owing to the lack of time, mounds Nos. 5 to 8 have not, as yet, been explored.—CLEMENT L. WEBSTER, *Charles City, Iowa.*

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A MONTHLY JOURNAL
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IN THEIR WIDEST SENSE.

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THE

AMERICAN NATURALIST

VOL. XXIII. AUGUST, 1889. 272.

THE EDENTATA OF NORTH AMERICA.

BY E. D. COPE.

NORTH America has possessed during late Cænozoic times a limited number of species of Edentata, which have been outliers of the great horde which has peopled South America since the Eocene.

This order embraces two suborders, whose characters were first noticed by Flower,[1] and whose names were given by Gill.[2]

Mutual articulations of posterior dorsal and lumbar vertebræ normal; *Nomarthra.*

Posterior dorsal and lumbar vertebræ with episphen and zygantrapophyses which bear articular surfaces; *Xenarthra.*

Of these divisions it is evident that the Nomarthra are the least specialized, and must be regarded as ancestral to the Xenarthra. Neither of the living families of Nomarthra can, however, claim this position, as they are too specialized in various parts of their structure. They are now exclusively Old World, while the Xenarthra are confined to the New World. The families are distinguished as follows:

NOMARTHRA.

No dermal scuta; teeth, each composed of parallel dental elements; *Orycteropodidæ.*

Body covered with corneous scuta; no teeth; *Manidæ.*

[1] Osteology of the Mammalia, 1870, p. 55.

[2] Standard Natural History, 1884, p. 66.

XENARTHRA.

Astragalus and calcaneum elongate; latter without trochlea; no dermal bones; unguiculate; teeth (sloths);	*Bradypodidæ.*
Astragalus and calcaneum short, former with trochlea; unguiculate; teeth; no dermal bones;	*Megatheriidæ.*
Astragalus short, with trochlea; on dermal bones; unguiculate; no teeth (anteaters);	*Myrmecophagidæ.*
Astragalus short, with trochlea; a carapace of dermal bones; subunguiculate; teeth simple (armadillos);	*Dasypodidæ*
Astragalus short, with trochlea; a carapace of dermal bones; posterior feet ungulate; teeth sculptured by vertical grooves;	*Glyptodontidæ.*

Common ancestors of the Nomarthra and Xenarthra are unknown. But few extinct representatives of the Nomarthra are known.[3] A Manis has been obtained in the Sivaliks of India, and a genus Palæomanis (Forsyth Major) from the Miocene beds of the island of Samos in the Grecian Archipelago. The *P. gigantea* is three times as large as the largest existing species. The same locality has yielded a species of Orycteropus.

The existing forms of the Xenarthra appear to be widely separated from each other, but paleontological discovery has greatly narrowed the intervals between them, so that the homogeneity of the order is certain. Thus the Megatheriidæ are equally allied to the ant-eaters, the sloths, and the armadillos, and such genera as Nothropus and Chlamydotherium connect these with the Glyptodons. The carapace is rudimental in genera both of Glyptodontidæ and Megatheriidæ. The Megatheriidæ also indicate a point of contact with other orders of

[3] The *Pangolin gigantesque* of Cuvier, was referred to a genus Macrotherium by Lartet, and allied forms have been placed in a genus Ancylotherium in Europe and Moropus in America. Macrotherium turns out from the researches of Filhol to have no definite relation to the Edentata, and to be founded on the foot-bones of Chalicotherium. Chalicotherium must be then widely distinguished from the Perissodactyla, where it has been placed. I have proposed a new order, the Ancylopoda, to receive it. See Osborn in AMERICAN NATURALIST, 1888, p. 758, and Cope, l. c. 1889, p. 153.

mammals, as M. Ameghino has discovered some extinct genera from the Parana, in which the teeth possess a narrow band of enamel. The connection is to the Bunotheria, which were probably the ancestors of the Edentata.

The Megatheriidæ are probably the ancestors of both the Bradypodidæ and the Myrmecophagidæ. The modification of the tarsus characteristic of the former is probably due to the assumption of the habit of suspension from limbs of trees by the ancestors of the sloths. This is not only probable from the mechanics of the case, where support on the ground has been followed by suspension below a branch, but also by the analogy of the bats. In these animals, as Dr. H. Allen has pointed out, the similar habit of suspension has produced in the hind limb a similiar modification of the forms of the astragalus and calcaneum.

The Megatheriidæ embrace a large variety of genera, all extinct, and nearly all restricted to the Neotropical Realm. They embrace mostly species of large size, though there is much variation in dimensions. They differ in the number of digits, and the extent to which progression was accomplished on the external edge or sole of the foot. They are also distinguished into Mylomorpha and Rodimorpha (Ameghino), the former having a homogeneous molar dentition, the latter having the anterior tooth in each jaw developed into a canine-like form and function. These types graduate into each other through the genera Mylodon and Lestodon, but not so completely as to destroy the diagnostic value of the character. The genera may be then distinguished as follows:

I. Mylomorpha.

a Molar teeth $\frac{4}{5}$.

Molars with two cross-crests; *Cœlodon* Lund.

aa Molar teeth $\frac{4}{4}$.

Molars with cross-crests; *Ocnobates* Cope.[4]

Molars not ridged; nasal bones connected with premaxillary spine; *Grypotherium* Reinh.

[4] Orocanthus, Ameghino; preoccupied.

aaa Molars $\frac{5}{4}$.

Molars with two cross-crests ;	*Megatherium* Cuv.
Molars simple ; last not elongate ;	*Scelidotherium* Owen.
Molars simple ; last elongate, grooved ;	*Mylodon* Owen.

II. Rodimorpha.

a Molar teeth $\frac{5}{4}$.

Molars with two cross-crests ;	*Pliomorphus* Amegh.
Molars simple, last elongate ;	*Lestodon* Gerv.
Molars simple, none elongate, canines widely separated ; claws compressed ;	*Megalonyx* Jeff.
Molars simple ; canines close together ;	*Diodomus* Ameg.

Besides these, there are several genera described by M. Ameghino, of which the characters are not yet accessible to me. Thus Promegatherium[5] differs from Megatherium by the presence of a band of enamel on the inner side of the molar teeth, but the number of these is unknown. Promylodon[6] Amegh. differs from Mylodon in the same way, but here also the number of these teeth, and other characters, are unknown.

The genera of this family known to occur in North America are Megatherium, Mylodon, and Megalonyx. Of the first, a single species, *M. mirabile* Leidy, is known. It was a large animal, exceeding the Indian Rhinoceros in dimensions. Its remains have been found as yet only in the Pliocene of the Southern States. Mylodon is represented by two species, *M. laqueatus* Harlan, from the eastern region of the continent as far north as Pennsylvania, and *M. sodalis* Cope (Fig. 1), from the Pliocene beds of Oregon. Both were large animals, not smaller than an ox in dimensions. Megalonyx is represented by a larger number of species. The *M. jeffersonii* Cuvier has a geographical range nearly equal to that of the *Mylodon laqueatus*, while another species (Plate XXXI.) has been only found in the Ticholeptus formation of Kansas. In Pennsylvania the bone caves have yielded the teeth of *M. loxodon* Cope, *M. dissimilis* Leidy, and *M. tortulus* Cope.

[5] Bol. Acad. Nac. Cienc. Cordova, 1883, p. 293.

[6] Bollet. Acad. Nac. de la Cienc., Cordova, 1886, p. 184.

These huge beasts were all vegetable feeders, living on the foliage of the trees which they uprooted, or whose branches they

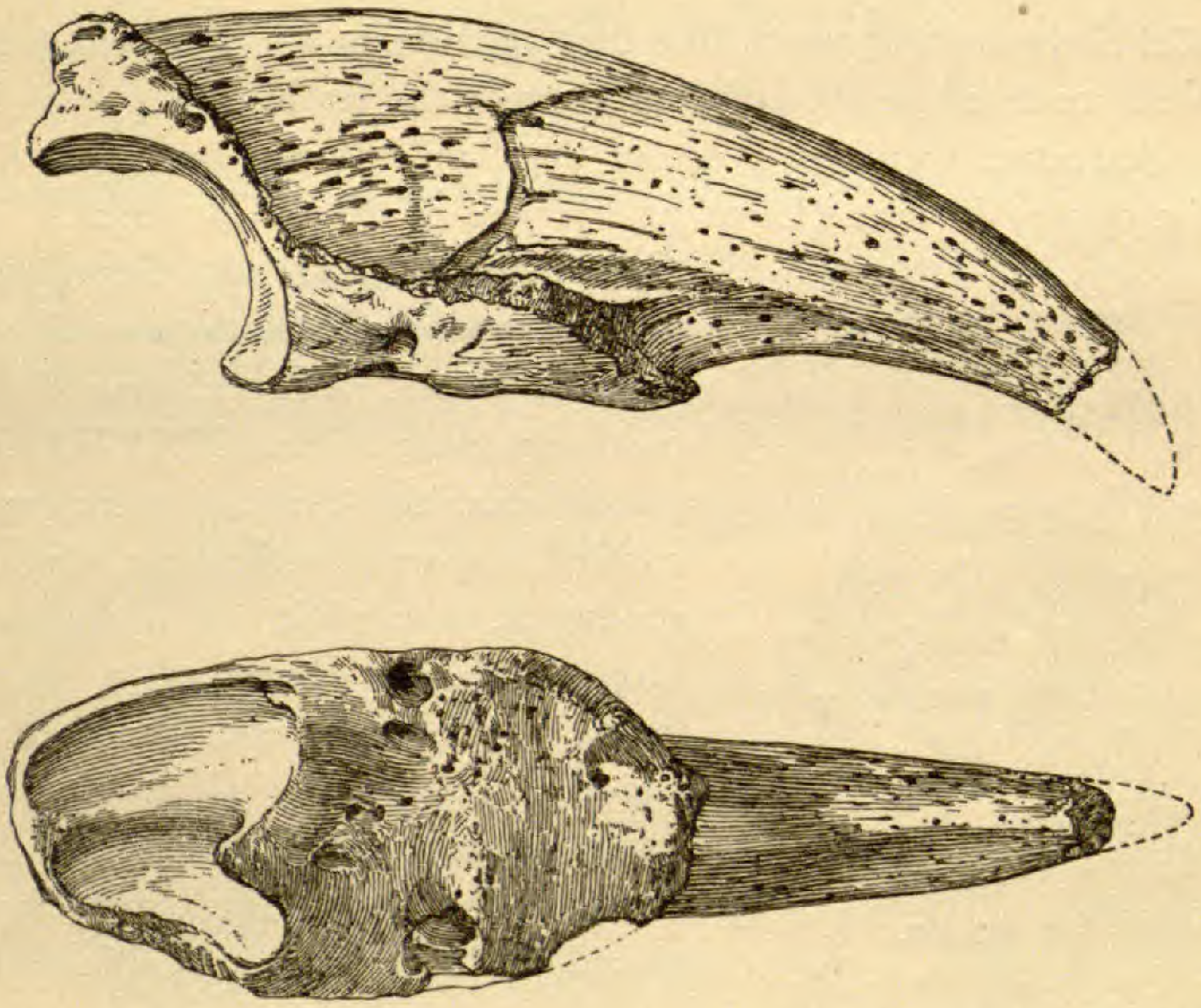


FIG. 1.

could reach. They are of late arrival in North America, and two genera, Megatherium and Mylodon, are each represented by species which persisted to or even into the period of human occupation.

In the Myrmecophagidæ, the terrestrial habit has been retained, but the disuse of the teeth, following the habit of swallowing ants whole in saliva, has resulted in their loss. Corresponding habits and loss of teeth are seen in the Old World Manidæ. No extinct species are known.

The ancestors of the Glyptodontidæ from the Miocene of the Parana, like those of the Megatheriidæ from the same region, possess narrow bands of enamel on the teeth. This discovery, made by Ameghino, confirms the anticipation expressed by myself,[7] that the Edentata are descended from mammalia with enamel-covered teeth. Such forms as the Tæniodonta of the North American Eocene correspond to such a type. These animals were armed with the powerful fodient claws, and the texture of their bones was much like that of Edentata. The enamel is much reduced on the adjacent faces of the teeth.

Ancestral forms of some of the families have been found in the upper Miocene (Loup Fork) beds of North America. The *Caryoderma snovianum* Cope, from Kansas, was a Glyptodont with partially developed carapace, consisting of osseous nodules. (Plate XXXII.) The plates covering the tail were better ossified, apparently forming rings of acuminate tuberosities as in the genus Hoplophorus. Hoofs of a similar form, from Texas, are described by Leidy. The genus Glyptodon exextended its range to North America during Pliocene time. A species was abundant in the valley of Mexico at that period, and specimens of probably the same from southwestern Texas and Florida have furnished the basis of our knowledge of the *G. petaliferus* Cope. (Fig. 2.) Leidy has described a still larger species (*G. floridanus*) from the state after which it is named.

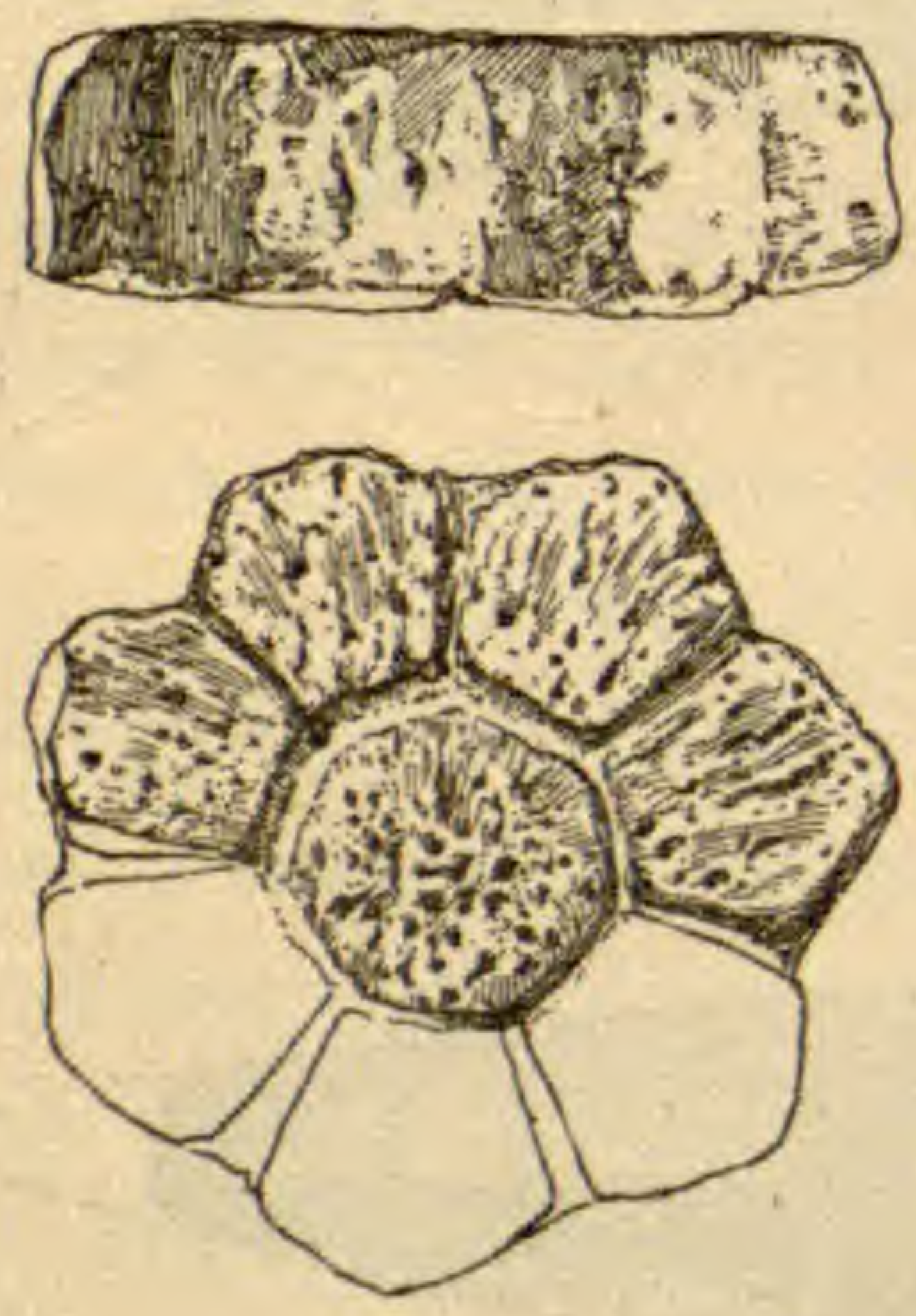


FIG. 2.

The genera of the family may be defined as follows:

I. Teeth with two internal and two external ribs.

Last two molars prismatic; grinding faces plane; *Nothropus* Burm.

II. Teeth with two internal and three external ribs. Tail with distinct rings.

Scuta of carapace nodular; (? teeth)[8] *Caryoderma* Cope.

Scuta of carapace quadrate; *Chlamydotherium* Lund.

[7] U. S. G. G. Surv. W. of 100th Mer., 1887, p. 158; AMERICAN NATURALIST, 1885, p. 352.

[8] Teeth unknown.

PLATE XXXI.

SKULL OF MEGALONYX.

III. Teeth with three internal and three external ribs.

a. Tail, with distinct rings, and without terminal tube.

Digits 5-4; *Glyptodon* Owen.

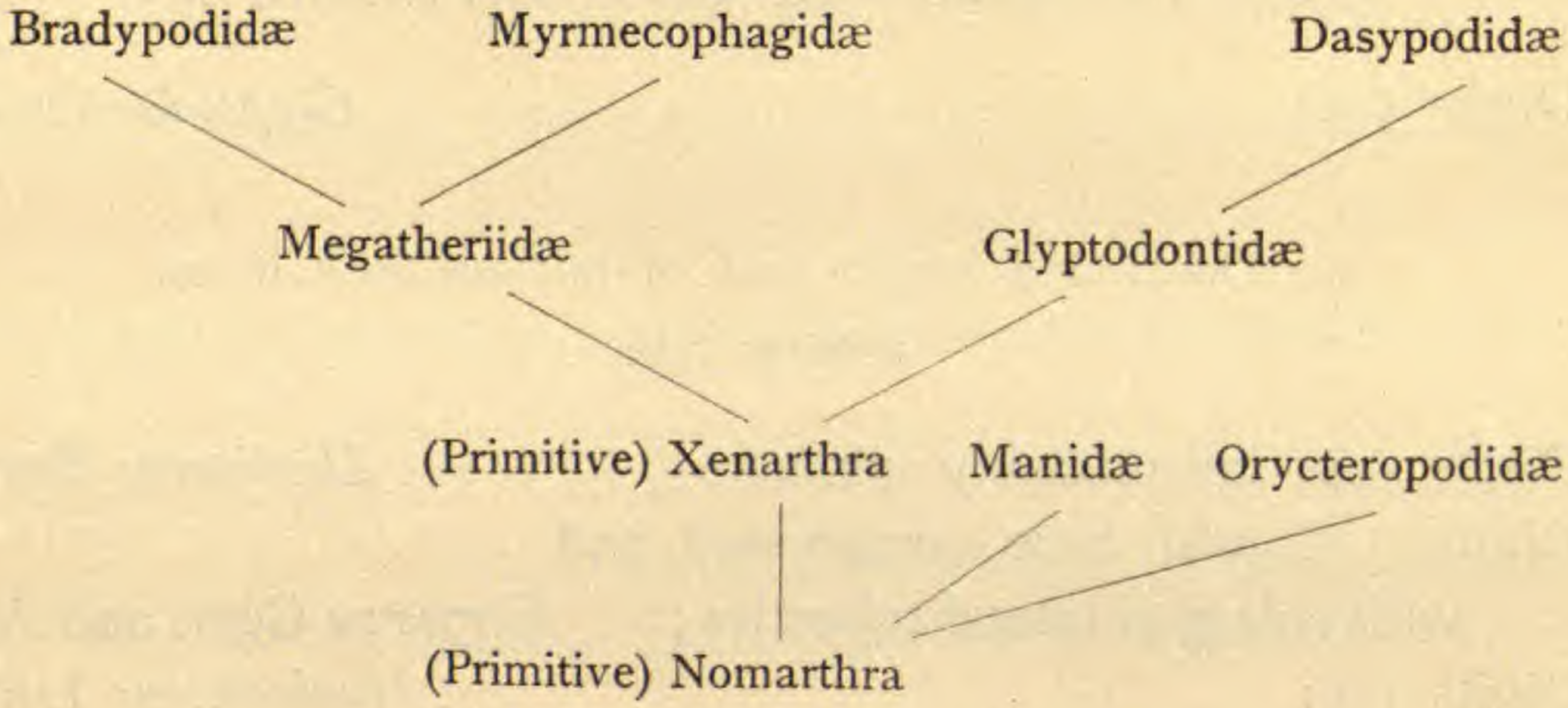
aa. Distal and longer part of tail enclosed in an osseous tube.

Digits 3-4; tail probably spinous; *Dœdicurus* Burm.
Digits? Caudal tube compressed, and with enlarged lateral tubercles; *Euryurus* Gerv. and Am.
Digits 4-4; *Hoplophorus* Lund.

The species of these genera are of various dimensions. *Caryoderma snovianum* (Plate XXXII.) was about the size of a glutton or catamount, while *Chlamydotherium gigas* was nearly equal in size to a rhinoceros. The *C. humboldtii* and various species of Glyptodon and Hoplophorus might be compared to the *Tapirus americanus*. *Dœdicurus clavicaudatus* Owen reached a length of twelve feet, according to Burmeister, and its massive spinous tail was an efficient weapon. *Hoplophorus tuberculatus* Owen is said to be as large as a rhinoceros. It can be seen how greatly their existing descendants, the armadillos, have diminished in size, as well as simplified the forms of their teeth.

It is probable that the Dasypodidæ are descendants of the Glyptodontidæ by a reduction of the complexity and increase in number of the teeth. The posterior ungual phalanges of fœtal armadillos are, according to von Ihring, ungulate and trilobate, as in Glyptodontidæ. Extinct species of Dasypodidæ occur in the later Cænozoic beds of South America, most of which belong to existing genera. The principal extinct genus known is Eutatus Gerv. which usually resembles Tatusia, but has five digits on all the feet instead of four. Several species are known.

Much remains to be learned about the phylogeny of this order. The present phase of the subject may be represented as follows:



EXPLANATION OF PLATE XXXI.

Three views of the skull of a species of Megalonyx.

EXPLANATION OF PLATE XXXII.

FIGS. 1—16. Dermal bones of *Caryoderma snovianum* Cope, natural size.

FIG. 17. Ungual phalange of do.

PLATE XXXII.

Caryoderma snovianum Cope.

HISTORY OF GARDEN VEGETABLES.

BY E. L. STURTEVANT.

(Continued from p. 987, Vol. 1888.)

LIMA BEAN, *Phaseolus lunatus* L.

THIS bean is of American origin, as its seed has been found in the mummy pits of Peru,[1] and Bentham cites specimens spontaneous in the region of the River Amazon and Central Brazil.[2] Thevetus, in 1558, published his "Les Singularities de la France Antarctique ou Amerique," and in this he speaks of the "Americanorum Faba, omnino alba, valde compressæ, nostratibus latiores et longiores," which is probably this species. The striæ radiating from the eye of the Lima bean make its identification very easy, and hence we cannot be in error in our recognition of the figures given by Lobel[3] in 1591, Clusius[4] in 1601, J. Bauhin[5] in 1651, and Chabræus[6] in 1673, and Clusius notes that he first grew it in 1576.

The synonymy, as I have studied it out, is as follows:

Phaseoli magni late albi. Lob. Ic., 1591, 2, 60.

B. peregrini I. genus alterrum. Clus. Hist., 1601, 2, 223 (seen in 1576) fig.

Phaseolus, lato, striata, sive radiato semine. J. Bauh., 1651, II., 267, fig.

P. novi orbis, latus, totus candidus similaci hortensis affinis. J. B., 1651, II., 268, fig. Chabr., 1673, 137, fig.

Phaseolus lunatus, L. sp., 1763, 1016.

P. inamœnus, L. sp., 1763, 1016.

P. bipunctatus. Jac. Hort., I., t. 100, ex Mill. Dict.

P. rufus. Jacq. Hort., I., 13, t. 34, ex Mill. Dict.

P. saccharatus. Macfad., 1837, 282.

P. puberulus. Kunth. Syn., 1825, IV., 106.

Bushel or Sugar Bean. A Treat. on Gard. (1818[?]).

1 Squiers. Peru, 78.
2 Decandolle. Orig. des Cult. Pl., 276.
3 Lobel. Ic., 1591, 2, 60.
4 Clusius. Hist., 1601, 223.
5 J. Bauhin. 1651, II., 268.
6 Chabræus. Ic. et Sciag., 1673, 137.

Sugar Bean. Maycock, Barb., 1830, 293.

Lima Bean. McMahon, 1806.

This bean requires a warm season, and hence is not grown so much in northern and central Europe as in this country. Vilmorin[7] describes three varieties and names two others. Martens,[8] however, describes five well marked varieties.

1. The *large white Lima* is among those figured by Lobel[10] and by J. Bauhin,[11] and this places its appearance in Europe in 1591, and according to Martens it is the *Phaseolus inamœnus* L. It was in American gardens[9] in 1828, and probably before.

2. The *potato Lima* is a white bean, much thickened and rounded as compared with the first. It seems to be fairly figured by Lobel[10] in 1591, and to be the *Phaseolus limensis* Macfad.[12] justly esteemed in Jamaica.

3. The *small white Lima*, or *Sieva*, *saba*, *Carolina*, *Carolina sewee* and *West Indian*, is esteemed on account of its greater hardiness over the other varieties. It is also well figured by Lobel in 1591, under the name Phaseoli parvi pallido-albi ex America delati. On account of the names, and the hardiness of the plant, and as being probably cultivated by the Indians, I am disposed to suggest that it may be the Bushel or Sugar bean, esteemed very delicate, and of various colors, as white, marbled, and green, and grown in Virginian gardens before 1818.[13] Lawson[14] in 1700–8 says: "The Bushel bean, a spontaneous growth, very flat, white, and mottled with a purple figure, was trained on poles" in the Carolinas. The Sieva, if a synonym of the Bushel bean, is the white form, and was in American gardens before 1806. Vilmorin mentions a variety of the Sieva spotted with red.

4. The *speckled Lima* has white seeds striped and spotted with a deep, dark red. The figures of Lobel, 1591, under *Phaseoli rubri*, very well represent the cultivated variety, as also a sort sent

[7] Vilmorin. Les Pl. Pot., 1883, 278.

[8] Martens. Die Gartenbohn, 1869, 96.

[9] Fessenden. New Am. Gard., 1828, 36.

[10] Lobel. Ic., 1591, 260.

[11] J. Bauhin. Hist., 1651, II., 168.

[12] Macfadyen. Jam., 1837, 280.

[13] A Treatise on Gardening; by a Citizen of Va., n. d., 275.

[14] Lawson. A Voyage to Carolina, 76, 77.

me as growing spontaneously in Florida in abandoned Indian fields.

5. The *large red* I cannot trace; it may be the blood red bean Martens received from Texas, Sierra Leone and Batavia. It differs from the next but in size.

6. The *small red* answers well to the description given of *Phaseolus rufus* Jacq. by Martens, and this put its appearance at 1770.

These six varieties, with their synonyms, include all the Lima beans with which I am acquainted, but there are a number of other sorts described, which sooner or later will appear and be claimed as originations. A careful reflection over my list will clearly convince that our varieties are all of ancient occurrence, and that there have been no originations under culture within modern times. A black white-streaked form is recorded in Cochin China by Loureiro; a white black-streaked form is figured by Clusius in 1601; a black as *Phaseolus derasus*, Schrank, in Brazil. The *P. bipunctatus* Jacq. has not as yet reached our seedsmen, although grown at Reunion under the name of pois du Cap. Martens describes several others with a yellow band about the eye, and variously colored, and one with an orange ground and black markings occurs among the beans from the Peruvian graves at Ancon at the National Museum.

The Lima bean is called in India[15] the *Duffin* or *Vellore bean;* in Jamaica[16] the *Sugar bean*, as also in Barbadoes.[17] In France, *Haricot de Lima, feve creole;* in Germany, *Lima bohne;* in Italy, *Faguiolo di Lima;* in Spain, *India de Lima;*[18] in Ceylon, *ooru-dumbala.*[19]

LOVAGE. *Ligusticum levisticum* L.

This plant is yet to be rarely found in gardens. At the present day, says Vilmorin, Lovage is almost exclusively used in the manufacture of confectionery; formerly the leaf stalks and bottoms of the stems were eaten, blanched like celery.[20] The whole

[15] Ainslie. Mat. Med., I., 28.
[16] Macfadyen, l. c.
[17] Maycock, Fl. Barb., 293.
[18] Vilmorin, l. c.
[19] Birdwood. Veg. Prod. of Bomb., 122.
[20] Vilmorin. The Veg. Gard., 1885, 316.

plant has a strong, sweetish, aromatic odor, and a warm, pungent taste, and is probably grown now in America, as in 1806, rather as a medicinal than as a culinary herb. It appears to have been known to Ruellius [21] in 1536, who calls it *Levisticum officinarum*, and was only seen in gardens by Chabræus [22] in 1677.

It is called in France *ache de montagne*, *liveche ;* in Germany, *liebstock ;* in Spain, *apio de monte*.[22]

MALLOWS. *Malva crispa* L.

This plant is considered nearly indispensable in French gardens, although it is not an esculent, but the leaves are used for garnishing.[23] It was known to Camerarius[24] in 1588, and was only known to Dodonæus,[25] in 1616, as a cultivated plant. The mallows which were used by the Romans as a pot-herb appear to be the *Malva rotundifolia* L. Even Pythagoras thought much of this spinage, and it is even now said to be grown extensively on the banks of the Nile. *M. sylvestris* L. appears also to have been grown by the Romans as a pot herb, and *M. verticillata* L. has been recognized among Chinese vegetables from the 5th century. All these, and, indeed, all malvas have now disappeared from cultivation as edibles in European countries.

The Curled Mallow is called in France *mauve frisée*, *mauve crepue*, *mauve à feuilles crispées ;* in Germany, *krausblättrige malve ;* in Italy, *malva crespa*.

The *M. rotundifolia* L. was carried to North America previous to 1669, and now appears as a weed. It is the *mallows* of Britain and America, the *mauve* of France, the *runde kasepappel* of Germany, the *malva* of Italy, the *moloha* or *molohe* of Greece. In Yemen called *hobsen*.[26]

The *M. verticillata* L. is called in Egypt *khobbeyzeh ;* in China *tung han ts'ai*.[27]

[21] Ruellius. De Nat. Stirp., 698.

[22] Chabræus. Icones et Sciag., 1677, 401.

[23] Vilmorin. The Veg. Gard., 319.

[24] Camerarius. Hort., 1588.

[25] Dodonæus. Pempt., 1616, 653.

[26] Pickering. Ch. Hist., 348.

[27] Gard. Chron., July 10, 1886, 41.

MANGOLD. *Beta vulgaris*, var.

Mangolt was the old German name for the Chard, or rather for the beet species, but in recent times it has become applied to a large growing root of the beet kind, used for forage purposes. In the selections size and the perfection of the root above ground have been important elements, as well as the desire for novelty, and hence we have a large number of very distinct appearing sorts,—the long red, about two-thirds above ground, the olive shaped or oval, the globe, and the flat-bottomed Yellow d'Obendorf. The colors to be noted are the red, the yellow, and the white. The size often obtained in single specimens is enormous; a weight of 135 pounds[28] has been claimed in California, and Gasparin in France vouches for a root weighing 132 pounds.[29]

I have ascertained very little concerning the history of mangolds. They certainly are of modern introduction. Olivier de Serres[30] in France, 1629, describes a red beet which was cultivated for cattle-feeding, and speaks of it as a recent acquisition from Italy. In England it is said to have arrived from Metz[31] in 1786, but I find a book advertised of which the following is the title:—Culture and use of the Mangel Wurzel, a Root of Scarcity, translated from the French of the Abbe de Commerell, by J. C. Lettsom, with colored plates, third edition, 1787,[32]—by which it would appear that it was known earlier. McMahon[33] records it in American culture in 1806. Vilmorin describes sixteen kinds, and mentions many others.

The beet is one of the plants most easy to improve by selection, as the experience of Vilmorin proves, as well as the more perfected varieties which are constantly being advertised. I doubt not but that the prototypes of all the distinct forms could be found in nature, but unfortunately I find no descriptions which I

[28] U. S. Department of Agriculture Report, 1866, 597.

[29] Pr. Es. H. Soc., 3rd Ser., IX.. 258, note.

[30] Decandolle. Geog. Bot., 831.

[31] Sinclair. Hort. Gram., Woburn, 1824, 410.

[32] Wesley. Nat. Hist. Book Circular, No. 71, 1886.

[33] McMahon. Am. Gard. Cal., 1806, 187.

can use to illustrate this idea, which receives such constant support with other plants whenever facilities for investigation occur.

The *mangold*, *mangold-wurzel* or *Root of Scarcity* is called in France *Disette*, *Racine d'abondance*, *Betterave Disette;* in Germany, *mangel-worzel*, *futter-rube*, *futter-runklerube;* Flanders and Holland, *mangel-wortel;* in Spain *remolacha de grav cultivo*, *betabel campestu.*

MARTYNIA. *Martynia*, sp.

The fruits of the Martynias, when gathered while young and tender, make an excellent pickle, and they are occasionally grown in our gardens for this purpose. There are two species.

M. proboscidea Glox. This purple-flowered form occurs wild on the banks of the Mississippi and lower tributaries to New Mexico. It is also cultivated in gardens further north, about which it is apt to become naturalized.[34] It is mentioned under American cultivation in 1841.[35] It was known in England as a plant of ornament in 1738,[36] and perhaps there has scarcely as yet entered the kitchen garden.

M. lutea Lindl. This species, originally from Brazil, has yellow flowers.[37] It does not appear to be in American gardens, as I have never seen it, nor is its seed advertised by our seedsmen. It reached Europe in 1824.[38] It is described by Vilmorin as under kitchen garden culture.

The Martynia, or Unicorn plant,[39] is called in France *martynia*, *cornaret*, *cornes du diable*, *bicorne*, *ongles du diable;* in Germany, *gemsenhorner;*[37] in Italy, *testa di quaglia;*[40] in Malta, *testa di quaglia.*[36]

MEADOW CABBAGE. *Cirsium oleraceum* Scop.

This plant is included among vegetables by Vilmorin,[41] although he says it does not appear to be ever cultivated. The swollen

[34] Gray. Syn. Flora, II., 321.

[35] Kenrick. New Am. Orchard, 3d ed., 1841, appendix.

[36] Gard. Chron., 1843, 608.

[37] Vilmorin. Les Pl. Pot., 329.

[38] Noisette. Man., 1829, 537.

[39] Burr. Field and Gard. Veg., 1863, 612.

[40] A Smith. Treas. of Bot.

[41] Vilmorin. Les Pl. Pot., 1883, 157; The Veg. Gard., 1885, 321.

root-stock, gathered before the plant flowered, was formerly used as a table vegetable. It does not appear to have ever reached American gardens or use.

MELON. *Cucumis melo* L.

Both the word *melon* and *pepon* have been used in a generic sense, and sometimes as synonymous. Albertus Magnus,[42] in the thirteenth century, says, *melons*, which some call *pepones*, have the seed and the flower very nearly like those of the cucumber, and also says in speaking of the cucumber that the seeds are like those of the *pepo*. Under the head of the watermelon, *citrullus*, he calls it *pepo*, with a smooth, green skin, but the *pepo* is commonly yellow and of an uneven surface, and as if round semicircular sections were orderly arranged together. In 1536 Reullius[43] describes our melon as the *pepo;* in 1542 Fuchsius[44] describes the *melon*, but figures it under the name of *pepo*. In 1550 Roszlin[45] figures the melon under the name of *pepo*, and in 1558 Matthiolus[46] figures it under the name of *melon*. The Greek name of *pepon*, and the Italian, German, Spanish, and French of *melon*, variously spelled, are given among synonyms by various authors[47] of the sixteenth century, and *melones* sive *pepones* are used by Pinæus in 1561,[47] *melone* and *pepone* by Castor Durante[48] in 1617, and by Gerarde[49] in England, in 1597. *Melons* and *pompions* are used synonymously, and the melon is called *muske-melon* or *million*.

Whether the ancients knew the melon is a mattter of doubt. Dioscorides,[50] in the first century, says the flesh or pulp (cara) of the *pepo* used in food is diuretic. Pliny,[51] about the same period, says a new form of cucumber has lately appeared in Campania called *melopepo*, which grows on the ground in a round form, and he adds, as a remarkable circumstance, in addition to their color

[42] Albertus Magnus. De Veg., Jessen ed., 1867, 501.

[43] Ruellius. De Nat. Stirp., 1536, 503.

[44] Fuchsius. De Stirp., 1542, 702, 701.

[45] Roszlin. Kreuterb., 1550, 116.

[46] Matthiolus. Com., 1558, 262.

[47] Pinæus. Hist., 1561, 194. Camerarius, Epit., 1586, 296, etc.

[48] Castor Durante. Herb., 1617, 345.

[49] Gerarde. Herb., 1597, 775, 770.

[50] Dioscorides. Vergelius trans., 1532, 219.

[51] Pliny, Lib. XIX., c. 23.

and odor, that when ripe, although not suspended, yet the fruit separates from the stem at maturity. Galen,[52] in the second century, treating of medicinal properties, says the autumn fruit [*i.e.*, ripe] do not excite vomiting as do the unripe, and further says mankind abstain from the inner flesh of the *pepo*, where the seed is borne, but eat it in the *melopepo*. A half century later Palladius[53] gives directions for planting *melones*, and speaks of them as being sweet and odorous. Apicius,[54] a writer on cookery, about 230 A. D., directs that *pepones* and *melones* be served with various spices corresponding in part to present customs; and Nonnius, an author of the sixth century, speaks of cucumbers which are odoriferous.[55] In the seventh century Paulus Ægineta,[56] a medical writer, mentions the medicinal properties of the *melopepo* as being of the same character, but less than that of the *pepo*, and separates these from the *cucurbita* and *cucumis*, not differing from Galen, already quoted.

From these remarks concerning odor and sweetness, which particularly apply to our melon, and the mention of the falling spontaneously of the ripe fruit, a characteristic of no other garden vegetable, we are inclined to believe that these references are to the melon, and more especially so as the authors of the sixteenth and following centuries make mention of many varieties, as Amatus Lusitanus,[57] in 1554, who says, "*quorum varietas ingens est*," and proceeds to mention some as thin skinned, others as thicker skinned, some red fleshed, others white.

I know scarcely enough about melons as yet to classify into types, as I am only acquainted with fifty-eight names of varieties under growth, but varieties occur that can be described as round, flattened, oblong, oval, long; as smooth, netted, ribbed, warted; as white, green, red, orange fleshed; as early, late, and winter.

The following may be considered as notes only; not as com-

[52] Galen. De Alim., Lib. II.; Gregorius ed., 1547, 97.

[53] Palladius, Lib. IV., c. 9; Lib. V., c. 3; Lib. VI., c. 15.

[54] Apicius Cœlius. De Opsonibus, etc., Amsterdam, 1709, 82.

[55] Nonnius. Quoted from Lister in Apulius, l. c.

[56] Paulus Ægineta. De Simp., 1531, 76.

[57] Amatus Lusitanus. In Diosc., 1554, 265.

plete classification, nor even as any classification, and a single and the earlier reference is in most cases only used.

1. Early and late melons, as also winter melons, are described by Amatus[00] in 1554; summer and winter by Bauhin[57] in 1623.

2. White and red fleshed are described by Amatus in 1554; yellow fleshed by Dodonæus in 1616; green fleshed by Marcgrav[62] in 1648; green, golden, pale yellow, and ashen, by Bauhin[57] in 1623.

3. Sugar melons are named *sucrinos* by Ruellius[58] in 1536; *succrades rouges* and *succrades blanches* by Chabræus[59] in 1677; and *succrius* and *succredes* by Dalechampius[60] in 1587.

4. Netted melons are named by Camerarius[63] in 1586, as also the ribbed. The warted are mentioned in the Adversaria[64] in 1570; rough, warted, and smooth by Bauhin[57] in 1623.

5. The round, long, oval, and pear-form by Gerarde[65] in 1597; the quince form by Dalechampius[66] in 1587; the oblong by Dodonæus in 1616; the round, oblong, depressed, or flat by Bauhin[57] in 1623.

The quality of melons varies widely, even in the same variety, under different conditions of growth, as was well known in 1513, when a Spanish author, Herrera,[67] says, "If the melon is good, it is the best fruit that exists, and none other is preferable to it. If it is bad, it is a bad thing. We are wont to say that the good are like good women, and the bad like bad women."

The melon reached America nearly with the discovery, for in 1494 ripe *melons* are recorded as grown by the companions of Columbus.[68] In 1516 "*melons* different from those here" are mentioned in Central America,[69] but perhaps not the melon, but a cucurbit. In 1535, however, Cartier[70] speaks of "*musk melons*"

[00] Amatus Lusitanus. In Diosc., 1554, 265.

[57] Bauhin. Pinax, 1623, 310, 311.

[58] Ruellius, l. c.

[59] Chabræus. Ic. et Sciag., 1677, 134.

[60] Hist. Gen., Lugd., 1587, 623.

[61] Dodonæus. Pempt., 1616, 664.

[62] Marcgrav. Bras., 1648, 22.

[63] Camerarius. Epit., 1586, 296.

[64] Pena and Lobel. Adv., 1570, 285.

[65] Gerarde, l. c.

[66] Hist. Gen., Lugd., l. c.

[67] Herrera. Agric. Gen., ed. 1809, II., 114, quoted from D. C. Geog. Bot., 906.

[68] F. Colombo. Hak. Col., II., 533.

[69] Narrative of Pasceral de Andagoya, Hak. Soc. Ed., 29.

[70] Pinkerton's Voy., XII., 652; Hakl. Voy., III., 276.

on the St. Lawrence. In New Mexico, *melons* are named by Gomara[71] in 1540, and also 1542.[72] In 1565, *melons* were abounding in Hayti.[73] In 1582 de Espijo[74] speaks of *melons* and pumpkins as grown by the Indians of New Mexico; in 1584 as found in Virginia[75] by Captains Amidos and Barlow; and again as *muskemelons* in 1609.[76] In 1609 also they were seen on the Hudson River,[77] and are described as abundant in New England by Master Graves[78] in 1629, as also by Woods.[79]

In 1806 McMahon names thirteen kinds under American culture. At the present time at least a hundred different names of varieties can be collected.

The *melon* or *muskmelon* is called in France and Spain, *melon;* in Germany, *melone;* in Flanders and Holland, *moloen;* in Italy, *popone, melone;* in Portugal, *melas;*[80] in Greece, *peponia;* in Russia, *dina;*[81] in Norway, *melon;*[82] in Arabic, *beteekh, kirboozeh,*[83] *domeyri, dremmaijre;*[81] in Bengali, *kurbooja,*[83] *khurbuz,*[84] *phuti;* in Burmah, *tha-khwahmwæ:*[84] in Comanche Indian, *pehena;*[86] in Ceylon, *rata-komadu;* in Hindustani, *karbooja;*[83] in Japan, *tenkwa, kara uri;*[87] in Malay, *labofrangee;*[83] in Persia, *kharbuza;*[85] in Sindh, *gidhro;*[83] in Tagalo, *tabogo;*[85] in Tamil, *molam;*[84] in Tartar and Turkish, *kaun.*[81]

MINT. *Mentha viridis* L.

This garden herb was well known to the ancients, and is mentioned in all early mediæval lists of plants. Amatus Lusitanus[88] in 1554 says it is always in gardens, and later botanists confirm this statement for Europe. It was in American gardens

[71] Wipple & Turner. Pac. R. R. Repts., III., III.

[72] Cabeca de Vaca, Relation. Smith's ed., note, p. 165.

[73] Benzoni. Hist. of the New World, Lond., 1857.

[74] Hakl. Voy., III.

[75] Pinkerton's Voy., XIII.

[76] A True Decl. of Va., 1610, 13.

[77] Delafield. N. Y. Agr. Soc. Trans., 1850, 359.

[78] Mass. Hist. Soc. Coll., 1st ser., I., 124.

[79] Woods. New Eng. Prosp., 1st ed., II.

[80] Vilmorin. Les Pl. Pot., 1883, 332.

[81] Decandolle. Geog. Bot., 906, 908.

[82] Schubeler. Culturpflanz, 108.

[83] Birdwood. Veg. Prod. of Bomb., 156, 301.

[84] Drury. Useful Pl. of Ind., 172.

[85] Pickering. Ch. Hist., 229.

[86] Marcy. Red River, 275.

[87] Kaempfer. Amoen., 811; Thunb. Jap., 323.

[88] Amatus Lusitanus. In Diosc., 1554, 319.

in 1806,[89] and probably far earlier, for it was collected by Clayton in Virginia about 1739[90] as a naturalized plant.

Mint, green mint, or spearmint is called in France *menthe vert;*[91] in Spain, *hierva buena, ortelana;* in Italy, *menta;* in Germany, *muntz;* in Arabic, *nahanaha;*[92] in the Mauritius, *menthe;*[93] in India, *podeena;*[94] in the Deccan, *pahari-poodenah.*[95]

MUGWORT. *Artemisia vulgaris* L.

This plant, of insignificant use, is yet included among the plants of the garden by European writers. The leaves are strong, bitter, and aromatic, and are sometimes used for seasoning.[96] It was formerly employed to a great extent for flavoring beer, before the introduction of the hop,[97] and the leaves are said to have been used for food in China in the fourteenth century.[98] It is as yet scarcely in the vegetable garden, and it is unnecessary to inquire when the first entry was effected.

The *mugwort* is called in France, *armoise, couronne de St. Jean, herbe a cent gonts;* in Germany, *beifuss;* in Holland, *bijvoet;* in Italy, *santolina;* in Arabic, *artemasaya, utmeesa;* in Hindustani, *nagdowna;* in Persia, *birunjasif;* in Telugu,[99] *davanamu;* in Japan, *gai* or *jamogi.*[100]

MUSTARD. *Sinapis* sp.

Mustard was well known to the ancients, but the use seems to have been more medicinal than dietetic, yet Apicius,[101] about 230 A. D., makes frequent uses of it in his receipts on cookery, and in an edict of Diocletian, A. D. 301, it is mentioned along with alimentary substances. In Europe, during the middle ages, mustard was used with the salted meats which formed such a

89 McMahon. Am. Gard. Cal., 1806.
90 Gronovius. Virg., 1762, 89.
91 Vilmorin. Les Pl. Pot., 1883, 353.
92 Camerarius. Epit., 1586, 477.
93 Bojer. Hort. Maur., 1837, 247.
94 Speede. Ind. Handb. of Gard., 1842, 183.
95 Birdwood. Veg. Prod. of Bomb., 64, 241.
96 Vilmorin. Les Pl. Pot., 1883, 12.
97 Johnson. Useful Pl. of Great Brit., 154.
98 Bretschneider. Bot. Sin., 51.
99 Birdwood. Veg. Prod. of Bomb., 47.
100 Kaempfer. Amoen., 1712, 897.
101 Apicius. De Opsoniis, etc., Anesblodami, 1709.

large portion of the winter diet of our ancestors.[102] It is, however, as a vegetable that we treat of it here.

Sinapis alba L.—White mustard is grown in gardens for the young leaves, which are used in salads, and about London is grown in gardens to a large extent. In 1542 Fuchsius,[103] a German writer, says it is planted everywhere in gardens. In 1597, in England, Gerarde[104] says it is not common, but he has distributed the seed, so that he thinks it is reasonably well known. It is mentioned in American gardens in 1806.[105]

White mustard, or Salad mustard, is called in France, *moutarde blanche*, *moutardin*, *plante au beurre*, *seneve blanc*; in Germany, *gelber senf*; in Flanders, *witte mostaard*; in Holland, *gele mosterd* or *mostaard*; in Italy, *senapa bianca*; in Spain, *mostaza blanca*;[106] in Greece, *agriourouva*, *napi*, *sinapi*;[107] in China, *kai kie*.[108]

Sinapis nigra L.—The black mustard is described as a garden plant by Albertus Magnus[109] in the thirteenth century, and is mentioned by the botanists of the sixteenth century. It is, however, more grown as a field crop for its seed, from which the mustard of commerce is derived, yet finds place also as a salad plant. Two varieties are described, the *black mustard of Sicily* and the *large-seeded black*.[110] It was in American gardens in 1806 or earlier.

Black mustard, *brown mustard*, or *red mustard* is called in France, *moutarde noire*, *navuce rouge*, *russebau*, *seneve noir*; in Germany, *brauner senf*; in Flanders, *zwarte mustaard*; in Holland, *bruine mosterd*; in Spain, *mostaza nigra*;[106] in Italy, *senape*, *senapi*.[107]

Mustard.—Chinese Cabbage-Leaved.—This vegetable, the species not indicated, is described by Vilmorin[106] as under European culture, and he says that in warm countries it forms one of the most highly esteemed green vegetables. In China *Sinapis*

102 Pharmacographia, 1879, 64, 69.

103 Fuchsius. De Stirp., 1542, 537.

104 Gerarde. Herb., 1597, 190.

105 McMahon. Am. Gard. Cal., 1806.

106 Vilmorin. Les Pl. Pot., 1883, 355.

107 Pickering. Ch. Hist., 246.

108 Bretschneider. On the Study, etc., 17.

109 Albertus Magnus. De Veg., Jessen ed., 1867, 568.

110 Vilmorin. The Veg. Gard., 1885, 352.

brassicata L. is said to be cultivated abundantly,[111] and *S. chinensis* L. to occur in Cochin-China in two varieties. *S. pekinensis* Lour. was introduced to France from China in 1837.[112] This plant, says Livingston,[113] is more extensively used by all classes of the Chinese than any other,—perhaps than all the others together. It is carried about the public streets for sale, boiled, in which state its smell is extremely offensive to Europeans. It is recorded as in the United States by Burr[114] in 1863. In Portugal its seeds were sown by Loureiro on his return from Cochin-China in the eighteenth century.[111]

THE SEGREGATIONS OF POLLED RACES IN AMERICA.

BY R. C. AULD.

COMING to America itself it is interesting to investigate the tendency toward the throwing off the horns among the native cattle, as developed by the environment of so decidedly different characters from that the species was formerly accustomed to.

South America.—In a passage quoted from Major Hamilton Smith, allusion was made to the occurrence of polled cattle in Spain; and on the supposition that they may have been transported thence to form the polled breed of Assumption in Paraguay. Darwin seems to have disregarded this view; for his opinion is that they "appeared suddenly from what we call spontaneous variation," this being the only instance in which the origin and formation of a polled race were fully known.[1]

[111] Miller's Dict., 1807.

[112] Bon Jard., 1882, 533.

[113] Livingston. Hort. Trans., V., 54.

[114] Burr. Field and Gard. Veg., 1863, 386.

[1] Letter to Macdonald and Sinclair, authors of "History of Polled Cattle."

Dr. J. Cowles Pritchard (Hist. of Man), while alluding to these South American cattle, "which are brown, red, and black," refers to the observations of Don Felix de Azara (Voyages dans l'Amérique Méridionale), also quoted by Darwin, who states that in 1770 a bull without horns was born, from which a race so characterised was founded;—"En 1770 il naquit un taureau mocho ou sans cornes, dont ca race s'est très multipliée." He notes the influence of a polled bull. The calves by him were "also destitute of horns." This case, stated to be the only instance of the origination of a peculiar breed taking place under man's own observation, and the only instance of such a kind within the knowledge of such an eminent investigator as Darwin, is very interesting.

A year or two ago a gentleman of Buenos Ayres informed me that polled calves occurred among herds on the Pampas.

North America.—Speaking of the early importations of cattle into Maine, Dr. Holmes states ("Agriculture of Maine," p. 80; 1855): "Up to 1719, there were also occasionally found some polled or hornless cattle, which were probably introduced from England, or from some of the British provinces adjoining us."

In an interesting essay entitled "Remarks on the Physiology of Breeding," contained in the "Report of the Commissioner of Agriculture, Washington, 1863," Mr. S. L. Goodale states "that many years ago there were in the Kennebec valley a few polled or hornless cattle. They were not particularly cherished, and gradually diminished in numbers. Mr. Payne Wingate shot the last animal of this breed (a bull calf or a yearling), mistaking it in the dark for a bear. Thirty-five years subsequently all the cattle upon his farm had horns, but at the end of that time one of his cows produced a calf which grew up without horns, and Mr. Wingate said it was in all respects the exact image of the first bull of the breed brought there.

Judge T. C. Jones, of Delaware, Ohio, writes that in his boyhood days, say three-score years ago, "the cattle in the Ohio valley, as in other parts of the United States, were of every variety of form and color,—some with and some without horns. This diversity of characteristics resulted from the fact that emigrants from Europe brought with them whatever sort was reared in the various localities in which they lived;—some Dutch, a few French; but the majority from various parts of the United Kingdom."

Mr. William Warfield, writing in 1883, said: "I well remember spending the night, nearly a quarter of a century ago, with my father, Captain Warfield, and Dr. R. J. Breckinridge, at the home of Colonel Henry Clay, of Bourbon county, and seeing driven up for our admiration a whole herd of what he called "short-horn muleys"—rather a paradoxical title, but not an unmeaning one. A splendid lot of plums they were, and their owner and inventor was justly proud of them. He had made up his mind, like many of our Western men, that hornless cattle were desirable, and he was convinced that short-horns were the most desirable breed in existence, and so he just set to work and made himself a herd of hornless short-horns. I never learned from him the exact details or the tediousness of the process he pursued further than that he started with a few 'muley' cows—common beasts—and short-horn bulls. But the result spoke for itself. We may ask in vain, What has become of them? In England we should have had them preserved and admired, and made into a wide spread and esteemed polled breed, which in course of time would have had its herd-book, and its great auction, and its enthusiastic supporters. In America, like the achievements of so many of our men of talent, they are left to fade away into nothing. No man takes interest enough in them to keep them up. They are worth just so much per pound, and when a cry arises from our western plains for a hornless race, they are brought, at expense of time and money, from Angus and Aberdeen." In regard to this lament, as far as the shorthorns are concerned, it would seem, according to a recent article by William Housman, of England, that the reverse of the above is the case, and the latter country seems destined to do the lamenting; for, as will be immediately seen, it has been left to this country to preserve and establish a variety of polled shorthorns, and to rescue this variety from the "swamping effects of intercrossing."

In the "History of the Red Polled Cattle," Vol. II., 1883, of the Red Polled Herd-Book, published at Norwich, England, Mr. H. F. Ewen, the Secretary, says:

"'Muley' cattle have been in Virginia for a great many years, and their descendants have also been uniformly polled. The use of a Red Polled bull has specially brought the young stock to the desirable uniformity of color. It would be of value to the students of the history of cattle were search to be made respecting the introduction of polled stock into America. It is recorded that many of the earlier settlers were natives of Norfolk and Suffolk villages. May they not have taken over the polled cattle which in that day were so numerous in Suffolk and on the Norfolk borders?" This passage has been commented on, and we leave it here till we deal with the philology of the subject.

Mr. A. B. Allen, a well-known authority in America, writing me on the subject of "Muleys," says: "I have read your articles with much interest, and regret to say I can give you no further information on our native muleys otherwise than that I know them only as bred from imported European stock, which has been introduced into America from time to time, ever since the settlement of the country, and is sparsely scattered over it. Polled cows have been crossed by all sorts of bulls in this country, but no distinct race has been bred from their crosses. They are mixed up helter-skelter, like all the rest of the native cattle. In native cattle I do not include Shorthorns, Devons, etc.; although bred for generations in our country, we keep them distinct, and class each breed by itself." But there have been a few breeders scattered about who have made attempts, and successful ones, at establishing "native" races of polled cattle from the general conglomerate formed previous to the "distinct" breeding period.

Gen. Ross, of Iowa City, Iowa, also writes: "I have really no opinion as to the origin of the native polled or muley cattle of the United States. From my early boyhood — over fifty years ago — in Illinois, I remember to have seen occasionally a polled cow or steer. They were all colors. The cow that was the ancestor of my home-bred polls was white. Two crosses were made with the Shorthorn, and one with the Devon, by which I procured my first red polled bull, Brigham Young. He was one-half Devon, three-eighths short-horn, and one-eighth unknown blood. One of the best cows of my herd is exactly of the same blood — a beautiful red color, and nicely polled."

Mr. E. W. Perry, of Chicago, informs us that about 1848 Henry Carver took from Ohio to Muscoda, Wis., a number of white polled cattle. He used two yoke of white polled oxen. For a few years his cattle were bred pure, probably from bulls out of his own herd; but wherever the cows were crossed with scrub bulls — there were no improved cattle there at that time — the calves came white and polled in almost every instance. All had black muzzles and ears; and down about the feet and on the fore-legs a few black or brown spots, about the size of a dime to a quarter. About 1853, A. Palmer, of Boscobel, bought one heifer, and from her got a white heifer, polled. Since then he has always had some of them on his place. These white cattle were favorites, because they were very docile, large and rich milkers, and fair beeves, being of good size and reasonably hardy.

I have made extensive inquiries into this matter in America, and I find that in all directions and in all classes of the "natural" stock — from the scrubs of the Eastern States to the long-horned Texan, almost extinct now in its pure-bred state of ultra-Uri type — muleys, or mulleys, or mooleys, are common. Usually they seemed to be regarded as something bastard; and an animal fit only for ridicule and ill-treatment. Any amount of ill-usage they could endure, it was thought. They were of all colors. In a few cases, however, they were prized for thrift, and as pet milchers; and formed a foundation for those who thought of naturalizing a local polled sort.

The following, by Mr. Wm. W. Towne, gives a very graphic idea of the former status of polled cattle in America, and shows how they were given over to neglect — a curious contrast to the high position attained by the muley to-day:

"Ten years ago hornless cattle in America, as a fixed breed, were almost unknown. The few natives seen were regarded as freaks of nature, their peculiar features not justified by their ancestry, and, excepting here and there a man strangely awakened to the comfort and safety of his cattle, no one thought of collecting a herd of them. The term 'mulley' was an epithet to imply low rank in cow circles. In the village where I was born, the mention of Jake Thompson's or Joe Brown's old mulley cow brought to mind a neighbor who was generally out of work, and always out at the elbows, who hunted a little in winter, fished some in spring time, worked a few days at double wages for the farmers in harvest, and completed his efforts at earning a living by digging snake-root and ginseng from the forests around, which he exchanged at the general store for whiskey and tobacco, necessaries in the households of Messrs. Thompson and Brown. This for a routine picture of the owner of the cow; and, as I recall her outline, I remember a cat-hammed beast, with a big udder, ewe neck, small shoulders, poor in flesh and shag in coat, who lived by stealth as her owner lived in idleness. Among the bovine aristocrats of the thriving farmers near around, the mulley cow had no welcome, and if she ever came by unlooked-for birth or unsought purchase, she was either sold to Thompson and Brown, aforesaid, or sent to the butcher. And yet for the children of Thompson and Brown she was both bread and meat, as all the grown-up T.'s and B.'s will affirm.

"Those patient old polls! It was a wonder with me that they continued to be born at all after so many years of neglect, if not outright extermination. Looking around for a reason for their continued existence, it was found in their intrinsic worth. So soon as there was talk among the neighbors of the advantages of hornless cattle as herders, feeders and shippers, it was a gratification to learn that every man spoken to had kind words for some old, uncrowned bossy of memory; the villagers, Thompson and Brown, found them large producers of milk, great foragers, and hence the best poor man's cow in all the land. Lack of food and housing care did not give them rounded forms; generations of cruel neglect robbed them of ancestral beauty, and they were only permitted to survive for the fittest of all reasons — they were useful. Nearly every farmer, it was found, had fond recollections and kind words for some old smooth-pated cow, recalling her quiet ways, and more than average milking qualities. Docility and milk — these are great parts in anybody's cow. If to these we add form and size, the long sought for 'general purpose' cow is found."

"*The Guinea Cow.*"—This is the name of a race but little known beyond Florida and the southern tier of counties in Georgia. The race is now well established, their most prominent characteristics being their adaptability to the region to which they belong. Early in the present century Col. Stapler, who lived near the Florida line, in Lowndes county, Ga., owned several of them, and so far as known all the present herd are descendants of the Stapler stock. *The Breeders' Gazette* published some account of the Colonel's efforts to establish the race, from which we quote. The supposition is that they may be traced to some Brittany cattle imported by some settlers from that country:

"The native pasturage of the pine barrens was neither abundant nor luxurious, indicating the necessity for an animal of small bulk, hardy, and a wide ranger. He succeeded in getting an admirable little animal, that asks for little other food than the scant supply of grass she can gather upon the range, and will keep fat upon a diet that to the larger breeds would be starvation rations. As to size, some fellow says: 'She is a yard high, a yard and a half long, and about a yard wide.' One brought to Enterprise, Volusia Co., Fla., is described by the local paper as follows: 'She is broad on the back, slim neck, small and delicate legs and feet, well filled up in fore and hind quarters, long for her height, which is just thirty-nine inches, and an eye in which meekness and content with gentleness shines. She keeps fat where a common Florida cow would starve, and gives about two gallons of milk, of a high grade, twice a day. This little cow might butcher about 400 lbs. net, and is undoubtedly the most contented and gentle animal in Florida.' Another says: 'Their body is scarcely a foot from the ground, and the udder is enormous. They are hardy and gentle, active browsers, and eat about half what is needed for an ordinary cow.' Yet another says: 'They are usually of a deep red color, always fat and gentle, with crumpled horns and deep escutcheon. They require less food and give more milk than the ordinary cow, and are much hardier and more intelligent.'

"They differ considerably in both size and color; while some are polled others are not. This diversity is doubtless owing to the different degrees of purity of blood. For years it was known as the 'Stapler cow,' and attracted but little attention. But after sales from this herd began to be made the people of the surrounding counties came to appreciate their excellence, and of course they must have a name, and 'Guinea' was the result. The demand for the 'little cow' was such that it was seen to be worth while to breed them for sale. When found for sale the price ranges from $40 to $100 for females; males much lower."

The Jamestowns is the local name used to designate a family of cattle that sprang from a pure Suffolk heifer that came to this country in the United States relief ship "Jamestown" (Captain R. B. Forbes), in the year 1847, on its return from a trip to Ireland loaded with a cargo of provisions for her starving inhabitants. This heifer was given to Captain Forbes by the Lord Lieutenant of Ireland as a token of acknowledgment on the part of his people. The heifer proved a deep milker, giving at her best twenty-six quarts per day, beer measure, of the richest milk. She was bred for several years to Jersey and other horned bulls, nearly all her progeny being without horns, though all her calves but one, so far as I can learn, were bulls, which, according to my experience, are much more likely to show the horns than are heifers from such cross-breeding. In 1854 this remarkable cow dropped a bull-calf sired by Thomas Motley's Jersey bull Beverly. This bull was out of Flora by a first-prize winner at the Royal Agricultural Show in Jersey. Flora was one of the best cows imported by Mr. Motley, having made sixteen pounds of butter per week. The calf was named Jamestown from the ship that brought over his mother, and was secured by the late Dr. Eben Wight and brought to Dedham, Mass., where he was kept many years, leaving a numerous progeny, and so highly was the blood prized by the people in the vicinity that a vote was at one time passed at a meeting of the Norfolk county Agricultural Society, permitting Jamestown to compete for the Society's prizes on an equal footing with other distinct breeds.

The American Agriculturist also recently described a race of white polled cattle that has been successfully raised in New York state, and gave some excellent figures of them as well as details concerning them. In concluding its interesting account it says: "We regard these polled cattle as distinctly American as any cattle we have. They have, of course, a European origin, but what it is remains in obscurity. They are to-day as truly American as are the Chester White pigs, Vermont merino sheep, Plymouth Rock fowls, or Morgan horses." Why not start a Register for these American polled cattle?

At the Ohio Centennial Exhibition, held at Columbus last fall, Messrs. Clawson and Shafer exhibited some very fine specimens of native polled Durham's, *i.e.*, cattle raised from native muleys of Durham stock.

Pure-bred Polled Shorthorns.—But the most interesting modern instance supplied by America is that of providing specimens of polled individuals among pure bred shorthorns. A small herd of these was established near Minneapolis, Minnesota, the joint property of Mr. H. W. McNair and the estate of Hon. W. W. McNair. These cattle are all descended, either through dam or sire, from Oakwood Gwynne 4th (an imported Medora by Horatio) by Marquis of Geneva 10451. Nellie Gwynne and Mollie Gwynne (twins of October, 1881), from this cow and by 7th Duke of Hillhurst 34221; her bull calf King of Kine (August 15, 1883), by Bright Eyes Duke 31894; also Nellie Gwynne 2d, out of Nellie Gwynne and by Favorite 48182; Mollie Gwynne 2d, out of Mollie Gwynne and by King of Kine—all were entirely devoid of horns from birth; and King of Kine, at the head of this herd, has in one instance only got a calf with horns, and in that case the horns were very small. There is also in the herd Hazel Hill Pride (calved October 6, 1886), by King of Kine, out of Music Gwynne 6th [an imported Music by (9918)], and Lord Elmor (calved July 9, 1887) by King of Kine, out of Eugenie 4th (an imported Britannia), both "doddies."

These cattle will all appear in Vol. XXXIII. of the herd book.

This little herd was purchased by W. S. Miller, of Elmore, Ohio, and exhibited by him at the Ohio Centennial Exposition at Columbus last fall.

Mr. Miller informs me that the following breeders have had pure-bred mooley shorthorns in their herds: J. M. Jackson, Coitsville, O.; R. Baker, Elyera, O.; and Jacob Powell, Independence, Mo. But it is only now since the advantage of the want of horns on cattle has become apparent—and when it has been demonstrated that the hornless cattle can be as masterful and of as good quality as the horned—that the polled tendency has been watched for by shorthorn breeders, and the character severed from "the swamping effects of free intercrossing with the parent form"—a principle made prominent recently by Prof. G. J. Romanes, F.R.S.

A few years ago a hornless Durham bull was brought to Richmond, N. Y. Mr. Pitts, a breeder of pure shorthorn cattle, kept the bull for use in his herd, and his get proved to be hornless, and the hornless stock being sold in neighboring towns founded this variety, which was here shown and received premiums.[2]

William Warfield, commenting on "Inbreeding and Crossing," uses the following illustration: The former of a new breed is ordinarily in the position of having nothing but one or two representatives of the direction in which he wishes to improve. What can he do but in-breed? Say, for instance, that a hornless calf is accidently produced, and we wish to frame a breed of hornless calves, nothing is left to us but to breed this calf to his own daughters and granddaughters—to breed his offspring together, and so on, not because inbreeding as inbreeding 'fixes a type,' or 'improves,' but because these are the only hornless cattle we have. If we had other hornless cattle inbreeding would be a folly. It consequently happens that in the formation of any breed inbreeding is a necessity."

The above selections of cases are necessary to the complete consideration of the subject of "The Mooley Cow," and afford some excellent illustrations of the principles and theory of breeding and selection.

[2] *National Live Stock Journal*, Nov. 1881, p. 485.

THE EFFECT OF RAIN ON EARTH-WORMS.[1]

DURING the rain in Washington, D. C., on the 20th of March, my attention was attracted to the earth-worms so abundant on the paths, the sidewalks and the streets of the city. They seemed to be everywhere. Some were large, some small; some active, some sluggish; some alive, many dead. I had noticed their presence before during January and February in the Capitol grounds, especially on the pavements. I supposed then they had simply come out from under some rubbish lying along the sides of the walks, and that they would straggle back again. I have since come to a different conclusion,—a conclusion which is, in effect, that few indeed of those which come out are ever able to, or at least seldom really do, straggle back.

During the time referred to I determined to see, if possible, the extent of the mortality among the earth-worms. So I took the opportunity of counting, as I walked slowly along, the number upon the ground, alive or dead. This I did in several places and under different circumstances.

The first place examined was a gravel walk in the Smithsonian grounds, while the rain was still falling. In a distance roughly estimated at 425 feet, I noticed 380 worms. Probably three-fourths of these were dead, lying drowned in pools of water, or else crushed by the feet of passers-by. On another path in the Smithsonian grounds were some very large examples, one of which was at least nine inches in length and as large round as an ordinary lead pencil. I have since seen specimens even larger than this.

A second place examined was on the asphalt sidewalk of Massachusetts avenue, between Fourteenth and Fifteenth, a distance of about 600 feet, and after the rain had ceased. In this distance I counted 180 worms, the dead ones averaging nine out of every ten. On one side of this stretch is a stone wall, generally with a considerable amount of dirt at its base, and on the

[1] Read before the Biological Society of Washington, April 20, 1889.

other side is a narrow strip of soil. The worms were counted as I walked slowly along, and it is most probable that all were not observed.

A third place was in Franklin Park, between Thirteenth and Fourteenth and K and L streets. Crossing this diagonally about half way, and noting the worms, not on the asphalt walk but on the little strips of gravel alongside, seldom more than twelve or eighteen inches wide, I counted 325 worms. Very few of these were alive. It was sprinkling slightly at the time and the ground was wet. Many lay in puddles of water where they had been drowned. During a rain of the following week I noticed the worms in the same place again, this time not so numerous. But the strip of gravel was marked all over by the trails left by the crawling creatures.

A fourth locality, and one seemingly very favorable to the existence or appearance of the worms, was on Fifteenth street, just north of Rhode Island avenue. The sidewalk was brick, and at one side was an open lot used as a tennis court. In a distance estimated at 200 feet I counted no less than 340 worms. They lay in the cracks between the bricks, on the bricks themselves, and in little pools of water. I doubt if there were a dozen alive out of the 340.

These four places were by no means the only ones where the worms were seen. On the roads and paths in the neighborhood of the Smithsonian and National Museum, on Fourteenth street, on Thirteenth street, on Massachusetts avenue, where there was a brick pavement, they were equally numerous. As before stated I had previously seen them in the Capitol grounds and other places in the Northeast.

There are two points of interest connected with this subject. One is the extraordinary abundance of the worms, and the other is their excessive mortality. We have, of course, no way of knowing positively the number of these creatures to each square yard or square foot of surface. Darwin, quoting Henson, says (Formation of Mould, pp. 158, 159), that there are in England about 53,767 to an acre: that he has seen 64 burrows in 14½ square feet, or 9 in 2 square feet. Further, that in a cake of dry earth as large as his two hands, there were seven burrows as large as goose quills (p. 160). If the numbers observed here above the surface are any good index to those below, their total number must be simply enormous.

The mortality among the worms, as shown by the number of dead ones, is immense. Taking the number as given above for a single acre—53,767—we find there are five to every four square feet, or 1¼ for every square foot of surface. Calculating the area observed in Franklin Square and the number there seen, we find one worm for every one and a half square feet. In the same way the number seen on Fifteenth street was one to every five and a half square feet, and in the Smithsonian grounds one in every nine square feet of surface. It should be remembered that the larger part of these were dead, and if, as in the case of Franklin park, one for every one and a half square feet out of a possible five in every four square feet die, it is easily seen that the mortality is enormous. If this proportion holds out in any way at all over the two hundred and seventy and odd miles of streets in Washington, what an epidemic among the worms there must have been during the three-days rain referred to.

Again, what is the cause of the mortality? We cannot say they are crushed by the feet of pedestrians, because many of them show no signs of injury. It would seem as if, attracted to the surface by the moisture, they crawl out upon the hard asphalt or gravel, and then finding it impossible to return to Mother Earth, die on account of exposure, or are drowned in the deluge of water, many meeting death in the last form.

A NATURALIST'S RAMBLES IN CEYLON.

BY H. HENSOLDT.[1]

ABOUT fourteen years ago—it was in October, 1875—when I was a student at Giessen, a small but well-known university town in Germany, a friend, and for awhile fellow-student, Dr. Ferdinand Goldschmied, was preparing for a voyage to the distant island of Ceylon. Dr. Goldschmied was a young man of unusual attainments, an enthusiast, a lover of science for its own sake,—not one of those who look upon science as a sort of trade, which they follow for the sake of what it is likely to bring them in the shape of money or fame. He took an interest in every department of science, but his favorite subjects were ethnology, oriental languages, and the ancient civilization of the East.

A year or two previous to this German orientalists had been greatly excited over the publication (by a Leipzig professor) of a little work on ruined cities in southern India, Ceylon, and several of the islands of the Malay archipelago, such as Java, in which it was attempted to prove that long before the Aryan invasion—at a time so remote that neither history nor tradition has preserved the slightest trace of it—these countries were densely inhabited by a race of people possessed of a high degree of civilization, as evinced by the splendor of their cities, still imposing in their ruins, by their enterprise and skill in constructing reservoirs, tanks, canals, highways, etc., rivaling in this respect the most celebrated achievements of modern engineering, but a race which in language, customs, architecture, and so forth, was totally different from the present inhabitants of these countries.

Dr. Goldschmied was profoundly impressed with this work. Here was an entirely new field for research, a field practically untrodden, and promising glorious revelations; here perhaps lay buried some of the most important secrets of the past (he was one of the believers in the vast antiquity of the human race), but a field accessible only to one who could personally go and

[1] School of Mines, Columbia College, New York.

explore it. And so, although his means were slender, and his constitution none of the best, he resolved to set out on what may be truly termed a voyage of discovery, prepared for years of toil and travel in the tropics of the East, and the island of Ceylon was the country he intended to explore in the first instance.

When Dr. Goldschmied first asked me to accompany him, I treated the matter as a joke, for nothing, I thought, could be more foolish for one like me, still engaged in study and with a particular career sketched out for him, than to embark in such an enterprise. But I began to reflect over the proposal, and the more I reflected the more attractive it became, the more fascinating, until it grew perfectly irresistible, and to the surprise of many friends, and against the advice of near relatives, who predicted dire calamities, I determined to go with the young explorer.

More than thirteen years have elapsed since then, and I cannot say that I have once looked with regret upon that resolution. It was a mistake in some respects; it drew me away from what looked like a promising career at home, and flung me upon the very high seas of life; it brought in its train many troubles and disappointments which I would not have encountered had I remained in the fatherland, but those two years of Eastern travel taught me a number of invaluable lessons. It opened my eyes to things which I would never have understood had I stayed at home,—things of surpassing interest and beauty; it afforded me an insight into the mysteries of an almost unknown world, an insight into some departments of natural history which no amount of book-study could have given me, even if I had mastered whole libraries of science; it enlarged my horizon, and gave me a totally different idea of this queer world in which we live: indeed I may say that I shall never regret that voyage to Ceylon.

Now I do not here propose to give the details of this voyage in a sort of diary-fashion. I presume that the reader does not care over-much for an account of mere incidents of travel; what I desire is to tell him something about Ceylon, about my impressions of that island, of what I saw and observed there during a two years' residence, and I shall drop the style of personal narrative as much as possible, and only revert to it when absolutely necessary. But a few words on the voyage out may not be amiss here. We left Germany on November 12th, 1875, starting from Frankfort, and traveling through Southern Germany, a part of Switzerland, France and Italy to Genoa, on the Mediterranean. This was *via* Geneva and the great Mont Cenis tunnel. Owing to an unfortunate delay of nearly a day at Turin we managed to miss a certain steamer of the Rubattino line, with which we had intended to sail, and as we would have had to wait more than fourteen days for another, we left Genoa, within two hours after our arrival, for Marseilles, where we secured berths on board the *Anadyr*, one of the French mail-steamers, of the Messageries Maritimes, which go to China, but touch at Ceylon and Singapore. During the passage through the Mediterranean we had the opportunity of seeing no less than three volcanoes, viz., Mt. Vesuvius, at Naples (where the steamer called for additional mail and passengers), Mt. Etna, on Sicily, and Stromboli, that singular little volcano—one of the Lipari islands—which rises abruptly from the waters, and which we passed within a few hundred yards distance. The Suez canal struck me as singularly narrow; so narrow indeed it is that two moderate-sized steamers cannot safely pass one another, and that was the reason why it took our steamer nearly two days to go through (the canal is only some eighty miles long.) Whenever a steamer was sighted or signaled coming the other way, one of the vessels had to turn into one of the basins which are cut into the sides of the canal, at intervals of about two miles, and this takes a great deal of time, so that a ship may take three days and longer in going through that canal. The voyage from Suez to Aden, through the Red Sea, which took about six days, I still hold in lively remembrance. The heat was something terrible, and there was no escape from it; a young Frenchman died on board with sunstroke. Dr. Goldschmied and I were the only Germans on board, the majority of the passengers being Frenchmen, bound for Saigon on the coast of Annam, and the rest Spaniards, going to Manilla.

We landed in Ceylon on December 9th, exactly three weeks after our departure from Marseilles. So much of the voyage. Dr. Goldschmied's mission, I am sorry to relate,—the great task which he had set himself of unraveling the mysteries of a forgotten past,—was not accomplished; he died of jungle fever two months after our arrival at Anuradhapura, in the wilds of northern Ceylon. Of this Anuradhapura I shall have occasion to say more anon. It is the most remarkable labyrinth of ruins yet discovered on the island, and is now believed to have been the capital in that very remote past. The ruins, now completely surrounded and partly covered by the jungle, extend over an area of many square miles, and were then as now practically unexplored, though a number of coffee-planters, English officers, and other Europeans residing on the island had visited them,—more, I dare say, to gratify curiosity, and for the sake of the sport that could be had in the hunting of elk and elephants on the road, than to carry on systematic explorations. This region is now exceedingly unhealthy, like most of the low-lying districts of Ceylon, and so it happened that shortly after our arrival Dr. Goldschmied, and two young Englishmen who had joined us at Colombo "to see the fun," as they expressed it, were attacked with dysentery and jungle fever, the two most dreaded diseases to Europeans on the island. The Tamil coolies we had with us and, strange to say, my humble self, remained in good health, but poor Goldschmied died after about ten days of dreadful suffering. Had he lived, I am firmly persuaded that he would have become one of the most famous of men; he had all the elements of a true scientist, and though young was a profound Sanscrit scholar. He would have developed into another Max Müller; in fact, would have outrivaled that great orientalist and philosopher.

I did not continue Goldschmied's explorations. I had not the necessary preliminary knowledge to enable me to attempt such a task; my studies and tastes lay in other directions. I was interested in geology, mineralogy, in zoölogy, in botany,—in short, in natural history, and I remained for two years in Ceylon, gathering such information as I could, making collections, and observing things generally to the best of my ability. I traveled from the extreme north to the extreme south of the island, and from east to west, in all sorts of directions; spent months in unhealthy, swampy regions on the coast and in the interior;

months in the lovely hills and valleys of the central highlands; in towns, villages, on coffee plantations; in remote hamlets among the natives of the backwoods on the gem-rivers: indeed, there is hardly a spot of interest on that island which I did not visit.

And now I will endeavor to give an account—a very condensed account—of some of the things which I saw and observed there. A few preliminary remarks on the island in a general sense may be here of value.

The Island of Ceylon was known already to the ancients, and we find it frequently alluded to, under the name of Taprobane, by Greek and Roman writers. To the Arabs it was known as Lanka and Serendib, and under this latter name it is mentioned in the "Arabian Nights" as the scene of some of Sindbad the Sailor's remarkable adventures. Some modern investigators have asserted that Ceylon is identical with the land of Ophir, whence Solomon obtained his gold, precious stones, and ivory; but as this very land of Ophir has already been searched for in various parts of Africa, on the Island of Madagascar, and even Sumatra, I only mention this as a curiosity. According to a tradition still current in the East Ceylon was the original seat of paradise. The "Vajasanga-Sanhita," one of the sacred books of the Brahmins,—a collection of Sanscrit myths, the age of which Max Müller, the greatest Sanscrit scholar and orientalist of the present, estimates at something like 4,500 years,—contains a legend quite similar to the Bible tradition of paradise, a legend which in my opinion has served as original to the latter. Even the names are almost identical: a first pair of human beings, Adiah (Adam) and Evana (Eve) were created by Brahma and placed in the Paradise, which was Lanka, the Island of Ceylon. They were of gigantic size, says the Sanscrit legend. For some offense they were driven out of paradise; Adiah, on his flight to the mainland of Asia, placed his left foot on a mountain-top in Ceylon, while he planted the right, with a single step, near Markuna in Siam, a distance of about 1,500 miles.

Now in the southwestern part of the island, about fifty miles from the coast, and isolated from the central range, the so-called Highlands of Ceylon, there rises a singular mountain, a very symmetrical cone — yet not of volcanic origin — about 7,000 feet high, which has been known to the Singhalese (the natives of Ceylon) from time immemorial as "Adiah-Ruah," or Adam's mountain, and which is recorded on every map of Ceylon as Adam's Peak. On the summit of this mountain is a flat piece of rock, garnetiferous gneiss, on which is to be seen the distinct impression of a gigantic foot. This is said to be Adam's foot-print, and the Buddhists of Ceylon, as well as the Brahmins of India, the Tamils, and even the Mahommedans there are vying in the homage which they pay to this sacred relic. A low wall has been built around the "foot-print," and a purple awning, supported by wooden pillars, keeps off the rain, while a number of Buddhist priests are engaged in pious ceremonies, and processions of pilgrims from all parts of Ceylon constantly arrive and depart. I made a point of visiting that celebrated mountain top, and, of course, recognized at a glance that Adam's foot-print was a fraud, and a very big one. It was artificially cut or chiseled into the rock, and, moreover, by a very unskilled person, who had not even omitted to provide *nails* for the toes, notwithstanding the fact that a mere foot-print could not possibly show anything of the kind. Besides, the length of the imprint was in no proportion to that of the enormous stride, for although the foot-print was about 65 inches long, yet for such a stride it ought to have had a length of at least 300 miles. But faith, which as we know is capable of moving mountains, apparently causes the pilgrims to find the looks and dimensions of Adam's foot-print very natural and reasonable. I, for my part, took great care not to appear by looks or questions as if doubting the genuineness of the relic, and even considered it wise to leave a small present for the temple.

The climate of Ceylon is, of course, essentially tropical. From the coast to a distance of about 30 miles into the interior the island is flat and covered with forest and jungle — the latter a dense and thorny mass of vegetation, almost impenetrable to man, and affording shelter to innumerable wild animals, snakes, birds and insects. The tropical forest, on the other hand, is often quite free from underwood. The entire coast is surrounded by a seam of cocoa-nut palms, which appear to thrive best in the sandy coastal belt, but they are also abundant in the interior, and I have found them even high in the mountains.

The Portuguese were the first Europeans who settled on the island, and for several centuries only the flat coastal region was known to them, as no white man dared penetrate to the mountain country of the interior, which was inhabited by a bold and warlike race, with an ancient and highly-developed civilization. The natives of the coast were evidently only degenerate or effeminate descendants of this mountain race, and very little reliable information did the Portuguese obtain as to the state of things in the interior. Only now and then the natives would tell them of the splendor of the capital, Kandy, situated high in the mountains, the very existence of which was long regarded as a fable. In Kandy an ancient dynasty of kings was said to rule over the noble race of the Singhalese, but woe to the stranger who dared approach its walls. No Portuguese in those days saw the interior of Ceylon, and even the Dutch, who subsequently held the island for a hundred years, never succeeded in penetrating to Kandy. It was only about 80 years ago that the English, who took the island from the Dutch during the Napoleonic war, at the beginning of this century, managed to capture that remarkable town, and thus solve the riddle of centuries.

The present population of Ceylon is about two millions, but the island would be capable of supporting more than ten times that number of people. At least four-fifths of this populace inhabits the coastal region, but only as far as the cocoa-nut trees go, viz., from three to six miles into the interior. Thus the stranger, landing for the first time in Ceylon, and seeing the busy life along the coast, the innumerable huts of the natives in the shade of the giant palms, villages miles long, extending almost uninterruptedly along the entire southwestern coast, from Point de Galle to Colombo — a distance of 75 miles — is apt to consider Ceylon one of the most densely inhabited countries in the world. But if he travels in a straight line to the interior, the scene changes with surprising suddenness, and after proceeding a few miles he either finds himself in the dense jungle or the solitude of the tropical forest.

More than eighty per cent. of the population of Ceylon consist of the Singhalese, a very remarkable and interesting race, which has resided on that island for at least 3000 years, but probably much longer. The Singhalese differ in many respects from the inhabitants of the continent of India, especially from the Hindoos, with whom they have very little in common. While the average Hindoo is small, delicate, and by no means distinguished for courage, the Singhalese is tall, muscular, extremely well-proportioned, and, moreover, bold and intrepid. Only in the fine antique cast of the features do these two races resemble each other and betray a common origin. It is hardly necessary to remind the reader that the inhabitants of India are not negroes, although the English merchants and officials very brutally and indelicately call them niggers, but a nobly-formed and highly developed race with entirely Caucasian features, so that, except for the difference in color and dress, it would be impossible to distinguish them from Europeans. The Singhalese, as well as the Hindoos, have, on an average, beautiful and expressive faces, well-proportioned bodies, and surprisingly small hands and feet; it is rare to find a downright ugly specimen among them. They are Aryans, a branch of that great Indo-Germanic race from which, as modern ethnology and comparative philology have clearly shown, most of the European races are derived. Sanscrit, that wonderful language of the ancient Hindoos, which has been a dead language for more than 3000 years, holds the key to many a puzzling mystery. In that language—embalmed, as it were, like mummies in an Egyptian tomb, and shrouded in mystery—lay the histories of the origin of numberless races, including those from which we have sprung, till modern philologists began to pierce the gloom, and a Max Müller arose and threw the electric beam of his genius into the ancient manuscripts of the Brahmins, into the Rig-Veda and Ramayana.

The Singhalese have been Buddhists for the last two thousand years, for the teachings of the great Hindoo philosopher were generally accepted by the people already about 500 years before our era, and the island is even now regarded as the headquarters of Buddhism. Indeed, Ceylon may be called the Palestine of the Buddhists; it is held in the same esteem by the Buddhist world in which Jerusalem was held in Europe at the time of the crusades. To explain this, I must relate a curious tradition. According to the Pali manuscripts, the sacred books of the Buddhists, which are older and at least as reliable as our bible, Buddha came personally to Ceylon about 550 B. C., and preached his new creed, which was received with the greatest enthusiasm, and began to spread with surprising quickness. He had twelve followers or disciples with him. The story of the twelve apostles of Christ is evidently borrowed from the much older Buddha tradition, yet is even here nothing new, but an astronomical allegory, the origin of which must be sought in remotest antiquity. By the twelve followers of Buddha, as well as the twelve disciples of Christ, are meant the twelve signs of the zodiac, which were known already to the ancient Egyptians, Assyrians and Chaldeans. The story of Christ, there cannot be the shadow of a doubt, is an allegory; Christ representing the sun which, rising in the sign of Virgo (the virgin), proceeds higher and higher, till it crosses the highest meridian (whence the origin of the cross), and then, gradually sinking, brings summer to another world (descent into Hades), but ultimately again rises in renewed splendor (resurrection from the dead). These astronomical facts some oriental philosopher tried to interpret to the benighted and unreasoning multitude, and thus once more resorted to the story of a semi-divinity with twelve disciples, which, as we know, is of far more ancient date. Even long after Buddha[2] and Christ, we have again the story of the mythical King Arthur and his twelve knights of the round table, and of Charlemagne with his twelve paladines. Of course we know Charlemagne to be an historical character, but probably so were King Arthur, Christ and Buddha, still that they should all be accompanied by twelve is very significant and points to the same eastern source.

Now Buddha, when he felt his end approaching, commanded his disciples to erect a large funeral-pyre and cremate his body,

[2] Buddha, like Christ, was born of a "virgin," viz., the virgin Maya.

but afterwards they should carefully search the ashes, in which they would find some relic of him, which they were to preserve and treasure as the most sacred thing on earth. Whatever nation had possession of this relic would prosper to the end of time. Buddha's body was faithfully cremated by the twelve, and when they searched the ashes they found nothing but a *tooth*, a single tooth, as all that was left of him. This tooth of Buddha, as Singhalese history shows, has been preserved for more than two thousand years at Kandy, the ancient capitol of the Singhalese Kings, and has been worshipped as something more than sacred. A magnificent temple, the "Maligawa Dalada" (temple of the tooth), was specially erected, which is still one of the wonders of the island. I have often visited this temple during my stay at Kandy, and was always treated with great politeness and kindness by the Buddhist priests. A broad marble stair leads to a kind of raised platform, in front of the temple, whence several passages lead to the interior of the latter. The central one terminates at a curious round tower in which, behind a strong iron grating, is to be seen a miniature Buddhist pagoda, about three feet high and made of gold. In this Buddha's tooth is preserved. Since 1820 no human eye had seen it, for it may only be exposed once every hundred years, except when some great calamity is to be averted,—for instance in times of great drought or pestilence. Then it is brought out and exposed with great pomp and circumstance in front of the temple, and the evil, of course, speedily vanishes. A kind of altar in front of the iron grating is covered day and night with beautiful red Mogra blossoms, which are mostly brought by women as a sacrifice.

Two years previous to my arrival in Ceylon the duke of Edinburgh visited the island, and it was then vainly attempted to induce the chief priest of the temple to show the tooth as a curiosity, but he indignantly refused to expose so sacred an object to the profane gaze of even a duke of Edinburgh. While I was in Kandy, in March, 1876, it so happened that the Prince of Wales came to Ceylon. He had been sent out on a voyage to India, as a matter of policy, by the government, to show himself among the natives and make the English royal house more popular, as an offset against Russian intrigues. He was received with great pomp at Kandy, and this time the governor of Ceylon, Sir William Gregory, succeeded in getting the head priest to exhibit the tooth of Buddha; thus I also had the rare opportunity of casting a look upon that famous relic.

It was on a Sunday morning, and the news that the tooth of Buddha was to be publicly exposed must have traveled with lightning speed all over Ceylon, for the night before the day in question the large square in front of the temple was crowded with Singhalese, Tamils, and half-castes, who remained there, patiently waiting, all through the night. At about ten o'clock in the forenoon the Prince of Wales appeared with his brilliant suite of Europeans [3] and native chiefs, and ascended the marble stairs in front of the temple. On the platform stood a large ebony table, curiously carved, and covered with a yellow silken cloth. After a few minutes spent in waiting, there issued from the chief portal, slowly and solemnly, a procession of Buddhist priests, with their shaven skulls and long yellow robes. One of them carried a rectangular box, about 15 inches long, and 7 or 8 inches broad, made of gold, and set all around with uncut rubies of considerable size, which he placed upon the table. The chief priest opened it with a small key, and took out of it another box, which was ornamented with the largest, and, perhaps, the finest pearls found in former centuries on the Ceylon coast. In this was another still smaller box, covered with a profusion of uncut gems,—sapphires, rubies, emeralds, etc.,—and in this was an immense sapphire,[4] hollowed out like a cup, in which, upon a golden lotus-leaf, rested the tooth of Buddha. The moment the relic was exposed one of the priests made a sign to the people, and the whole dense crowd sank to the dust in reverence; no Singhalese dared to raise his head to gaze on that sacred object. As for the Prince of Wales and the rest of the assembled Europeans, it was

[3] Among those who accompanied the Prince of Wales on his tour were the Duke of Sutherland, Mr. Russell of the *Times*, and the Russian painter, Verestchagin.

[4] Tradition has it that this marvelous gem was found by a "Rhodia" (Singhalese outcast) in a little mountain creek, at Morowe Korle, not far from Adam's Peak. It is of the opaque, asteriated variety, known as "star-sapphire," which, if suitably cut—en cabochon—shows in the sunlight a beautiful, many-rayed star.

difficult for them to repress their mirth. I stood among a number of coffee-planters, not more than five yards from the relic, thus having as good an opportunity of inspecting it as I could wish for under the circumstances. No one—not even the Prince—was allowed to touch the tooth, or to approach it very close. The worthy Buddha must have had a wonderful set of teeth when he was among the living. The specimen here represented was at least five inches long, and was, of course, no human tooth at all, but the side tusk of a pig,—probably a wild boar,—somewhat yellow and discolored from age, like Siberian ivory. That the priests should have had the courage, or rather impudence, to bamboozle the benighted people with an ordinary pig's tusk, by representing it as a part of Buddha's masticating apparatus, and thus lead them by the nose for more than two thousand years, struck me as very singular; but it is really in no way different or worse than the swindle carried on even at the present day in numerous cathedrals and monasteries of Europe, where nails from the true cross, tears which Christ wept, pieces of Jacob's ladder, and, in one Bavarian cloister,[5] actually a bottle full of that darkness which came over Egypt (an ordinary brandy-flask, smoked inside with lamp-black), are exhibited and worshipped by superstitious and degraded multitudes.

Now with regard to this tooth of Buddha, I have my own special theory. I do believe that a real, human tooth,—and possibly of Buddha, who, there can be very little doubt, was an historical chararcter,—once existed in that temple, but became lost. In the "Mahawanso," the great historical record of the Singhalese, we read that the Tamils of the Malabar coast of India, about three hundred years before our era, made war upon the Singhalese, ravaged the island, and carried the tooth in triumph to India. But the Singhalese, burning for revenge, equipped a fleet, and a few years later invaded the Tamil country, never resting till they had recovered the precious masticator and brought it back to the temple at Kandy. This is stated to have actually happened twice, for the tooth was held in great esteem on account of its supposed virtues, and neighboring races were anxious to get hold

[5] The monastery of Banz, near Bamberg, in North Bavaria.

of it. Now I believe that in these wars and troubles the original tooth was lost, and that the priest substituted another, and, moreover, one of more respectable dimensions, which could be plainly seen from a distance, and which it was not so easy to lose.

Of course all this has nothing to do with the Buddhist religion. That religion is a grand and noble one,—a religion of tolerance and humanity, superior in many respects to Christianity. It forbids the destruction of life in any form, holding that every creature, down to the most despised insect, is in a sense sacred, and has as great a right to exist as man. Therefore the orthodox Buddhist carefully avoids the killing or molesting of animals; he will not even hurt a scorpion or venomous serpent, and is thus compelled to live entirely on vegetable food, chiefly rice. Many will not even drink milk, for fear of depriving the calf of its necessary nourishment, and the coffee-planters of Ceylon are obliged to hire Tamils as cooks, for no Singhalese will boil an egg, as it involves the destruction of the life within. Another of the reasons why they do not kill animals is because they believe in the transmigration of souls. They do not believe in a heaven such as the Christian pictures it, viz., a region of eternal bliss, or its opposite, a place of torment. The Buddhist philosophy is that a state of perpetual happiness is absolutely impossible; happiness ceases to be happiness the moment it takes the character of constancy. We are no longer happy when we have obtained what we were wanting, and, for similar reasons, a state of eternal misery is unthinkable. The only *possible* state of eternal bliss is the "Nirvana," the great culminating-point of Buddhism. This Nirvana is a state of indifference: the soul, freed from the body, feels neither pain nor joy, is oblivious of everything—not aware of its existence even—and to enter the oblivion of Nirvana is the chief aim of every Buddhist. The great world-soul, which gave us all our being, takes us back into its mysterious night. But to become worthy of Nirvana the Buddhist must lead a virtuous life, otherwise his soul after death, instead of going to Nirvana, enters another body, is born again, and compelled to face anew all the troubles and disappointments of life. This migration may continue for centuries, or for millions of years, till the necessary degree of perfection is reached. Thus life itself, far from being an advantage, is looked upon as a state of suffering, and, even under the most favorable circumstances, as something neither to be envied nor desired.

I have found the Buddhist priests in Ceylon an exceedingly kind and worthy set of men. They live in the strictest celibacy, and in the most frugal and unpretentious manner. They are forbidden to own property, and must obtain their food by begging. In the Singhalese villages one may therefore see the priest every day with his begging-bowl, a cocoanut shell, collecting rice from house to house. The command is that nothing must be stored up, but every meal has to be specially begged for, and by means of this excellent provision the accumulation of wealth in monasteries, with all its corrupting concomitants, is successfully prevented. The priests dress in long yellow robes (yellow being the sacred color), with the right arm hanging out naked, and the left concealed within the folds of the garment. They go bare-footed, bare-headed and closely shaven. I once asked an old priest for the origin of this custom of keeping their heads shaved. His answer was very remarkable: "Sahib," he said, "we follow in this, as in everything else, the example of our great master (Buddha). If we were to let our hair grow, we might occasionally be tempted to molest or kill certain small insects which, as you may have observed, are not of rare occurrence among, or rather *on*, the natives of this country. To avoid this we go shaved." Now the tonsure of the Roman Catholic clergy, along with many other rites and ceremonies of Catholicism, can be easily and unmistakably traced back to Buddhism whence they are derived, though I am somewhat doubtful as to whether Catholic priests will feel much flattered upon learning that the tonsure was merely inaugurated for entomological reasons, viz., in the sole and exclusive interest of parasites.

Looking at the position of Ceylon on the map, one would naturally conclude that the island was once connected with the mainland of India. Such was indeed the opinion held by geologists till comparatively recent years. It was taken for granted that Ceylon had been separated from the peninsula either through the agency of currents or partial submersion. But modern investigations have disproved this, and it is now tolerably certain that Ceylon was never connected with India, but is one of the few remaining vestiges of a huge continent which stretched in almost boundless expansion to the south, far beyond the equator into the distant regions of the Pacific. The geological features of Ceylon are very unlike those of Southern India; the configuration of the mountains, the stratification of the rocks and their geological ages are quite different. In Ceylon we have a mountain region, rising more or less abruptly from the lowlands, and composed almost entirely of metamorphic rocks, chiefly gneisses, schists and slates, resting on an ancient granite. The formation is essentially Archæan: there is an almost total absence of any of the fossiliferous strata of the more recent periods, and an entire absence of Tertiary rocks. The only limestone found is an ancient dolomite of crystalline structure, in which every trace of organic remains — if ever existing — has been obliterated. Now most of the continent of Southern India consists of *recent* rocks, and it would seem that at the commencement of the Tertiary period the greater part of the peninsula was still covered by the sea, but that in the south a great continent extended eastward and westward, connecting Malacca with Arabia. The Himalaya range then only existed as a chain of islands, and did not, till a much later age, become elevated to its present proportions, a change which took place during the same revolution that raised the great plains of Siberia and Tartary. While these gigantic land masses slowly rose from the ocean depths the huge continent between the tropics underwent a simultaneous depression. This continent, in all probability, once connected the distant islands of Ceylon, Sumatra and Madagascar.

In Ceylon we find about 38 species of birds which are unknown in continental India, but these very birds occur in Sumatra, Borneo and others of the Sunda Islands. The insects of Ceylon are more closely related to those of the Malay Archipelago than to those of India. The elephant of Ceylon is *not* identical with that of India, but presents characteristics which are also possessed by that of Sumatra. The first to point this out was Prince Lucien Bonaparte (Proc. Zool. Soc. London, 1849), and Prof. Schlegel, of the University of Leyden, has since confirmed the identity of the Ceylon elephant with that found in the Lampongs of Sumatra. According to a Singhalese tradition, Ceylon, in a very remote past, formed part of a huge continent which connected Africa with China.

The precious stones, for which Ceylon has been celebrated from time immemorial, are found in the sand and gravel of the rivers. Most of these rivers — and Ceylon possesses quite a number of them — have their source in the central mountain district. The gems occur in a natural state as constituents of the garnetiferous gneiss, which is prominently developed in Adam's Peak, Newera Ellia, and neighboring points. The gradual disintegration of these gem-bearing masses, through aqueous and atmospheric agencies, leads to the freeing of the gems, which are washed out and precipitated along with other detritus by the mountain torrents during heavy rains, thus finding their way into the various river-beds, in which they roll for miles, and are gradually worn off or smoothed into roundish pebbles. The most celebrated of these gem-rivers is the Kalu-Ganga, which has its source near Adam's Peak, and flows into the sea about midway between Point de Galle and Colombo. On this river, and about twenty miles distant from Adam's Peak, is the ancient town, or Singhalese village, of Ratnapoora (literally, "the city of rubies.") Here is the headquarters of the Ceylon gem trade, so far as the native business is concerned; here gems have been dug, or washed out of the river mud for two thousand years, and here they are still found in the same profusion. The river in olden times appears to have been much broader, extending for more than a quarter of a mile beyond either of its present shores, and anyone digging within that region to a depth of six or seven feet comes to the so-called "gem gravel," viz., the ancient river-bed, in which are found rubies, sapphires, topazes, cats-eyes, garnets, cinnamon-stones,—in fact almost every known variety of gems except the diamond, which, so far as I know, has never yet been found on the island.

The desire for precious stones is very intense in the East, chiefly on account of their supposed inherent virtues. They are worn as charms by the superstitious—and what Oriental is free from superstition? Thus the greatest buyers are the wealthy high-caste natives, especially the Indian rajahs. They have their agents at every noted gem-mine, who have the picking of all that is found, and who eagerly buy up everything of exceptional value. No really fine gem—fine in an Oriental's eyes—ever goes to Europe or to this country, unless by accident. European traders and their agents cannot, with their paltry offers, compete with the Indian princes, who pay immense sums for fine stones to be set in their crowns, on their fans, their sword-handles, their turbans, their very slippers. European and American dealers have to content themselves with third and fourth-rate specimens, which they palm off as marvels of Oriental finds upon their unsophisticated customers. During my stay in Ceylon the celebrated pearl-fishery near Putalam, on the north-western coast of the island, which had been prohibited for more than thirty years to give the oysters a chance to grow, as they had been nearly exterminated by unscrupulous parties, was resumed for a period of six weeks. During that time more than seven thousand basketfuls of oysters were brought ashore, and quite a number of agents were on the spot ready to buy the pearls. Only four exceptionally fine pearls were found, which were all secured by the Maharajah of Jeypore, while the European agents had to do the best they could with inferior specimens, deformed, off-color, and seed-pearls.

The value of the gems and pearls possessed by some of these rajahs, and to be found in the treasure-shrines of the temples, is something fabulous. For a long time it was a puzzle to me how these chiefs and priests could have accumulated such immense treasures—for I was tolerably sure that they could not have all been paid for in money or any other equivalent. Finally I discovered the reason. It is well known that the natives of India, especially the Hindoos, are divided into castes. Of these castes there are, among the Hindoos, nominally four, but in reality more than twenty, which are strictly separated from each other in a social sense, as if surrounded by invisible walls. There are the Sudras, the lowest of all, then the fishermen, jaggery-people, water-carriers; carpenters, and so forth, up to the Rajah. Now the very lowest castes are not allowed to wear any jewels whatever, and from the carpenters up to a certain caste they can only wear inferior stones, such as moonstones, carbuncles, amethysts, garnets, cinnamon-stones, etc., while some of the higher castes are allowed to wear rubies, sapphires and even diamonds up to a certain size, but all highly valued gems above a certain weight go to the Rajah, who alone may wear them, and any infringement of these rules is, or was, severely punished, not long ago even with torture and death. Thus, as a matter of course, the Rajahs obtained possession of all the fine stones found within their domains, at little or no expense. The priests, on the other hand, dominated over the Rajahs; they assisted them in their tyrannical rule by keeping up the illusion of the divine right of kings, pooled with them, and naturally came in for a share of the plunder.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Description of a New Genus of Corals, from the Devonian Rocks of Iowa.—Of the fossil species occurring in the Devovian rocks of Iowa, many of them are as yet new to science, which fact is well shown by my own cabinet of fossils, personally collected from these strata. Also, many species which are described and have long been known to science are, in fact, but very imperfectly known. This is owing more particularly to the insufficiency of material heretofore obtained.

These statements are especially applicable to the coralline forms of nearly all divisions of this formation in the State.

In this paper will be found a description of a few of these corals from the Independence shale and the Rockford shales of Iowa.

Macgeea, n. gen.—Corals growing in solitary, cylindrical, sometimes compressed, cup-shape cells; usually from five mm. to forty-seven mm. in length, and calyx from one and a half mm. to eighteen mm. in diameter; slightly curved, externally irregular, usually showing ing evidence of attachment.

Calyx generally as deep as wide, but very rarely being only one-sixth as deep as wide; outer wall thin, rays numerous, from thirty-two to seventy-six in number, alternating in size within the cup.

Costæ (often very strong, and usually alternating in size) continuous with the rays over the edge of the cup and for some distance below the margin; lower down generally interrupted, or covered with a more or less epithecal coat (the epithecal coat is, however, sometimes entirely wanting), showing traces of numerous transverse partitions. Bottom of the cup large, and occupied by a slight depression; rays sometimes very slightly twisted in the bottom of the cup. The rays, and costæ for some distance below the margin of the cup, more or less distinctly denticulate on the edge.

The description of this genus is based almost exclusively upon the species *Pachyphyllum solitarium* of Hall and Whitfield, although made also to include *Macgeea culmula* of this paper. This genus differs conspicuously from the genus *Pachyphyllum* (to which the specimens upon which this generic description is based have been referred by

Hall and Whitfield), as will be readily seen by a comparison of the descriptions of the two genera. This genus is named in honor of Mr. W. J. McGee, of the United States Geological Survey.

Macgeea solitaria, H. and W.—*Pachyphyllum solitarium* H. and W., Twenty-third Annual Report of Board of Regents on New York State Cabinet, page 232. The specimens referred to this species are often quite available, and show several important features not mentioned in the original description. The denticulate character of the rays and costæ is most usually observed only in well-preserved specimens.

A critical examination of nearly two hundred specimens of this species reveals that the bottom of the calyx in well-preserved specimens is never occupied by a "slight elevation or columella" but, on the contrary, by a depression, as shown in Plate IX., Fig. 8, of the above-mentioned Report. This feature is the result of weathering.

Macgeea parva n. sp.—Coral single, very small, from five to six mm. in length, and from five to six mm. in greatest diameter; sometimes scarcely, and at other times sharply curved; subconical, but at times very strongly produced on the convex side of the cell, thus giving the calyx a distinct ovate marginal outline.

Calyx contracted at the top, about as wide as deep; outer wall of moderate thickness, bottom of the cup large. In the longitudinal section of a single specimen, the bottom was seen to be occupied by a very slight elevation; but whether or not this is a constant feature can be ascertained only by securing a larger number of specimens for examination than has as yet been obtained.

Costæ continuous with the lamellæ over the margin of the cup and for some distance downward; lower down covered by a smooth, perfect epithecal coat, sometimes annulated by fine striæ, of growth; lamellæ and costæ alternately large and small, sometimes slightly denticulate on the edge (the occasional absence of this feature is apparently due to attrition); from thirty-five to forty-two in number.

This species is closely related to *M. solitaria* of the Rockford shales, but differs from that species in its very small size, always continuous, perfect, and much smoother epitheca; the relatively thicker outer wall, as well as the strong constriction of the upper portion of the cell.

Position and locality: Blue shales below the Devonian limestone, Independence, Iowa.

Macgeea culmula, n. sp.—Coral small, elongate, cylindrical, slightly contracted and bent in the middle; externally somewhat irregular; calyx small, flattened at the bottom, width and depth about equal, outer wall thin; rays of moderate strength, from thirty to thirty-two in number. Costæ continuous with the rays over the margin of the cup, and for a short distance below; lower down interrupted or covered by a continuous, perfect epithecal coat. Costæ and rays alternating in strength; apparently denticulate on the edge. This feature, however, is not distinctly made out, owing to a slight erosion of the specimen.

The specimen in hand is attached nearly full length to a fragment of *Diphyphyllum*, although not a truly parasitic species. Dimensions: Diameter, four mm.; length, twenty-two mm. Position and locality: Rockford Shales, Hackberry, Iowa.—CLEMENT L. WEBSTER, *Charles City, Iowa.*

Pohlig on Elephas Antiquus.—Professor Pohlig, of Bonn, gives us the result of his investigations into the characters of *Elephas antiquus* (Falconer), in 260 pages quarto, and ten quarto plates. Especial interest attaches to this species as the ancient representative of the African elephant in Europe, and on account of its annectant character to the typical forms of the genus. Prof. Pohlig has successfully worked out its entire dentition, including the smallest milk-teeth, which are the rarest parts of Proboscidians to be found in collections. His material has been mainly derived from the museums of Germany, and of Italy. Particularly useful are his descriptions of the first deciduous molars, and the deciduous superior incisors. Towards the close of the memoir he gives his views as to the phylogeny of the species of Elephas. He will not admit that the Africanus group originated from the same type of mastodons as the others; he even believes that it descended from some pre-mastodont genus. We cannot assent to this view, as it is evident that the Tetrabelodons include the possibility of all the species of elephants.

Incidentally Prof. Pohlig expresses his views on other species of the genus Elephas. He thinks that a form preceded the *Elephas primigenius* in Europe which was intermediate in characters between it and the *E. meridionalis* (Nesti), which he calls *E. trogontherii*. He regards the *E. hysudricus* Falc. Cautl. as identical with the *E. meridionalis*. He regards the *E. militensis* Falc., *E. mnaidriënsis* Leith Adams, and *E. falconeri* Busk, as dwarf forms of *E. antiquus*, due to their restriction to the Mediterranean islands on which they have been found. He also defines a dwarf variety of the mammoth as *E. primigenius* *leith-adamsii*, the remains of which are found in Germany, and are well represented in the museum of the University of Bonn.

The memoir is a most important contribution to a difficult part of the subject, and will be welcomed by all paleontologists.—E. D. Cope.

The Cretaceous Formation of S. W. Maryland.—For many years past the Tertiary formation of this section was an enigma which, under the light of the past, could not be satisfactorily resolved in accordance with the generally accepted theory that where the Tertiary formation was located, there was no other system to be looked for.

That idea has been a stumbling block that but few have been able to get over in a satisfactory manner.

The great cliff at Fort Washington, Prince George's county, has been to the author for the last twenty years a sealed book, an enigma not to be translated by any one, because, surrounded on all sides by Eocene deposits, it gave no sign of Eocene fossils, notwithstanding it stood up to an elevation of from 60 to 65 feet.

But recent ideas suggested by the work and labors of Prof. Wm. B. Clark, of Baltimore, have thrown off the confusion and made that locality readable. Visiting that formation recently we found evidences sufficient to put it down as Cretaceous. At this cliff we found Eocene shells scattered around—not in situ, but amongst the fallen débris—sufficient to prove it was once covered with the Eocene deposit, which is well developed higher up both Swan Creek on the north and Piscataway Creek on the south. We found both fossils, shells, and casts, plants and lignite in the cliff; one plant in my collection could be determined by an expert, from the leaves or parts of leaves which were collected.

A result of the examination of the cliff was the fact that we found it to rest upon a bed of variegated Jurassic clay, from one to two feet above high water mark, in which there is lignite. Further up Piscataway creek we found years ago large coprolites, pieces of bone, sharks' teeth, and palates of sharks, and amber, now in the possession of Mr. Philip Uhler, of Baltimore. We did not then know what these meant, but by the light of to-day we have to admit the formation to be, contrary to the generally received opinion, Cretaceous. The village of Piscataway is upon that formation. The old men of that place informed us that all the wells dug in that village since they could recollect, went down upon and into black micaceous sand and clay, and that they got water at from twelve to twenty feet. Traveling out from thence we found the Cretaceous clays covered with Eocene beds in every direction ; notably so in Bond's Retreat, Prince George county. The Cretaceous system is found in every deep washout or gully upon Mattawoman Swamp for ten miles above tide water ; the same is true of all the swamps between the Potomac and Patuxent rivers, and doubtless beyond that river. Swainson's Swamp, the dividing line between Charles county and Prince George's county, gives Cretaceous clays overlaid by Miocene deposits ; so does all that horizon. The Eocene and and Miocene can be found lapping the Cretaceous in all lower Maryland.

Given these facts, it is in order to ask ; how is it that the Cretaceous has not been better worked up in this region ; and why have the deep cuts failed to give us the remains of some old saurian,—such as Hadrosaurus or Lælaps. Such a discovery would round out the Cretaceous most grandly, and might bring us out upon the Jurassic with an interest hitherto unknown.

There have been already obtained in this deposit of Maryland from seventy to seventy-five species of fossil shells and casts of shells ; but no fossil plants except the one noted in this paper.

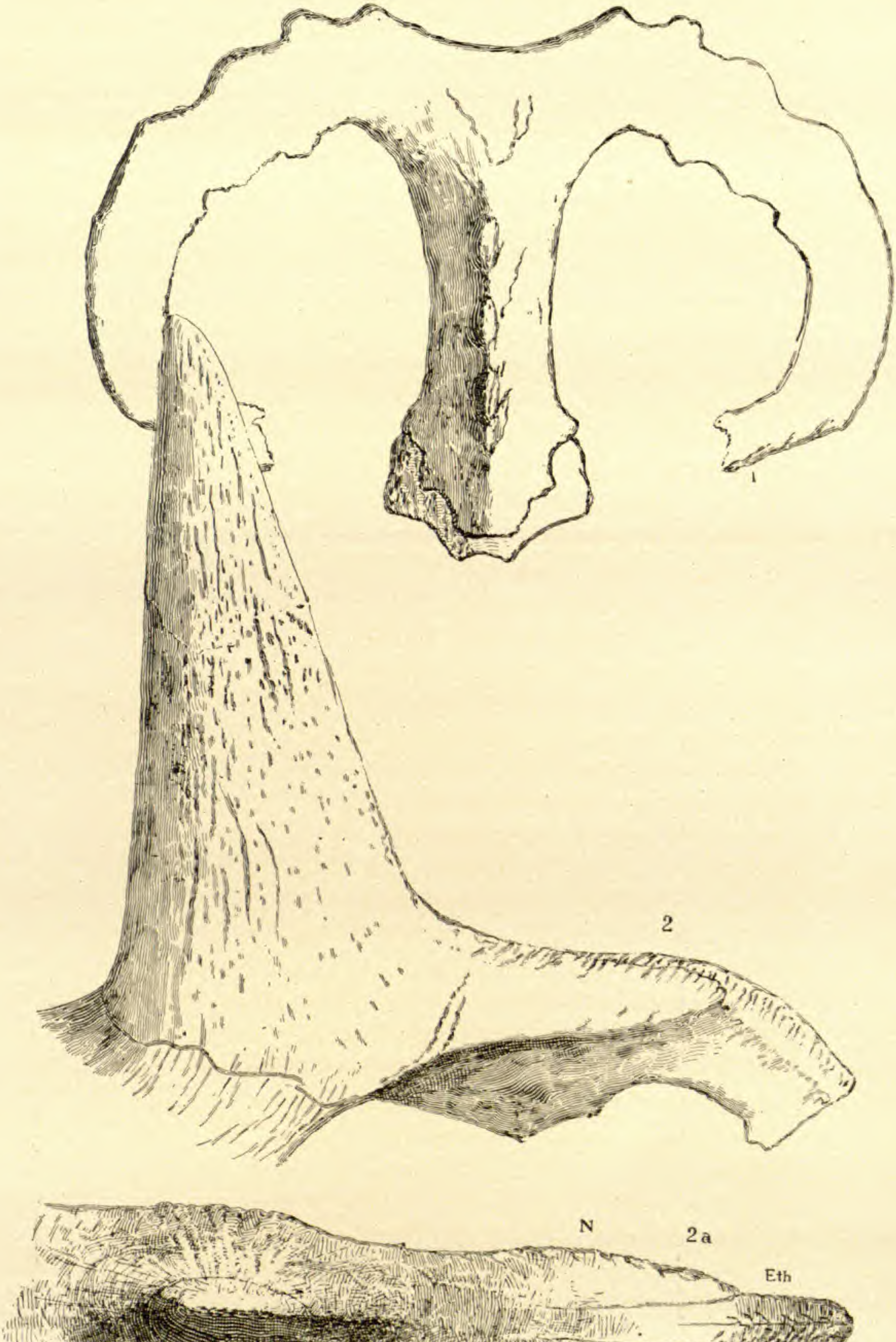
We find but little to say upon the Cretaceous of the Virginia shore of the Potomac. We found upon examination years ago that the Acquia creek sandstone begins below Occoquan Bay, Fairfax county, Va., and runs out at Mt. Vernon, and that upon that formation nowhere upon the Potomac river could we find any other sign of the Cretaceous, except a deposit of very perfect leaves and stems at the White House —no black marl, no Cretaceous shells. That fact made the great cliff at Fort Washington more incomprehensible.

If our diagnosis is correct for the lower formation at Fort Washington—that it is Jurassic—then by a parity of reasoning that formation continues down at least to Smith's Point, Charles county, being occasionally lost below high water, and then rising from two to six feet above it.

In the upper end of Charles county, upon the Potomac river, opposite Mt. Vernon, there are three thousand acres of land, a plateau from one to twenty feet above high tide, surrounded with an amphitheater of hills in which Eocene and Cretaceous are well developed. In the plain below there is no sign of fossils, neither Miocene, Eocene, nor Cretaceous.

To what formation then shall we assign this locality? If not Jurassic —then, what is it? All the wells of this particular locality penetrate a variegated clay but no micaceous sand.—OLIVER N. BRYAN, *Marshall Hall, Md.*

PLATE XXXIII.



1. *Monoclonius crassus.* 2. *M. sphenocerus.*

The Horned Dinosauria of the Laramie.—Since my last note on this subject (AMERICAN NATURALIST, December, 1888, page 1108), the publication, by Professor Marsh, of a figure[1] of a skull of one of the species, enables me to determine more exactly the affinities of several species of the family which have been in my possession for many years.

The most complete skeleton in my collection is that of the *Monoclonius crassus* Cope.[2] This includes representatives of all the elements excepting the bones of the feet. The posterior part of the skull is preserved, including the left frontal bone. This bears a horn over the middle of the orbit, of small dimensions, and with the apex anteroposteriorly compressed. The parietal bones are enormously expanded, and are interrupted on each side of the middle line by a huge foramen, which causes the remaining parts of the bone to resemble the corresponding parts of Chamæleo, depressed in a horizontal plane. The squamosals are lateral, and consist of a wide plate with convex external border with a slightly undulating outline. The ilium is remarkably elongate, both anterior and posterior to the acetabulum, appropriate to the ten vertebræ which constitute the sacrum. It and the sacrum resemble very closely those of the *Agathaumas sylvestre* Cope,[3] which fact, with the evidence derived from the other vertebræ, leaves no doubt that the Agathaumas is to be referred to the family of horned herbivorous Dinosauria, with Monoclonius and Polyonax. This family is called by Marsh the Ceratopsidæ; but as it is not certain that Ceratops, Marsh, is distinct from one of the genera previously named, I shall call it the Agathaumidæ (or hellenicé Agathaumantidæ), from the longest known genus, Agathaumas.

The characters of Polyonax Cope are not yet fully known. The frontal horns of the typical species, *P. mortuarius*[4] Cope, are long and slender, while those of the known species of Monoclonius are shorter and robust, and there is a large nasal horn. The *Agathaumas sylvestre* is the largest of the species.

I now give a list of the species of this family known to me:

[1] *American Journal of Science and Arts*, December, 1889.

[2] Proceedings of Academy, Philadelphia, October, 1876. AMERICAN NATURALIST, 1886, page 154.

[3] Proceedings of American Philosophical Society, 1872, page 482; Cretaceous Vertebrata of the West, 1875, page 54, plates v, vi.

[4] Bulletins U. S. Geological Survey Terrs., 1874, April; Cretaceous Vertebrata of the West, 1875, page 63, plates II., III.

Agathaumas sylvestre Cope, l. c.

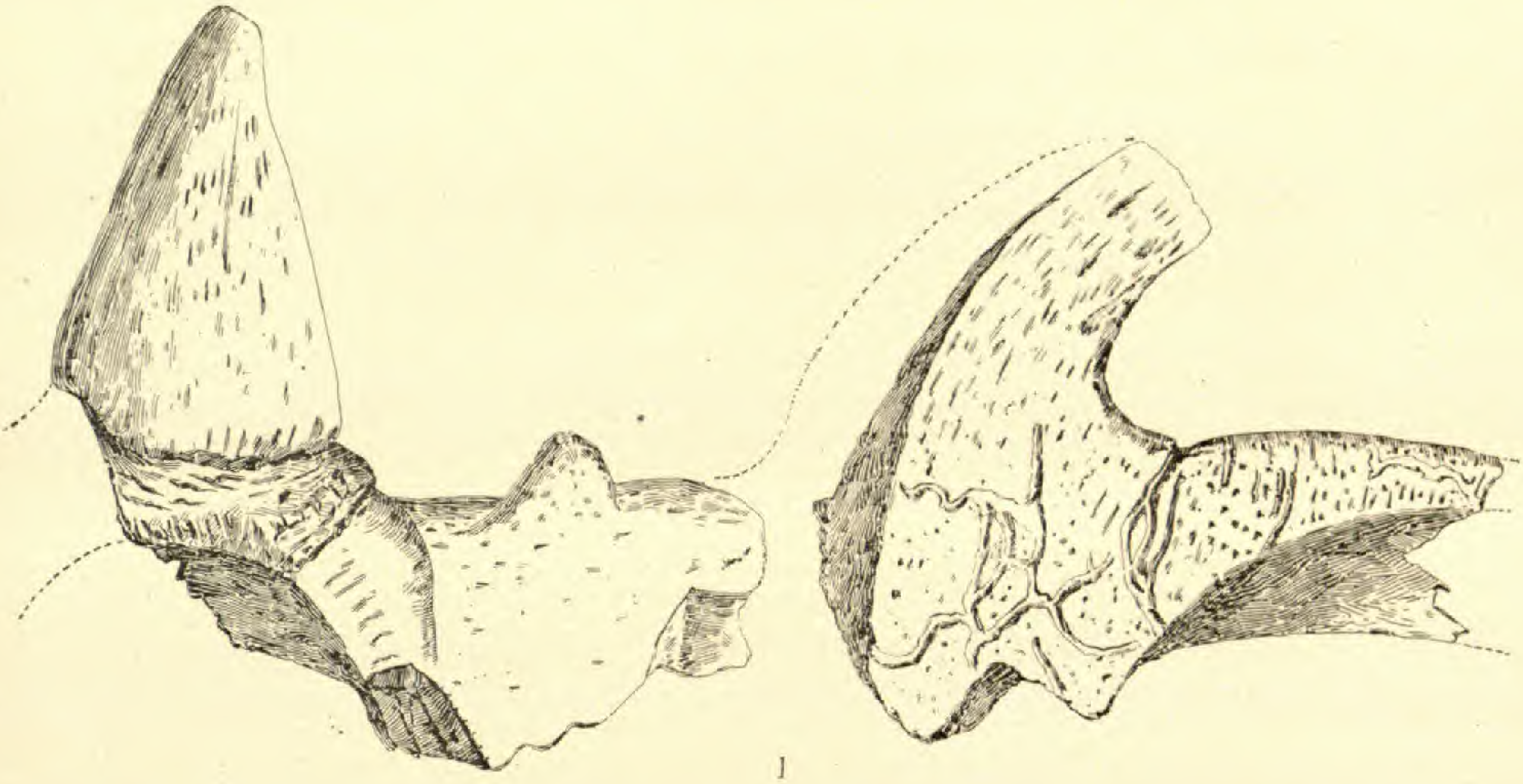
Polyonax mortuarius Cope, l. c.

Monoclonius recurvicornis Cope, sp. nov. Dinosaurian Cope (Bulletin U. S. Geological Survey Terrs. III., 1877, page 588; plate 34, figures 7 and 8.)

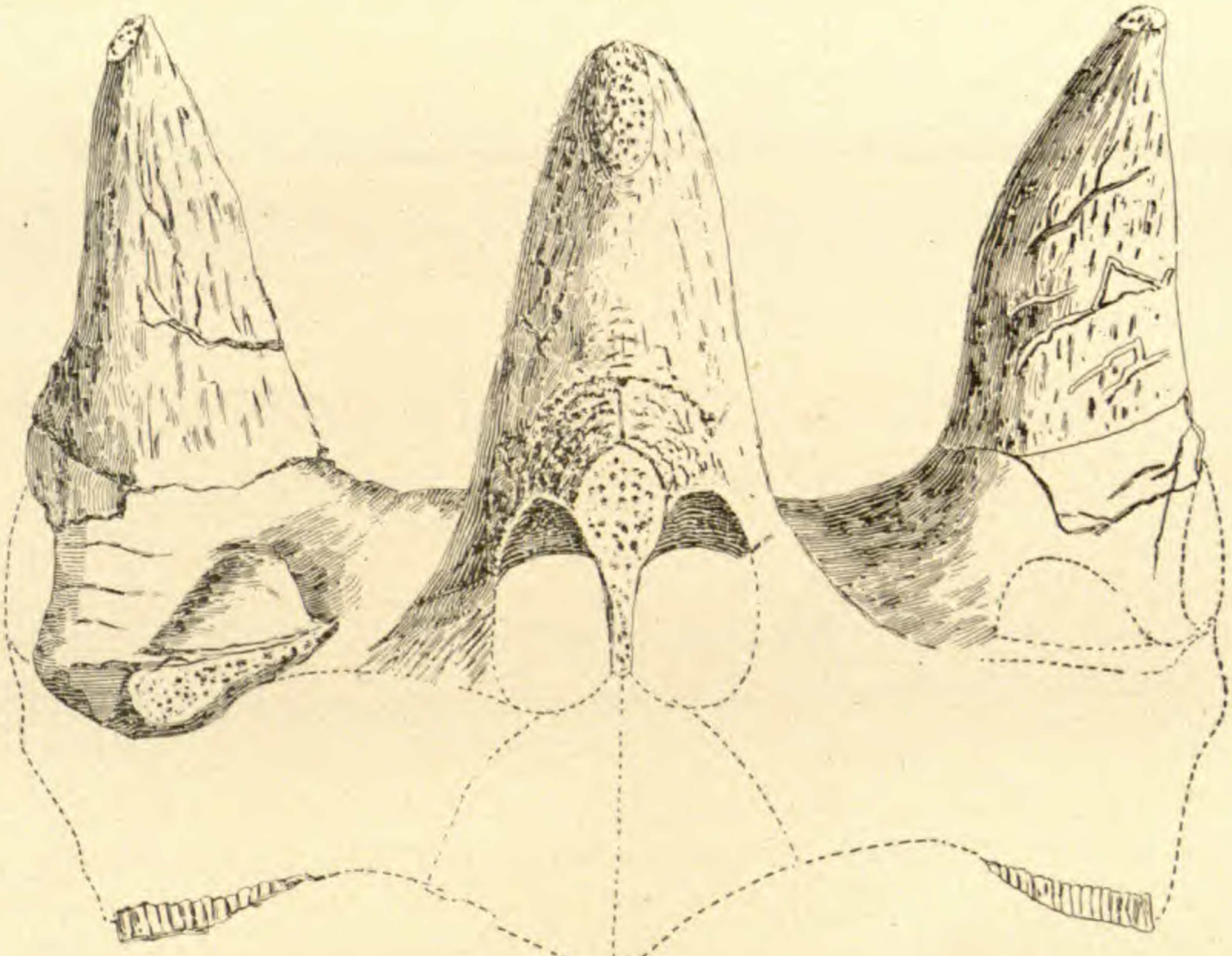
I excavated the bones of the skull of this species in Montana, and described them as above; but suspecting that they might belong to some of the species already known, I did not name them. The fortunate discovery by Prof. Marsh enables me to determine them. The supraorbital horns are robust, straight, and rather short. Their section is an anteroposterior oval at base, and at the middle rounded subquadrate. The nasal bones are wedge-shaped and much narrowed forwards; they support a coössified median septum below. Superior face rounded, very rugose. Some distance posterior to the apex they support a very robust horn, which is compressed and turned abruptly forwards at the apex. Posterior face injured. Length of supraorbital horn 210 mm., long diameter at base 115 mm.; width of nasal bone at base of horn 100 mm.; diameter of nasal horn at base (transverse) 95 mm.; elevation (on curve) to broken apex, 115 mm. Between the supraorbital horns on each frontal bone a low tuberosity. This was a colossal animal and of peculiar characters. The squamosal is narrower than in *M. crassus*, and had marginal tuberosities.

Monoclonius sphenocerus Cope, sp. nov., represented by numerous parts of the skeleton, including parts of the skull, which were found by Charles H. Sternberg, on the Missouri River, near Cow Island, in 1876. The end of the muzzle is preserved, and presents characters which show that the species is quite different from the one last described. The nasal bones are greatly produced to form a slender, compressed, decurved apex, with a prolongation of the inferior median ethmoid septum. The superior face is round in the transverse section, and is rugose. At a long distance behind the apex the nasal horns rises. It is compressed and vertical in direction, and was not less than 250 mm. in length, but the apex I have not yet found in the packages. Supraorbital horns unknown. The nasal bones are narrower at the base of the horn than in the *recurvicornis*, and the horn is of different form. The anterior border converges regularly to the posterior, and its anterior edge is acute for the distal half. Length of nasals in front of horn, 255 mm.; transverse diameter of nasals below at base of horn, 70 mm.; diameters of base of horn, anteroposterior, 160 mm.; transverse, 60 mm.

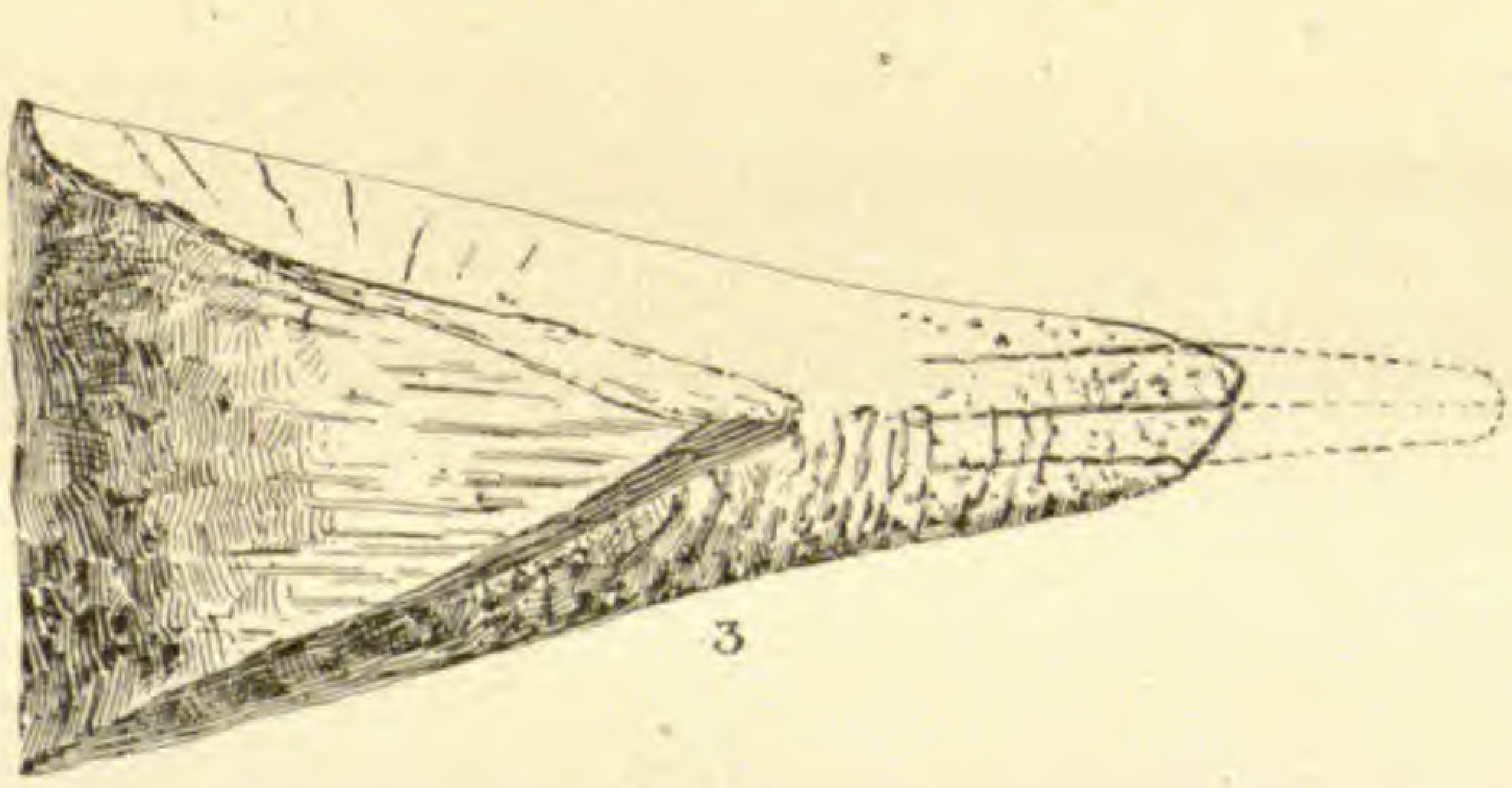
PLATE XXXIV.



1



2



3

Monoclonius recurvicornis.

The *Monoclonius sphenocerus* is an animal of large size, exceeding the rhinoceros in height, and the nasal horn is the most formidable weapon I have observed in a reptile.

It may be that the two species last described belong to Agathaumus, as the cranial characters of that genus are not known.

MONOCLONIUS CRASSUS Cope, l. c. Parts of two individuals found together.

MONOCLONIUS FISSUS Cope, sp. nov.

Founded on a squamosal bone of an individual of much smaller size than those above described. The suture with the parietals is relatively shorter than in the *M. crassus*, occupying only the distal third of the margin. The plate anterior to the transverse suture for the quadrate is more nearly in one plane, is wider in relation to its length, and has a squamosal sutural surface, and a transverse groove not seen in the *M. crassus*. The excavation posterior to the process which joins the quadrate is deeper. External border mostly lost. Total length 180 mm.; length in front of quadrate suture 50 mm.; width in front of do. 87 mm.; width at postquadrate concavity, 62 mm.

EXPLANATION OF PLATES XXXIII. AND XXXIV.

Bones of Agathaumidæ much reduced.

FIG. 1. Parietal bone of *Monoclonius crassus* one-eighth natural size.

FIG. 2. Nasal and part of ? ethmoid bones of *Monoclonius sphenocerus; a* side view; *b* from above; two-ninths natural size.

FIG. 3. Part of frontal bone of *Monoclonius recurvicornis* with supraorbital horn, and nasals with horn; profile, two-ninths natural size.

FIG. 4. Front view of supraorbital and nasal horns and adjacent bones of *Monoclonius recurvinostris;* two-ninths natural size.

FIG. 5. Part of nasal bones of do. with part of median horn, from above; two-ninths natural size.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—An epitome of the various facts known to petrographers with relation to the act of crystallization in rock magmas, and the conditions under which this takes place, has been sorely needed by students who are unable to keep abreast of the widespread literature of modern lithology. Mr. Iddings[2] has recently succeeded in presenting the subject to us in a manner that is at the same time scientific and untechnical. His work will surely be appreciated by all of his co-laborers in petrography, as well as by students and geologists at large. Mr. Iddings' paper is divided into two distinct parts. In the first the phenomena of crystallization are discussed, with especial reference to the crystallizations of mineral in rock magmas. The second portion of the article deals with the causes of crystallization; and in this it is that the author has given the most valuable results. After mentioning the cases in which rocks and rock-forming minerals have been artificially produced, and calling attention to the analogy that exists between the originally molten rock-magma and saturated solutions of salts, it is concluded that (1) the order of crystallization in rocks depends primarily upon their chemical composition, and (2) its nature upon the physical conditions obtaining during the solidification; the principal physical conditions affecting crystallization, in the order of their importance, being temperature, rate of cooling, chemical composition of the original magma, the presence of mineralizing agents (aiding in the formation of crystals, *e. g.*, water in many rocks), and finally pressure. The effect of each one of these conditions is briefly alluded to, and the impression which each leaves upon the cooling magma during its progress from the interior of the earth to its surface is clearly described. In the course of the article the word *phenocrysts* is suggested as an equivalent for the German word "Einspringlinge,"—porphyritic crystals.—— The controversy between Prof. Judd and Dr. Geikie as to the origin of the massive rocks of the Western Isles of Scotland has been intensified by the appearance of Geikie's[3] "History of Volcanic Action During the Tertiary Period in the British Isles," and a reply to this by Prof.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] On the Crystallization of Igneous Rocks. Phil. Sec. of Wash. Bull., Vol. XI., pp. 65–113.

[3] Trans. Roy. Soc. Edinb. XXXV., pt. 2, pp. 21–184.

Judd.[4] It will be remembered that Judd,[5] in 1874, published an article in which was shown that there exist in the Western Isles of Scotland granites and gabbros, grading imperceptibly into vitreous pitchstones and tachylites, and emanating from five distinct centres, which were regarded as the seats of old volcanoes. The acid rocks of the region were regarded as older than the basic ones, and the district was thought to have been one of great volcanoes. In Dr. Geikie's monograph the last two conclusions are denied acceptance, while on the whole the first two are accepted. In his present article Judd gives his reasons for insisting upon the truth of his previous statements, and refuses to accept the view of Geikie that the great outbursts of lava took place from fissures (as in the Western States), rather than from volcanic vents. According to Judd the gabbros are the deep-seated portions of a magma, which, upon the surface, assumed the structure of basalt. This gabbro filled the fissures which were opened during the extravasation of the basalt, and is therefore contemporaneous with this rock. Geikie asserts that the gabbro injections belong to a distinct and later period than the outflow of the basalt. The controversy bids fair to yield results of great interest to petrography; for this reason it has been referred to in this place. The acid rocks of this region present some very interesting appearances, which are described by Judd[6] in a short paper. Granitic eruptive masses usually pass towards their peripheral portions into granophyres, smaller eruptive bosses and laccolites exhibit the granophyric structure throughout; while apophyses from intrusive masses display the same structures, sometimes on a very minute scale. A labradorite-andesite is composed of large crystals of labradorite scattered through a glassy base containing microlites of feldspar, augite and magnetite. In a specimen of this rock from Dun da Ghaoithe in Mull are large idiomorphic labradorite crystals, consisting of a central, sometimes rounded and corroded, core surrounded by an irregular fringe of the same mineral substance,[7] differing from the core in extinction and in other properties. This enlargement takes place only where the original crystal was in contact with the glassy matrix. The crystallographic continuity of the core and the surrounding envelope is shown by the passage of twinning planes from the one into the other; the optical

[4] The Tertiary Volcanoes of the Western Isles of Scotland. *Quart. Jour. Geo. Soc.*, May, 1889, pp. 187–219.

[5] Ib. XXX. [1874], pp. 220–302.

[6] *Quart. Jour. Geo. Soc.*, May, 1889, pp. 175–187.

[7] cf. AMER. NATURALIST, 1885, p. 1216; 1888, pp. 168 and 732.

differences by the extinction of the envelope in zones whose angle of extinction varies *gradually* and progressively from the centre outward, reaching finally (in some cases) the albite limit. This enlargement is regarded by the author as having taken place after the solidification of the rock, and at the expense of the glassy matrix. Further, the granophyric structure is supposed to owe its origin to a similar set of phenomena, viz., the secondary devitrification of a glassy matrix. A third very interesting article by the same writer [8] treats of the processes by which the plagioclase of the Oedegaarden "gepleckter-gabbro" has been changed into scapolite. In the fresh rock a labradorite with twinning lamellæ is distinctly observed. Along these twinning bands are accumulations [9] of cavities containing solutions of sodium chloride. As the rock loses its granitic structure and becomes schistose the feldspar loses its distinctive features, becomes granulated, and changes gradually into scapolite, at the same time losing its store of sodium-chloride solution. The production of the cavities with their contents of sodium-chloride is supposed to be the result of statical pressure—the solution having penetrated the mineral along its planes of easiest solution. Under the influence of mechanical stress the mineral was crushed and suffered granulation, reactions were set up between the feldspar molecules and the included sodium-chloride solution, resulting in entire conversion of the plagioclase into scapolite. The augite of the same rock presents a parallel series of changes. It first becomes schillerized, and then, by mutual reactions between the augite substance and the material producing the schillerization, is changed into hornblende. It is pointed out by the author that similar changes must have taken place in the Canadian scapolite rocks studied by Messrs. Adams and Lawson.[10] Prof. Judd would call the first kind of change "*statical metamorphism*," since the production of secondary cavities in minerals and schillerization are the result of solutions acting on mineral substances under the influence of heat and pressure. "Dynamical metamorphism," on the other hand, necessitates movement in the mass, with the accompaniment of the crushing of minerals and the production of schistosity. A comparison of the effects of the two kinds of metamorphism is briefly given by the author in a separate paper.[11]

[8] *Mineralogical Magazine*, VIII., pp. 186–202.

[9] cf. AMER. NATURALIST, 1887, p. 761.

[10] AMER. NATURALIST, Feb. 1889, p. 169.

[11] *Geological Magazine*, VI. 300, pp. 243–249.

A little south of Murfreesboro, in Pike county, Arkansas, is a mass of peridotite of Cretaceous age, whose microscopical features have recently been examined by Dr. R. N. Brackett.[12] The rock consists of porphyritic crystals of colorless olivine and brown mica in a ground-mass composed of lath-shaped crystals of augite, little crystals of peropskite and grains of magnetite in a decomposed yellowish glassy base. The rock is similar in many respects to the only other two peridotites described from the United States. It is placed by the author in the group of kimberlites or picrite-porphyries of Lewis. The ore-bearing rock at the Treadwell gold mine in Alaska is, according to F. D. Adams,[13] "A hornblende granite, much crushed, altered and impregnated with secondary quartz, calcite and pyrite." This includes kernels of more compact granite in which alteration has not proceeded so far. Much of the gold present in the rock occurs free in the pyrite. The rock is interesting in that it contains original epidote. Interesting intergrowths of the rare mineral allanite and epidote are described in some detail by Dr. Hobbs[14] in a porphyritic granite at Ilchester, Md., and by Lacroix[15] in the pyroxene-amphibole gneiss of Finisterre, in the pyroxene-wernerite gneiss of the Lower Australian Waldviertel, and in the scapolite-gneiss of Odegården in Norway. These intergrowths (in the Ilchester rock) consist of an idiomorphic core of brown allanite, zonally developed, and around it an idiomorphic or an allotriomorphic mantle of pale yellowish green epidote. In the allanite the axis of elasticity is inclined at an angle of 36° to the vertical axes, while in the epidote this is only 3°. Analysis of the purified epidote yielded Dr. Hildebrand:

SiO_2	$Fe_2O_3.FeO$	MnO	CaO	MgO	H_2O	P_2O_5	TiO_2
37.63	15.29	.31	22.93	.31	2.23	.44	3.78

Dr. Hobbs regards the epidote as secondary in the Ilchester rock, while Lacroix thinks it primary in all the occurrences described by him.

Mineralogical News.—In a short paper forming an appendix to his notes on the minerals occurring in the neighborhood of Baltimore, Dr. Williams[16] briefly mentions fifteen new species that have been

[12] *Amer. Jour. Sci.*, XXXVIII., July, 1889, p. 56.

[13] *American Geologist*, Aug., 1889, p. 84.

[14] *Amer. Jour. Sci.*, XXXVIII., Sept., 1889, p. 223.

[15] *Bull. de la Soc. Franc. de Min.*, XII., April, 1889.

[16] Johns Hopkins Univ. Circulars, No. 75.

identified in the region within the past two years. Among these is *ottrelite* from certain phyetites occurring at an old copper mine near Liberty, Frederick county. The crystals of the mineral are arranged nearly perpendicular to the cleavage planes of the rock. Their morphological and optical properties leave no doubt as to their true nature. In addition to the minerals described by Williams, Mr. Gill[17] describes two very rare chromium minerals found in the dump heaps of the chrome pits in Montgomery county. The first is a *chrome tourmaline*. This occurs in fissures in chromite, and is generally associated with *fuchsite*, both usually being imbedded in a chloritic matrix. The tourmaline is in the form of long dark green needles, exhibiting marked dichroism in green and straw-colored tints, and a beautiful zonal structure. The fuchsite is in little green scales, whose optical angle in air is 68° 16′ for sodium light, and pleochroism : A=robin's egg blue, B= yellowish green, C=bluish chrome-green. Analyses of the two minerals, made by Dr. Chatard, are given below. I. is that of the tourmaline, II. is the analysis of the fuchsite.

	SiO_2	B_2O_3	Fl	P_2O_5	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_8	NiO	CaO
I.	36.56	8.90	.06	.04	.09	32.58	4.32	.79	.05	.75
II.	42.21	. . .	. . .	. . .	. . .	34.55	2.03	1.03		.47

MgO		Na_2O	K_2O	H_2O	Sp.Gr.
9.47	I.	2.22	.13	3.74	3.062-3.089
3.13	II.	.82	9.16	6.77	. . . . . .

Analyses and short descriptions of three other rare substances are communicated by Dr. Genth ;[18] Gadolinite from Burnett and Llano counties, Texas, has a black color, is translucent in thin splinters, and has a greenish gray streak. Analysis of a specimen of the Burnett county mineral gave:

SiO_2	Al_2O_3	Ce_2O_3	ThO_2	$(Di.La)_2O_3$	$(Y.Er)_2O_3$	MnO	FeO
22.87	.28	2.65		5.22	44.35	.22	13.69

BeO	MgO	CaO	Na_2O	K_2O	Ign.	Sp.Gr.
9.24	.07	.64	.20	.15	.72	4.201.

Cacoclasite is the name suggested by H. C. Lewis for some tetragonal white crystals present in a blue calcite at Wakefield, Ottawa county, Quebec. Dr. Genth's analyses indicate that the substance is a mixture of several compounds whose nature cannot be determined. A

[17] Ib. p. 75.

[18] *Amer. Jour. Sci.*, Sept., 1889, p. 198.

monazite from the Villeneuve Mica Mine, Ottawa county, Quebec, has a reddish-brown color, slightly waxy lustre, and an indistinct cleavage. Analysis:

SiO_2	ThO_2	Fe_2O_3	Ce_2O_3	$(La.Di)_2O_3$	$(Y.Er)_2O_3$	MgO	CaO
.91	12.60	1.07	24.80	26.41	4.76	.04	1.54

P_2O_5	H_2O	Sp.Gr.
26.86	.78	5.233

Galmite and a *columbite* crystal from Delaware county, Pennsylvania, are also described and analysed by Dr. Genth.[19]

BOTANY.

The Cooke Herbarium.—From the June number of *Grevillea* we learn that the large herbarium of fungi, transferred by M. C. Cooke to the Royal Herbarium at Kew, is now for the most part incorporated with that great collection. The specimens are distributed as follows:

Hymenomycetes, about	11,000
Gastromycetes and Myxogasters,	2,000
Ustilagines and Uredines,	6,000
Discomycetes,	6,000
Pyrenomycetes,	12,000
Incompletæ,	9,000

The collection is a most valuable one, containing, as it does, contributions from many eminent mycologists, Berkeley, Curtis, Duby, Ellis, Fries, Leville, Montague, Peck, Ravenel, Rabenhorst, Winter, etc.

The Flora of Madagascar.—It may now be said with perfect truth that the vegetable productions of Madagascar have been, though not thoroughly, very extensively explored, and that the majority of the plants inhabiting the island are known to science. The country has been traversed by botanists in many different directions, its highest mountains have been ascended, its lakes and marshes crossed, its forests penetrated, and large collections of plants have been made from time to time, which have been examined and described in various publications. Our knowledge of the flora of Madagascar is due, in the first instance, to the labors of Flacourt, Dupetit Thouars, Commerson, Chapelier, Bernier, Lantz, Boivin, Pervillé, De Lastelle,

[19] Proc. Ac. Nat. Sc. of Phila., 1889., p. 50.

Grevé, Hilsenberg, Bojer, Goudot, Bréon, Vesco, Grandidier, Thompson, Lyall, Ellis, and others, most of whom collected plants chiefly in the east, north, and north-west parts of the island. * * * *

Within the last five years our knowledge of the flora of the island has been very materially increased, so that, whereas until recently less than two thousand species of plants were known, there are now named and described about four thousand one hundred, though many of them will doubtless prove repetitions when they are properly compared and worked out. * * * *

In Madagascar a considerable area is covered by primeval forests. On the eastern side of the island,—that is, the part eastward of the highest range of mountains, which forms the chief watershed,—there is a forest which extends probably eighteen hundred miles from north to south, almost, if not entirely, without a break, and which, if what is frequently stated be true, continues round the island, forming a complete, or almost complete, belt some distance from the sea. * * * *

It is grievous to relate, however, that the forests of Madagascar are being destroyed in the most ruthless and wholesale manner by the natives. Every year thousands of acres of country are cleared, the trees being burned to the ground, and that for no other purpose than to provide ashes as manure for a mere handful or two of beans, or a few cobs of Indian corn, or a little rice to be grown in the clearing. * * * *

The following figures will show at a glance the number of natural orders and generas of flowering plants represented in Madagascar as compared with those known throughout the world according to Bentham and Hooker's "Genera Plantarum":

Total known in the world, . . . Orders, 200; genera, 7,569.
Total known in Madagascar, . . Orders, 144; genera, 970.

Of the four thousand one hundred plants at present known in Madagascar, about three thousand (or three-fourths of the total flora) are, remarkable to say, endemic. Even of the Granicueæ and Cyperaceæ about two-fifths of the plants in each order are peculiar to the island. There is but one natural order confined to Madagascar, the Chlænaceæ, with twenty-four species, which, however, M. Baillon places under Ternstrœmiaceæ. Of ferns more than a third are endemic, and of orchids as much as five-sixths, facts which in themselves are sufficient to give a very marked individuality to the character of the flora. —Richard Baron, in *Jour. Linn. Society.*

Some Recent Botanical Literature.—In the August and September numbers of the *Journal of Botany* George Murray continues his useful catalogue of the Marine Algæ of the West Indian Region. —Mr. Buchanan White, in the September number, publishes a list of British willows, amounting to seventeen different speces, with many varieties and hybrids.—Britten and Boulger's Biographical Index of British and Irish Botantists has reached Lindsay. It is a most condensed index, and one wishes it could have been a little less so, especially in case of such men as Knight, Leighton, Lindley, etc.—A short obituary of the Rev. M. J. Berkeley appears in the September *Grevillea.* Born in 1803, he lived until the 30th of July of this year, reaching the ripe age of nearly eighty-six years. For more than half a century he was a careful student of the fungi. His herbarium, containing the types of about five thousand species, was deposited in the Kew Herbarium in 1879.—M. C. Cooke's new edition of his Handbook of the British Fungi has reached the genus Russula. The last species described is numbered 1214. Professor Underwood and O. F. Cook have compiled a generic synopsis of the Basidiomycetes and Myxomycetes covering twenty-one pamphlet pages. It is designed to accompany A Century of Illustrative Fungi, distributed by the authors.

BACTERIOLOGY.

Phenyl Alcohol as a Preservative for Growths of Bacteria on nutrient Agar agar.—While working on bacteria at the Illinois Laboratory of Natural History recently, the writer of this note made a few experiments with a view to finding something that could be used to preserve growths of bacteria in and on nutrient agar agar. Among a number of preservatives employed a thirty per cent. solution of carbolic acid in alcohol was finally settled on, as giving the most satisfactory results. The acid counteracts the whitening tendency of the alcohol to such an extent that the preserved agar agar is more transparent than the original. For very profuse surface growths it does not answer well, because the alcohol hardens, and renders them brittle, so that they are liable subsequently to flake off from the gelatine. Growths which have not been allowed to stand too long, however, before fixing, retain in the preservative much of their original appearance. The alcohol used was the ordinary commercial article (in the neighborhood of 95 per cent.), and it may prove that a weaker grade, as likely to alter the gelatine less, will answer the purpose better.—H. GARMAN.

The Effects of CO_2 Upon Bacteria.—An important paper has recently appeared, by Dr. Carl Fränkel, on the influence of carbonic acid gas upon the life and activities of micro-organisms.[1] Fränkel was led to undertake this investigation by noticing that the deeper layers of soil, when freshly examined, contained very few germs, but after standing a few hours became prodigiously rich in bacteria. Thus, for instance, a sample of earth taken from the depth of three-and-a-half meters was found to hold in one-fiftieth of a cubic centimeter twelve living germs, but in twenty-four hours this number had mounted to 40,888. The question therefore arises as to why the micro-organisms existing in the lower strata of the soil do not thrive and multiply, since they are evidently in the presence of abundant and satisfactory food. Plainly there must be some influence in the sub-soil distinctly hostile to the development of the bacteria which are there present. Fränkel suspected that the unfavorable conditions might lie in the peculiar composition of the ground air, since this differs from ordinary atmospheric air in the smaller amount of oxygen and the much larger amount of carbonic acid which it contains. He has consequently studied the effects of carbonic acid upon micro-organisms with a view to clearing up this matter, and to throwing some light on the problems of putrefaction.

After giving the details of a series of skilfully conceived and carefully executed experiments, Fränkel briefly sums up his results.

1. A certain number of the known species of bacteria are able to thrive practically as well in CO_2 as in ordinary air.

2. Others, although able to develop in CO_2, have their growth delayed and hindered by its presence.

3. A third group does not grow in CO_2 under ordinary conditions, but develops when placed at the incubating temperature [35°-37°].

4. The greater part of the rest, including many saprophytic kinds, do not thrive in CO_2 under any conditions whatever, but are not, however, killed, and always develop when the CO_2 is replaced by atmospheric air, even after being subjected to the action of the CO_2 for a long time.

5. Some bacteria, among them the most important pathogenic kinds

[1] Die Einwirkung der Kohlensäure and die Lebensthätigkeit der Mikroorganismen. *Zeitschrift für Hygiene*, V. Bd., II. Heft, S. 332, 21 Nov., 1888.

(Cholera and Anthrax), are destroyed by the CO_2 more or less completely.

In spite of this influence of CO_2 in checking development, and in some cases in partially destroying the germs, it is not available as a means for preventing putrefaction, and is therefore not an antiseptic in the narrower sense of that term. A relatively insignificant admixture of ordinary air allows a rich development of even the kinds of bacteria most sensitive towards CO_2.

CO_2, then, for some micro-organisms is not an indifferent gas, but exerts a strongly inhibitory influence upon their multiplication, and in some cases destroys part of the germs submitted to its action. That this injurious effect is not due to the absence of oxygen is shown by the fact that a number of this group are anærobic in habit. For other kinds of bacteria CO_2 is apparently wholly inert.—E. O. JORDAN.

The New Science of Hygiene.—Whatever his opinions of the modern times may be in other respects every one must admit that the present contrasts most sharply with the past in its keen sensitiveness to the public welfare. Especially is this true of great cities, which have gone so far in this direction that it seems to be their highest endeavor to overcome the obstructions to the public health incurred by unnatural conditions such as density of population, and to work out for themselves new and better conditions of existence. A new root has sprung from the tree of knowledge, and hygienic science is shedding its light even in the darkest places, and civilized nations are hastening to meet this new necessity by the establishment of hygienic laboratories, yet at the same time it is but a one-sided view which regards hygiene as the handmaid of medicine only ; on the contrary, it touches practical life in manifold ways of the utmost importance.—*Zeitschrift für Hygiene.*

ZOÖLOGY.

Excavating Habits of our Common Sea-Urchin.—The habit of certain species of sea-urchins of boring in solid rock is well-known, and has been again and again described, and made a subject of more or less extended study by naturalists. Although familiar with this work of the sea-urchins from descriptions and the study of specimens from other coasts, it has never been my good fortune to observe specimens of rock excavated by our species of Strongylocentrotus (*S. drobachiensis*) before the present summer. As other naturalists may have an interest to know of a place where this process can be readily seen, I have ventured to call their attention to the locality where it was observed.

The eroded rocks of the shore of Grand Manan and the sunken ledges about it offer exceptional features for the study of the phenomenon referred to, but even here it is rare and difficult to observe, although for miles and miles the bottom just below low tide is paved with these echinoderms. There are only limited localities where the excavating of these animals can be seen. One of the best places is on the Black Ledges, a few miles from Nantucket, Grand Manan. These ledges, wholly covered by high tide, are beaten at times by a tremendous sea, and around them course the violent tides of the Bay of Fundy. At low water they are bare ridges of rocks more or less covered with kelp, their surfaces with depressions in which standing water remains between low and high water. The sea-urchins in these pools lie so closely packed together that they touch each other, forming the bristling carpeting of their floors. In one of these pools these echinoderms have made excavations in the rock from one to three inches in depth, perfectly symmetrical and smooth, so close together that the rock has an appearance of the surface of honeycomb when the inhabitants of the cavities are removed. The rock in which these curious formations occur is a hard, gray slate, readily scratched with a knife, forming seams between the harder quartzite so prominent on many of the islands. The excavations are confined to the softer rock, and, as far as observed, were not seen in the quartzite. The sides of the basin in which they were found lie at an angle of about 80°, or almost perpendicular to the floor. The ridges which separate the cavities are tipped by a thick, calcareous, purple alga, which, while it may increase the apparent depth of the cavity as measured from the rim of the same, is comparatively thin as respects the depth of the excavation itself.

Near by this pool there are others with sea-urchins, apparently under the same conditions, where there is no sign of excavations, and long stretches of coast on the neighboring island, where the rock is perfectly paved with sea-urchins, show no attempt on the part of these animals to form even the slightest depression in the rock surface. The existence of these excavations is exceptional even in the Black Ledges, and the phenomenon is thought to be rare even on Grand Manan. Except that possibly the spines about the mouth were stouter than those found on sea-urchins which had not made the excavations, there is nothing to distinguish the inhabitants of the excavations from their neighbors. In no case was it found that the sea-urchins had sunken into the rock below its surface level, nor were the animals in any instance larger than the entrance of the cavities, or unable to escape from the holes in which they were found, as seen in so many specimens in our museums.

It is said by fishermen that our sea-urchins bore into the birch stakes used in building weirs, but I was unable to observe this phenomenon. In some places, however, the back and outer rings of the wood fibre was removed, apparently by them.

The one explanation of this work of the sea-urchins which an examination of the cavities suggests, is that they bury themselves in this way for protection, or for a more effective way of clinging to the cliff, but if such is the true explanation, why is the habit so localized and limited in area?

The method by which the cavities are hollowed out of solid rock is also a prolific subject for a theory, and many explanations have been advanced. I incline to believe that it is simply the effect of a mechanical erosion in the case of the Grand Manan specimens which were studied.

The rate of wearing of the holes is very slow, and there is reason to believe that many sea-urchins were concerned in the production of one excavation. The individual which at present occupies the cavity is probably the last of a series of several members, and the same may be true even when the sea-urchin is larger than the entrance to the chamber in which it lives. When the sea-urchins are removed from the cavities and the excavations uncovered a new tide will repeople them, so that there is little change in their appearance. The new denizens take up the work where their predecessors left off. This continued work, undisturbed for years, by successive sea-urchins, in time forms the cavities. Their own movements, and the wash of the sea, possibly that of the tides, combine to file away the rock under their soft spines, which are renewed or replaced as time goes on.

It is instructive in connection with a mechanical explanation of the excavating habit of the sea-urchins to consider a geological phenomenon which the cavities inhabited by these animals at once suggest. The pot holes found between tides at certain points on Grand Manan are very beautiful examples of rock cavities worn by stones found within them. The general appearance of the sea-urchin cavities is much the same except in size and depth. The worn surfaces of the cavities are almost identical, and there seems no good reason why we should look for different causes in the two cases. All bowlders, even on apparently good positions, do not form potholes, as the majority of sea-urchins do not wear away a cavity for themselves, but in certain circumstances they do, and the result of the erosion is almost identical. It therefore seems as if it were far-fetched to bring in an acid secretion of the sea-urchin as an agent in forming these depressions in the rocks. It also seems as if the movement of the body did not wholly account for them, but that they are, in part at least, due to the erosion of the rock by the sea beating them against the rock surface, notwithstanding they are practically anchored by their feet.

I hope to be able later to present a more extended account of these sea-urchin excavations, accompanied by illustrations in which it will be possible to show the successive growth of a typical depression. What is here given, while it has a bearing on the deep cavities made in rocks by other species of echinoids, does not necessarily apply to them, but only to the excavations of *S. drobachiensis* found at Grand Manan.—J. WALTER FEWKES.

Moulting of Spiders.—M. Wagner (*Annales des Sciences Naturelles,* VI. 4, 5, 6), contributes an extensive review of the moulting processes which take place in the Arachnida. The writer does not confine himself to the formation of the new integument and the rejection of the old one, but treats also of the formation of the hairs, and the moulting of the eyes, respiratory organs, glands, intestines, and tendons, as well as the modifications observed in the blood-corpuscles during the process, and the biological phenomena which accompany the moulting. The interval between the old and new integument is at first filled with liquid, but this is absorbed before moulting. The new cuticle, unable to expand upon the thorax, forms folds, and the new hairs are held in tubes of the old cuticle. The old skin splits at the line of junction of the upper and lower parts of the cephalothorax, and the members gradually free themselves from their sheaths, commencing posteriorly. This is the ordinary mode, but there are exceptions. The Tarantula (*Trochosa singoriensis*) passes through four moultings before commencing an independent life, and passes through several others before it attains full size. The author describes the peculiarities of certain genera. The hairs of an arachnid are produced from the lowest stratum of the cuticle, which rises in the form of a tube and perforates the upper layers, and are unicellular. The moulting of the eyes is confined to a comparatively sudden increase, the retina withdrawing itself from its envelopes. Sight is lost during the process, but it does not seem that that process in simultaneous in all the eyes. The moulting of the lungs is accomplished at once, and breathing is difficult during its duration, but the time occupied is short. Two of the three layers which compose the tracheæ are lost during moulting. The linings of the silk glands of the arachnids are shed, the broken parts of the old tubes remaining among the silk by which the arachnid is attached during the moult, and all glands formed by ectodermic invagination also lose their linings. The pharynx, œsophagus, and rectum take part in the moult, as do also the tendons, especially of the muscles of the limbs, the matrix growing around the old tendon and forming a new one, while the old one atrophies and is cast away with the tegument. During the operation of moulting the number of spherical corpuscles, which usually is only three to four per cent. of the total number of corpuscles, increases to ten per cent., almost all the colored corpuscles being transformed into spheres. Want of movement during the process seems to be one, but not the sole, cause of this change in the condition of the blood, and it must be remembered that a development of all the internal parts of the body takes place at the moulting period, so that the casting off of the teguments, etc., is really but a secondary act.

Some Arachnida seem to pass through the entire process of moulting easily, and take little or no precaution (many Thomisidæ, *e.g.*), while others, as many Attidæ and the adult Trochosa, take all possible precautions to shelter themselves from danger, since after the rejection of the tegument they are so feeble that an insignificant foe can master them. If a limb be detached immediately after a moult, it is renewed before the next moult, but if the loss takes place a short time before moulting, only a papilla is formed in the interval. Increased time is occupied in the moulting of adult individuals, and spiders do not moult in winter nor when deprived of nourishment for a considerable time.

Zoölogical News.—Cœlenterata.—Some points in the life history of the coral Fungia are given by Mr. J. J. Lister in the *Quarterly Journal of Microscopical Science*. When young, examples of *Fungia discus* and *F. dentata* are attached by a broad base and have vertical thecal walls. The youngest have six septa larger than the rest. After a varying height has been obtained, the upper part begins to widen out, forming at first a shallow cup with thecal walls facing outwards and downwards, and finally a disc depressed in the center, with the thecal walls facing directly downwards, the cup still remaining attached to the narrow stalk. After awhile absorption of the calcareous skeleton takes place at the junction of disc and stalk until the former falls off. At first there is a round scar on the centre of the free disc corresponding with a similar scar on the top of the stalk, the scar showing the thecal wall and sections of the septa, which latter unite with the trabeculæ that fill in the middle. The scar in time becomes covered, and finally all trace of it is lost.

The soft tissues are first exposed in the scar. The septa unite with the trabeculæ, which fill in the middle. In the disc there is no communication with the gastric region, except through the interspaces among the trabeculæ. The surfaces of the calcareous structures where absorption has taken place are white and opaque as compared with the general surface of the hard parts of the coral.

The first change visible in the stalk is that the septa throw up delicate fluted laminæ with serrated edges. A mouth is formed in the center, and the lips, in spirit specimens, seem almost in contact with the trabeculæ below. A thecal wall then springs up, usually a little within the margin of the thecal wall of the stalk. A new cup is thus formed, as the product of the structures in the base of its predecessor. As the walls grow they expand outwards, until a new disc is formed, and the former round of changes repeated. The stalk grows in height with each detachment, the place of every one of which is marked by a ridge.

Dr. von Lendenfeld thinks Fewkes' parasitic hydroid *Hydrichthys mirus* a Sarsia (*Biol. Centralblatt*, IX., p. 53). It is described in this journal (Vol. XX., p. 354).

Ortmann has been studying the stony corals of the Strasburg Museum, and gives some generalizations on their distribution. (*Zool. Jahrbuch*, Bd. III.) He says there are two faunæ,—an Indo-Pacific and an Eastern-American,—and these have only two species (*Heliastraca annularis* and *Siderastraca radius*) and nine genera in common, and these nine genera are old Tertiary forms. He, therefore, thinks that the two faunæ have been distinct since the Tertiary. In the Atlantic he recognizes two divisions,—a West Indian and a Brazilian.

Worms.—The development of *Peripatus novæ-zealandicus* receives elucidation from Miss Lilian Sheldon in the *Quarterly Journal of Microscopical Science* for December. The eggs were removed from the uterus immediately after the mother had been killed with chloroform. Out of forty-five examples, twenty-two were males and nine females without ova: the others had from seven to eighteen eggs. The ovum is heavily charged with food-yolk. The development is antrolecithal, and the protoplasm is mainly at one pole. From the stages of development observed on embryos extracted in December, April, January, and July, Miss Sheldon concludes that the ova pass from ovary to uterus in December, and that the young are born in July.

Mr. F. E. Beddard (*Quart. Jour. Micr. Sci.*, Dec. 1888) has an article on certain points in the strutures of Urochæta, with especial reference to the excretory system of it and other earth-worms. The paper also includes a description of *Dichogaster damonis*, n. gen. et sp. The writer concludes with a review of the various modifications of the nephridial system found on earthworms, commencing with Perichæta, in which the nephridial network is continuous from segment to segment, and thus distinctly comparable with that of the Platyhelminths, and ending with Lumbricus, in which there is but a single pair of nephrida per segment. In Dichogaster (as in Acanthodrilus) the network of nephridial tubules is discontinuous at the septa, and the tubules are longer, less abundant, and occupy less space than in Perichæta. In Dichogaster the nephridia of the posterior segments are larger, and open by a single cœlomic funnel. In Dinodrilus some specimens show a slight connection from segment to segment.

Crustacea.—M. R. Koehler has studied the so-called scales of the peduncle of Pollicipes, and states that they are not comparable with those of the peduncle of Scalpellum, but have a peculiar and complicated structure, and are not properly scales. Their form is that of rectangles with rounded angles, and they are ranged in longitudinal and oblique lines upon the chitinous layer of the peduncle.

MM. A. Grird and J. Bonnoir have discovered a cryptoniscian isopod parasitic upon the amphipod *Angelisca diadema*. It is the first epicaridan that has been discovered upon an amphipod, and in its characters approaches *Cryptothiria marsupialis*. It has been named *Podascon dellevallei*. Not less curious is the discovery by the same naturalists of *Aspidœcia nouveani*, a parasite upon a parasite, residing in the posterior part of the dorsal buckler of *Aspidophryxus sarsi*.

Insects.—From the researches of M. J. K. d'Herculais, it appears that the locust most to be dreaded in Algeria, and, in fact, in North Africa generally, is not *Acridium peregrinum*, the locust of the Bible, but *Stauronotus maroccanus*, an autochthonous species of different habits. *A. peregrinum* has its permanent home in Central Africa, probably in the region of the great lakes. Its subpermanent region is that part of Africa between the Sahara and its home, while the entire north of Africa is its temporary region, where it cannot maintain itself more than two years. This locust arrives in Algeria in April or May in immense flocks, couples soon afterwards, and the females deposit deeply in the earth, in damp spots, egg cases containing eighty or ninety eggs. Two months later the young appear, and continue the ravages commenced by the parents. In forty-five days they acquire wings, and take flight. *S. maroccanus* has a wide geographical distribution, embracing all the mountains and districts around the Mediterranean from Spain to the Caucasus. It is a lover of dry and mountainous districts. The winged adults appear in Algeria in July and August, and the females deposit at a slight depth, upon rocky and dry ground, notably upon hillsides with a southern or eastern aspect, egg cases containing thirty to thirty-five eggs. The young escape nine months afterwards,—*i.e.*, in the spring of the next year,—and become adult in sixty days. This species loves rugged and mountainous spots, and flourishes where the winters are cold and the summers hot; whereas *A. peregrimum* is a creature of the humid plains and valleys, and needs the heat of summer for its multiplication.

Fishes.—The salmon taken in the rivers of Finland are in many cases found to contain, in the throat or in the alimentary canal, a copper hook of a form unknown in Finland. Among three thousand fishes taken between the end of June and August, 1883, in a salmon-fishing establishment on the river Uba, twenty-five contained a hook of this kind, sometimes with a portion of the attached line. It is now known that these copper hooks are those used in the north of Germany, where the salmon fishery is chiefly carried on in the winter. Thus some of the salmon of the Finnish rivers descend in winter to the Baltic coasts of Germany. A sea fishery of salmon is also carried on upon the coasts of Sweden, and in the island of Bornholm. In the Baltic, as upon the Scotch shores, it is observed that the salmon usually seeks its food upon a sandy bottom. This marine fishery, which in Bornholm alone produces some twenty thousand salmon, is carried on throughout the year, but is most successful in winter. M. Fendersen has shown that almost every river of Iceland has its peculiar form of salmon, and that each of these forms frequents, during its growth, the seas adjacent to its native river.

EMBRYOLOGY.

Notes on the Development of Ampullaria depressa, Say. —During last spring Mr. Jos. Willcox sent a lot of the large ova of the above-named species of this interesting genus from Florida to my colleague, Professor Leidy, who very kindly placed some of the material at my disposal for study. These ova were placed in the conservatory connected with the Biological School, where they underwent development in an apparently normal way, at the surface of the water in aquaria in which Algæ are kept. It was found that the egg must not be immersed in the water; if immersed they are apparently asphyxiated. This corresponds with what Mr. Willcox has related to me in regard to the habits of oviposition of this fresh-water mollusk; the parent animal creeping, according to his observation, to the surface upon the stems of water plants, and after having reached the portions of the plants which rise above the water, the large eggs are deposited in a single layer on the leaves exposed to the air. Whether a glutinous covering invests the freshly laid ova I was not informed; it is certain, however, that the ova are firmly secured by a transparent glutinous substance to the large leaves of the water plants upon which they are found. Each of the spherical ova adheres to this glutinous matter, and its inferior side rests in a concave depression on the adhesive matter which forms a pretty thick layer on the leaves over the area covered by a brood of eggs. The broods vary in number, and, if the lots which I had under examination were undisturbed before reaching my hands, they may reach the number of forty or more, lying in a group about an inch wide and three or four inches long. Semper found seventy to eighty eggs in a single brood of *A. polita*.

The color of the living ova is pinkish by transmitted, but lighter by reflected light, because of the white of the calcareous shell. The pinkish color is not due to the presence of any coloring matter in the substance the egg shell itself, but is owing to the reddish brown color of the albumen which invests the ovum proper.

The diameter of the entire ovum is about one-fifth of an inch. This measurement includes the secondary egg-envelopes, *i.e.*, the calcareous shell and the albumen. The ovum proper is quite small, measuring only two-thirds of an millimeter or one thirty-seventh of an inch in diameter.

The structure and physiological relations of the shell, albumen, air-vesicle and ovum are complex ; quite as much so, in fact, as in the egg of the common fowl, from which Ampullaria is of course exceedingly remote. There is even a striking resemblance between the bird's egg and that of Ampullaria in a number of respects. These are found in the common feature of an air space, a peripheral more liquid and a central more viscid mass of albumen, in which the ovum is embedded in both cases. I have been unable, however, to make out distinct chalazæ in the eggs of Ampullaria.

The size of the youngest segmented ova was two-thirds of a millimeter, which is unusual for the egg of a gastropod and is not greatly exceeded by the ova of most forms ; the more usual dimensions being far below this, though in some it is probably much greater, as in Bulimus, for example, judging from the size of the shell.

The great size of the egg makes it certain that development proceeds by epiboly, the germinal or animal pole of the egg being probably marked by a blastodisk at an early stage. The early stages, of course, were not observed by me, having been passed over long before the ova came into my possession. A very large yolk was present in the youngest stages and the yolk substance was homogeneous and not granular. The relations of the yolk and the development of the walls of the mid-gut are of considerable interest as revealed in sections of entire embryos.

The account given by Semper of the development of *A. polita* Derhayes, is very incomplete as respects the early stages. The entire egg of *A. polita* is much smaller than that of *A. depressa,* measuring only three millimeters instead of five as in the latter. But there evidently remains a large yolk mass, as shown by one of Semper's figures, in which there is also represented a hemispherical cap, the blastoderm probably, composed of vesicular cells. One of his figures, showing four blastomeres, gives one the impression at first that cleavage is total, but this view is irreconcilable with the next figure, and if I have understood his text properly he has recorded nothing which is in conflict with the conclusion that the segmentation was partial ; since there is a large yolk mass represented in all of his figures of the latter stages.

In other respects the development of *A. depressa* and *A. polita* are very similar. The mid-gut has its walls greatly thickened in both cases. This is due to the hypertrophy of its constituent endodermal cells, which are evidentally occupied, as shown in sections of the latter stages, with the work of appropriating the yolk which still dilates the intestine. The yolk is absolutely without nuclei of its own, and is brownish-yellow in color. The dilated portion of the intestine bulges the body-wall outward into a hump-like prominence between the edge of the young shell and the back of the head of the embryo. There is a simple ctenidium or gill developed in the pallial chamber, and the young paired "hepatic" diverticula are greenish in color. The foot bears an operculum on its dorsal side long before the young animal leaves the egg-shell. No teeth seem to be differentiated on the radula in the older larva, one and a half millimeters in diameter. The foot, and a slight fold above the mesopodium and between the latter and the head, are ciliated, as well as the thickened epidermis about the mouth and the tips of the tentacles. The muscular mass underlying the radula, the otocysts and eyes, are well developed. The latter show pigment at this time. The yolk in the intestine has in my oldest stages grown quite small in amount, and causes only a slight projection of the body wall behind and above the head. The whole embryo rotates within the reddish albumen in which it is embedded, on account of the action of the cilia covering the foot. From the dimensions of two-thirds millimeter the embryo grows until it fills out the whole of the space of five millimeters in diameter inclosed by the egg-shell. In the course of this process the albumen surrounding the embryo is probably swallowed by the young snail and appropriated by the hypertrophied amœboid cells of the intestinal wall.

The air-vesicle is always at the upper pole of the egg, and forms a lenticular cavity just within the calcareous shell. It doubtless has to do with the respiration of the embryo, and recalls in a striking way the *vesicula aeris* of the bird's ovum, except that it has a different position, and does not seem to be separated from the albumen by a membrane.—JOHN A. RYDER.

Development of Crangon vulgaris.[1]—Dr. Kingsley's third paper on the development of this crustacean has just been published. His general conclusions are interesting as pointing out the presence of

[1] Bulletin Essex Institute, Vol. XXI., 1889, plates I.–III.

structures indicative of wider or more general affinities with other Bilateralia. The summary given below is in his own words.

1. The arthropod egg is not to be regarded as centrolecithal and having a superficial segmentation, but as having a central segmentation, the blastoderm being formed by migration of the resulting cells to the surface.

2. The primitive groove in the arthropods is a modified blastopore, and the absence of invaginated entoderm in some forms is to be explained by Cope's and Hyatt's theory of acceleration and retardation.

3. In Crangon the anus occupies the position of the blastopore.

4. In Crangon and many other crustacea the young germinal area is actually larger than the much older embryo.

5. All of the appendages belong to the primitively post-oral series, and the appendages move forward more rapidly than the corresponding ganglia.

6. There are indications of segmental sense organs in every segment of the body.

7. The alimentary tract proper is nearly, if not entirely, formed from the proctodeal and stomodeal invaginations, the entoderm giving rise to nothing but the liver.

8. The green gland is mesodermal in origin, and belongs to the category of segmental organs.

9. The genital ducts are modified nephridia.

10. The nauplius is an introduced feature, and represents no adult ancestral condition in the crustacean phylum.

Development of Sepia officinalis.—M. L. Vialleton concludes in the *Annales des Sciences Naturelles* (Tome VI., Nos. 4, 5, 6), an important contribution to the knowledge of the early phases of the development of *Sepia officinalis*, illustrated by six plates.

The formative vitellus in the Sepia is reduced to a laminæ at the pointed end of the yolk, and in this laminæ, directly after fecundation, a germinative central disc can be distinguished The first plane of segmentation is meridional, and divides the disc into five equal parts. Two and finally four secondary meridional divisions finally divide it into eight unequal segments. The polar globules place themselves near the first furrow at some distance from the centre of the egg. These eight segments have the value of macromeres. In the fourth stage the two inferior segments are divided equatorially, the others meridionally, dividing off two micromeres, so that the blastoderm at this stage has fourteen macromeres and two micromeres. By a further bipartition, the blastoderm comprehends twelve micromeres and twenty macromeres, eight of the former being parted from eight of the micromeres. By this method of parting off micromeres, the latter at the end of segmentation are more than three hundred in number, and form a plaque with the smaller micromeres in the centre. The peripheric zone of the blastoderm occupied by the macromeric segments or blastocones, becomes transformed into a special thin bed which intercalates itself between the embryo and the vitellus, and is called by Vialleton the perivitelline membrane. Meanwhile a division of the micromeres or blastomeres perpendicular to their height produces a deeper layer of cellules—a mesoderm. Thus the egg at this stage consists of: (1) the ectoderm, which forms a circular plate composed in its centre of a single layer of cellules, but around its edge of several layers, produced by delamination at the expense of the superficial layer. (2) Of the mesoderm (*pars*) represented by the deeper beds of the borders of the blastoderm; and (3) by the perivitelline membrane or primitive endoderm. The border of the blastoderm then parts into a clear portion which becomes the vitelline sac, and an interior embryonal area. By secondary determinations, the ectoderm afterwards furnishes additional elements to the mesoderm. The entoderm, usually formed at an early stage, does not show itself in the Sepia until the eyes and pallial folds have been sketched out; and its development is very rapid, and seems to be formed at the expense of the perivitelline membrane.

PSYCHOLOGY.

The Psychic Life of Micro-Organisms.[1]—M. Alfred Binet, one of the most eminent representatives of the French School of Psychology, has presented in the above work the most important results of recent investigations into the world of micro-organisms. The subject is a branch of comparative psychology little known; as the data of this department of natural science lie scattered for the most part in isolated reports and publications, and no attempt has hitherto been made to collate and present them in a systematized form.

[1]THE PSYCHIC LIFE OF MICRO-ORGANISMS. A Study in Experimental Psychology. By Charles Binet. Translated from the French by Thomas McCormack, with a preface by the author written especially for the American edition. Chicago: 1889. The Open Court Publishing Company. Cloth, 75 cents. Paper, 50 cents.

M. Binet's researches and conclusions show, "that psychological phenomena begin among the very lowest classes of beings; they are met with in every form of life from the simplest cell to the most complicated organism." The author contests the theory of Prof. George J. Romanes, who assigns the first appearance of the various psychical and mental faculties to different stages or periods in the scale of zoölogical devolopment. To M. Binet mind is an aggregate of properties which exclusively pertain to living matter, the existence of which is seen in the lowest forms of life as well as in the highest.

Prof. Charles Richet contests this view in the *Revue Scientifique,* and maintains with Romanes, that the supposed exhibitions of consciousness in the Protozoa are merely reflexes of protoplasm.

M. Binet finds that the movements of many Protozoa when seeking food display evident design. He thus describes their actions:

"In a large number of animacules the prehension of food is preceded by another stage, the search for food, and in the case of living prey, by its capture. We shall not investigate these phenomena among all the Protozoa, but shall direct our attention especially to the ciliated Infusoria. Their habits are a remarkable study. If a drop of water containing Infusoria be placed under the microscope, organisms are seen swimming rapidly about and traversing the liquid medium in which they are in every direction. Their movements are not simple; the infusory guides itself while swimming about; it avoids obstacles; often it undertakes to force them aside; its movements seemed to be designed to effect an end, which in most instances is the search for food; it approaches certain particles suspended in the liquid, it feels them with its cilia, it goes away and returns, all the while describing a zigzag course similar to the paths of captive fish in aquariums; this latter comparison naturally occurs to the mind. In short, the act of locomotion, as seen in detached Infusoria, exhibits all the marks of voluntary movement.

"The hunter Infusoria are constantly running about in quest of prey; but this constant pursuit is not directed toward one object any more than another. They move rapidly hither and thither, changing their direction every moment, with the part of the body bearing the battery of trichocysts held in advance. When chance has brought them in contact with a victim, they let fly their darts and crush it; at this point of the action they go through certain manœuvres that are prompted by a guiding will. It very seldom happens that the shattered victim remains motionless after direct collision with the mouth of its assailant. The hunter, accordingly, slowly makes his way about the scene of action, turning both right and left in search of his lifeless prey. This search lasts a minute at the most, after which, if not successful in finding his victim, he starts off once more to the chase and resumes his irregular and roving course.

"In constant pursuit of its prey, the *Leucophrys* seizes its victim by the two stout vibratile lips with which its mouth is armed, and swallows them alive and whole. The victims may be seen struggling and tossing about for a time in the interior of the Leucophrys's body, and afterward to expire slowly under the action of the digestive juices of the vacuole in which they have been enclosed. Placed in a medium well-stocked with small Ciliates, the Leucophrys have their bodies constantly crammed with victims swallowed in the manner above described. Like the other hunter Ciliates the Leucophrys does not espy its victims from a distance, and does not guide itself toward them. It simply darts about from right to left, every moment changing its direction. It thus increases its chances of coming in collision with its prey, and every time that one of its unfortunate victims falls in contact with its vibratile lips, it is seized, irresistibly drawn toward the mouth and swallowed within less than a few seconds.

"The prehension of food by the *Didinium* exhibits interesting aspects which have not as yet been observed in any other Infusory. M. Balbiani, in his first observations, had often been surprised at seeing animalcula that the Didinium had passed by without touching, suddenly stop as if violently paralyzed; whereupon our carnivorous specimen straightway approached and seized them with seeming facility. More careful examination of the Didinium's actions soon furnished the key to this enigma. If, while swiftly turning in the water, the Didinium happens in the neighborhood of an animalculum, say a Paramecium, which it is going to capture, it begins by casting at it a quantity of bacillary corpuscles which constitute its pharyngeal armature. The Paramecium immediately stops swimming, and shows no other sign of vitality than feebly to beat the water with its vibratile cilia; on every side of it lie scattered the darts that were used to strike it. Its enemy then approaches and quickly thrusts forth from its mouth an organ shaped like a tongue, relatively long and resembling a transparent cylindrical rod; the free, extended extremity of this rod it fastens on some part of the Paramecium's body. The latter is then gradually brought near by the recession of this tongue-shaped organ toward the buccal aperture of the Didinium, which opens wide, assuming the shape of a vast funnel in which the prey is swallowed up.

"There exist organisms which lead a life of habitual isolation, but which understand how to unite for the purpose of attacking prey at the desired time, thus profiting by the superiority which numbers give. The *Bodo caudatus* is a voracious Flagellate possessed of extraordinary audacity; it combines into troops to attack animacula one hundred times as large as itself, as the Colpods for instance, which are veritable giants when placed alongside of the Bodo. Like a horse attacked by a pack of wolves, the Colpod is soon rendered powerless; twenty, thirty, forty Bodos throw themselves upon him, eviscerate and devour him completely.

All these facts are of primary importance and interest, but it is plain that their interpretation presents difficulties. It may be asked whether the Bodos combine designedly in groups of ten or twenty, understanding that they are more powerful when united than when divided. But it is more probable that voluntary combinations for purposes of attack do not take place among these organisms; that would be to grant them a high mental capacity. We may more readily admit that the meeting of a number of Bodos happens by chance. When one of them begins an attack upon a Colpod, the other animacula lurking in the vicinity dash into the combat to profit by a favorable opportunity.

M. Binet compares the movements of the Protozoa in reproduction with those of the reproductive elements in the higher animals,—the spermatozoid and the ovum. He says:

"A remarkable circumstance in this connection is, that the copulation of the spermatozoöid and ovule is not without analogy to the copulation of the two animals from which they originated. The spermatozoid and the ovule, to some extent, repeat on a small scale what the two individuals perform in their larger sphere. Thus, it is the spermatozoöid that, in its capacity of male element, goes in quest of the female. It possesses, in view of the journeys it has to make, organs of locomotion that are lacking in the female, and are useless to it. The spermatozoöid of man and of a great number of mammifers is equipped with a long tail, the end of which describes a circular conical movement, which, together with its rotation about its axis, determines the forward motion of the spermatozoöid.

"The spermatic element, in directing itself toward the ovule to be fecundated, is animated by the same sexual instinct that directs the parent organism towards its female.

"In the higher animals the movements of the spermatozoöid that is endeavoring to reach the female exhibit a peculiar character which it is important to emphasize: these movements do not appear to be directly provoked by an exterior object, as those of micro-organisms are; the spermatozoöid endeavors to reach an ovule which is frequently situated a great distance away; this is the case particularly with animals that fecundate internally,—with birds and mammifers. A fact that is important to mention in a general way is the length of road the spermatozoöid has to traverse before coming up with the ovule.

"Let us now follow the spermatozoöid in its journey to the ovule. It is known that the road it has to traverse is, in certain instances, extremely long. Thus in the hen the oviduct measures 60 centimeters, and in large mammifers the passages have a length of from 25 to 30 centimeters. We might ask ourselves how such frail and minute creatures come by a power of locomotion great enough to enable them to traverse so long a path. But observation discloses the fact that they are able to overcome obstacles quite out of proportion to their size. Henle has seen spermatozoöids carry along with them masses of crystals ten times larger than themselves, without appreciably lessening their speed. F. A. Pouchet has seen them carry bunches of from eight to ten blood-globules. M. Balbiani has attested the same fact. These globules, which have fastened themselves about the head of the spermatozoöid, have each of them a volume double that of the head. Now, according to Welcker, the weight of a globule of human blood is 0.00008 of a miligramme: allowing that the spermatozoöid has the same weight, we may then say that it is able to carry burdens four or five times heavier than itself."

EXPLANATION OF PLATE.

Fig. 1. Conjugation of *Chilodon cucullueus*. *A*, beginning of conjugation; *b*, mouth; *n*, nucleus; *nu*, nucleolus; *vc*, multiple contractile vesicles. *B*, division of the nucleolus into two segments, *nu' nu'*; the nucleus *n*, beginning to show signs of regression. *C* each of the two individuals in conjugation contains two nucleolar segments, brought near together, of which one probably comes from the individual opposite by course of exchange, and will fuse with the segment not exchanged to form a compound segment (Maupas). *D*, division of the segment into two portions, which grow to unequal sizes; the larger *nu* will become the new nucleus; the smaller, the new nucleolus of the new formation *nun*. *E*, the old nucleus *n* reduced to a small, pale and rumpled mass, is replaced by the new nucleus *nu*, near by which is seen the new nucleolus *nun*. (From Balbiani.)

Fig. 2. *Paramecium aurelia;* positions preliminary to conjugation.

Fig. 3. Gemmiform conjugation of the vorticellinæ (*Carchesium polypinum*). *A*, firs stage; the microgonidium *nu* has fastened itself by a filament upon the peduncle of the

macrogonidium. *B*, a more advanced stage; the microgonidium has fastened itself directly on the body of the macrogonidium, and its substance begins to penetrate into the latter. In both individuals the nucleus has separated into small rounded fragments, and in the microgonidium are seen the two striated segments resulting from the division of its nucleolus. *C*, last stage of the conjugation. The microgonidium, completely void of its contents, remains attached to the body of the macrogonidium under the form of a minute hollow tube, which in the end drops away;—*ma*, macrogonidium; *mi*, microgonidium; *n*, nucleus; *nu*, nucleolus; *vc*, contractile vesicle. (From Balbiani.)

Fig. 4. *Stentor cæruleus* fixed upon a conferva filament, enlarged fifteen diameters. (From Balbiani.)

Fig. 5. *Stylonychia mytilus*, in position preliminary to copulation. The individuals are in contact by their ventral faces. (From Balbiani.)

MICROSCOPY.[1]

Kultschitzky's[2] Methods of Staining the Central Nervous System.—The tissue, having been hardened in Müller's fluid, or preferably in Erlichi's fluid, imbedded in celloidin, and sectioned, is allowed to remain in the stain from a few minutes to several hours. The first solution of hæmatoxylin is made as follows:

Boracic acid (saturated sol.)	20 ccm.
Water (distilled)	80 ccm.
Hæmatoxylin	1 g.

The hæmatoxylin should be dissolved in a small quantity of alcohol, and then mixed with the boracic acid and water. The resulting fluid will at first be yellow, but in two or three weeks it will change to a dark yellowish red. *Before using, the solution should be acidulated with a small quantity of acetic acid*, two or three drops in a watch-glass being sufficient. After the sections have been in the stain fifteen minutes, the medullated fibres are found to be of a dark violet or blue, while the other elements are of a light yellow or yellowish red. If the sections are allowed to remain longer, from eighteen to twenty-four hours, an intense differential stain results.

[1] Edited by C. O. Whitman, Clark University, Worcester, Mass.

[2] *Anat. Anzeig.* IV., No. 7, 1889, p. 223.

PLATE XXXV.

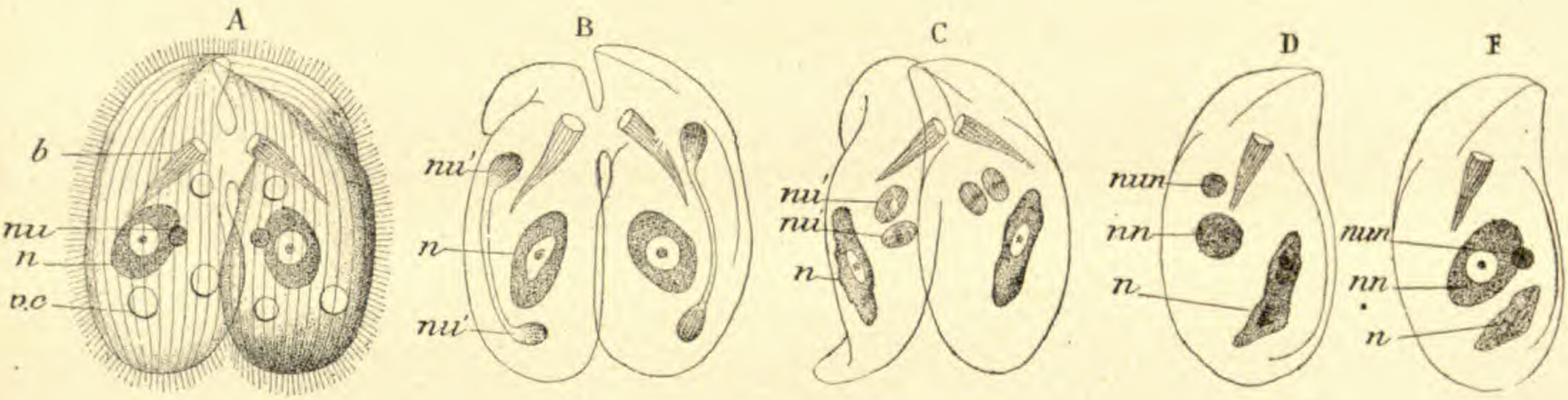


FIG. 1.

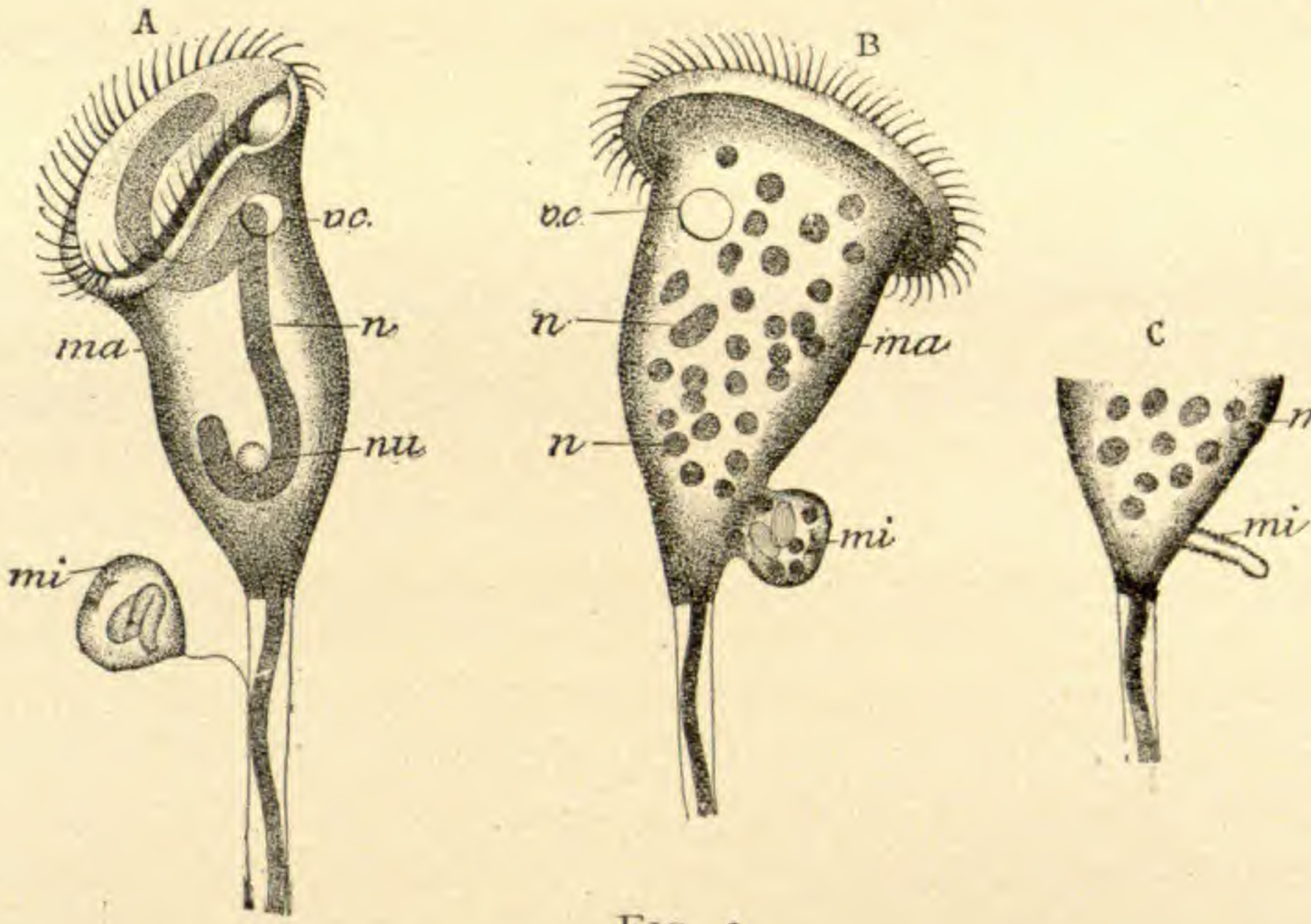


FIG. 3.

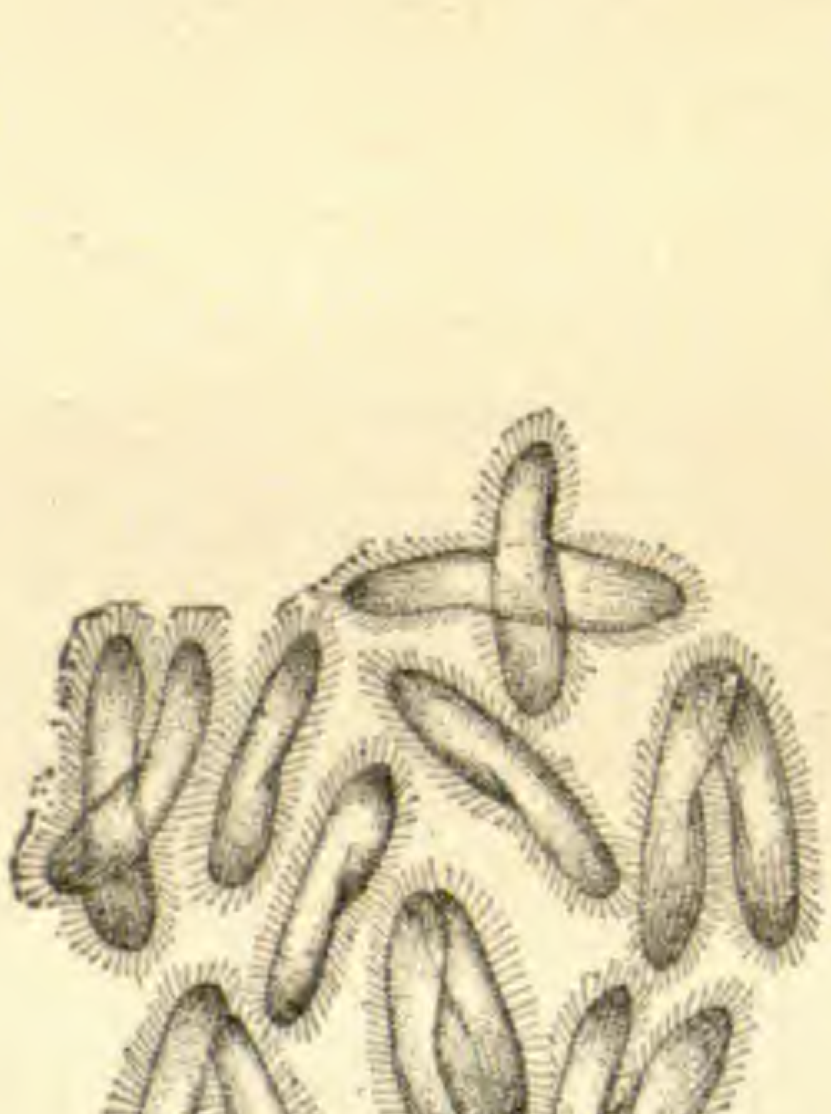


FIG. 2.

FIG. 4.

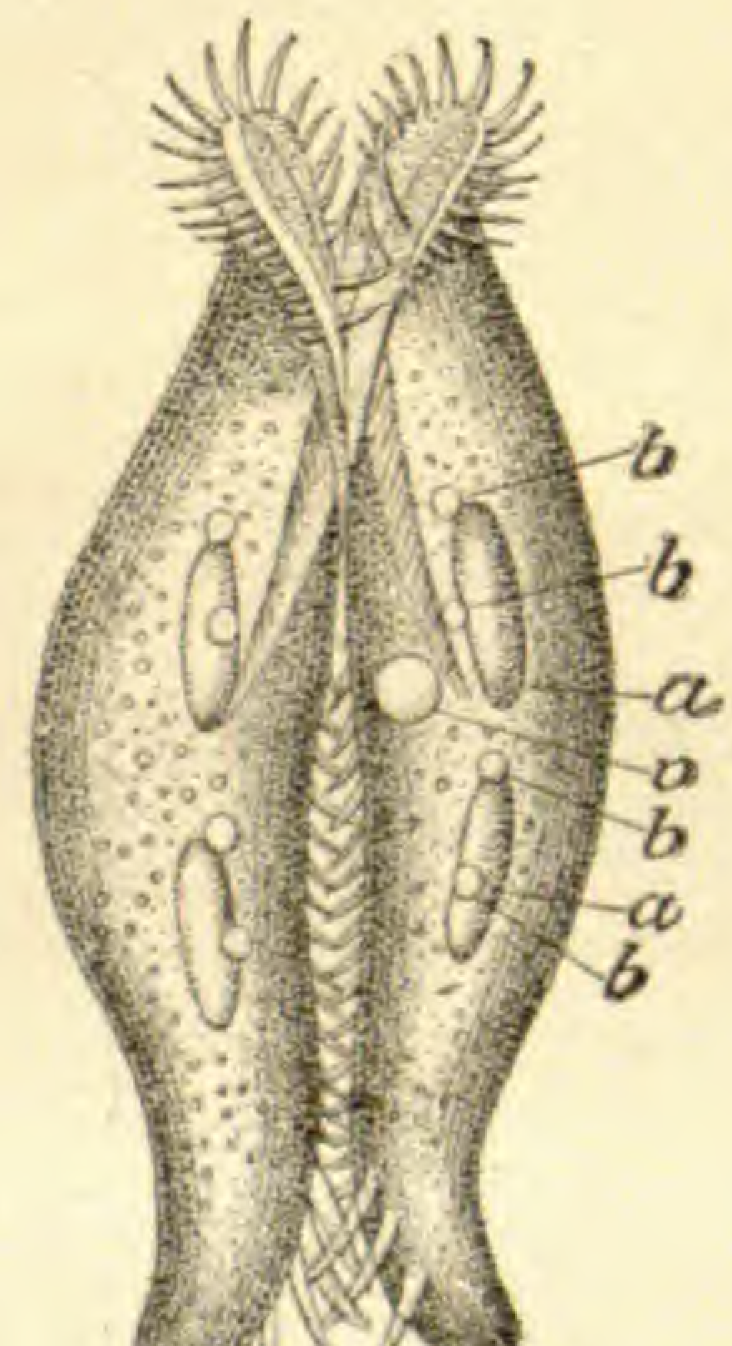


FIG. 5.

When the desired grade of staining is reached, the sections are washed in alcohol, and mounted in Canada balsam.

Still finer results may be obtained if the sections, after lying some time in the stain, are placed in a saturate solution of sodium or lithium carbonate, for twenty-four hours.

The following method will give quite the same results as the above, and is used more easily.

Acetic acid (2 per cent. solution)	100 ccm.
Hæmatoxylin (dissolved in alcohol) . . .	1 g.

A Simple Method for Removing the Gelatinous Layer from the Batrachian Egg.— Professor Blochmann[3] recommends the following as a quick and safe method for treating large masses of frog eggs :

The spawn, having first been hardened in chrom-osmic-acetic acid, and then thoroughly washed in water, is placed in a beaker partly filled with dilute Eau de Tavelle (from three to four parts water), and gently agitated, that the fluid may reach all parts. In from fifteen to twenty minutes, according to the strength of the fluid, the glairy layer and the underlying membrane are dissolved, and the free eggs rest upon the bottom of the vessel.

At this point special care must be taken lest the eggs become injured by striking each other. The fluid being poured off, the eggs are carefully washed with water and placed through successive grades of alcohol.

If the material thus prepared is not made use of at once it should be kept in a dark place to prevent the further withdrawing of the chromic acid.

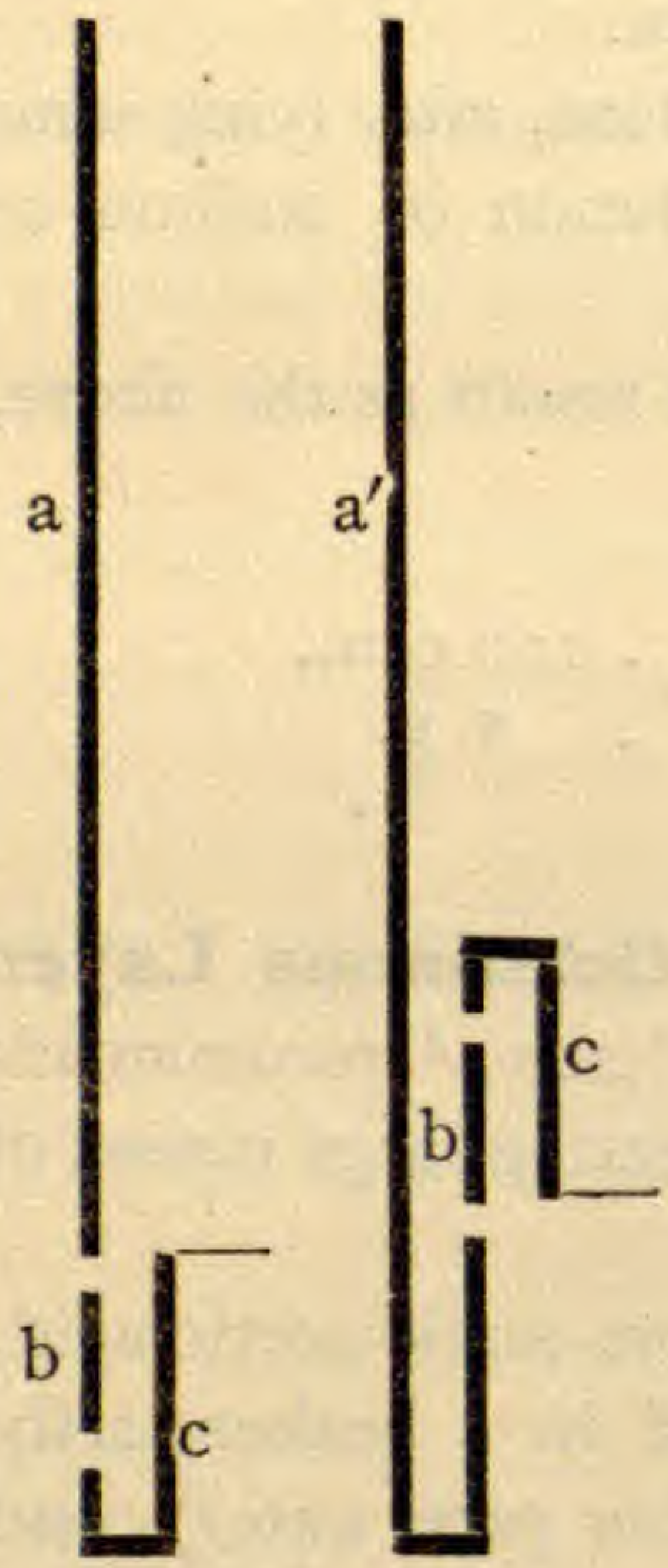
Eggs prepared in the above method stain nicely in borax carmine.

This method of Blochmann's is the same as that recommended by Whitman in June, 1889 (*vide* this journal).

The Differentiator Modified from report read before the British Association, September 11, 1889, at Newcastle, Eng. —According to the nature of the fluids in use, the differentiator takes one of the two forms here illustrated. As will be seen, a or a′, the reservoir, b, the object-cylinder or object-box, and c, the filter, are three pieces of glass tubing joined together by means of caoutchouc tubing, the lat-

[3] *Zoolog. Anz.* XII., No. 307, May, 1889, p. 269.

ter for the sake of clearness *not* shown. The filter, c, is easily made a follows: take a piece of glass tubing twice the length of the required filter, heat it red hot, draw it out to arm's length and break it in two; remove all the capillary part except about three inches on each half, heat, and bend into the required form (c); next carefully heat the capillary portion in a small alcohol flame, draw out exceedingly fine, and break off so as to leave a minute orifice.



To use the differentiator, proceed as follows: Suppose objects fixed by corrosive sublimate are to be studied in balsam after staining with borax-carmine. Fill the filter with sublimate solution and insert a plug of cotton (previously boiled in water to remove the air) at the U-bend. Join the object-box to the filter, fill up with sublimate solution, and push a plug of cotton into the lower end of the box, avoiding bubbles. Wrap the cotton in fine linen if the subjects are minute. Put the objects into the box, plug the upper end in the same manner as the lower end, and finally join the box and filter thus filled to the empty reservoir a, and hang the instrument up in the position here illustrated. The objects are now transferred to 33 per cent. alcohol in the following manner: mix equal parts of sublimate solution and 33 cent. alcohol (call this mixture 2). Mix equal parts of 2 and sublimate solution (call this 1). Mix equal parts of 2 and 33 per cent. alcohol (call this 3). Add mixture 1 to the reservoir until it is one-fourth full, mixture 2 until it is half full, mixture 3 until it is three-fourths full, and then fill up with 33 per cent. alcohol. If the successive mixtures are added with sufficient care, they will, owing to difference in specific gravity, remain distinct. If forced rapidly in, a nearly uniform mixture of about equal parts sublimate solution and 33 per cent. alcohol will result. The desirable procedure lies between these two suppositions, and gives rise to a uniform gradation of *differentiation from sublimate solution to 33 per cent. alcohol in passing upwards through the reservoir.* The flow, which at once commences drop-wise from the point of the filter, should be so regulated, either by tipping the instrument, or by breaking off more or less of the capillary part of the filter, as to cause the reservoir to be emptied in from two to five hours, when the objects will of course be in 33 per cent. alcohol, having been *guarded to the utmost* against diffusion currents. They are now to be transferred to borax-carmine, a fluid *heavier* than 33 per cent. alcohol, by the use of reservoir a′· Fill the long arm of the reservoir with borax-carmine, and cork it, leaving the short arm empty and open. Mix equal parts of carmine and 33 per cent. alcohol (call this mixture 2). Mix equal parts of 2 and carmine (call this 1). Mix equal parts of 2 and 33 per cent. alcohol (call this 3). Add mixture 9 to the short arm of the reservoir until it is one-fourth full, mixture 2 until it is half full, mixture 3 until it is three-fourths full, and fill up with 33 per cent. alcohol. Transfer the object-box and filter to a′, avoiding bubbles, and uncork the long arm. The flow begins as before, but this time *upward* through the object-box, and the object-box, and the objects are thus transferred in from two to five hours to borax-carmine.

After staining, the objects are transferred to 30 per cent. alcohol by means of reservoir a, the flow being so regulated that the change takes place in from five to ten hours. Then change successively to acidulated 70 per cent., 90 per cent., and absolute alcohol, allowing five, or better, ten hours to each change. Transfer to turpentine, chloroform, oil of cloves, or any oil desired by reservoir a′. Finally to thin balsam, *still by means of the differentiator.*

Whenever the objects are to be transferred to a lighter fluid, use reservoir a ; whenever they are to be transferred to a heavier fluid, use reservoir a′. If objects are to be transferred to glycerine, transfer first to 50 per cent. glycerine in twelve hours, and then to pure glycerine in twenty-four hours.

Objects which defeat successful fixation by untimely contractions may be rendered insensible by means of the differentiator, and then fixed *perfectly outstretched.* Transfer them to alcohol of from 5 to 30 per cent. (or other paralyzing solution such as chloral hydrate) in from two to three hours, when they will be insensible and outstretched, and may be fixed as desired. A specially large object-box is easily contrived for larger specimens.

The differentiator, already in extensive use, was recently invented at Naples to overcome shrinkage and contraction in Anguillulidæ, and has speedily recommended itself for a great variety of delicate organisms, such as diatoms, desmids, and other delicate algæ, moulds, pteropods, and all sorts of embryological material, and takes its place at once as a permanent and very valuable addition to the paraphernalia of the biologist.

SCIENTIFIC NEWS.

Dr. W. J. Vigelius, well known for his researches on the anatomy and embryology of the Polyzoa, died at the Hague, December 3, 1889.

Dr. G. C. Vosmaer is no longer at the Naples Zoölogical Staton, but may be addressed at the Zoölogical Laboratory, Utrecht, Holland.

Dr. Franz Johon, recently privat-docent in Bonn, has been called to the chair of botany and zoölogy in the Normal School of Santiago, Chili.

Prof. Hemrecatt, the Nestor of French botanists, died in Paris, December 23, 1889, at the age of 91 years.

Prof. R. A. Philippi, of Santiago, Chili, celebrated his 80th birthday on the 18th of September last.

Mr. Charles L. Flint died in Boston, February 26, 1889. He was born in Middleton, Mass., May 8, 1824, and was appointed Secretary of the Massachusetts Board of Agriculture in 1853, holding the position for twenty-five years. While Secretary he issued the second edition o Dr. Harris's "Injurious Insects," and published a series of annual reports which from either scientific or agricultural aspect have not been excelled in this country. He was influential in the establishment of the Massachusetts Agricultural College, and the Institute of Technology.

M. Suchetet, professor at Rouen, France, would be very much obliged to any person making known to him the hybrid animals they possess or have observed in other places, living or stuffed.

Dr. Victor Signoret, one of the most prominent students of the Hemiptera, died at Paris, April 3, 1889.

Dr. H. A. Mayer, who with Karl Möbius was engaged in the study of the Fauna of the Gulf of Kiel, died at Forsteck, May 1, 1888.

Dr. G. Ruge, of Heidelberg, is the successor of Dr. Max Fürbringer, at Amsterdam.

Several deaths of naturalists have escaped notice in these pages at the time. Among these are those of Giovanni Bellonci, the anatomist, died at Bologna, July 1, 1888; Henry Stevenson, an English ornithologist, died at Norwich, August 18, 1888; Johann Kriesch, professor of zöology in the Budapest Polytechnicum, died October 24, 1888; Churchill Babbington, an English botanist and ornithologist, died January 12, 1889; Bellier de la Chavignerie, a French entomologist, died September 27, 1888; Richard S. Wray, an English student of the morphology of birds, died February 12, 1889.

M. Fernand Lataste has left Paris to accept the position of Director of the National Natural History Museum, and Professor of Zoölogy in the medical school at Santiago, Chili.

Dr. J. W. Van Wijhe, of Freiburg, has been appointed ordinary professor of anatomy in the University of Groningen.

Prof. Guiseppe Meneghini died in Pisa, January 29, 1889. He was born in Padua, July 30, 1811, and held for nearly thirty years the professorship of physics, botany and chemistry in the university there. In 1848 he was called to the chair of geology in the university at Padua, a position which he held at the time of his death.

The Late Xenos Y. Clark.—Xenos Young Clark, well-known on the Pacific Coast as well as in Massachusetts, died on the fourth day of last June at the residence of his mother in Amherst, in the latter State. He was the son of Prof. Henry James Clark, who died in the same place on the first of July, 1873.

The father first became known to the scientific world as a very promising student of the late Prof. Asa Gray. He was afterwards and for several years associated with Prof. Louis Agassiz as an assistant, and in 1860 became adjunct Professor of Zoölogy at Harvard College; after this he was connected with the Agricultural College of Pennsylvania, the University of Kentucky, and in 1872 with the Massachusetts Agricultural College at Amherst. He was a large contributor to the late Prof. Agassiz's volumes on the Natural History of the United States, and was also the author of various papers, memoirs, etc. His volume "Mind in Nature," the result of his micro-physiological studies, published in 1865, an imperial octavo of over 300 pages, and his memoir on "The Lucernariæ and their Allies," a quarto of one hundred and thirty pages and several plates, forming number 242 of the Smithsonian Contributions to Knowledge, etc., are perhaps his chief works; the latter appeared in 1878.

Xenos, the son, was born in Boston in May 1853, and studied in the preparatory department of the Kentucky University at Lexington, and graduated at the Massachusetts Agricultural College in 1875. He went to California the same year, and entered the University of California at Berkeley, as a special student in Natural History, and soon afterward received the appointment of student assistant in natural history and geology, and preparator for Prof. Joseph LeConte. He was at various times a draughtsman in the office of the Surveyor-General of the United States, in San Francisco, and was also Curator of the San Francisco Microscopical Society, and lectured on microscopic zoölogy at this time. During his residence in California he also taught in the public schools. In 1879 he went to Europe, and studied for several months in Leipzig. Since 1880 he has resided part of his time in California and partly in Massachusetts, his health being very poor. During these latter years he has frequently contributed to the leading magazines, scientific publications, and weekly papers, including *The Nation*, *The Open Court*, etc., and THE AMERICAN NATURALIST. The latter for April 1879 contained a highly interesting article by him on "Animal Music: its Nature and Origin." He inherited much of his father's genius and ability; he was artistically skilful with the pencil, and his communications to the public exhibit a cultured and philosophic mind, which needed only a more robust physical body to command a prominent position. He was regarded as one of the most brilliant and popular students in college, and took a high rank in his scholarship. At the time of his death, which was attributed to Bright's disease and some affection of the heart, he was only 34 years old, and was connected with the Massachusetts Agricultural College at Amherst.—*R. E. C. S.*

Clark University, Worcester, Mass.—The following is the preliminary announcement of the Department of Biology:

ACADEMIC STAFF.

C. O. Whitman, A.M., Ph.D., acting professor of Animal Morphology.[1]

Warren P. Lombard, A. B., M. D., assistant professor of Physiology.

Franklin P. Mail, A.B., M.D., adjunct professor of Anatomy.

Henry H. Donaldson, A.M., Ph.D., assistant professor of Neurology.

[1] Editor of the *Journal of Morphology*.

ANNUAL APPOINTMENTS.

J. Playfair McMurrich, A.M., Ph.D., Docent in Animal Morphology.

C. F. Hodge, A.B., Ph.D., fellow in Neurology.

H. C. Bumpus, A.M., fellow in Morphology.

F. Tuckerman, A.B., M.D., fellow in Anatomy.

Other annual appointments are under consideration, and scholars, fellows and docents in this department may be designated and students may be received up to November 1. Only special students can be received later.

FORESTAL AND AGRICULTURAL EXHIBITION AT VIENNA.

To the Editor of the AMERICAN NATURALIST:

DEAR SIR:—I beg to announce that the Imperial Royal Agricultural Society of Vienna, will hold there in the year 1890 a *General Forestal and Agricultural Exhibition.*

It will take place in the Rotunda and the adjoining park grounds of the Prater, and will last from the fifteenth of May to the middle of October, perhaps to the first of November. The aim is to exhibit a complete picture of the present standing of all branches relating to agricultural and forestal efficiency.

The management of the undertaking is in the hands of a general committee especially selected for the purpose. The programme issued by this committee contains the following divisions intended for international participation.

Machines and implements for agriculture and forestry and their industries; for horticulture, orcharding, vinticulture, and hop culture; for the breeding of poultry and bees, and the keeping of silk-worms; for dogs, and the art of hunting and fishing.

Auxiliary means employed for farming, viz.: artificial manure, food produced for the market, of veterinary products, etc.

MODELS, PLANS, DRAWINGS, AND STATISTICAL DATES.

(*a.*) Of agricultural and forestal works of melioration and engineering.

(*b.*) Of the system of agricultural and forestal instruction and experimenting, literature included.

(*c.*) Of the use and sale of the waste matter.

(*d.*) Of the support of large cities with provisions, and finally

(*e.*) The division poultry and dogs.

To these divisions all foreign countries can contribute.

The essential success of the exhibition through its international divisions depends to a great extent upon a numerous participation from foreign countries.

I beg leave to ask you to call, by means of an item in your esteemed journal, the attention of those in the United States to this exhibition, in whose interest it would be to participate.

I have the honor to be, Sir,

Yours most respectfully,

The Consul of Austria and Hungary, at New York.

NOTICE TO CONTRIBUTORS

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A MONTHLY JOURNAL
DEVOTED TO THE NATURAL SCIENCES
IN THEIR WIDEST SENSE.

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THE

AMERICAN NATURALIST

VOL. XXIII. SEPTEMBER, 1889. 273.

SEGMENTATION OF THE OVUM, WITH ESPECIAL REFERENCE TO THE MAMMALIA.

BY CHARLES SEDGWICK MINOT.

(Concluded from page 481.)

DURING all these early stages the cells (segmentation spheres) are naked, *i.e.*, without any membrane; the nuclei, when not in karyokinetic stages, are large, clear, and vesicular; the yolk granules are small, highly refractile, and more or less nearly spherical; they show a marked tendency to lie in the cell half-way between the nuclear and the edge of the cell, or when the cells are large, around the nucleus and at a little distance from it.

It is at about this stage that the ovum passes from the Fallopian tube into the uterus, where it dilates into what is known as the *blastodermic vesicle.* This dilatation is due principally to the multiplication and flattening out of the cells of the outer layer, and of course involves the expansion and consequent thinning of the zona pellucida, (compare Figs. 8 and 13.) The inner mass meanwhile remains passively attached to one point on the circumference of the vesicle, (Fig. 11, *i.m.*) By this process the thin fissure between the inner mass and the outer layer becomes a considerable space, (Fig. 13).

The blastodermic vesicle continues to expand, and in the rabbit and mole there is a corresponding enlargement of the tubular uterus at the point where the vesicle is lodged. "It is clearly impossible for the delicate walled ovum to expand in the form of a vesicle, and distend the uterine walls by virtue of the growth of its cells; it must be therefore concluded that it obtains some support. This support is rendered from within. The vesicle contains a transparent fluid, the nature of which I am only sufficiently conversant with to say that, after a treatment with alcohol, a white precipitate is present in the vesicle. It is equally evident that this fluid can only have been obtained from the uterus, and that it is present

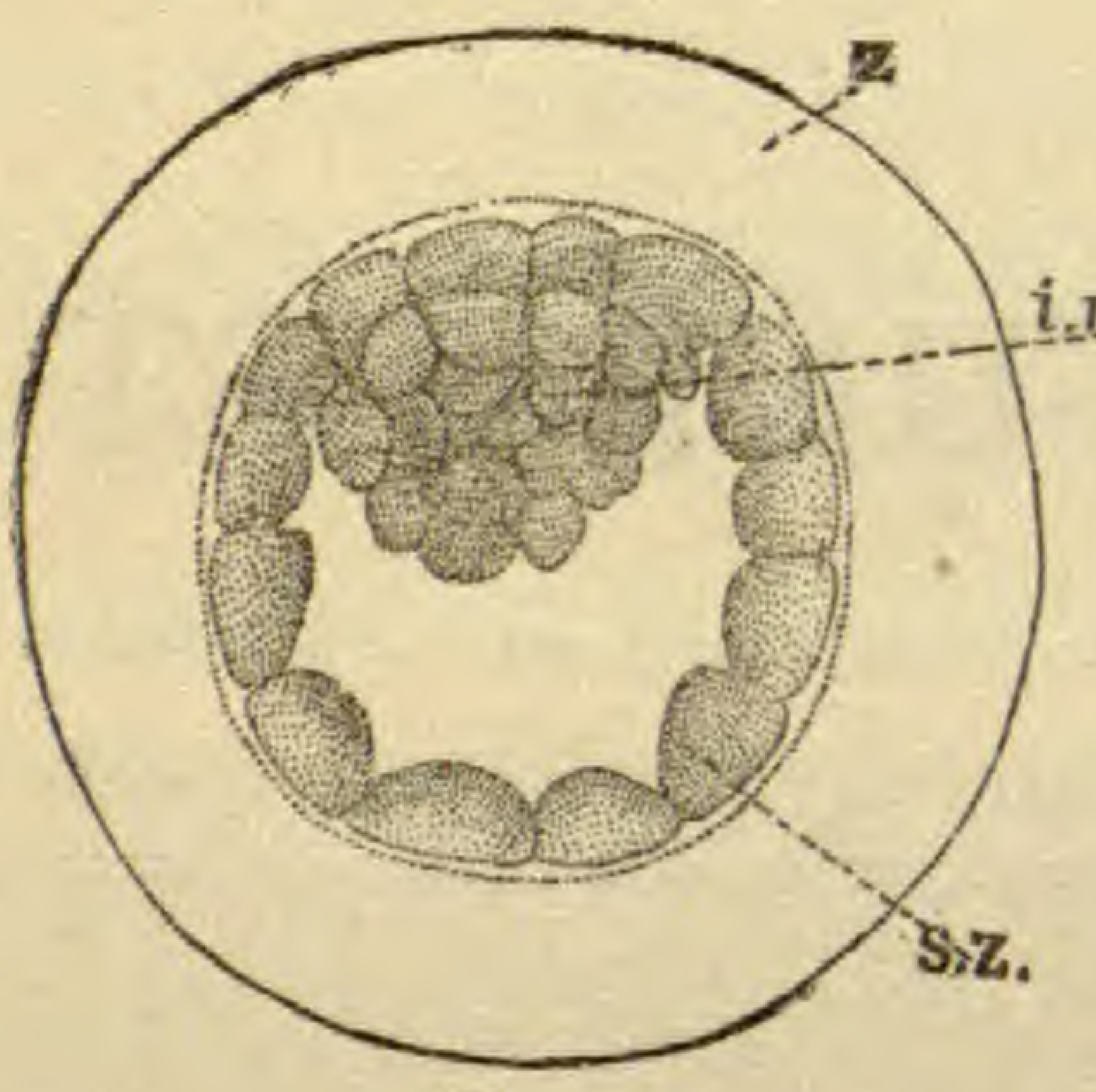

FIG. 11.

Young blastodermic vesicle of a mole, after Heape: *M*, mucous envelope; *z*, zona pellucida; *i m*, inner mass; *en*, entoderm; *s c*, segmentation cavity.

within the vesicle at a very considerably greater pressure than in the uterus itself. Such a condition is caused by means of the cells of the wall of the vesicle; this function being performed against a pressure which is greater on their inner than on their outer side, exactly as the cells of the salivary glands are known to act. The uterine fluid is secreted by glands present in great numbers in the uterine tissue, and is poured through their open mouths into the cavity of the uterus. There is every probability it has nutritive

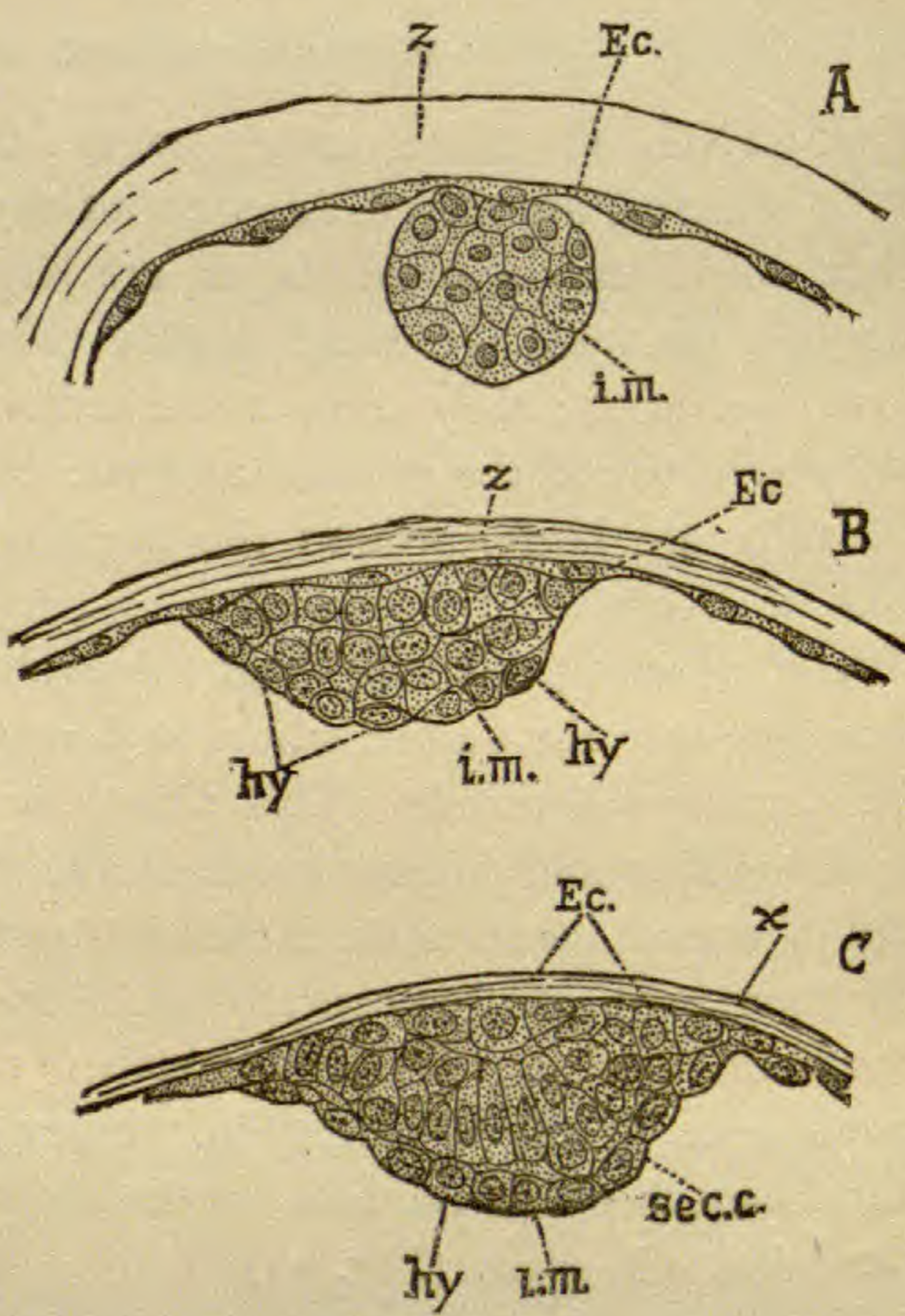

FIG. 12.

Sections through the inner mass of the blastodermic vesicle of the mole at three successive stages: *z*, zona pellucida; *s z* subzonal layer; *i m*, inner mass.

qualities, since it is thence taken up into the cavity of the embryonic vesicle, which eventually functions as a yolk-sac, in the walls of which embryonic blood-vessels ramify."—*Heape.*

The inner mass (Fig. 11, *i.m.*) does not at first grow much, and retains its rounded form, becoming, at least in the mole, nearly globular. (Fig. 12, A.) The inner mass subsequently flattens out, becoming lens-shaped, thinner, and of larger area. (Fig. 12, B.) It continues spreading laterally, and separates into

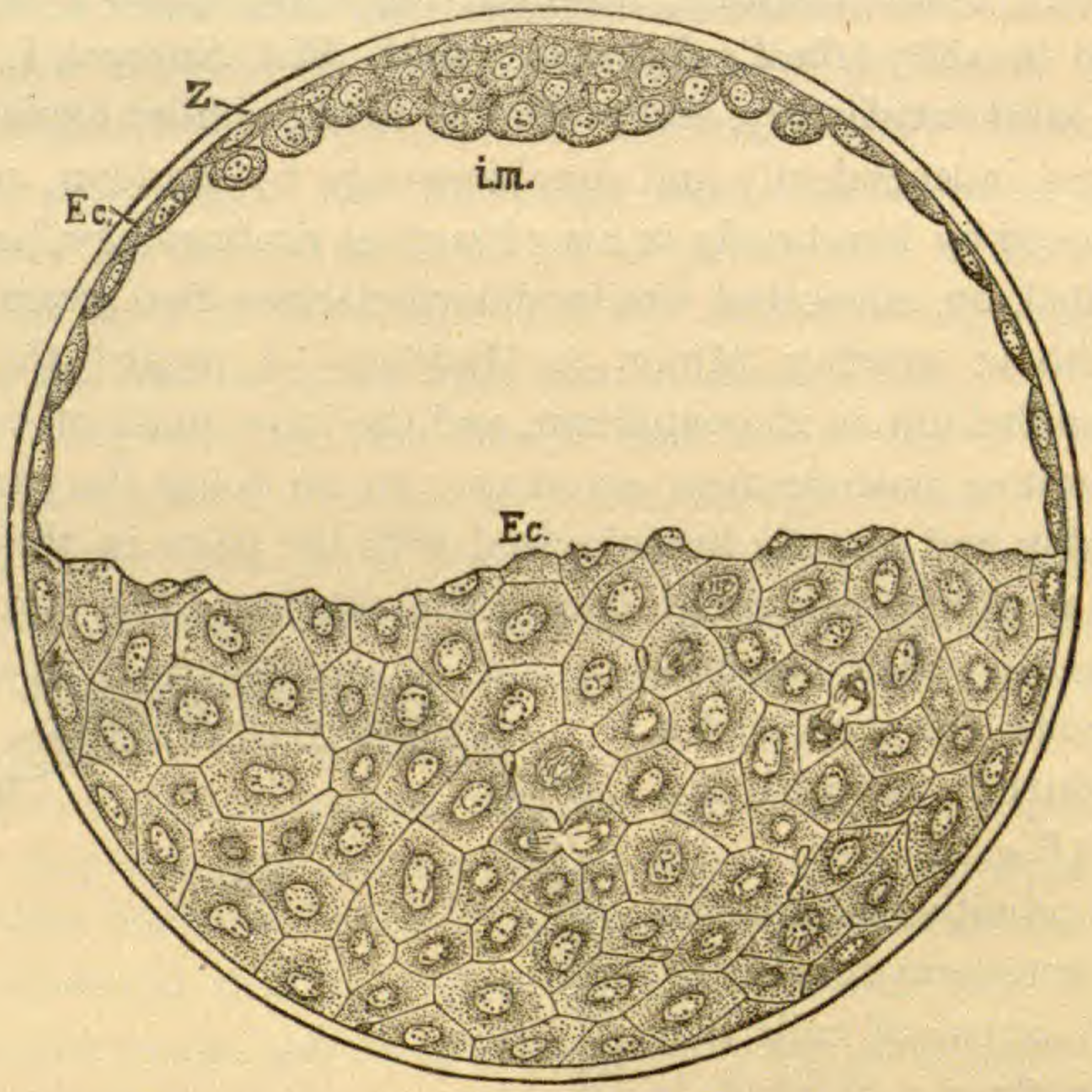

FIG. 13.

Ovum of rabbit ninety-four hours after coitus, after van Beneden: *en* subzonal epithelium (entoderm); *z*, zona pellucida; *i m*, inner mass of cells.

three distinct layers. The ovum now consists of a very thin zona pellucida (Fig. 13, *z*), close against which is a single layer of thin epithelial cells, *En:* at one pole this layer is interrupted by a lens-shaped mass, *i.m.*, formed by three layers of cells. These three layers were first clearly described by E. van Beneden *9*, and have been since figured by him *10;* van Beneden identified these three layers with the three permanent germ-layers, which do not arise until later. Rauber, however, showed that both the outer layers enter into the formation of the ectoderm, while the inner layer is concerned in the production of the permanent entoderm; the outermost layer Rauber terms the Deckschicht Lieberkühn *31a*, and others have since then confirmed Rauber's results.

Homologies of the mammalian blastodermic vesicle.—We have so little accurate information concerning the details of the formation of the blastodermic vesicle, that any interpretation must be tentative. I still consider, however, the view which I brought forward in 1885 (*Buck's Reference Hdbk. Med. Sciences*, I., 528), as the most satisfactory, and preferable to the similar explanation advanced independently and simultaneously by Haddon, *20*, and reproduced by him briefly in his "Practical Embryology," 47–48. F. Keibel, *27*, advocated similar interpretations two years later, but without quoting Minot or Haddon. I regard the subzonal epithelium as the entoderm, and the inner mass of cells as the primitive blastoderm or ectoderm: by so doing the parts can be readily and exactly homologized with the parts in the frog's ovum, as will be evident at once if the diagram (Fig. 14) of the mammalian vesicle be compared with the section of a segmented amphibian ovum, (Fig. 4).

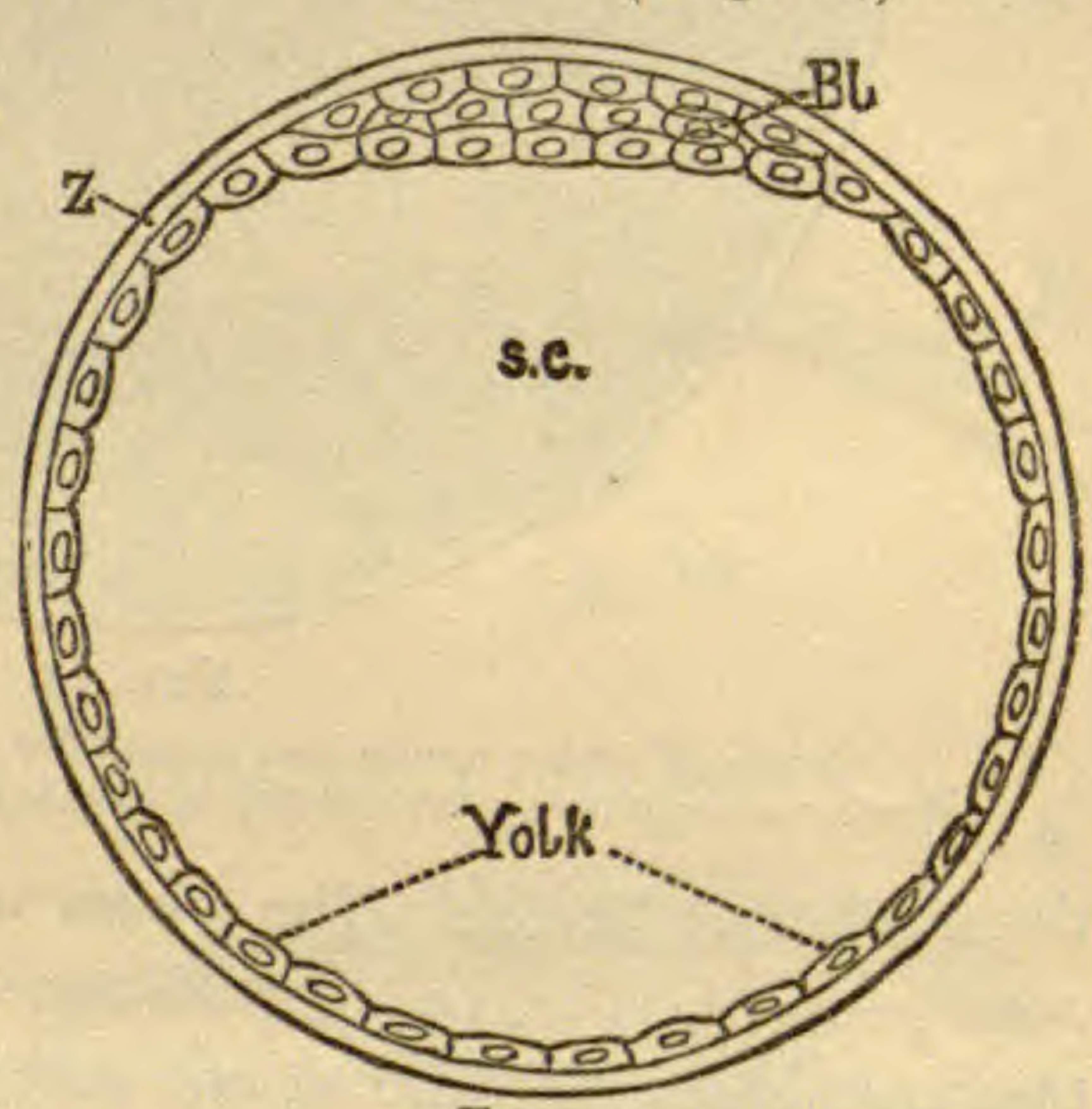

FIG. 14.

Diagram of a segmented mammalian ovum: *z*, zona pellucida; *Bl*, primitive blastoderm; *s c*, segmentation cavity; *yolk*, layer of cell representing the remnant of segmented yolk.

The primitive blastoderm *Bl.* or ectoderm consists of several layers of cells rich in protoplasm; below it is the large segmentation cavity, *s.c.*, relatively much larger in the mammalian than in the amphibian ovum. At its edge the primitive blastoderm joins the entoderm *yolk*, which in amphibia is a large mass, in mammals only a single layer of cells. Now, we know that the ancestors of the higher mammals had ova with a large amount of deutoplasm, which in the course of evolution has been lost, so that in the ova of the Placentalia there is very little yolk material. We know, further, that the readiness of cellular divisions depends on the amount of yolk; hence when the yolk is lost, we should expect to find the entoderm, which, as we have seen, is derived from the vegetative substance of the ovum, to be represented by relatively small cells. If we imagine the number of entodermic cells in the frog's ovum (Fig. 4, *Yolk*) reduced, their connection with the primitive blastoderm and their character as a continuous layer being preserved, we obtain at once the characteristic arrangement of the mammalian blastodermic vesicle, (Fig. 14.) The homology here established is further confirmed by the coarse net-work of protoplasm in the cells of the outer layer of the vesicle (Ed. van Beneden, *10*), suggesting at once the meshes which have been emptied of their deutoplasm. Adam Sedgwick, *43*, has shown that in the ova of *Peripatus capensis* the yolk matter has been lost, though abundant in other species of the same genus, and the coarseness of the protoplasmic net-work is preserved as evidence of the granules formerly present. This observation serves to confirm the view I have suggested as to the significance of the wide-meshed reticulum of the cells of the mammalian sub-zonal layer, (Fig. 14, *Yolk*.)

The disposition of the animal pole in the ovum before segmentation also conforms to the homologies here advocated. It will be remembered that the protoplasm of the animal pole extends far into the ovum, and is enveloped by a cup (deutoplasm zone) of the substance of the vegetable pole. Hence when the animal pole forms cells they lie as an inner mass, (Fig. 11, *i.m.*)

If Minot's view be adopted, then the ectoderm lies within the entoderm at a certain stage of development, for the one cell which retains, as shown in Fig. 8, the connection of the ectoderm with the exterior, is subsequently overgrown by the outer layer of cells (van Beneden, Heape). There is then a complete inversion of the germ layers in all (?) placental Mammalia. In most cases the inversion is temporary; the inner mass, as described above, flattens out, and probably flattens out *inside* the outer epithelial layer; if this is the case, then the external layer of the lens-shaped mass (Fig. 12, B and C, *im*) is really entoderm; this layer is Rauber's *Deckschicht*, which, as already stated, usually disappears, leaving the true inner mass, or permanent ectoderm, to form part of the surface of the blastodermic vesicle, so that, with the exception of the reduction in the dimension of the entoderm, the relations are the same as in other vertebrate ova.

The inner layer of the flattened inner mass gives rise to the entoderm, and this at first sight appears to be conclusive evidence against the homology here drawn between the inner mass and the primitive ectoderm of other vertebrates. The same thing was formerly supposed to occur in the blastoderm of other vertebrates, but it is now known that the entoderm is added from another source to the under side of the primitive blastoderm or ectoderm, and though we possess no exact information whatever as to the origin of the entodermic cells under the primitive blastoderm of the Mammalia there is no reason to assume that they arise in a manner fundamentally different from that typical of other vertebrates. We may therefore dismiss this objection. The origin of the entodermic cavity I hope to discuss on another occasion.

Planes of Division during Segmentation.—The plane of the first divisions determines those of the subsequent divisions, and also of all the axes of the embryo.[1] It is itself determined by the position of the long axis of the first amphiaster or nuclear spindle, to which it is at right angles. It, therefore, is a matter of great interest to ascertain what factors determine the position of the first spindle, or, in other words, the axis of elongation of the segmentation nucleus. So far as at present known there are two factors: I. Relation to the axis of the ovum; II. Position of the path taken by the male pronucleus to approach the female pronucleus. The axis of the ovum is fixed before impregnation. It passes through the center of the animal and that of the vegetable pole. Usually the nuclear spindle which leads to the for-

[1] In certain cases, notably in birds as described above, the segmentation is irregular; and it is, therefore, not known yet whether the scheme of arrangement of the cleavage planes here given can be applied to all ova or not. We may say, however, that the scheme is the primitive one, from which any modifications arose phylogenetically. The best discussion is by A. Agassiz and Whitman, *I*, 34–41.

mation of the polar globules has its long axis coincident with that of the ovum, hence the point of exit of the polar globule marks one end of the ovic axis. *The first amphiaster or spindle is always at right angles to the ovic axis.* This, however, leaves the meridian plane undetermined. Roux, *39*, from a series of interesting experiments on frog's ova, concludes that the plane is fixed by the path of the spermatozoon. So far as I know this idea was first suggested by Selenka, in 1878, in his paper on "The Development of *Toxopneustus variegatus*." Compare also Mark, *32*, p. 500. In the frog's egg the path of the male pronucleus is marked by a line of pigment, as was first described by van Bambecke, *4*, p. 65, and has been well figured by O. Hertwig, *25a*, Pl. V., fig. 4. The pigment renders it easy to ascertain the position of the male road, even after the first cleavage of the ovum. This Roux has done in sectioned ova, and from experiments and observations reaches this result: *The long axis of the first segmentation spindle lies in a plane which passes through the axis of the ovum and the path of the male pronucleus.* If Roux's conclusion is confirmed, it will become of fundamental importance. Yet there must be other factors which can at least replace the male pronucleus in this special role, since the development of pathenogenetic ova, in which there is no male pronucleus at all, is equally determinate. It is probable that the distribution of the protoplasm is the real cause determining the position of the nucleus; thus in oval eggs the spindle lies in the direction of the long axis. It is quite probable that if the male pronucleus has the effect ascribed to it by Roux, it produces it indirectly by altering the distribution of the protoplasm within the ovum; that such alteration takes place is indicated by the occurrence of the male aster.

That the first cleavage plane is determined by relations existing in the unimpregnated ovum has been suggested by O. Schultze in consequence of his finding the germinal vesicle lying excentrically in the eggs of the brown frog. Schultze suggests that the first plane passes through the ovic axis and the excentric nucleus. Roux, Biol. Col., VII., 420, maintains that this suggestion is set aside by his own observations cited above. For further discussion see Schultze's short note, *42*, and Roux's rejoinder, *9*. I think the question whether the first cleavage plane is determined by the ovum's structure or not is still an open one.

As already stated, in the primitive segmentation, both invertebrate and vertebrate, the second cleavage plane is at right angles to the first, and also meriodional, while the third plane is at right angles to both the first and second, and therefore equatorial. In some meroblastic vertebrate ova this regularity is entirely lost.

Differentiation of the ectoderm and entoderm.—As already pointed out the essential feature of segmentation is the unlikeness of the cells produced; the manifold variations in the process of segmentation depend chiefly on the amount of yolk.

Minot, in 1877, *33*, first established the generalization that *in all animals the ovum undergoes a total segmentation during which the cells of the ectoderm divide faster and become smaller than the cells of the entoderm.* Compare Fig. 15. There are, however, a small and, I think, diminishing number of cases, where the process of segmentation is imperfectly understood, and which cannot yet be shown to conform to this generalization. "All the known variations in the process of segmentation depend merely upon: 1. The degree of difference in size between the two sets of cells; 2. the time when the difference appears; 3. the mode of development, whether polar or by delamination,[2] either of which may or may not be accompanied by axial infolding. In gastropods, planarians, calcispongæ, gephyrea, annelida, fish, birds, and arthropods the difference is great and appears early. In echinoderms, most

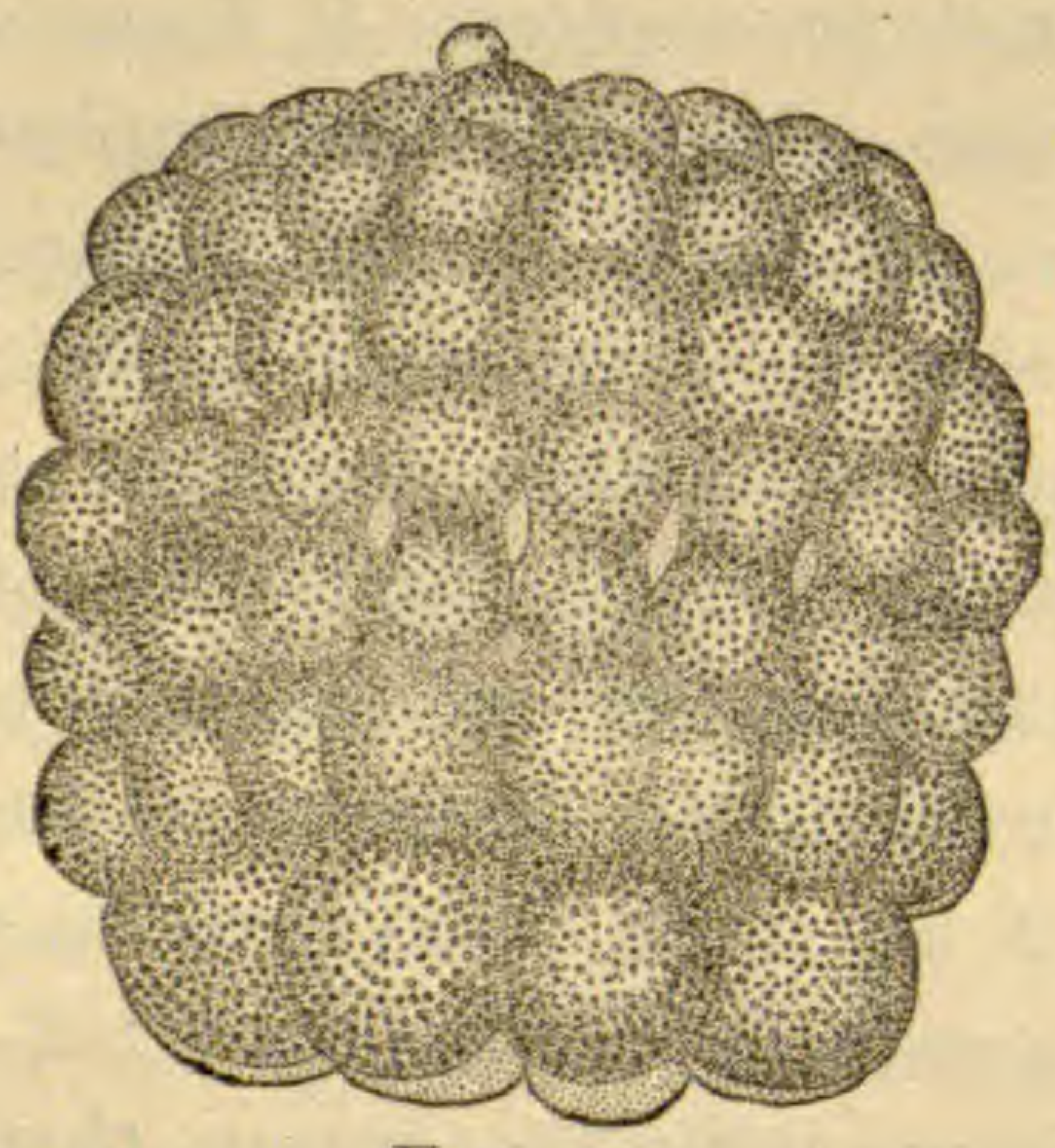

FIG. 15.

Ovum of *Amphioxus lanceolatus* during segmentation; stage with 88 cells, x 280 diams., after B. Hatschek. One pole is occupied by large entodermal, the other by smaller ectodermal cells.

[2] There is not a single satisfactory description known to me of the process of the so-called delamination and I feel a very great skepticism as to its being an actual occurrence. It is certainly at most a very rare and probably secondary modification of segmentation. It does not occur among vertebrates.

cœlenterates, some sponges, in nematodes, amphibians, etc., it is less marked and appears later.

In most cases the entodermic cells are very decidedly larger and less numerous than those of the ectoderm. This distinction is obviously necessary on account of the mutual relations of the two primitive layers. The ectoderm has to grow around the entoderm, which it can do only by acquiring a greater superficial extension; this the ectoderm accomplishes by dividing very quickly at first into small cells. After the entoderm is fully enveloped it may then continue to grow until its superficies is much greater than that of the outer layer, within which, however, it still finds room by forming numerous folds; thus is gradually reached the condition in the higher adult animals, where the intestine sometimes has an enormous surface, but is, nevertheless, contained in body-walls covered by ectoderm presenting much less surface. It is, therefore, only during the early stages of segmentation that we find the entoderm expanding more slowly than the ectoderm.

The terms *holoblastic* and *meroblastic* are applied to ova according to their manner of segmentation. The first is employed for those ova in which there is either very little or only a moderate amount of yolk, so that the whole of the ovum splits up into distinct masses (cells) which enter into the composition of the embryo. The second designates ova with a very large amount of yolk, so that while the protoplasm from which the ectoderm arises divides rapidly into distinct cells, the entodermal portion merely develops nuclei at first, with the result that while one portion of the egg is "segmenting," another portion (the entodermal) remains unsegmented, so far as the external appearances are concerned. Eggs, then, with much yolk undergo the so-called partial segmentation; hence the adjective *meroblastic*.

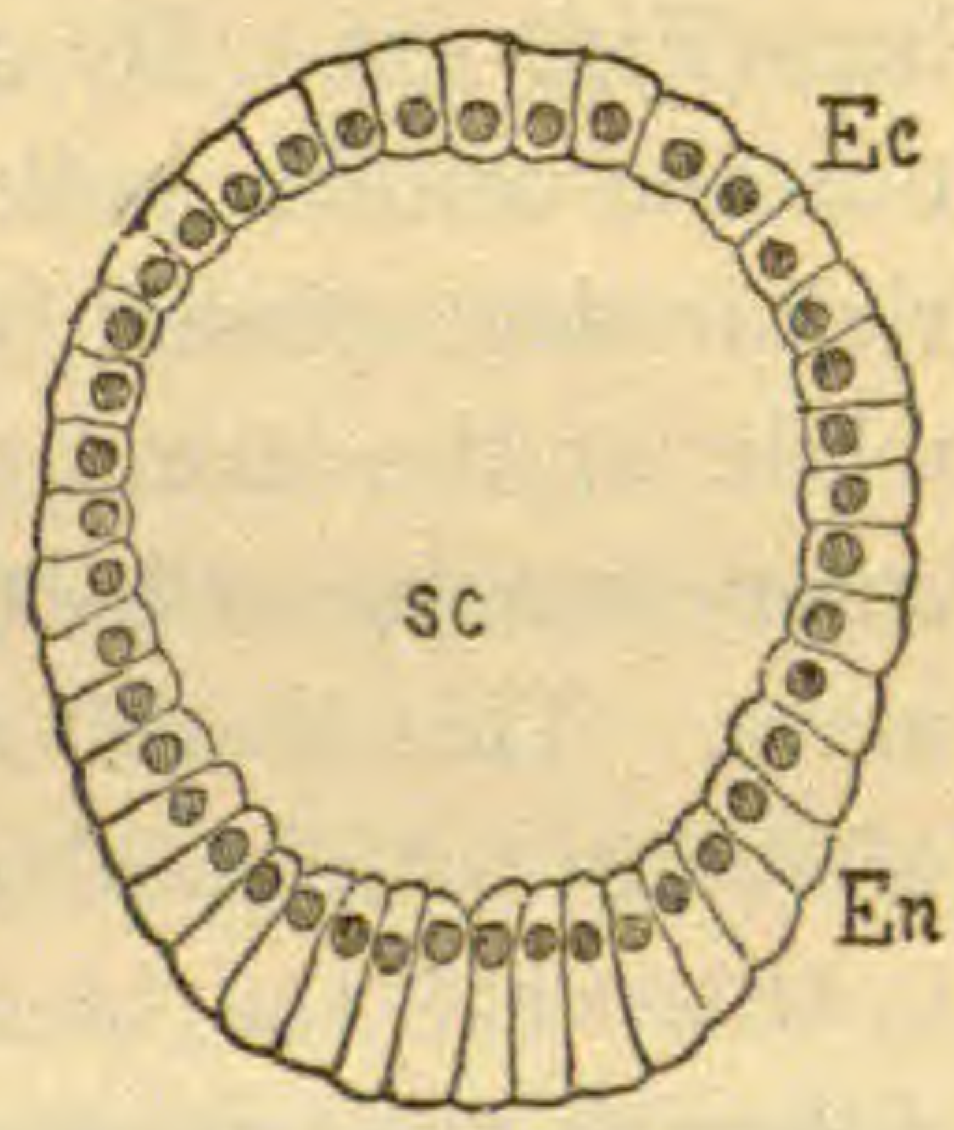

FIG. 16.
Blastula stage in the development of *Echinocardium cordatum*, after Selenka.

Whatever the exact mode of segmentation, there results always the same type of organization, to which Minot has applied the term *diaderm;* it is characterized by consisting of two plates of cells, differing in character, joined at their edges (ectenal line), and surrounding a central segmentation cavity: the two plates or laminæ are the two primitive germ-layers, the ectoderm and entoderm. The earliest form of the diaderm is that known as the *blastula*, as Haeckel has felicitously named the first larval form of the lower animals. In the blastula we have a simple epithelial vesicle, the cavity of which is the large segmentation cavity (Fig. 16); the epithelial layer is one cell thick and divided into two regions, the one composed of smaller cells is the ectoderm, *Ec*, and the other, of larger cells, is the entoderm, *en.* This stage occurs with sundry modifications in a great many invertebrates. These modifications are due principally to the increase in the size of the entodermic cells, which, as already pointed out, results from the increase of the yolk matter in the ovum. Thus in many mollusks the entodermic cells are very large, and at first, few in number, (Fig. 17). By a still further modification the cellular yolk is replaced by a mass rich in deutoplasm, but not divided by cells, while at the same time the segmentation cavity is reduced by the invasion of the yolk mass. This is well exemplified in the ova of many arthropods, (Fig. 18). We have in this case the blastula type still evident, although the entoderm has at this stage no trace of its epithelial structure. In vertebrates we have the additional modification that cells are several layers deep in the ectoderm, and primitively in the entoderm also,—compare the section of the frog's ovum (Fig. 4). In certain forms, as we have seen, the entoderm is not

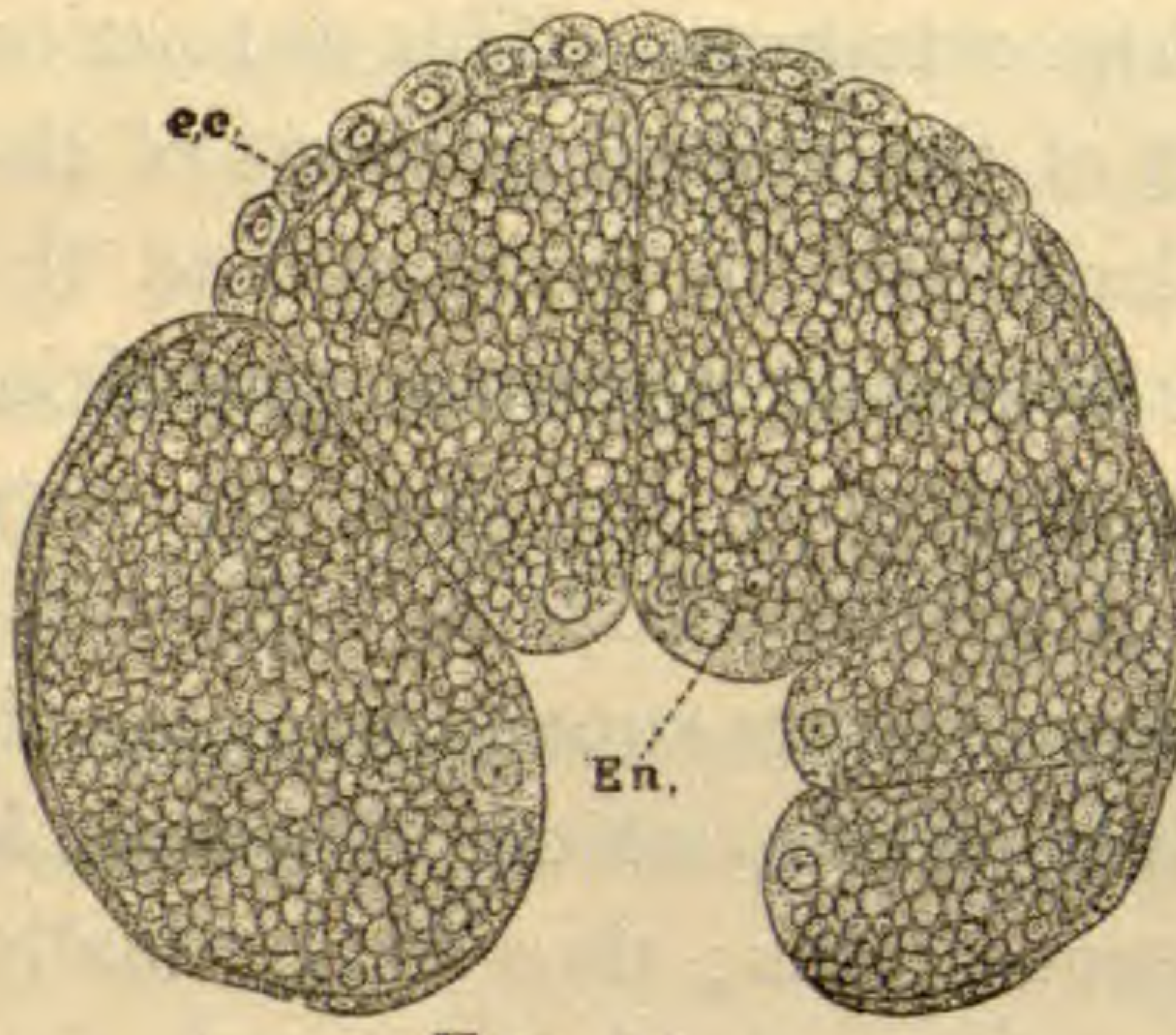

FIG. 17.
Blastula stage in the development of Natica; after Bobretzky.

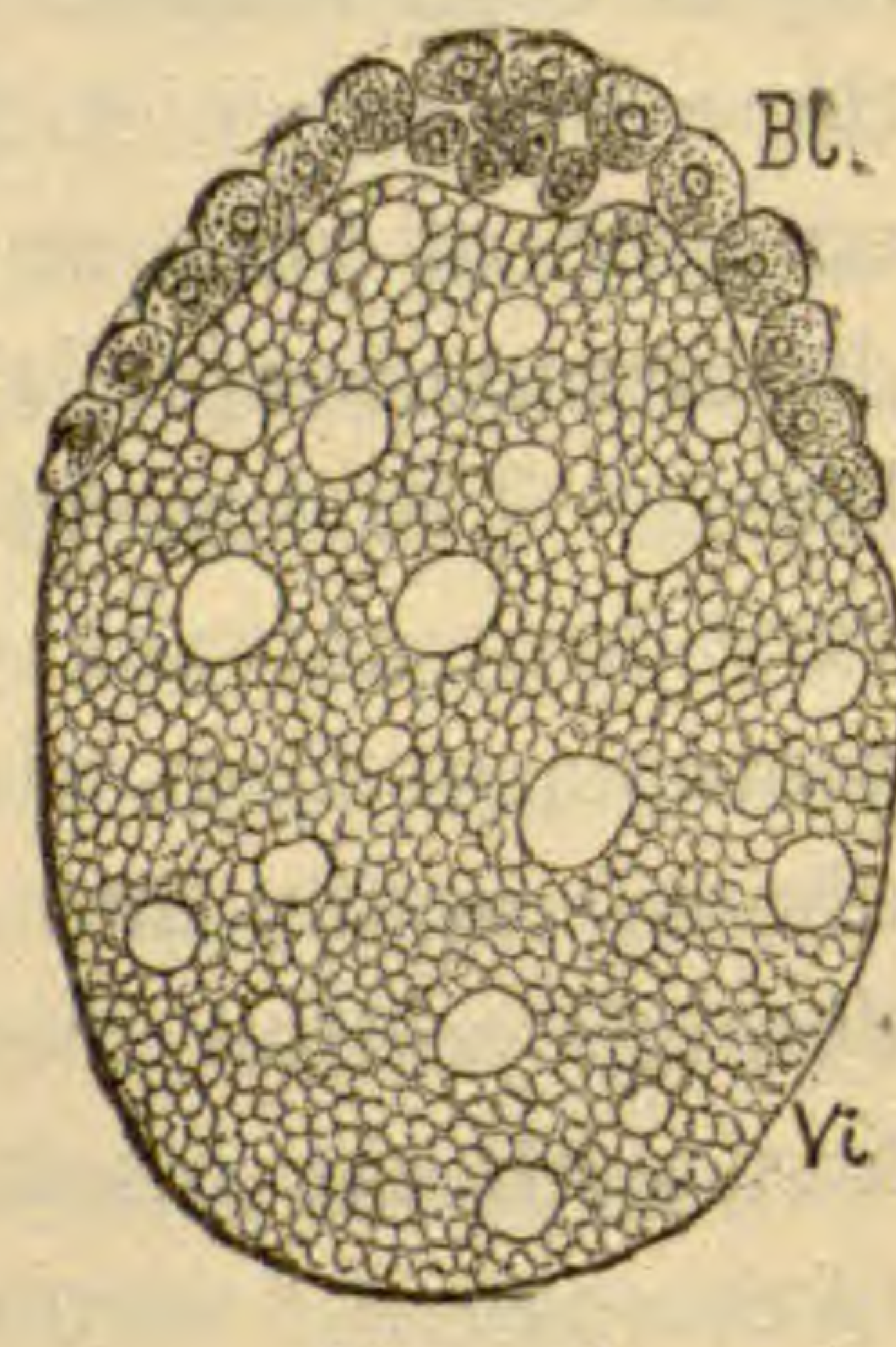

FIG. 18.
Section of the ovum of *Oniscus murarius;* after Bobretzky. *Bl*, blastoderm: *Vi*, vitellus or yolk representing the entoderm.

divided into discrete cells, but remains one mass; this is the case in elasmobranchs and the amniota, but in the highest amniota (Placentalia) the yolk is lost and the entoderm is again represented by a single layer of cells (Fig. 13).

It seems to me evident that *the first step of development in the segmenting ovum is the differentiation of the two germ-layers, ectoderm and entoderm, resulting in the diaderm stage.* Diaderm is a term preferable to blastula, because the latter is applicable strictly only to a special larval form, while the former is a general term which refers to the essential differentiation at this stage. It is important to remark that the two layers are distinct in the diaderm or blastula stage; it is often erroneously affirmed that the blastula consists of a *uniform* layer of cells, part of which subsequently becomes the entoderm.

The segmentation cavity comprises the whole space between the entoderm and ectoderm; it is very early invaded by cells produced from the two primitive germ-layers. These cells are in vertebrates of many kinds, and enter the segmentation cavity at various periods. It is customary to group the cells which enter early into this cavity under the common name of *mesoderm,* and to consider them as a third and distinct germ-layer. For convenience we may adopt this custom, for, to a certain extent, the mesoderm of authors is a separate germ-layer, but it by no means includes all the tissues which occupy the space between the two primitive germ-layers. As the space between the entoderm and ectoderm is always homologous with itself it follows that the entire room between the epithelium (entoderm) of the digestive tract and its appendages on the one side, and the epiderm on the other, is homologous with the segmentation cavity.

The mesoderm of authors comprises three tissues: (1), free wandering cells (*mesamœboids*); (2), embryonic connective tissue or cells connected together by processes (*mesenchyms*); (3), epithelium, which forms two or more separate sacks. The origin of the mesoderm and the relations of the three tissues it contains do not fall within the scope of this article.

The Gastrula theory.—In invertebrates with holoblastic ova the blastula passes into a stage known as the *Gastrula.* Gastrula is, properly speaking, a new name for a larval form called *Planula* by older writers; but the term is now generally employed to designate an ideal embryonic stage supposed to be common to all multicellular animals.

The blastula changes into a gastrula by a process of invagination. The entodermal area of the blastula flattens out, the ectoderm meanwhile expanding by multiplication of its cells; after flattening, the entoderm turns inward, forming at first a shallow cup, then a pit which has an opening or mouth, the rim of which is the ectental line. The larva is now a double sack, and has an external wall or ectoderm, and an internal wall or entoderm; the entodermic cavity is entirely distinct from the segmentation cavity. The process of gastrulation is here described as it occurs among the lower invertebrates.

Typical gastrulæ are the free swimming larvæ of many marine invertebrates. We may take as an example that of a sea-urchin, (Fig. 19). The larva is round; at one pole it has an opening, *M*, the gastrula mouth leading into an internal cavity; as this is a free swimming larva it is provided with long cilia for organs of locomotion; the cilia in many gastrulas are distributed over limited areas or they may be wanting altogether. The larva consists of a double sack,—a larger outer one of small epithelial cells, *ec*, the ectoderm; and a much smaller inner sack composed of larger entodermal epithelial cells, *en*; at the mouth, *M*, of the inner sack the two layers are continuous with one another; in the space between the two sacks, which corresponds to the segmentation

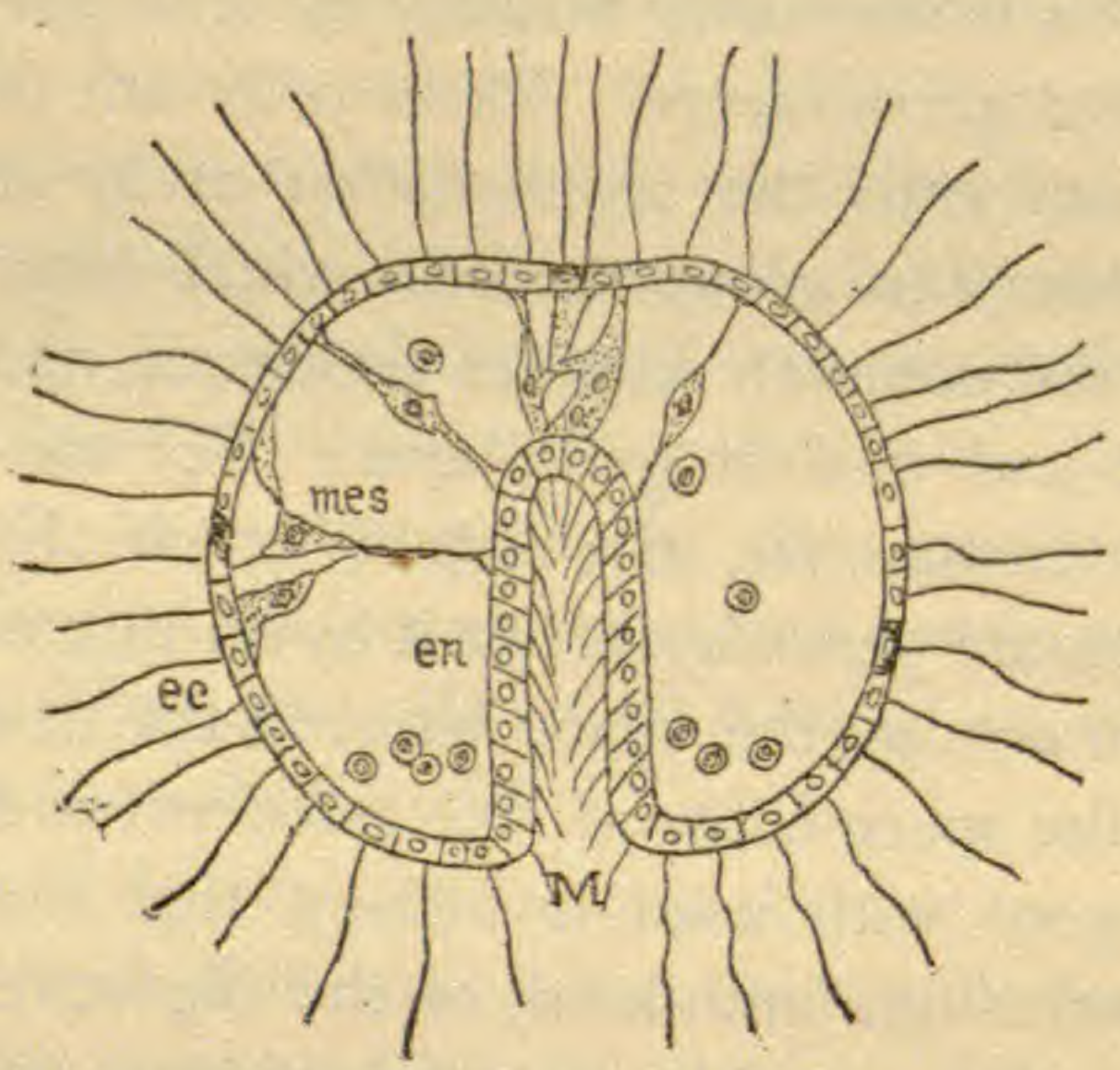

FIG. 19.

Section of a gastrula of *Toxopneustus lividus*, after Selenka; *ec*, ectoderm; *en*, entoderm; *mes*, mesoderm; *M*, mouth.

cavity, are a few scattered cells, the first members of the mesoderm, *mes*.

The entodermal sack of the gastrula is known as the *archenteron;* other terms are also in use, *e.g.*, mid-gut, cœlenteron, Urdarm, etc. The opening is known as the *gastrula mouth* (archistome, Urmund, etc.). The cœlenterates preserve the gastrula organization throughout life, but in all higher classes the archenteron gives rise, not only to the permanent digestive tract, but also to many appendages and derivatives thereof; and moreover the gastrula mouth closes over, and in vertebrates the true mouth is an entirely new formation which arises without any connection whatsoever, so far as known, with the gastrula mouth. By gastrulation the ectental line becomes the rim of the gastrula mouth.

A line passing through the centre of the mouth and the opposite pole of the gastrula is the so-called axis. Now if the mouth be elongated, there would at once be a new *longitudinal axis* marked out, and the gastrula would become *bilaterally symmetrical.* If, further, the mouth is pulled out into a slit, and in the process of evolution the lips come together and unite in their middle part, the animal would still have the two ends of the original mouth left open, and would so acquire two apertures to its archenteron, one anterior to serve as mouth, and one posterior to serve as anus. This hypothesis of the conversion of a gastrula into a bi-laterally symmetrical animal by the elongation of the mouth and concrescence of the lips or ectental line, was first suggested, so far as I am aware, by Rabl, *36*. A very perfect exemplification of the process is afforded by the developing ova of *Peripatus capensis* as shown by Balfour, *3*, and Sedgwick, *43*, Pl. XXXII. Figs. 23–26. There are, however, serious difficulties in applying the theory to bilateral invertebrates. I am strongly inclined to think that further research will obviate these difficulties.

In certain vertebrates and annelids the concrescence of the ectental line has been clearly demonstrated, but the process is rendered by secondary modifications much more complex than that described in the preceding paragraph.

The Gastrula theory is that all metazoa have a common inherited stage of development, which follows immediately after the diaderm; this stage is characterized by there being an outer ectodermal sack with a perforation, to the edge of which is attached the entoderm, which forms a closed inner sack, the archenteron.

The term gastrula was introduced by Haeckel, and is now universally used by embryologists. The discovery of the importance of the gastrula is due to the brilliant researches of Kowalewski on various invertebrates, including Amphioxus, then supposed to be a vertebrate. Haeckel then seized upon the idea of the gastrula, and wrote an essay, *21*, upon it, which from its brilliant style attracted much notice, and did much to direct attention to the important discovery of Kowalewski. Although Haeckel indulged his fantasy unduly, and was misled into speculations which are now unheeded and almost forgotten, he did great good by starting the interest of zoölogists in the right direction. By a remarkable coincidence Lankester published an essay, *31*, of a purport very similar to Haeckel's, at about the same time. A great deal remains to be done before the gastrula theory of evolution can be fully established, for there are many facts not brought into accord with the theory in its present form.

The gastrula, like the diaderm, varies greatly, the chief modifications depending on the amount of yolk present; this is illustrated by the accompanying diagrams, (Fig. 20). The mesoderm is intentionally omitted; A corresponds to such a larva as Fig. 19; the difference in size between the two sets of cells is slight but evident. In B the difference is more marked, and fairly represents a gastrula of Amphioxus. In C the difference is very great, and corresponds to that observed in certain gastropod larvæ. In

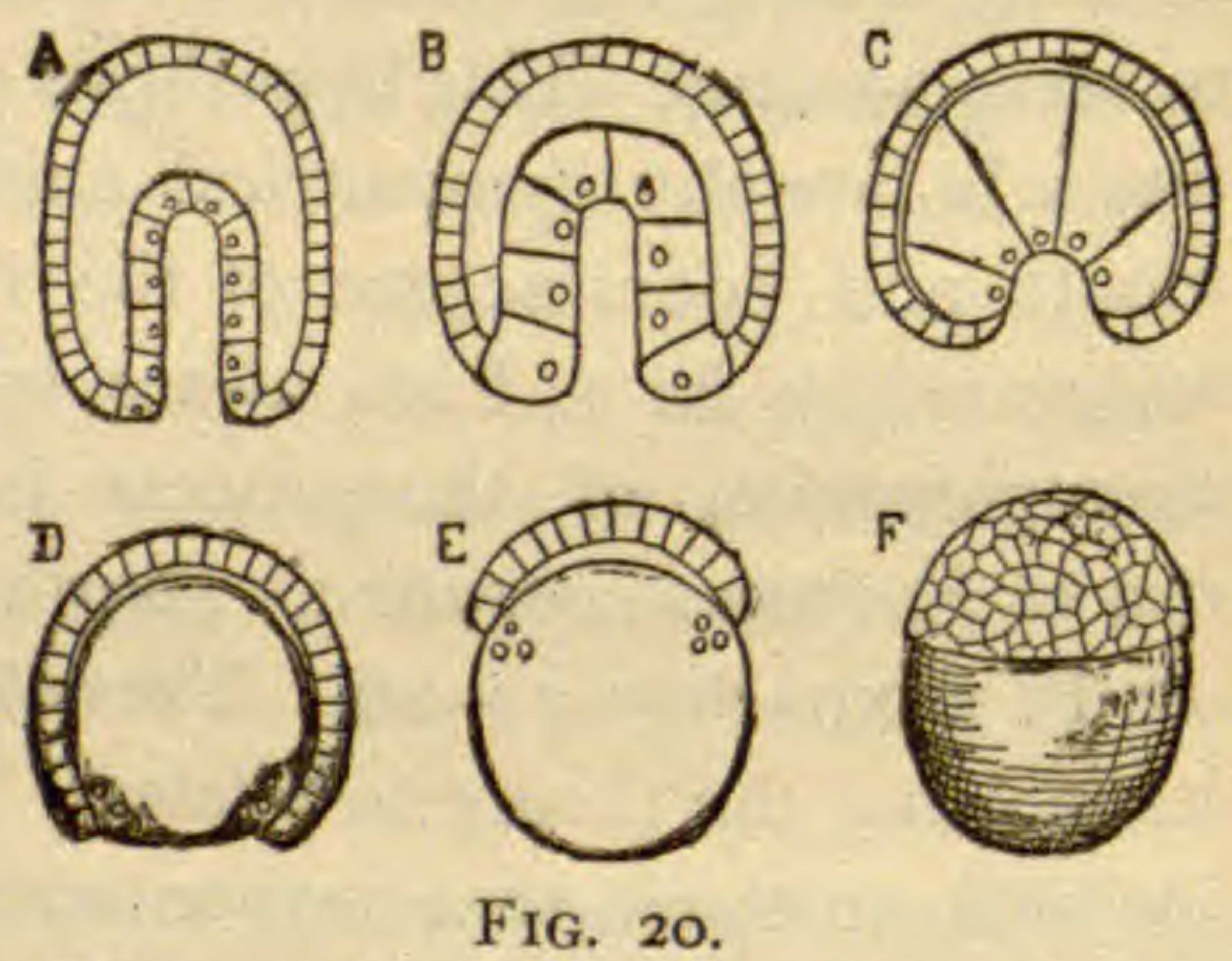

FIG. 20.
Diagrams of the principal modifications of the gastrula (see text), *A E* represent sections.

D the inner set is no longer separated into distinct cells, although there are a number of nuclei, each of which marks the centre of a future cell; in such instances we must regard the whole inner portion as not yet transformed into a definite entodermic *cell-layer.* This figure is particularly instructive, because it shows that what we call the yolk is not something distinct from the germ, but really belongs to the inner layer of the embryo. E shows a similar egg, in which the outer set of cells has not yet grown around the yolk. F shows the same egg, not in section but seen from the outer surface.

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NOTES ON THE LIFE-HISTORY OF *CHOROPHILUS TRISERIATUS.*

BY O. P. HAY.

ON the 22d day of last March, while searching the ponds about Irvington, Indiana, for Amblystomas and their eggs, I discovered some amphibian spawn whose parentage I did not then recognize; but which, after hatching, development, and metamorphosis, proved to be that of the little frog, *Chorophilus triseriatus*.

The eggs were deposited in an admirable situation for making observations upon them. A large tree, standing at the edge of a shallow temporary pond, had been overthrown; and when the roots had been buried, a hole some two feet deep had been left, and this was full of water. It was so cut off from the pond that by arranging a few sticks and leaves it was made very difficult both for the tadpoles coming from these eggs to leave the pool and for those of the other species to enter it. There were large numbers of the eggs, hundreds of them; but whether or not all had been deposited by a single female, I could not tell. The species is here apparently rare, but a single specimen having been captured. Many such animals, however, have a faculty for concealing themselves for years; until some lucky accident, or an unusually close search, reveals to us their real abundance.

The eggs were deposited in bunches of various sizes and were attached to branches and twigs which had fallen into the water. They clung to one another and to the twigs by means of the clear jelly that surrounded each egg. They had already gone well forward in their development, since each contained a larva of the form shown in Figure 1. It will be seen that the dorsa flexure is very pronounced, and the tail is thrown over the back. The diameter of each egg is about 3 mm.

Figure 2 represents the larva as it appears on the 28th day of March. It is now 5 mm. long, and has lost its dorsal flexure, but is coiled laterally within the egg membranes. Sections show the nasal pits formed, the eye-balls beneath the skin, and the auditory organs as simple hollow cavities. There is no mouth, only a depression where the mouth will be. The "suckers," or "holders," are fully developed.

By the 5th of April the tadpoles had escaped and were swimming about in the pool. The mouth is not yet perforated, there are no gill slits, and the gills themselves appear as mere buds. It does not appear that they ever become important organs. The holders are present, but they seem scarcely as prominent as they were in the unhatched young. The larvæ are thin from side to side, and slenderer than are those of *Rana virescens* at the same stage. They are of a yellowish gray color, with punctulations of black. It is with great difficulty that, in sections, one can make out the cartilaginous lower jaw, the hyoid, and one or two branchial arches.

On the 11th of April the young have reached a length of 7.5 mm. The body is becoming broader and more pear-shaped, owing to the growth of the intestine. The eyes are completed; the iris is of a golden color. The back is now flecked with golden dots. They spend much of their time sticking to the sides of the aquarium, but it is probably not by means of their holders, since sections taken two days later show that these have disappeared. No external gills are visible; neither could I observe that water was being taken in. Sometimes when disturbed they would start off and spin round and round in the water for awhile before taking any definite course. By the rapid streaming of water over the body it was evident that a vigorous ciliary action was going on.

On the 13th the external gills were gone, water was to be seen streaming through the nostrils and out through the pore on the left side, which alone appeared to be open. The body is pear-shaped. The back is black, speckled with gold; the belly is also black and gold except along the middle line, where it is transparent enough to show the coils of intestines. The now open mouth is triangular, and the jaws furnished with black, minutely denticulated, horny sheaths. One specimen examined had these alone; another had, in addition, two rows of black horny teeth on the lower lip. The convoluted intestines are loaded with fine sand and vegetable débris. The cartilaginous structures of the head have undergone astonishing development since the 5th.

By April 20 the length has become 10 mm. There is a bud of tissue on each side at the base of the tail, the rudiment of the future hinder limbs. The mouth is nearly surrounded by a row of fleshy papillæ, inside of which are the rows of horny labial teeth. There are now two rows on each lip, the one next the upper beak being interrupted in the middle line. All these teeth are finely notched at their tops, the whole forming a most admirable apparatus for scraping off the layer of algæ that covers everything in the water. Ciliary action is still going on over the body.

A week later the length has increased a little. By means of their sucker-like mouths they adhere to the vessel in which they are kept. They are probably at the same time busy feeding. The lower lip is now provided with three rows of denticles, a third short row having made its appearance outside of the others. The eyes are more lateral than are the *Rana virescens* larvæ.

Measurement of the tadpoles on the 4th of May shows their length to be 19 mm. The hinder limbs show signs of segmentation. The body is jet black, with dots of gold; the belly is nearly covered with gilt of a brassy reflection. In one specimen currents of water were seen to enter the nostrils, and feebler currents the mouth. One was seen to come to the surface for air, and others to emit bubbles of air beneath the water. Observation of these larvæ and those of *Acris gryllus* shows that the water used in breathing is drawn in through the nostrils and emitted through the pore on the left side until about the time when the forelegs are to appear. It is then drawn in, principally, at least, by the mouth. I have also observed in the case of both species that after the forelegs have been set free and the tail begins to be observed at least a portion of the water taken in by the mouth is sent out by the nostrils. This may be due to the partial closing up of the excurrent branchial pore. The stream may bathe the yet present gills; but if the water continues thus to be drawn in and expelled after the gills are absorbed, as I have reason to think it does, we shall have then a sort of pharyngeal respiration such as Profs. Gage have observed in *Aspidonectes* and *Cryptobranchus*, and myself in three species of *Amblystoma*. This mode of respiration in the frogs named, if it really is such, differs from that in *Amblystoma* in that in the latter the water enters by the nasal passages and leaves by the mouth.

It may be proper here to describe the labial dentary apparatus of *Chorophilus* as compared with that of *Acris*, as we find it in maturer tadpoles of both. In *Acris* there seem to be but four rows of denticles, two on the upper and two on the lower lip; while, as already said, in *Chorophilus* there is a short third row on the lower lip. In the former species the teeth are not notched at their tips; in the latter each tooth is notched at the tip so as to present about eight little points. The teeth are also more numerous in *Chorophilus* than in *Acris*. This may be most briefly presented as follows:

Number of Teeth.	Chorophilus.	Acris
In outer, or upper, row of upper lip .	90	50
" inner or lower " " " .	80	44
" " or upper " lower " .	85	57
" second " " " .	95	60
" third " " " .	55	—

By the 26th of May the tadpoles had attained a length, in some cases, of 27 mm., 16 of which is tail. Many of them about this time succeeded in releasing their fore limbs from the skin which bound them down. There was so much difference in size among them that I was quite convinced that tadpoles of other species had invaded the pool; but this proved not to be the case. The difference was principally in size and plumpness; but it was evident that as soon as the fore-legs were released, and even before, there was a reduction in the animal's bulk.

These four-legged tadpoles were very lively and very timid, and darted about in great alarm when disturbed. They would also crawl out of the water on stones in the aquarium, and sit there in great contentment. They were also perfectly ready to leap out upon the table or the floor. It was easy to see even at this period that they belonged to some species of tree-frog, since the hinder digits were furnished with disks ; as were also the fingers even before they were set free. No stripes were yet visible. As the tail shows signs of absorption the body continues to shrink in size, probably owing to the shortening of the alimentary canal. The dorsal stripes also begin to appear, so that it becomes easy to recognize the species.

They now show a decided inclination to leave the water. They climb up the sides of the aquarium ; and to keep them in netting must be put over it. Having no web on their feet they are poor swimmers, and many of them were found drowned. When free they doubtless early leave the water, and hide away among the sticks and leaves, where they are protected, and can find suitable food.

By the first of June many of the larvæ had lost nearly the whole of the tail. Others were slower in development, and it was not until the 12th of June that all had completely transformed. Twenty-five or thirty of these were shut up in a box containing dirt and chips, and covered with netting. An attempt was made to furnish them with insect food, with the intention of watching them further. They hid away under the chips, and lived for some days ; but they grew emaciated, and many died, and the effort to raise them was abandoned.

I doubt much that this species is, to any considerable extent, a tree-inhabiting frog, Such specimens as have been taken where I could learn of the circumstances have been captured in the grass. Dr. Coues states, in the "Bulletin of the U. S. Geological Survey," IV., p. 290, that it was found in the greatest abundance in prairie pools and streams in Northern Dakota and Montana. Some of them were taken at Frenchman's river on the 1st of July. It is probable that even at that late season they were depositing their spawn.

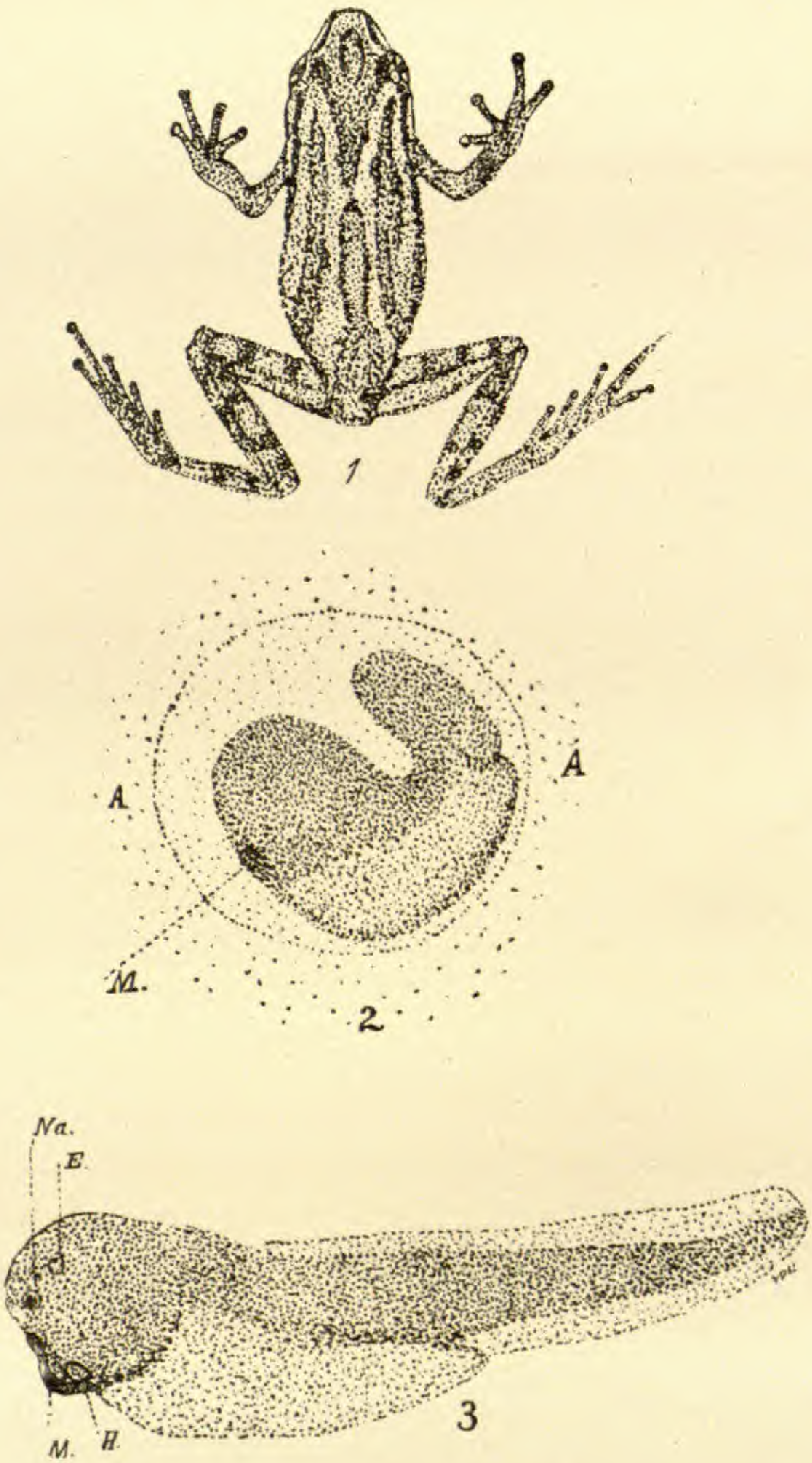
EXPLANATION OF PLATE XXXV.

FIG. 1. Adult frog of natural size.

FIG. 2. Egg on March 22, with contained larva. A, gelatinous envelope around egg ; M, mouth.

FIG. 3. Larva on 28th of March, straightened ; Na, external nares ; E, eye ; M, mouth ; H, holders.

PLATE XXXVI.



Chorophilus triseriatus.

PROF. D. W. C. DUNCAN'S ANALYSIS OF THE CHEROKEE LANGUAGE.

BY C. L. WEBSTER.

TO classify and define the words of an Indian tongue, to ascertain and codify its mysterious laws of expression, and, by means of literary associations, so wed it to our own as to give it a guarantee of prospective existence commensurate with that of the English, has hitherto been regarded as one of the most difficult problems in the science of language.

Prof. D. W. C. Duncan, of Charles City, Iowa, is one of the few men that have ever had the courage to undertake such a work, and the still fewer that have enjoyed a fitness for its execution. The language which he now has in the crucible of reduction is the Cherokee. By the accidents of birth, the tongue he is dealing with is, in one sense, to him a familiar vernacular. Besides this natural advantage, he enjoys that of a finished classical education, together with an instinctive taste for linguistic research, especially in the more remote and hitherto untrodden fields of that kind of learning.

He says, "Human language is not always and necessarily *expressive;* it is sometimes in the main only *suggestive.* Where there is an affluence of thought, there is a corresponding wealth in the means of expression. In that case, language naturally becomes much more elaborate and complicated in its structure. But in the lower grades of social life, where the sphere of ideas is small, there exists but little motive for linguistic improvement. The words are generally few in number, and limited in meaning. Many of them indeed can hardly be called *words;* they are more like unintelligible exclamations, whose office it is, not to imprint an idea, or a thought, upon the apprehension of the person addressed, as do the words of a cultured tongue; but rather to arrest the attention and direct it to the subject in hand, leaving the desired impressions to arise in his mind as the result of his own observation and reflection. In these rudimentary tongues sentences are to be found very often in but an embryonic state. They are concise and extremely simple in structure. The great periods which seem so formidable to the stranger, will be found, when analyzed, to consist mainly of simple sentences of co-ordinate rank linked together, by implied or expressed connectives."

Besides the above general features, we are told by Prof. Duncan that the Cherokee is also characterized by a peculiar disregard for the distinct individuality of its words. In practice, they are often brought together and so consolidated as to give a whole sentence the brevity and consistency of a single word. Nor does the process of agglomeration always stop exactly at the point of mutual contact; the words often meet and mingle, like two drops of fluid, so thoroughly disguising the identity of each as to baffle the discernment of all except an expert in the use of the tongue. He illustrates as follows:

"Take the word-sentence *nēwē* (thou sayest). Released from the bonds of synthesis, it stands thus: *nē hē wē ; ne*, an obsolete prefix; *hē*, thou; *wē*, say. Had any other consonant stood in the place of *h*, a fusion of the first two syllables could not have occurred. That letter being only an attenuated aspirate, the two adjacent vowels are regarded as standing in actual contact, a predicament for vowels which is strictly forbidden by the laws of the language. Hence the form of condensation: *n* (*ē h*) *ē wē* = *nēwē*.

Again, word-sentence: *ta̤wālógä ;* (do thou write them). Expanded, *tē hē a̤wālógä,*—*tē*, a prefix denoting the plurality of the object of the verb, and may be translated by the pronoun *them*. Here *h* being regarded as incompetent as a separatrix, three vowels come in contact. To relieve this misadventure, to maintain the euphony of the sentence, and to conform to the law forbidding a hiatus, contraction is effected thus: *t* (*ē hē*) *a̤wālógä* =*ta̤wālógä*. It is noticeable that the pronoun in this case entirely disappears; and the fact that *hē* (thou) is the subject of the verb, is only made known by its absence.

An exceptional method of contraction is illustrated by the word-sentence, *hnätógä*, (do thou); expanded, *hē nätógä; h*(*ē*)*nätógä*.

There are six vowels in the Cherokee language, *ä ā ē a̤ o̤ ó*; and twelve consonants, d g h k l m n q s t w y. Every syllable ends with a vowel; and this rule covers all cases where the syllable consists of a single vowel.

The general law of contraction may be stated thus:

When a vowel comes in contact with another vowel, the one preceding is dropped; and the consonant of the preceding syllable unites with the following vowel, forming a new syllable.

It is obvious from what has been said, that the pronoun *hē* (thou) may take as many different forms as there are vowels. *Hē* is the original form; the others are derived as follows:

1. Hēnäno̤ga̤wēskä; expanded, Hē näno̤ga̤wēskä.
2. Hē älāhógä; contracted, Hälāho̤gä.
3. Hē āda̤hōgä; contracted, Hāda̤hógä.
4. Hē a̤stó; contracted, Ha̤stó.
5. Hē o̤ga̤tä; contracted, Ho̤ga̤tä.
6. Hē óta̤nóhä; contracted, Hóta̤nóhä.

That is to say, the pronoun *hē* may be heard in conversation under six different forms: hē, hä, hā, ha̤, ho̤, hó, in addition to the many other guises which it may assume upon contraction with certain other words and prefixes that *precede* it, as we have above shown."

Prof. Duncan adds in this connection: "Now when we reflect that all the pronouns, more than fifty in number, with adverbs, modal auxiliaries, tense-endings, and a large family of numeral and personal prefixes (some of them obsolete), are never, or seldom, seen or heard of, except in these condensed forms of expression; and that each of these words is liable to assume any one of six different forms, according as it may happen to be touched, fore or aft, by the initial or terminal vowel of a neighboring syllable, in every case giving the whole word-sentence a new, strange and unexpected aspect, it is easy to appreciate the importance of a thorough mastery of the rules by which these myriad changes are effected; indeed, without such mastery, any progress in a scientific knowledge of the Cherokee tongue would be utterly impracticable."

Among the curiosities of Cherokee etymology, those pertaining to the pronoun are specially curious and interesting. Prof. Duncan says:

"The properties of the pronoun are chiefly person and number; though case is not altogether ignored. In English, the pronoun *we* may have a variety of applications; it may include the first and third persons, excluding the second; or the first, second and third; or the first and second, excluding the third; or the first and third, excluding the second. The Cherokee pronoun has a different form for each of these ideas; in some cases, *two* forms for the same idea. The *last two* ideas, in Cherokee, are dual in number. Thus:

1. { A̤tsē-, (1 + 3—2); derived forms, a̤tsä-, a̤tsā-, atsa̤-, atso̤-, a̤tsó-,
   { A̤kē-, (1 + 3—2); " " a̤kä-, a̤kā-, a̤ka̤-, a̤ko̤-, a̤kó-,
2. { Ētē-, (1 + 2 + 3); " " ētä-, ētā-, ēta̤-, ēto̤-, ētó-,
   { Ēkē-, (1 + 2 + 3); " " ēkä-, ēkā-, ēka̤-, ēko̤-, ēkó-,
3. Ānē-, (1 + 2—3); " " ānä-, ānā-, āna̤-, āno̤-, ānó-,
4. A̤stē-, (1 + 3—2); " " a̤stä-, a̤stā-, a̤sta̤-, a̤sto̤-, a̤stó-,

2d Per. Sing.

Hē (thou), derived forms, hä-, hā-, ha̤-, ho̤-, hó-.

2d Per. Plu.

Ētsē-, (you), derived forms, ētsä-, ētā-, ētsa̤-, ētso̤-, ētsó.

2d Per. Du.

Ēstē-, (you, 2), derived forms, ēstä-, ēstā-, ēsta̤-, ēsto̤-, ēstó-.

A̤-, or O̤-, (he), 3d Per. Sing.

{ Änē- (they), 3d Per. Plu., derived forms, änä., äna̤-, äno̤-, änó-.
{ O̤nē- " " " " o̤nä-, o̤nā-, o̤na̤-, o̤no̤-, o̤nó-.

Each of these pronouns may be converted into the reflexive form by suffixing the syllable dä, thus, O̤dä-, (himself); Hädä-, (thyself); A̤kēdä, (ourselves).

Besides these *simple* pronouns, there are a few compounds which bespeak two different persons at the same time, said persons being in different cases. The English sentence, "You help me," would stand in Cherokee thus: *Skēstālō.* Here the pronoun *skē-*, carries the meaning of both English words, (*you-me.*) Skē-, original; derived forms, squä-, squā-, squa̤-, squo̤-, squó-.

In the same way, gó-, (I-thee); gókē-, (they-me); äkē-, (he-me); tsó-, (I-you); ētsó-, (we-you); gówänē-, (they-them); and some others.

In view of such an array of pronominal forms, and knowing there is more to come, the learner is apt to faint with discouragement; but when he takes into the account the fewness of the *original* forms, together with the unvarying rhythm that marks the formation of the derived forms, it will be sensibly felt that it is no more of a task to master the Cherokee pronoun, than the same part of speech in Latin, or even English."

In reference to Cherokee lexicography, Prof. Duncan further remarks:

"In order that a word may be defined, it is necessary that it should be identified; yet it is a singular fact that no Cherokee can recognize the words of his own language (with small exception), even when seen in print or heard in conversation; though he may actually wield them with the tongue of an orator, or the pen of a poet. The cause of this is the fact that the Indian mind is trained to deal, not with single ideas, but with thoughts, or at least with groups of ideas. The Cherokee is not aware that his language can afford any word for *hand;* it is always *Äquạyānē* (my hand); that is, the idea of *hand* is always attended, in expression, with a conception of the one to whom it belongs. Now if we should resolve this word, and assign to each idea its respective part, it would stand thus: *Äquä ạyānē* (my hand). Yet if these words should pass under the eye of a Cherokee who was not skilled in the science of his language, he would doubtless fail to recognize them, and be apt to repudiate them as something foreign to his native vocabulary.

While what we have here said is largely true in reference to the nouns, it is much more so as to the verb. The Cherokee never expresses the idea of an action, except in connection with that of the actor, and often of the person acted upon. And the adjective, in expressing a quality, seldom loses sight of the object to which it belongs.

Hence the first and most arduous part of the Cherokee lexicographer's work is to identify the words to be defined. Let it be our desire, for instance, to register and define the Cherokee word meaning the same as the English word *write*. It is to be doubted if it was ever heard or written except in some such conglomeration of vocables as *Wētsóya̤wālänātēyē*. Now to find the word of which we are in quest, this word-sentence will have to be resolved into its component elements thus:

We^{1}-tsó^{2}-y^{3}-a̤wāl^{4}-ä^{5}-nā^{6}-tēyē^{7}. We may then define as follows:

1. Wē-. *adv.* Thither; indicating motion.
2. Lsó-. *pro.* I—you; carrying the meaning of two pronouns.
3. Y-. A letter inserted for the sake of euphony.
4. A̤wāl-. v. t. *Write*, *draw*, *inscribe*.
5. A̤-. Tense sign, indicating the present tense.
6. Nā-. Mode sign, showing that the action affects *rational* beings.
7. Tēyē-. Sign of the infinitive mode.

It were easy to extend these illustrations of the work before us, without impairment of interest, or much danger of exhausting the source from which they are derived; but we are admonished by the limits of this article that the foregoing must suffice.

As touching the questions of ethnological science, there is no field of research more instructive than that of human language. The mind is the measure of the man; and so it is the essential personality of a race or a nation. The remains of art which a departed people leave behind them may suffice to give us a pretty clear idea of what they could do; but if we would know them as they were, we must needs study them through the medium of their tongue.

The few fragmentary Indian tribes that still remain are the custodians of a very rich store of linguistic material, the value of which, as data for scientific contemplation, cannot be easily overestimated. Not one of these tongues, however, can be expected to survive for a great while, except by the interposition of some friendly hand to save it from extinction. A fact like this can not be regarded by the scientist but with feelings of the deepest concern; for if it is desirable (and there can be few things that are more so) that an intelligible specimen of the red man's language shall be preserved in the interest of science, the present is about the last opportunity that will ever be offered for the discharge of such a service. The time for a work of this kind, owing to the rapid decay of these Indian tongues, is necessarily short, and it should be diligently improved.

In order that a language may be of the greatest possible use as matter of reference in the establishing of scientific truth, it is not enough to be conversant with only a few of its more prominent features; it should be understood as a whole with entire familiarity. To this end it should be rendered as easy of access as possible by means of suitable guide-books of study. In a word it should, like a classic tongue, be reduced to a state of implicit subserviency to the will of any one who might have occasion to master its use or appeal to its facts.

A very serious want of this kind has long been felt, especially with reference to the aboriginal languages of this continent. The work which Prof. Duncan now has on hand is unique and thoroughly original, as well as rigidly scientific. When finished, it will, without doubt, constitute one of the most exact and exhaustive treatises on Indian philology that has ever been published. It will have the effect to rescue at least one of our many Indian tongues, the Cherokee, from oblivion; and by investing it with an intelligible immortality, make it an interesting fact for reference among students of philology for all time to come.

Charles City, Iowa.

SCULPTURED ROCK AT TREMPELEAU, WISCONSIN.

BY T. H. LEWIS.

LAST November, whilst surveying mounds in the upper Mississippi valley, my attention was called to some rock sculptures located about 2½ miles north-west from Trempeleau, Wisconsin. There is at the point in question an exposed ledge of the Potsdam Sandstone extending nearly one-eight of a mile along the east side of the lower mouth of the Trempeleau river, now known as the bay. Near its north end there is a projection extending out about seven feet from the top of the ledge, and overhanging the base about ten feet. The base of the ledge is forty feet back from the shore, and the top of the cliff at this point is thirty feet above the water. On the face of the projection, and near the top, are the sculpture figures referred to.

No drawings or descriptions of these fine specimens of ancient work having ever been published, I thought it best to copy them for the inspection of archæologists in a printed form. Whatever distinct markings were originally cut upon the face of this rock are doubtless there now, and the group as traced is complete and entire, and in its primitive condition, for it has not been mutilated by man nor perceptibly injured by exposure to the elements. Great care was taken to obtain correct tracings, the size of nature, and these having been reduced by pantograph the copy remains an accurate facsimile of the original.

The centre part of the rock projection on which these figures appear, faces to the west, the sides falling back at a somewhat obtuse angle to the parent ledge. Owing to the horizontal extent of the space covered by the carvings they cannot well be shown in one connected drawing, so they are divided here for convenience into three groups of nearly equal size. The following detailed description accounts for all the separate forms, and they are numbered in their natural order from left (north) to right.

NORTH FACE.

Fig. 1 is an outspread hand 13½ inches long.

WEST (FRONT) FACE.

Fig. 2 is an outspread hand 16½ inches long. The thumb is cut through the angle of the rock and ends on the north face. The middle finger also extends to the top surface of the rock.

Fig. 3 is an outspread hand 17¼ inches long. The two hands (2 and 3) are apparently right and left hands, the little finger of one overlapping that of the other.

Fig. 4 is an outspread hand nearly 13½ inches long.

Figs. 5, 5, are five so-called canoes. They are somewhat crescent shaped, but all vary more or less in outline.

Fig. 6 has the same form as the preceding, but the additional upright portion overlaps it.

Figs. 7 and 8 are also of the same form as 5, but 7 is cut in the bottom of 8.

Fig. 9 probably represents a fort, and its length is 18½ inches.

Fig. 10 is a nondescript, and it partly overlaps 8.

Fig. 11 is a nondescript four-legged animal. Its length in a straight line from the end of the nose to the tip of the tail is 10½ inches.

Fig. 12 may be intended to represent a foot, but possibly it may be a hand. It is 7¼ inches in length.

SOUTH FACE.

Fig. 13 is an outspread hand a little over 13 inches long.

Fig. 14 undoubtedly represents a foot, and it is 4½ inches long.

Figs. 15, 15, are of the same class as Figs. 5.

Fig. 16 has the appearance of representing a bone, although somewhat distorted.

Fig. 17 is an outspread hand nearly 14 inches long.

Fig. 18 is an outspread hand about 6¾ inches long.

Fig. 19 is the largest hand, and deserves a more particular description. The palm is 10 inches long and 8¼ inches wide. The length of the thumb is 5¼ inches, of the index finger 10¾ inches, of the middle finger 13½ inches, of the ring finger 11½ inches, and of the little finger 9¼ inches.

These figures are sunk in throughout—intaglios—instead of being mere outlines, and vary in depth from a quarter of an inch to fully one inch. Although the surface of the rock is rough the grooves were rubbed perfectly smooth after they were pecked or chiseled out.

Such is a concise account of one of the most interesting antiquities of the country lying between the Trempeleau and Black rivers, and I shall feel gratified if by my instrumentality it shall be rescued from oblivion.

PLATE XXXVII.

SCULPTURED ROCK AT TREMPELEAU, WISCONSIN.

ORIGIN OF THE LOESS.

BY JNO. T. CAMPBELL.

THE loess, as understood in Indiana, is a thin sheet of very fine clay, or a sand so fine that it appears like clay, which covers the glacial drift. That the boulder clay, or till, here, is the work of an extinct glacier, is more evident the more it is studied. I have no more doubt of the past existence of a glacier here, than if I had been present when it existed, and seen it myself. But how came the fine yellow or buff-colored, and in many places ash-colored, clay on top of the glacial clay. To every observer the first thought that will occur is that it is the sediment from a body of still water. Next query—How did the water originate?—for it must be fresh water. Well, the melting glacier furnished it. Very well. A little more observation, and we find the clay at elevations rather high for a glacial pond to cover. Then we construct imaginary ice dams to hold the water in sufficient depth and time to make the deposits we find. Following our investigations southward we find the loess almost to the Mexican Gulf, where not only ice melts, but alligator eggs hatch in the sand; yet we construct an imaginary ice dam below the most southern loess to account for it. Then the ice dam theory becomes absurd, and we cast about for another cause. The wind-sifted sand from the western desert next suggests the cause. But it too has difficulties to be reconciled and harmonized that seem insurmountable.

If the clay were due to glacial lake deposits, we should expect the lowest valleys to contain the thickest beds of clay. But in my locality (Rockville, Ind.) the reverse is true. The highest land, and ridges in particular, have the thickest yellow clay, free from coarse sand and gravel.

What cause or causes could produce this clay that will not be contradicted by well-known existing facts?

I suggest some causes now at work that I think could and *did* produce the clay in question.

Some writer whom I have read often, Prof. G. K. Gilbert I think, said (in substance) he always liked to have all the steps, processes and observations by and from which an investigator has arrived at his conclusions. I like this myself, and shall, at the risk of being tedious to the reader, give my observations, impressions, conclusions, changes of opinion, disappointments, etc. Up to and for several years after 1872 I accepted the teachings of the books on Dynamic Geology with childish confidence. I supposed the surface, gravel-less clay was the sedimentation of a still lake. That year (1872) I had occasion to cut down a sugar maple tree in what is now the fair ground at Rockville, Indiana. The tree was about twenty inches in diameter at the stump. When it fell, the stump was so nearly sound that I did not notice a very small decay in the heart. I cut off eight feet of butt, and split it into quarters. It split as easy and straight as pine. When I halved it, I found a long, cigar-shaped, rotten heart, six feet long, by about six inches diameter. The centre of this rotten place was as perfect yellow clay as I ever saw. The fine grit could be easily detected by the teeth. Following it from the centre to the sides and toward the ends, the clay gradually changed to wet, soft, rotten wood. There was no distinct line where the clay ended and the rotten wood began. This was a curiosity to me, and I kept the sample several years. There was no hole in the body of the tree where any insect could then carry the clay in, and I doubt if there ever had been a hole grown over and closed over by concentric growths of the tree. I showed this to many people and told it to many more, and among the number to my teacher, Prof. B. C. Hobbs (Ex-Supt. Pub. Inst. Ind.). Being a Quaker he replied thus: "Thou hast not carefully observed it. A crawfish working up from below happened to strike the hollow of the tree, and kept hunting upwards for the surface of the mound, and thus filled the cavity of the tree with clay." A few days later I took my axe and visited the stump. The decay at the heart on the top was so small I could not put my fingers in it; but I cut the stump off a foot lower, and there it was entirely solid and sound. How came that clay to be sealed up in that tree? was the query. I then kept a watch out for all rotten logs and stumps that came in my way, and found that in very many of them there was a strong resemblance to the yellow clay, but I never again found as perfect a sample as the sugar tree mentioned. I often found grains of sand in the heart of rotten stumps and logs, where I could not see any possibility of its being carried in by insects. I have found gallons of rotten wood and sand mixed in the hollows of trees fifty feet or more above ground, where the rains in following down the bodies and limbs would trickle inside the hole, and be there retained till evaporated. This (finding of sand) is very often the case with white oak. Did the insects carry it there? Did the birds carry it there? Did the wind drift it there? If the latter, then the rough outside bark would hold much of it in the crevices. But not a grain could I find there.[1] Then there are the leaves of the trees, which by a careful invesgation I found to be, when compressed, equal to the last growth of the mother tree, or in the life time of a tree the compressed leaf fall is equal to the wood volume of the tree above ground. The compressed annual leaf fall in our dense forest I found to be one thirtieth of an inch. The body of the trees will make the same volume as the compressed leaf fall of their life-time. (I don't claim this as mathematically exact, but it is approximate.) Thirty years will make one inch of compressed leaf fall. One thousand years will make thirty-three (or more) inches. The bodies of the trees making as much more, we have sixty-six inches of decomposed trees and leaves for one thousand years—not allowing that any part will be reconsumed by the succeeding trees. Then add the unknowable volume of dead buffalo, deer, bear, and other animals, together with the birds and insects, with the excrement of all three during their lifetime, and we have a great volume of recently created matter, some of which must remain on the surface in some form. What form more probable

[1]Very recently I have found dark sand in several hollow black-walnuts, where the hollow was at the ground and the sand was mixed with the rotten wood inside the trees and three to seven feet above the outside opening; so that it was impossible for the rains to have washed it into the tree, and very, very improbable that it was carried in by the wind. Beside, I must remark again, that if carried in by the wind the crevices in the rough bark should also contain a great amount, but it takes the closest search to find a single grain.

than the surface yellow clay? This too is consistent with the thicker clay on the higher lands where vegetation first existed.

But chemistry teaches that it is impossible that trees, roots, leaves, and the flesh and blood of animals, birds and insects should turn to clay or sand. Then the more wonderful the facts I submit herein. For the time being I shall treat the facts according to their appearances, for appearances point so strongly, that the investigator on the field, shovel in hand, requires a constant effort to doubt them. But I remember too that the appearance of the surface of the earth is flat.

But here is a large erratic glacial bowlder on top of very recent creation. Why was it not covered by this recent creation? Ah, I see; once on top by any accident at the end of the glacial epoch, the subsequent freezing and thawing would keep it there. The freeze takes place at the outer edges first, forms an air-tight box, and in expanding lifts the bowlder, thus forcing a vacuum under it, which is filled with water by suction, which water is next frozen, causing still another lift and expansion. This second lift raises the bowlder above the first outside frozen support, causing a crevice. The succeeding thaw, which takes place first at the outer edges, forms a thin slush which fills the crevices, acting thus as props or supporting or staying wedges. Sometimes a bowlder will be so covered with a drift of leaves or the fall of a tree that the freeze does not get enough under to lift it. Then it ceases to climb on top as the building goes on, and it will in time be found in the midst of the surface yellow clay as we have often seen them.

Then again we find stray glacial gravel interspersed among the gravelless clay. Query—How came it there? The crows may have carried it and dropped the pebbles, as they do to-day; or the squirrel and other similar habited animals in digging through the leaves after fallen nuts may have kept them scratched up to the surface for a long time, and then by chance they were overtaken by a leaf drift, and remained where we find them to-day, in the midst of the surface clay. Also, animals burrowing in the gravel would carry the gravel up from their holes and leave it on the surface.

Then the roots of the trees cut a great figure in this work. Think of the millions, yea, billions of roots and rootlets that have occupied the upper part of the gravel. I feel confident that there is not a cubic inch of ground in the forests as they exist here, that has not been occupied by a root or rootlet, from the surface to three feet down, in the last thousand years. What has become of them? In twenty years at most after cutting down a forest, no trace of the roots or rootlets can be found here. They do not leave their cast, or even a trace of brown mould.

About two years ago I was riding homeward over the gravel road south-east of here (Rockville, Indiana), noticing the exposures along the road gutters. In many exposures the line between the "upper yellow clay" (as it is called here) and the under glacial clay (mixed with gravel) was as distinct and marked as the crack in a floor. When near the hill top on the east side of Raccoon creek, the surface clay suddenly changed to yellow sand. Away went my theory in a minute, which I had been years building. There was a small locality where the surface was sand instead of clay. Trees had grown, shed their leaves, died and rotted there, and been succeeded by others as abundantly as where clay existed. Do trees turn to sand also? I queried. Scarcely probable. But what has become of the trees, their leaves and rootlets, that have been growing on and in this sand for thousands and thousands of years? A little brown surface mould about six inches thick is all I can see to represent them.

Last May, while locating a bridge site across said Raccoon creek, I noticed in the steep bank the ends of the roots and rootlets of stumps and dead trees, and in some of them all had decayed and been consumed except the bark, which was filled with a sandy loam the same as the surrounding earth. Been carried into the hollow bank by the floods, I thought. But I dug into the bank after them, and found them thus filled in the bank a distance of over three feet; and in following these into the bank I ran across still others filled in in like manner, and lying parallel to the lines of the bank, where the flood never had touched them. Some of the roots were simply rotten wood inside of the bark, which was still fairly sound, for the bark is the last part to rot. Some root bark was filled with a mixture of sand and rotten wood. One was filled with rotten wood and a seam of sand shaped like a thick-backed knife blade lying lengthwise of the root, the back resting on the bottom, and the edge reaching to the top side of the hollow root bark. Since that time I have examined many roots along hillside exposures by the roadsides, and have found that the bark of the roots at a certain stage of decay will be filled with the same kind of earth in which the root lies. This would suggest that the sand or clay is carried into the hollow bark by insects. But I have found such root bark packed full of sand or clay where I thought it impossible for any insects large enough to handle such matter to get in, unless on leáving they sealed the hole so perfectly as to baffle observation. Last week I found one root bark about four feet long, the butt end filled with rotten wood and sandy clay about equally intermixed. The middle part was packed tight with sandy clay, and the top or smaller end was filled with damp rotten wood. In this case there was no noticeable insect pathway to the middle. I have dug trenches around old stumps and dead trees two to three feet deep to see what the old roots would show. Many showed at a distance of eight feet from the stump no traces of the roots whatsoever. In some I have found the common ants, and with them dark balls or lobes of mud about the shape of wheat grains, and a quarter to a third the size of the wheat. The teeth could plainly detect the grit in them.

Suppose the trees do not reform into clay and sand, and that the insects carry the sand and clay into the root bark and into the rotten logs and stumps. They can carry none but the finest material. The gravel would be left behind, and this alone would in time work the finer material to the top.

The crawfish is an industrious agent in wet lands in bringing up the lower earth to the surface. I have been examining their holes for the past six months, and in that time I have failed to find them bringing up any coarse material, though boring through the yellow into the glacial clay. I have so far found no gravel larger than bird shot in the cones which they build up about the top of their holes. The crawfish is a queer citizen. I can't understand him. I fail to see where he puts all the dirt that must come out of his hole. Last year I poured about a bushel of dry sand into one of his holes where many others were dug near by without filling it; yet the mud balls he had stacked up about the hole would not have filled my hat crown.

The ants too are known to bring a considerable quantity of earth from beneath to the surface in building their hills. Only a few days ago I was surveying in a five-acre cow pasture at Rosedale, a village in the south part of this county, and there I noticed that wherever the excrement of the cow was dropped, a bug which lays its eggs in a ball of the excrement and buries it in the ground, had carried up great quantities of fine earth from the excavations below. At a very recent one there was fully a gallon of fine earth piled up on the ground. This was on the second or terrace bottom of Raccoon creek, and over a gravelly subsoil.

On the insect hypothesis, there would of course be a limit to the thickness of each surface formation. Insects will dig no deeper than will serve their necessities. I have no reason to suppose they would go deeper than three feet; but I have often seen the yellow clay ten to twelve feet thick on the high ridges. This would require a deep digging insect, or else an accumulation from some source above the surface. The crawfish would dig deep enough, but he leaves the field when it becomes high and dry. Besides this, if the fine material had been taken out of the top of the glacial, gravelly clay, it would have left a stratum of clean gravel as far down as the fine material had been thus extracted, which we do not find to be the case here.

I notice in the second or terrace bottoms along the Wabash river in this vicinity a coat of fine sandy loam on top of the original gravel and sand, which latter was left by the Wabash when it carried ten thousand times as much water as it now does. There has never been any slack water over these terrace bottoms since the Wabash which made them dropped into its present limits. I shall some time try to prove what I here merely assert, to-wit: That the ancient water supply of the Wabash was suddenly cut off, and there was one last great flood, which left its natural marks, and there has never been another large enough to efface or even modify these marks. Therefore the loess covering of these terrace bottoms must have some other than an aquatic origin.

In the flat table lands of the Wabash country, where the rainfalls have lain on the ground till removed by evaporation, the surface clay has an ashen color. On the high ridges, and at the crests of hills or ravines in the flat wet lands before mentioned, the surface clay is yellow, or buff colored. In the terrace river and creek bottoms the color is generally ashen, and the material a sandy loam, with occasional spots of pure yellow clay.

If this loess is decomposed vegetable and animal matter, why does it assume so many shades of color, and varied coarseness or fineness of shades of sand grain, being buff colored on the high land, ashen on the flat and the terrace bottoms, black in the Illinois prairies, and Indiana swamps? I do not pretend to answer, "Sufficient unto the day is the evil thereof." Nor do I know why the first fifteen outside growths of a white oak (and varying numbers for other trees) are white and will decay in a short time after the tree is killed, and all the inner growths are red and will endure the weather many years after the white growths are gone; but it is a *fact.* Fifteen years from to-day, all the present white growths will be red and far more durable, and new white growths will have formed outside of them.

My observations have been confined to my own locality, and my deductions may be very wrong. I submit them for whatever they may be worth.

PLATE XXXVIII.

Cryptobranchus Alleghaniensis.

RECENT LITERATURE.

Cope's Batrachia of North America.[1]—This is an octavo of 515 pages, with eighty-one plates executed by phototype process, issued by the U. S. National Museum as its Bulletin No. 34. It is one of a series of monographs on North American Vertebrata projected by Professor Baird at the time of the establishment of the Museum of the Smithsonian Institution, which has since become the U. S. National Museum. The monographs of the Mammalia and Birds were published by Professor Baird himself, as Volumes VIII. and IX. of the Reports of Surveys for a Railroad to the Pacific Ocean. The preparation of those on the Reptilia and Batrachia were delegated to Professor Cope, and he has been for some years accumulating the material and observations which are described and recorded in the present volume. Although not published in the same form and style as the monographs of the Mammalia and Birds, the present volume will be welcome to students of the interesting forms of which it treats, and none the less on account of its convenient size. The large material of the National Museum has been thoroughly sifted, the characters of the species defined, and their varieties pointed out. In the latter regard the work will be found to be especially useful to students of specific variation, as numerous sub-species are defined, and their distinction from mere varieties dwelt on. The total number of species described is 107, which are referred to 31 genera. The species are distributed in their orders as follows: Proteida, 2; Urodela, 53; Trachystomata, 2; Salientia, 50.

Among the new species described may be mentioned *Batrachoseps caudatus,* a salamander with an excessively long tail, from Alaska; a species of the tropical genus Hypopachus (*H. cuneus*) from Southwest Texas, and a new Bufo (*B. aduncus*) from Northern Texas.

The organography is extensively described and figured, but only the osteology is very completely represented. This portion of the work is thorough, and includes many new observations, especially on the carpus, tarsus and hyoid apparatus. A figure of the skeleton of the larva of the *Chondrotus tenebrosus* of the streams of California and Oregon is given, and its remarkable characters are pointed out in the text. The remarkable hyoid of the *Chioglossa lusitanica* is described for the first time. We copy here the figure of the inferior view of the skeleton of the hellbender (*Cryptobranchus alleghaniensis*), and a view of the viscera of the *Siren lacertina* (Plates XXXVIII and XXXIX).

[1] The Batrachia of North America, by E. D. Cope: Bulletin of the U. S. National Museum, No. 34; Washington; issued July 15th, 1889.

The illustrations are, with a few exceptions, well executed, but the paper on which they are printed is poor. To this may be excepted two lithographs which close the series. The subject is not, however, so fully illustrated as its scope demands, as there should be plates of the principal features of every genus. This we do not find, although some of the genera, as Amblystoma, Hyla, Bufo, and Rana, may be excepted from this criticism. An especially valuable feature of the work to American students is the illustration of the osteology of genera exotic to North America. This feature, together with the exhaustive character of the systematic analysis, renders the book a manual of the class at large.

Frequent reference to the habits of the species is made. We make the following extracts descriptive of the ways of these often abundant denizens of our forests and swamps. Of the *Amblystoma tigrinum*, Prof. Cope remarks (p. 83):

"The larvæ of this species are exceedingly abundant in all still water in the Rocky Mountain region and the plains. They are rapacious, eating animal food, and taking the hook readily. Late in the summer they complete their metamorphoses and take to the land, where they hide in the holes of marmots, badgers, etc. From these they emerge during and after rains. The larvæ are much less frequently seen in the East, where the species is less abundant, and the opportunities of concealment are greater. Market Lake is a temporary body of water covering many square miles in Eastern Idaho. It is formed by the overflow of the Snake River in Spring. On its shores I have found this species. On the shore of an adjacent pond of more permanent character I have observed this species occupying vertical holes, which were kept filled with water by occasional waves, but from which their heads emerged into the air. In this position their branchiæ were gradually absorbed. An adult from New Jersey occupied a burrow in the soil of my fernery for several weeks. The burrow had two orifices, in one or the other of which its head could be generally seen, observing what was going on."

The larva of *Chondrotus tenebrosus* is thus described:

"The larva of this species frequently exceeds in dimensions that of any other species, and quite equals the adult. It is a uniform lead color, or sometimes blackish, and the muzzle is rather abruptly shortened. The tail has a fin at its extremity, which extends also well anteriorly on the superior edge. The digits are flattened, and their apices are protected in many specimens by a horny cap of a blackish color. This larva, however, differs from that of other species of the genus in other characters of more importance. First. There are no

PLATE XXXIX.

Siren lacertina.

teeth on the splenial bone. (I have not examined very small specimens.) Secondly. The branchiæ have a peculiar shape. There are no processes such as exist in all other Urodele larvæ, but the fimbriæ arise from the edges of the vertical laminæ which separate the pharyngeal fissures (Fig. 3, p. 3, No. 7). The superior part of the lamina is a little more produced than the inferior, so as to form in some specimens, on the third lamina, a short process. This type of external branchiæ does not resemble any of those of the perennibranchiate types, where there are always processes which are frequently furnished with more or less numerous rami. Thirdly. The teeth of the larva are stronger than in the adult. They are compressed, double-edged, and acute. Having thus a dagger-shape, they can inflict a severe bite.

"As they approach maturity, the marbled colors begin to appear. They can probably reproduce without undergoing a metamorphosis, since I have found eggs in the ovaries ready for deposit.

"I observed these larvæ in some tributaries of the McCloud River, near Baird, Cal. They swam with great rapidity, darting about and hiding themselves among the fallen leaves that covered the bottom. I took from the stomach of one of them a larva of its own species of one-third its size. They are common in the mountain streams of Northern California and Western Oregon. The skeleton of a large specimen from Salem, Oregon, is figured on Plates 20–21. The hyoid apparatus of a younger larva is represented on Pl. 22, Figs. 2–3."

Bufo lentiginosus americanus is thus noticed :

"Dwellers in the country are familiar with the voice of this species in the early Spring, which is the season of the deposit of eggs. These are laid inclosed in a long, thick-walled tube of transparent albumen, secreted by the walls of the oviducts. These tubes lie in long spiral strings on the bottoms of the ponds where they are deposited. The young hatch out early, and are of a darker color than those of others of our Salientia. They retain the dark color till near the time of the completion of the metamorphosis. This takes place at an earlier date than that of the Ranæ, and the completed young are scarcely as large as those of the Hylæ or of the Scaphiopus. The voice of this species may be heard well into the summer. It is a sonorous ur-r-r-r-r, which may be readily imitated by whistling while one utters a deep-toned vocal sound expressed in the above letters. Individuals differ in the pitch of their notes, but a chorus of them has a weird sound well befitting the generally remote spots where they congregate and the darkness of the hour. When not thus engaged, they often take up their abode beneath the doorstep of the farmer's house, and issue in the evening to secure their insect food. They progress by hops, and only walk on very rare occasions."

Of *Rana virescens* (*halecina*) it is said:

"This species is especially an inhabitant of swamps. It is found in great numbers in those that border the large creeks and rivers of the Atlantic coast, and is comparatively rare inland, where it gives place to other species. With the *Acris gryllus*, it is the first species heard in Spring, and although its voice is not loud, the noise produced by thousands of them is deafening when heard close at hand, and is transmitted through the atmosphere for many miles. It may be imitated by the syllables 'chock, chock, chock.' As a harbinger of Spring it is always welcome."

The habits of the *Hyla pickeringii* are thus described:

"This, our most abundant Eastern species [of Hyla], is much more generally known by its voice than appearance. After the rattling of the *Acris gryllus* in the marshes and river banks in the lowlands is fairly under way, during the first bright days of Spring, the shrill cry or whistle of this little creature begins to enliven the colder swamps and meadows of the hill country. Different individuals answer each other with differently toned voices of a single note. This is exceedingly shrill and loud; the muscular force employed in expelling the air from the lungs seems to collapse the animal's sides till they nearly meet, while the gular sac is distended with each expulsion to half the size of the head and body together. They are chiefly noisy in the end of the afternoon, but in shady situations or on dark days may be heard through the morning and noon. When the breeding season is over they may be still found, but with difficulty, among fallen leaves in low places, where their color admirably adapts them for concealment, or in cellars, or on the ground in the woods. Not till the near approach of Autumn do we have evidence of their ascent into the trees. Then, when the wind is casting the first frosted leaves to the ground, a whistle, weaker than the Spring cry, is heard, repeated at intervals during the day, from one part of the forest to another, bearing considerable resemblance to the note of the purple finch (*Carpodacus purpureus*), uttered as it is while flying. These voices are heard during the same season; that of the Hyla is distinguishable as slightly coarser, or more like a squeak. Both are associated with the weak chirp of the late *Dendrœca coronata*, as it gleans its insect food on its Southern flight. These are the latest sounds of Autumn, and soon disappear before the steady advance of the ice king."

A bibliography, from which we notice the omission of some titles, and a full index to both plates and text close the book.

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General Notes.

GEOGRAPHY AND TRAVEL.

America.—The Gran Chaco.—Capt. J. Page, of the Argentine Navy, has in the March issue of the Proc. Roy. Geog. Soc. described the Gran Chaco and its rivers, accompanying his description with a map. This tract of flat country, lying between the tropic and 29° S., extends eastward to the Parana and Paraguay, and westward to the province of Santiago del Estero. Its area is 180,000 sq. miles. About one-third belongs to Paraguay, and a small part to Bolivia, but the bulk is in the Argentine Republic. The Argentinian portion is divided into two governorships, the Chaco Central, between the Pilcomayo and the Bermejo, and the Chaco Austral. The latter has extensive primeval forests, and is watered by many small streams. Across the entire Chaco, between 61° and 62° W., extends a depression, causing the waters of that part to be discharged into streams that find their way into the large river by first flowing away from the sea. The Pilcomayo has dark or brownish water, and runs southeast, parallel to the Bermejo, at a distance of about 130 miles. It has never been ascended, and the section between 61° and 62° W. is quite unknown. Both the great rivers are obstructed by narrow argillaceous beds, quite removable, and by fallen trees of indestructible wood, which fall into the river beds through the eating away of the banks beneath them. Neither stream receives tributaries throughout the lower and longer part of its course, but the impermeability of the subsoil prevents undue absorption of the waters. At a spot close to 22° S. the Pilcomayo's main stream, after running due south, turns north, and then again southward, yet some minor branches flow tolerably straight on. It is here that the river has been lost to explorers. Capt. Page states that the expedition commanded by M. Thonar in no way elucidated the geography of the river.

The upper waters of the Pilcomayo are in Bolivia, and it passes through the province of Caiza, the Bolivian Chaco, after leaving the mountains and before reaching the Argentine territory. The Bermejo, so called from the red tint of its waters, is formed by the aggregation of a number of small streams rising in the hilly interior of Bolivia and Argentina, and at Oran, lat. 23° S., where it receives the Zenta, becomes a large river; a few miles below the San Francisco joins it, and from this point to its mouth, 900 miles, it receives no tributary of any importance. All changes in the course of the Bermejo and of the middle and lower sections of the Pilcomayo exhibit a tendency to swerve to the eastward. The most important alteration of recent years was that of the Bermejo, which in 1869–70 became deflected at 23° 40′ S. and 63° 35′ W. from its ancient bed, and did not find a new one until 1872, when the main body of waters took a parallel course to the north and east of the old bed, forming an island 200 miles long. The Gran Chaco is no desert, but a rich alluvial lowland, fitted for colonization, which is hindered by the want of knowledge of the rivers and their shiftings. The forests yield many valuable woods, among them the tatané (*Portiera hygrometrica*), the palo rosa, the *Cesalpinia melanocarpa*) the urendey, rurupay, and quebracho, three species of algarroba or Prosopis, and the palo santo or lignum-vitæ. There are also many native fruits of good quality. The Austral Chaco has been developed along the banks of the Parana, where many prosperous colonies exist, and there is a successful colony about 140 miles from the mouth of the Bermejo. There are not more than 30,000 Indians in the entire Chaco. In the discussion which followed Captain Page's description of the Gran Chaco, Colonel Church said that the rainfall of the Chaco, or forest region, was from November to May, and was a downpour of some eighty inches. The rainy season of the Pampas was not at the same time. During the rains there was at the head-waters of the Bermejo a lagoon forty leagues across. The Pilcomayo, at 180 leagues from its mouth, filtered through a sandy swamp 100 miles across, and its bed above this was a mass of sandbanks, falls, rapids and snags. The Gran Chaco was in flood-time almost a lake region, and the upper Paraguay became an inland ocean. This flood district extended northward to the falls of the Madeira, 11° S., and northwest across the Beni almost to Peru. In the Beni there was a lake of 20,000 square miles, two to seven feet deep. It had been calculated that the Bermejo annually delivered into the Paraguay 6,500,000 cubic yards of detritus. Under these circumstances, navigation of these rivers seemed almost impossible.

The Selkirk Range Glaciers.—An interesting account of explorations in the glacier regions of the Selkirk range, west of the Rocky mountain water-divide, on the Canadian and Pacific railway, is given by the Rev. W. S. Green in the March issue of the Royal Geographical Society's proceedings. Mammalian life seems to be particularly abundant in this range, and the strange habit of the Sewellel for gathering flowers and laying them bouquet-fashion, stems together, at the mouth of its burrow, is enlarged upon. The notes are accompanied by a map which shows the great Illecellewaet glacier, with its accompanying névé, the Lily glacier, and those of Sir Donald, Dawson, Deville and Geikie. Most of the glaciers are at heights of from 7500 to 8800 feet, while the mountains rise but to 10,645 (Sir Donald mountain) and 10,622 (Mount Bonney).

Colonel Labre's Travels.—Colonel Labre, in 1887, crossed overland from the india-rubber settlements on the Madre de Dios, to the nearest navigable point on the Aquiry tributary of the Purus, in order to ascertain whether there were facilities for the construction of a road, and eventually of a railroad, to supersede the present route down the Madeira, which is so arduous that it needs thirty-four days to pass 161 miles, between San Antonio and the mouth of the Beni. The distance from Novo York, on the Aquiry, to Amapo, on the Madre de Dios, was found to be ninety-three miles, with only two rivers to cross.

The Ibuxy tributary of the Purus had previously been explored by Colonel Labre. In the wet season this river is navigable from its mouth to the falls, 370 miles. Colonel Labre established two rubber stations, in 1884, at the mouth of the Curykethé, 200 miles from the Purus. Above the Curykethé the banks are higher and the ground more undulating than below. The colonel estimates the number of wild Indians living on this river and its affluents at 8000.

Africa.—Mr. Thomson's Travels in Morocco.—The January issue of The Proc. Roy. Geog. Soc. contains a map of South-Western Morocco, reduced from the field maps of Mr. Joseph Thomson, who spent a part of last year in its exploration. The object of Mr. Thomson's journey was not only to extend our knowledge of a country the greater part of which is unexplored, but also to trace the parent sources of the infant civilization of Central Soudan.

From Tangiers to the Wady Tensift, on the way to Mogador, the country is a gently undulating upraised sea-bed, nowhere rising above 500 feet, and crossed by only one stream, the Um-cr-Rbia. Trees are absent and population scant. At the Tensift the area affected by the rising of the Atlas is reached, and the Tertiary gives way to Cretaceous lime-stones and shales, covered with a forest of the oil-tree called the "Argan," which lives where the olive cannot grow. Farther on, in the province of Shiedma, a crust of cemented calcareous particles practically seals up the soil from the husbandman.

From Mogador our traveler, with a party of men, returned to Saffi, and thence crossed the country to Morocco. The first part of the journey was over the raised sea-bed of Abda, the second over a higher step of the plateau called Bled Hammel, or the Red Country. The district of Rahanma, farther on, is composed of serrated ranges of denuded hills running parallel to the Atlas. The city of Morocco is in a great plain—the dried-up bed of an ancient lake. The first excursion was to the picturesque town of Demnat, situated in a most charming valley. A continuous boss or dyke of basalt marks for many miles the merging of the mountains from the plains. From Demnat excursions were made to the wonderful natural bridge-aqueduct of Iminifiri, and to Tasimset, south-west of Demnat. The great arch at Iminifiri is not only used as a bridge, but a stream which forms a cascade on one side of the gorge passes over it from its source on the other. From an elevation of 6000 feet near Tasimset it was evident that Cretaceous rocks not only formed the lower ranges, but the central mass of the Atlas. From Sidi Rehal, between Demnat and Morocco, a start was made for the higher peaks. After passing through glens with cliffs of red clays, red sandstone was reached. The pass of Tizi-n-Teluet was crossed at a height of 8381 feet. Compelled to turn back by the Kaid of Glauwa, the party followed the foot of the range south-westward, and the ascent of the Tizi Nemiri (9962 feet) was successfully performed.

Mr. Thomson had orders both from the Sultan and from the local Kaids not to venture into the mountains, and these orders seem to have been motived by a very reasonable desire for his safety, the mountain districts being semi-independent, and the natives jealous of intruders. Mr. Thomson was stoned, and had several narrow escapes from being shot. After a failure to ascend the gorge of the Urika, the Reraya glen was climbed, and the summit of Tizi Likunipt (13,151 ft.) was reached. Still later the end of the Atlas range was turned by the valley of a tributary of the Sus, the mountains of metamorphic rock rising to 6000 feet on one side, while on the other the Mtuga and Haha plateau of red sandstone rose only to some hundred feet.

Mr. W. B. Harris' Travels in Morocco.—Mr. W. B. Harris (Proc. Roy. Geog. Soc., Jan. 1889) gives an account of his visit in disguise to Sheshuan, a town some 60 miles south of Tetuan. The inhabitants are nearly all "Shorfa" or descendants of the Prophet, and it is death for a Christian to be discovered within the walls. Sheshuan is a walled town with seven mosques and five gates, its houses are built around patios or courts and have red-tiled roofs, there is a solid masonry bridge, and civilization is higher than in many more accessible towns. Mr. Harris's escape was little short of miraculous, and was largely due to his faithful Arab boy. Sheshuan does not acknowledge the authority of the Sultan.

After his visit to Sheshuan, Mr. W. B. Harris traveled without disguise among the fanatical tribes of the north-west mountains of Morocco, without molestation, and with every possible care for his well-being. This immunity was, however, due to his acquaintance with H. H. Mulai Mohammed, the Sherif or religious chief of Wazan, whose authority is great among these tribes which do not acknowledge the sway of the Sultan. His account of his excursion, in the August issue of the Proc. Roy. Geog. Soc., is illustrated by a map, upon which the local distribution of these tribes is mapped, the authorities for correctness being not only Mr. Harris, but Mulai Mohammed himself. Round Tangier are the Al Fahs, further inland the three small tribes of Beni M'sor, Wad Dras, and Beni Dir. Beyond these the Beni Arros have some small cities on the upper mountains, which are all well wooded with wild olive and cork. Between Tituan and Sheshuan are the Beni Hamar near the coast, and the Ghamara, Beni Hassan, Riff, Beni Ghorfad, Sheshuan and Lakhamis. The Beni Hassan is the most powerful tribe named here, and the Riff are Berbers, not speaking Arabic. South of Fez are the Berber tribes of Beni M'Tir and Beni M'Gild, and west of it the Zarun and the Zimmuri. In the Zarun is the sacred town of Mulai Idris, and Mulai Yakub, famous throughout Morocco for the healing powers of its hot springs. Here also are remains of the Roman city Volubilis. North of Fez are the Beni M'squilda, the Beni Zaran, and the large and important tribe of the Beni M'sara. Mr. Harris discribes this tribe as being for the most part fair, with blue eyes and yellow beards, handsome and well-built. They told Mr. Harris that their objection to Christians was based on the fear that they were spies, and would some day come with an army to take the country, but that a friend of Mulai Mohammed was welcome. The hill tribes of this part of Morocco seldom marry according to the law, but kidnap girls, who have a good time, dressed in velvet and silks, and doing no work of any kind. These girls perform ballets, and uncover their faces, often remakably beautiful, even before strangers. In the wars which arise through this kidnapping the women take part. With Mulai Mohammed himself Mr. Harris visited Ajin in the Ghruneh country north of Wazan. The Helserif, Beni Isof, and Beni Udeh, are other tribes between Wazan and

Sheshuan. To a recent demand of the Sultan for payment of taxes the Beni M'sara replied that they would pay them in bullets made of pesetas if he would send his soldiers to collect them.

The French Slave Coast Possessions.—M. A. L. D'Albeca (*Revue de Géographie,* September, 1889) gives some precise information respecting the French establishments on the Gulf of Benin. These are, in French orthography, Ogoué, Grand-Popo, Agomé Séva, Togodon, Whydah and its dependencies, Kotonou and territory, Lake Denham, with its posts of Aouansori and Afotonou, the river Ouémé, the kingdom of Porto Novo, the river and factories of Addo; and are situated on the slave coast, between 0° 4′ W. and 0° 36′ E. lat. of Paris. The frontage is 150 kilometres, and the boundaries are the German settlement of Togo westward, and eastward the English settlement of Lagos. The ideal line of demarcation between Togo and these settlements is prolonged to 9° N. lat. Outlets for commerce are looked for towards the middle course of the Niger. The river Addo, navigable for 70 miles, divides the French possessions from Lagos. It is the natural way to Abeokuta and Oye, two populous native centres. Through the action of the *barré* or Guinea current, there has been thrown up a line of sandbanks of varying width, behind which extends a series of brackish lagoons. The factories are on this *cordon littoral.* The entire coast is an unbroken sandbank, with nothing to orient the mariner save coco trees and the low tower of the church of Agoué. North of Grand-Popo and Whydah is a series of terraces which terminate in a wall at some distance from the ocean. The lagoon of Agoué, running west to east, empties into that of Grand-Popo, at the confluence of the latter with the Agomé river. The last-named lagoon, after passing Grand-Popo, Hevé, Agogo, and other factories, empties itself into the sea by the Bouche du Roi, near Arihoué. The Aroh river becomes navigable before entering the Whydah lagoon, which now no longer communicates with Lake Denham. It now runs westward, receives the Aroh, and finally mixes its waters with those of the lagoon of Grand-Popo. The Ouemé forms the boundary between Porto Novo and Dahomey. The waters of this large river form Lake Denham, which communicates with the sea by the canal of Kotonou. The lagoon of Porto Novo communicates with Lake Denham, and is always navigable.

Europe.—Corsican Railways.—At the commencement of 1888, there was a department of France without a mile of railway in operation. The first lines, from Bastia to Corte, and from Casamozza to

Tallone, were opened on February 1. Yet Corsica has an area of 8747 square kilometres, and has been a part of France since 1769. Lack of means of communication has always hindered the development of this island; it has been difficult for the peasants to bring their produce into the towns. The topography of Corsica is peculiar. There are two systems of mountains: one, of granitic summits, rising to 2800 metres, and crossing the island transversely; the other, of stratified rocks, running north and south along the eastern coast. The streams which enter the sea on the western side, run at right angles to the coast, between high walls; those which flow eastward are among the mountains just mentioned, yet some unite to form the Golo and the Tavignano, the most important rivers of the island. Thus the basins are all independent, and hitherto there has been no force with power enough to link together the populations of the eastern and western coasts. The interior is a labyrinth of mountains. One climbs from village to village by *scale*, or ladder-like footpaths.

Eight national routes were planned, to surround the island and cross it diagonally; but only 403 kilometres of these roads are actually in good state. These roads were long ago found insufficient, and 440 kilometres were projected in 1878. The writer, M. Daniel Bellet, then describes the principal features along the two completed railways, and concludes by pointing out some of the advantages to commerce that will accrue from them.—*Revue de Géographie, June and July, 1889.*

Progress in Russian Geology.—A new sheet of the geological map of Russia covers the southern Urals. Contrary to current opinion, the great chain consists in its southern parts of a number of parallel chains, all running from southwest to northeast. The main water-parting is built up of granites, syenites and gneisses, considerably worn by denuding forces. Towards the east it has a steep slope, and its base disappears beneath the Tertiary, while toward the west it is overlaid by Devonian, Permian and Carboniferous, folded into parallel chains, rising more than 3300 feet above the sea. Farther west, the country is a plateau, built up of the nearly horizontal strata of a formation intermediate between the Permian and Carboniferous of Western Europe. Above this there are Triassic deposits.

M. Tchernysheff shows that the bituminous gray and dolomitic limestones of the Ural, once thought to be Silurian, and as a rule poor in fossils, are in truth lower Devonian. The same series of limestones, quartzites and shales, also arrayed in ridges running southwest to northeast, occurs in Siberia and Turkestan.

Another sheet of the map shows the region on the right bank of the lower Volga. Here upper Carboniferous strata occur only in the deeper ravines; the Cretaceous is represented by the Aptian and Neocomian of the lower Cretaceous, and by the Senomanian, Turonian and Senonian of the upper; but nearly the whole of the region is covered by Eocene clay and sands. Boulders are strewn over the surface in such a way as to cause Professor Sintsoff to conclude that the ice-sheet of Russia came down to the Volga under the fiftieth parallel.

Asia and Oceanica.—The Transcaspian Railway.—The Hon. G. Curzon, M. P., (Proc. Roy. Geog. Soc., May, 1889,) gives particulars of the history and construction of the great Transcaspian Railway, a train of which steamed, amid the roar of cannon and the playing of bands, into Samarkand on May 27, 1888. The road from Merv to the Oxus was made at the rate of from a mile to a mile and a-half a day. The average cost of construction, rolling stock and rails included, was £4500 per mile, but the cost on the spot did not exceed £2700. Most of the region traversed is flat as a billiard-table, and only three bridges: across the Tejmd, across the Murghab at Merv, and over the Amu Daria, were required in 900 miles. The chief difficulties arose from scarcity of water and superabundance of sand, and though the railway was built in spite of both, both will still be potent factors of expense and hindrance. Artesian wells were sunk, and failed; sea-water was distilled, but now water is taken to and fro in huge wooden vats attached to the trains, cisterns having been built wherever there is a natural supply. Most of the line is laid either on a solid argillaceous surface, with saline efflorescence on the top; or on a loose soil which nourishes camelthorn and other desert shrubs, and with irrigation would yield abundant crops. The shifting sands are limited to: (1) the first 30 miles from the Caspian; (2) the stretch between the Merv oasis and the Oxus, and (3) a narrow belt between the Oxus and Bokhara. Soaking the permanent way with sea-water, covering it with clay, driving light palisades into the tops of the dunes, and the planting of tamarisk, *Haloxylon ammodendron*, or saksau, etc., are among the means adopted to check the advance of this shifting sand over the line. All lighting is done with distilled petroleum. Daily trains run from the Caspian to the Oxus, twice a week beyond. Mr. Curzon then describes the principal points upon the railway, the course of which is, however, sufficiently familiar to the readers of the NATURALIST. He states that the crests, and even the valleys on the southern side of the crests, of the Persian border mountains that skirt 300 miles of the railway, are in Russian hands. The railway will doubtless ultimately be extended to Tashkent, the Russian capital of Central Asia, 190 miles northeast of Samarcand. According to General Aurankoff, the constructive engineer of the Trans-Caspian Railway, there is no reason why a considerable portion of Transcaspia cannot be reclaimed for agriculture. A broad belt of loess, interrupted with sands in a few places only, stretches from Kyzylarvat to Askabad along the foot of the Kopet-dagh, and further east along the Abrek. Chemical analysis proves it identical with that of China. The Turcomans, who are the worst of agriculturists, get at Merv a return of 170 to 1. The barkans or sandhills are naturally covered with vegetation, among which the saksau is the best plant, and this and other plants have increased rapidly near the railway since the prohibition to cut bushes within three miles of the line. At Merv, in the last three months of 1885 and the first four of 1886, sixty-five inches of rain, above the average of Great Britain, was recorded. But there are no summer rains, and thus irrigation is necessary, and with the Amu Daria at Chardjui 27 miles wide, and flowing 6½ miles an hour, an irrigation canal sems quite possible.

The D'Entrecasteaux Islands.—The Louisiade and D'Entrecasteaux islands form the subject of a long article in the Proc. Roy. Geog. Soc. for September of this year by B. H. Thomson. The natives of Rossel look like hybrids between Papuans and Solomon Islanders. Short, robust, and sooty brown, with wide nostrils, flat nose, and prognathous face, they seem to be in a low state of savagery. The men's dress consists of a single pandanus leaf secured round the waist by a cord of human hair. The women wear grass petticoats. The cartilage of the nose is bored, and that of the ear enlarged, but tattooing is not practised. Stone axes have been discarded for iron blades picked up from wrecks, and inserted in stone axe handles. The pig and the dingo are the only domestic animals. Rossel is well timbered, and mountainous, rich in plants, and surrounded by a barrier reef. Joannet is flat, with a semi-circle of hills on the southeast. St. Aignan contains more than 100 sq. miles, and is thickly peopled. It has a range 3500 feet high, and no barrier reef.

Normanby Island is an L-shaped range of mountains, not exceeding ten to twelve miles in width anywhere, and containing about 350 square miles. There is much schistose slate with quartz veins, and in the north there is limestone, basalt, and porphyry. The natives are characteristically Papuan in dress and person. This island is the eastern limit of the Wallaby, and also of the largest of the avian genus Manucodia. Ferguson Island, the largest of the D'Entrecasteaux, probably has 500 square miles, and its highest summit, Kilkerran, is 6000 feet. Goodenough Island has a range of mountains culminating in two peaks not less than 7000 feet high. The people proved quiet and friendly, and their houses, built on raised platforms, with curved roofs, and tapering from the end nearest the village square, are peculiar.

GEOLOGY AND PALÆONTOLOGY.

The American Association for the Advancement of Science.—Numerous valuable papers were contributed to the Geological Section (E) at the late meeting at Toronto. We are indebted to our correspondent, Prof. Joseph F. James, for the following notes on some of them.

Topographic Types of North-Eastern Iowa. By W. J. McGee.—This paper was illustrated by a relief map of the section treated of, which showed the different character of the drainage channels of the district. In the extreme northeast was the dendritic system. In the lower portion the most peculiar feature was that the streams, instead of following the valleys, followed the ridges, and in them had frequently carved deep cañons for themselves. The cause of this was that the glacial period had so filled the valleys with drift deposits that on the retiring of the ice the streams were compelled to seek new channels, and these were easiest found along the ridges.

Glacial Phenomena of Northern Indiana and North-eastern Illinois. By Frank Leverett.—The writer detailed his investigations in the region in question, and mentioned in particular the moraines which he had followed in their windings. He mentioned one moraine which was so obscured that it was only by careful barometeric measurement that its presence could be detected. A profile, however, showed plainly the morainic character, with a long, gradual slope on one side, aud an abrupt one on the opposite. The lobations of some of the moraines were described, and mention made of the very different directions from which the materials were derived, even within a small area.

"*The Attractive Scenery of Our Own Land,*" was the title of a paper by Prof. A. S. Bickmore. In this the author described the scenery of the Northern and Canadian Pacific railways, dwelling in particular upon the beauties of the peaks of the Rocky mountains, with their perpetual snows and living glaciers. He entered an earnest plea for the study of the scenery of this continent, as opposed to that of Europe. In the one case we have Nature in all her freshness, while in the other man's presence has thrown a glamor over the scene.

On certain remarkable new fossil plants from the Erian and Carboniferous, and affinities of the Palæozoic Gymnosperms. By Sir. Wm. Dawson.—This was an interesting paper, in the course of which the author reviewed the main features of living gymnospermous plants and mentioned their affinities with other classes. Mention was made of a remarkable fossil found by R. D. Lacoe, of Pittston, Pa., to which the name *Dictyocordaites Lacoeï* was given. The specimen in question showed certain features which had previously been supposed to belong to several distinct genera, and it was thus the means of uniting them under one name. Various other specimens were mentioned which seemed exactly intermediate between distinct genera. To one of these the name of *Tylodendron* was given. The existence in Palæozoic times of a large series of gymnospermous plants was dwelt upon, and the idea advanced that from the highly developed Gymnosperms of the Palæozoic were developed, on the one hand the Acrogens, and on the other the Phanerogams, while the predominant family of that early time has degenerated into the meagre representation of our modern cycads and conifers. Although not an avowed evolutionist, Sir William has put a powerful weapon into the hands of working biologists by his description of the new intermediate or generalized forms mentioned in his paper.

Mammoth Cave. By H. C. Hovey.—In this paper reference was made to the extent of the cavern, and to the fact that it is in several tiers or galleries, and that these have been cut through in places by the action of water. What appear pits at one level become domes in the one below. Mention was made of the discovery of several new pits, in the vicinity of what is commonly called the "Bottomless" pit. Some other name must be found for this, as its depth has been sounded, and is found to be ninety-five feet. Late explorations have revealed the fact that Scylla, Charybdis, the Bottomless, Covered, and four other pits, are all connected together at the bottom, and are there united into a large hall several hundred feet in length, to which the name of "Harrison's Hall" has been given. The paper was illustrated by a large map and several diagrams of special portions of the cave.

Section of Makoqueta Shales in Iowa. By Joseph F. James.—In this paper mention was made of the locality where the typical exposure is to be found. It is near Lattner's Post-Office, reached from Graf, a station on the Chicago, St. Paul and Kansas Citv railroad, sixteen miles west of Dubuque. Details of the section were given, and mention made of the fossils found in the shales. A species of Orthoceras is especially abundant, and remarkable for its wonderful state of preservation, many specimens retaining their original pearly nacre. Groptobites were also finely preserved, and very abundant in certain layers. The junction of the shales with the Galena below was mentioned as having been observed.

Geology of Borneo.—Dr. T. Posewitz has published the results of three years' personal explorations in Borneo, and in the second part of his work deals with the geological and physical structure of that large island. There is no uninterrupted central mountain chain, but isolated mountains surmount table-lands which extend northeast to southwest. As far as is known, the Kina Balu mountains, which have a maximum height of 13,698 feet, are the highest. The geological structure is simple. The isolated mountains are slate or schist, penetrated by granite and diorite. Succeeding these are Devonian strata with auriferous veins. Within the last few years Carboniferous strata (mountain limestone) have been found, and are believed to occupy a wide area in north Borneo; and Cretaceous rocks have been found in a single locality in west Borneo. The Tertiary is spread over wide areas, and forms the plateaus through and over which the mountains rise. The older Tertiary includes sandstone, marl and limestone, and the greater part of the coral deposits occur in the sandstone. The older Tertiary strata are often much disturbed and broken by intrusive masses of andesite. Oligocene strata are only known in East Borneo, and include extensive deposits of coal.

Diluvium spreads over wide undulating tracts around the Tertiary hills, and contains the principal sources of the gold and diamonds of the island. There are no evidences of any post-Tertiary volcanic energy.

Geology of Tasmania.—R. M. Johnson, F.L.S., has published a systematic account of the geology of Tasmania, with a sketch map on a scale of fifteen miles to the inch. The cldest formations are in the west and northeast, and consist of crystalline schists, apparently Archæan, with clay slates, quarzites, sand stones and limestones of Cambrian, Ordovician or Silurian age, with small and doubtful evidences of Devonian. Between the two are as ot older rocks a tract of great extent, in the centre of the island, is occupied by coal-bearing strata. The lower series of these contains plants of Carboniferous age, but the higher coal-measures yield many plants of Mesozoic affinities. These strata have been invaded by igneous intrusions, and are to a great extent covered by Tertiary beds.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—A new type of rock has been discovered by Mr. Arnold Hague[2] in the Absaroka Range, Wyoming Territory. It was found as a boulder in the gorge of the Ishawooa River. The most striking feature of the rock is the number and size of the grains of fresh olivine scattered through it, the only other macroscopical ingredient being augite. These two minerals lie in a ground-mass composed principally of *leucite* and orthoclase, together with a small amount of plagioclase, magnetite, apatite, and minute flakes of brown mica. The rock is particularly interesting as the third occurrence of a leucite rock in North America. The leucite is partly idiomorphic and partly allotriomorphic. Some of its crystals are isotropic, while others show optical anomalies. A number contain minute augite grains as inclusions, arranged centrally or in a spherical zone about the centre of the crystal. An analysis of the rock reveals a very low percentage of potassium, a percentage so low as to suggest the existence of such conditions during the solidification of the rock as to allow of crystallization in two very distinct stages. The analysis was made by Mr. Whitfield.

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	Cl	P_2O_5	H_2O
47.28	.88	11.56	3.52	5.71	.13	9.20	13.17	2.73	2.17	.18	.59	2.96

——Two new localities for camptonite have been reported from the New England States within the past summer. The first is near Whitehall, Washington Co., N. Y., where Messrs. Kemp and Marsters[3] discovered dykes cutting the Georgia slates. In addition to the usual features of

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]*Amer. Jour. Sci.*, July, 1889, p. 43.

[3]*American Geologist*, Aug. 1889, p. 97.

camptonite, the rock from this locality possesses porphyritic zonal augites with inclusions of brown hornblende crystals, similar to those constituting the most abundant constituent of the rock. The rock also possesses amygdaloidal cavities filled with calcite. The second locality is made known by Mr. F. L. Nason.[4] It is a rock-cut on the Rutland and Burlington R. R. near Summit, Vt. The rock is almost identical in appearance with dyke No. 2, of Dr. Hawes.[5]——Prof. F. D. Chester[6] regards the serpentine of Chester Co., Pa., as having been derived from a bronzite-diallage rock through the alteration of the bronzite to tremolite, upon its contact with a dark green hornblende. The original rock is of a slightly fibrous character, composed of a ground-mass of green hornblende, diallage, a little olivine and magnetite, in which are phenocrysts of bronzite prismatically elongated. This hornblende surrounds and includes the bronzite. In both minerals, as alteration has proceeded, the original characteristics gradually disappear, and in their place appear those of tremolite. Enstatite-gabbros and gabbro-diorites are also described. The latter rock is thought to owe its origin to the dynamic metamorphism[7] of the former. ——The rock occurring in eruptive bosses in northwestern New Jersey has been examined by Mr. Kemp[8] and found to correspond with Rosenbusch's biotite-augite-porphyrites. The plagioclastic ingredient is probably near anorthite in composition. The composition of the biotite is:

SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Loss..
34.61	15.74	8.52	tr.	20.03	17.14	tr.	2.8

Apatite is a very abundant constituent of all specimens.——The staurolite of a staurolite-mica-schist in the neighborhood of a mass of granitite, lying to the north of Saint-Étienne, France, is thought by Ternier[9] to be older than the metamorphic minerals found in the same rock. He believes it to be original, and in no way connected with the presence of the plutonic rock in its vicinity. Tourmaline in the same rock owes its presence to the influence of the granitite.

Mineralogical News.—Becker[10] proposes to simplify the view held as to the relations existing between the silicic acids found in

[4] *Amer. Jour. Sci.*, Sept. 1889. p. 229.
[5] Ib. CXVII, p. 147.
[6] 2d. Geol. Survey of Penna., Annual Rep. for 1887, p. 93.
[7] cf. AMER. NATURALIST, Dec. 1886, p. 1049.
[8] *Amer. Jour. Sci.*, Aug. 1889, p. 130.
[9] Bull. Soc. Franç. d. Min., XII., p. 393.
[10] *Amer. Jour. Sci.*, Aug. 1889, p. 154.

silicates, by regarding meta-silicic acid as as a union of ortho- and poly-silicic acids ($H_4SiO_4 + H_4Si_3O_8 = 4H_2SiO_3$), and di-silicic acid as a poly-silicic acid from which ortho-silicic acid has been separated ($3H_4Si_3O_8 - H_4SiO_4 = 4H_2Si_2O_5$). The advantages of this view, as suggested by the author, are found in the discussion of the decomposition of natural silicates, and in the study of isomorphism in long series of isomorphous substances like the feldspars, and in the di-morphism of many groups of silicates. The amphiboloids, for instance, being meta-silicates, their dimorphism may be explained by supposing the base in the one case to replace the hydrogen in the ortho-acid, while in the other it may be supposed to be united with the residue of the poly-acid. According to this view all silicates may be regarded as salts of ortho- or of poly-silicic acids or their combinations.——The iron sulphates of Chili are at present the subject of careful work by chemists in this country and abroad. The investigations of Frenzel[11] and G. Linck[12] have already been noticed. Recently Mackintosh[13] has published notes and analyses of ***coquimbite***, ***copiapite***, ***roemerite***, ***amarantite***, and a few other substances with apparently definite compositions. A pulverulent flaky orange-colored substance associated with copiapite and amarantite has a composition corresponding to $(FeO)Fe.(SO_4)_2 + 4H_2O$. White pulverulent decomposition products of the above mentioned minerals are basic iron sulphates and combinations of ferrous sulphate with the corresponding sodium compound. Among the minerals described by the author is one to which he has given the name ***ferronatrite***. This mineral occurs in stellate groups of a pale green color, forming nearly spherical nodules, like wavellite. It is soluble in water, and has the composition:

SO_3	Fe_2O_3	Al_2O_3	Na_2O	K_2O	SiO_2	H_2O
50.25	17.23	.43	18.34	.40	2.00	11.14

corresponding to $Na_3Fe(So_4)_3 + 3H_2O$. —— In the Archæan limestone of Macomb, St. Lawrence Co., N. Y., Mr. Kunz[14] has discovered a cave whose walls are lined with crystals of sea-green ***fluorite***, forming groups weighing from ten to several hundred pounds. Attached to the fluorite are small masses of ***lithomarge***, and imbedded in these are very perfect tetrahedral crystals of ***chalcopyrite***. A water-worn fragment of ***fire-opal*** is mentioned by the same author as having been

[11] cf. AMER. NATURALIST, 1888, p. 1022.

[12]

[13] *Amer. Jour. Sci.*, Sept. 1889, p. 242.

[14] *Amer. Jour. Sci.*, July 1889, p. 73.

found in Crook Co., Oregon, and a *diamond* in Russell Co., Ky. The diamond weighs 7-16 carats. It was found on the top of a gravel hill, and is an elongated hexoctahedron, with rounded faces.—Almost all *epidote* crystals, as is well known, are elongated in the direction of their ortho-axes. Dr. Bodewig,[15] in America, and Artini, in Italy, have recently described crystals with a normal development, *i.e.*, with a prismatic habit, with the long direction parallel to the vertical axis. The American mineral was bought at the foot of Pike's Peak. The European specimen came from Elba.——Crystals of the hyacinth variety of *quartz*,[16] occurring in the saliferous clays in the Basses-Pyrénées district of France, contain numerous inclusions of *anhydrite* arranged zonally.——Both Rammelsberg[17] and Meyer[18] have concluded, as the result of independent chemical examination, that the substance described as *jadeite* by Fellenberg[19] is nothing more than *vesuvianite*.——As the result of a recalculation of the analyses found scattered through the literature of the natural sodium carbonates, and the light thrown upon these by some new analyses of salts produced by the solar evaporation of the waters of Owens Lake, Cal., Dr. Chatard[20] concludes that the substance known as *trona* ($Na_2CO_3 + 2\ NaHCO_3 + 3\ H_2O$) does not exist, either as a mineral or as an artificial compound, whereas all the published analyses of the natural carbonate, as well as those of the compound produced by artificial evaporation of mixed solutions of the carbonates, yield figures that correspond very closely with the composition of *urao*, a mineral described by Faxar,[21] and by Boussingault,[22] from Venezuela.——Bücking[23] has made a very thorough examination of the *glaserite*, *blödite* (*astrakanite*), *kainite*, and *boracite* crystals from the salt beds at Douglasshall, near Westeregeln, in the Stassfurt salt regions. The glaserite is in small, nearly colorless crystals, with a hardness of 2.75-3, and a specific gravity 2.632–2.656. They crystallize in the hexagonal system, with $a : c = 1 : 1.2879$, and usually have a rhombohedral symmetry, although individuals with an orthorhombic symmetry are not rare. Their refraction is positive with $\omega = 1.4907$ and $\varepsilon = 1.4993$. Its composition corresponds approximately to the formula $3K_2SO_4 + Na_2SO_4$. The kainite is also in small crystals, with

[15] *Amer. Jour. Sci.*, Aug. 1889, p. 164.
[16] Beaugey: Bull. de la Soc. Franç. de Min., XII., p. 396.
[17] *Neues Jahrbuch für Mineralogie, etc.*, 1889, I., p. 229.
[18] Ib. 1889, I., p. 270.
[19] cf. AMER. NATURALIST. March, 1889, p. 158.
[20] *Amer. Jour. Sci.*, July, 1889, p. 59.
[21] *Annals de Chemie*, II., II., p. 432.
[22] Ib. II., xxix., p. 110.
[23] *Zeits. für Kryst.*, xv., 6., p. 561.

a cleavage parallel to $\infty \bar{P}\bar{\infty}$. The axial ratio is $a : b : c = 1.2138 : 1 : 5862$. $\beta = 85°$. The boracite is found in carnallite layers. It occurs in small colorless or light green crystals that are combinations of the cube and tetrahedron, with occasionally dodecahedral and other faces. The new planes

$$\infty O 4, \left(\frac{4O}{2}\right), -\left(\frac{\infty O}{2}\right) \text{ and } -\left(\frac{16 O}{2}\right)$$

were observed.

Rare Minerals.—*Mazapilite*, described by Dr. König,[24] proves[25] to be a calcium-iron arseniate, with the composition:

As_2O_5	Sb_2O_5	P_2O_5	Fe_2O_3	CaO	H_2O
43.60	.25	.14	30.53	14.82	9.83.

It crystallizes in the orthorhombic system, has a prismatic habit, and a specific gravity of 3.582.——*Uraninite.*—In a preliminary notice, Mr. Hillebrand[26] announces the presence of nitrogen in uraninite, in such combination as to yield the free gas upon treatment with an acid. He adds also that all specimens of this mineral examined, with the exception of one from Bohemia, are found to contain thoria or zirconia.——*Plattnerite*, the rare lead di-oxide, is described by Wheeler,[27] and by Messrs. J. D. and E. N. Hawkins[28] as occurring in a lead mine in Shoshone county, Idaho. The specimens examined are black. They have a hardness of 5–5.5, and a fusibility of 2. Analyses show that the mineral contains between 91 and 96.63 per cent. of PbO_2.——*Gyrolite* occurs as a colorless, fibrous layer lining the walls of an apophyllite vein at the New Almaden Quicksilver Mine, in California. Its composition, as determined by Prof. Clarke,[29] is:

SiO_2	Al_2O_3. Fe_2O_3	CaO	K_2O	Na_2O	F	H_2O
52.54	.71	29.97	1.56	.27	.65	14.60

[24] Amer. Naturalist, Feb., 1889, p. 173.

[25] Proc. Acad. Nat. Sci., Phila., 45., 1888–9.

[26] *Amer. Jour. Sci.*, Oct., 1889, p. 329.

[27] *Amer. Jour. Sci.*, July, 1889, p. 79;

[28] ib., Aug., 1889, p. 165.

[29] *Amer. Jour. Sci.*, Aug., 1889, p. 128.

BOTANY.

Botany at the A. A. A. S.—The recent meeting of the American Association for the Advancement of Science, was notable in the activity of the botanical part of the section of Biology. The attendance of working botanists was unusually large, although the faces of many well known men were missed in the meetings. Among those present may be mentioned: Professor J. C. Arthur, of Purdue University; Dr. T. F. Allen, of New York City; Professor T. J. Burrill, of the University of Illinois; Professor W. J. Beal, of the Michigan Agricultural College; Professor N. L. Britton, of Columbia College; Professor D. H. Campbell, of the University of Indiana; David F. Day, of Buffalo; Professor W. M. Dudley, of Cornell University; Professor G. L. Goodale, of Harvard University; B. T. Galloway, of the Botanical Division of the U. S. Department of Agriculture; Professor B. D. Halsted, of Rutgers College; Professor J. F. James, of the U. S. Geological Survey; Professor W. R. Lazenby, of the University of Ohio; Thomas Meehan, of Germantown, Pa.; John Macoun, of the Canadian Geological Survey; Professor T. H. McBride, of the University of Iowa; and Professor F. L. Scribner, of the University of Tennessee.

In the meeting of the Society for the Promotion of Agricultural Science, which preceded the meeting of the Association, several papers were read upon botanical subjects, as follows:

J. C. Arthur.—What is Common Wheat Rust?

W. J. Beal.—A Study of Birdseye Maple.

C. E. Bessey.—The Grass Problem in Nebraska.

T. J. Burrill.—A Bacterial Disease of Indian Corn.

B. D. Halsted.—The Cranberry Gall Fungus.

B. D. Halsted.—Our Worst Weeds.

The Botanical Club of the Association, under the management of its Chairman, Professor Burrill, and Secretary, Professor Campbell, held meetings every morning, at nine o'clock, in the room assigned to Section F, and took part in a most enjoyable excursion, on Thursday, to Scarborough Heights, on the shore of Lake Ontario, in quest of rare specimens.

In the sessions notelets were read upon The Fertilization of *Hypericum canadense*, and The Cleistogamy of *Cerastium nutans*, by Thomas Meehan; The Pollen of *Pontederia cordata*, and The Explosive pods of the Wild Bean, by B. D. Halsted; Certain Additions to the North

American Flora, The Occurrence of a Siberian Labiate (*Elsholtzia cruciata*) in Canada, a notice of Dr. Morong's South American Work, and a description of a new genus of Vacciniaceæ from Brazil (Rusbya), by N. L. Britton; The Work of the Botanical Division of the U. S. Department of Agriculture, by F. V. Coville; On the Occurrence of Chlorophyll, in the Embryo of *Celastrus scandens*, Studies in Nuclear Division and The Culture of Aquatics in the Laboratory, by D. H. Campbell; The Management of a South Exposure for the Laboratory, by J. C. Arthur. The veteran Canadian collector, John Macoun, discussed methods of work in the field, in which he stated that he had long since abandoned the use of the tin collecting box, using instead a portable press supplied with strong straps, and into this he places his specimens at once as found.

Dr. N. L. Britton was elected President for the ensuing year, Professor F. L. Scribner, Vice-President, and Professor Charles R. Barnes, of Madison, Wis., Secretary.

At the close of the meeting resolutions were adopted urging the governing body of the University of Toronto to favor the plans of Professor Wright for the establishment of a Botanic Garden upon the University grounds.

In the meetings of Section F, the best paper was the address by Vice-President Goodale, in which he gave a summary of the recent advances in our knowledge of protoplasm and the anatomy of the vegetable cell. This address created much enthusiasm, and gave strength to the movement which finally resulted in the election of Dr. Goodale to the presidency of the Association.

Of strictly botanical papers read in the daily sessions there were twenty, as follows:

J. C. Arthur.—"A Bacterial Disease of Carnations," in which the author announced the discovery of a new micrococcus which produces one of the common diseases of carnations.

W. J. Beal.—"Notes on Seedlings of *Elymus virginicus*," noting the fact that glaucousness appears to be hereditary in this species.

W. J. Beal.—"Notes on Bird's-Eye Maple," illustrated by specimens, reaching the conclusion that the "bird's-eye" structure is due to some previous injury.

N. L. Britton.—"On the Genus Eleocharis in America," "On the Tropical Distribution of Certain Sedges," "On the Flora of New Jersey," "The New Botanical Laboratory of Barnard College."

T. J. Burrill.—"A Bacterial Disease of Indian Corn." The affected plants are smaller, yellow and slender. The bacteria are slightly elongated, usually paired, and take a marked polar stain, with a broad hyaline equatorial belt.

T. J. BURRILL.—"Fermentation of Ensilage." This appears to be due to *Bacillus butyricum*, a motile bacterium, which is capable of reproducing rapidly in the high temperature of the silo.

F. V. COVILLE.—"Revision of the United States Species of Fuirena."

DAVID E. DAY.—"An Observation on *Calamintha nuttallii*," noting certain suggestive variations, or reversions.

WM. R. DUDLEY.—"A Suggestion concerning Scientific Work," urging that attention be given to the study of the Fresh-water algæ, which possesses economic as well as scientific interest.

G. L. GOODALE.—"On a Convenient Method of Subjecting Living Cells to Coloring Agents."

B. D. HALSTED.—"Reserve Food-substances in Twigs," showing by means of drawings the distribution of the starch in twigs of various kinds.

B. D. HALSTED.—"Notes upon Stamens of Solanaceæ."

THOMAS MEEHAN.—"On the Position of the Nectar Glands in Echinops," "On the Epigynous Gland in Diervilla, and the Genesis of Lonicera and Diervilla," "On the Assumption of Floral Characters by axial growths in *Andromeda catesbæi*," "On the Significance of Diœcism as illustrated by Pycnanthemum."

F. L. SCRIBNER.—"The Grasses of Roan Mountain."

In the foregoing list it is impossible to give the substance of the papers without taking more space than we have at our command. This general remark can be justly made, that while there were a number of first-class papers, there were far too many short notes and isolated observations, which ought to have appeared in the Botanical Club, rather than in the Biological Section of the Association.

In order to secure, if possible, a higher grade of papers, the following resolutions were adopted:

Resolved, That one of the topics for discussion by Section F, at the meeting in 1890, shall be "The Geographical Distribution of North American Plants."

Resolved, That the following appointments be made of members of Section F, who shall be requested to prepare papers upon special parts of the general topic of the Geographical Distribution of North American Plants, viz.:

SERENO WATSON.—"The Relation of the Mexican Flora to that of the United States."

John Macoun.—"The Ligneous Plants of the Dominion of Canada."

John M. Coulter.—"The Distribution of North American Umbelliferæ."

L. M. Underwood.—"The Distribution of North American Hepaticæ."

B. D. Halsted.—"The Migration of Weeds."

N. L. Britton.—"The General Distribution of North American Plants."

The present secretary of the section is requested to give formal notification of the persons named, and the secretary of the section for 1890 is hereby requested to give such attention to this matter as may be necessary to perfect the proposed programme by correspondence, and through the circulars of the permanent secretary of the Association.

The next meeting will be held in Indianapolis, beginning August 21.

Charles E. Bessey.

ZOÖLOGY.

The Doctrine of Phagocytes.—The interest excited by the ingenious hypothesis of Metschnikoff is shown by the number of experiments made and the articles written in support or contradiction of the assumption that the mesodermal cells of the Vertebrata inherit the capacity of absorbing and destroying pathogenic bacteria from their ancestors, the unicellular Amœbæ, the mesodermic cells of Cœlenterata, Turbellaria, etc. The summary of Dr. H. Bitter's recent critique of the evidence *pro* and *con* is thus presented by the *Journal of the Royal Microscopical Society*.

Unicellular lower animals, amœbæ, and also the mesodermic cells of sponges, take up small plants into their protoplasm, and digest them. In more highly organized animals this intracellular digestion becomes extracellular and fermentative; certain cells, however, still possess a capacity for picking up and dissolving foreign bodies. This contrivance is regarded by Metschnikoff as a special arrangement whereby harmful elements, especially pathogenic organisms, are prevented from penetrating the animal economy, the process being complicated by the resistance made by the parasite to digestion. Those cells which are able to digest foreign bodies are called phagocytes, and are farther subdivided into large and small. Infectious diseases are recovered from when the phagocytes overmaster the exciting causes, and immunity after one attack or after inoculation depends on the phagocytes having become accustomed to combat the micro-organism.

This theory is supported by Metschnikoff's observations on Daphniæ which are attacked by a Torula with needle-like ascospores. These latter having been swallowed penetrate the tissues; as soon as this happens a leucocyte appears, and the spores are enveloped and destroyed. If the spore remain unattached and germinate the animal is infected. In frogs, too, anthrax bacilli are taken up by leucocytes and destroyed. At a temperature of about 30° Cent. only a few leucocytes take up the bacilli, and the animals become infected. This is explained on the hypothesis that the anthrax bacilli are more potent at this temperature, owing to their being accustomed to dealing with warm-blooded leucocytes [in the sheep]. In warm-blooded animals Metschnikoff rarely found bacilli in the leucocytes, but if the animals had been protected by a weakened virus the bacilli were picked up in quantities and destroyed. Hence it is concluded that immunity is derived from the leucocytes having got used to the poison of the bacteria.

Bacteria-eating phagocytes were also found in erysipelas and relapsing fever, and are also assumed to be present in gonorrhœa, leprosy, and tuberculosis.

According to Hess, the phagocytic privilege is shared by the cells of the splenic parenchyma, and of the liver, and Ribbert asserts that the spores of various kinds of Aspergillus and Mucor are got rid of in a similar manner. If, however, many spores be injected, the number of leucocytes may not suffice to prevent their development, and this last-mentioned author also believes that the viability of the fungi is diminished by the leucocytes cutting off the supply of oxygen. Other facts in support of the theory are, that if an animal survive the introduction of a small quantity of spores, there will be found, on a second injection, a much larger number of leucocytes, and that, as stated by Lubarsch, anthrax bacilli killed by boiling are not so quickly taken up by leucocytes in the frog as when injected in the living condition.

Against the theory are ranged numerous writers and experimenters, among whom may be mentioned Baumgarten and Weigert, who, while accepting the data, doubt the interpretation of the facts and the correctness of the hypothesis. Experiments made by C. D. Holmfield showed that only a few bacteria were taken up by leucocytes, and that the greater number of bacteria were destroyed outside the cells.

Emmerich gives similar results; thus after inoculating rabbits with erysipelas he found that this conferred a certain immunity against subsequent inoculation with anthrax, and also that the destruction of the bacteria was chiefly extracellular, and that the phagocytes made away chiefly with the dead bacilli. Again it is noticed by the author (H. Bitter) that in none of Metschnikoff's works, nor in those of other writers, is it certainly proved that the bacteria are destroyed by phagocytes, and by these alone, and in conjunction with Nuttall he has proved this experimentally.

With regard to Metschnikoff's experiments on frogs at high temperatures, it is obvious that the fluids of the body may become so altered by the increased heat that this fluid is thereby no longer able to weaken the bacteria.

Moreover, a series of observations has shown that anthrax bacilli have always suffered some damage before they became a sacrifice to the phagocytes. On the whole the author inclines to bring in a verdict of not proven.

Physalia in the Bay of Fundy.—In the published lists of Medusæ from Grand Manan, there is no mention of the well-known Portuguese-Man-of-War, *Physalia arethusa*. I am unaware that it has ever been taken from the Bay of Fundy, and up to last summer it was unknown to the fishermen who work in these waters.

During the last summer (August, 1889) several specimens of this interesting Gulf Stream jelly-fish were taken off Grand Manan and brought to me for study. I have also learned that many others have been seen in different parts of the Bay. This unusual appearance of these visitors from the tropics is connected with the great abundance of these animals all along the New England coast during the past summer. Its presence at Grand Manan, where the pelagic fauna is decidedly Arctic, is an interesting fact, as showing how far it may straggle from waters more congenial to its life. In this connection it may not be out of place to mention the fact that these Physaliæ were taken near the "Ripplings," tide eddies several miles off the west coast of Grand Manan, in which is collected at certain times of the tides a most wonderful abundance of free-swimming life. These eddies, which are feeding grounds for many of the larger marine animals, are peopled by a rich variety of marine life of all kinds, brought into its vortices by the extraordinary tides for which the Bay of Fundy is famous.—J. WALTER FEWKES.

Myxine: a Protandric Hermaphrodite.—True males are extremely rare in Myxine. Out of several hundred specimens examined, I have recognized only very few males, and even those were unripe. The male organs are usually easy to distinguish from the ovaries; they are generally lobate, have a milky whitish color—especially in somewhat mature state—whilst the ovaries are more translucent. Small nodules are visible in both, but the nodules of the testes (*i.e.*, the sperma-follicles) are smaller and whiter than the nodules of the ovaries (*i.e.*, the young ova). In quite an early stage there is, however, little difference between testes and ovaries: they have the same translucent appearance, and are developed only on the right side of the straight intestine. As stated by previous authors, the testis as well as the ovary is secured by a membrane (mesorchium mesoarium) to the mesentery at the point where it is fastened to the intestine.

The minute structure of the male organs will subsequently be described, but we will first examine their occurrence and extension. A feature which attracted my attention on the first superficial examination of the testes of the few true males I had been able to recognize was, that the testes were usually much more developed and prominent at their posterior than at their anterior end. The reason of that I could for some time not discover; it will subsequently be seen that I have, perhaps, traced the cause.

But why do the males occur so extremely seldom? Before we attempt to solve this question, let us discuss the generative organs of the large number of Myxine which were recognized not to be true males. On opening large specimens of Myxine, we generally find well developed ova in their sexual organs. If we, however, take smaller specimens of 28 to 32 cm. in length, and examine their sexual organs, we generally find that the anterior portion is but slightly prominent, and contains very small and young ova, whilst the posterior portion is often very broad and prominent, is lobate, and has a distinct whitish color along its margin, and has, in all respects, the appearance we would expect to find in a testis; and this it really is. If we take a piece of the margin of this portion of the generative organ, tease it, and examine it in the fresh state under the microscope, we generally find abundance of spermatozoa in various stages of development There can thus be no doubt then that that portion of the generative organ is a real male organ. It is, indeed, strange that Cunningham has so little succeeded in finding spermataozoa. Those young specimens of 28–32 cm. in length are consequently hermaphrodites, with quite immature ovaries but well developed testes, and they must be able to perform male functions.

If we now examine, somewhat more minutely, the generative organ of the large specimens, which generally contains a number of large and well-developed ova, we find that those ova occur only in the anterior portion of the generative organ, and that the mesoarium of this portion is very broad and prominent, whilst the membrane corresponding to the mesoarium of the posterior part of the generative organ is very narrow, and carries no reproductive elements, neither ova nor spermatozoa.

If we examine specimens of Myxine, of sizes between that of these large females and that of the hermaphrodite previously mentioned, we will often find specimens in which the anterior portion of the generative organ is rather prominent, and contains oblong young ova, whilst the posterior portion is of testicular nature and not very prominent. These specimens seem, consequently, to be in a transitory state between male and female states. Indeed, on examining a sufficient number of specimens, we will easily be able to find every transition stage from hermaphrodite males to fully developed females; and the rule seems to be that the larger the specimen is, the more are the female organs developed, and the more do the male organs disappear.

From what has been stated above, we seem already entitled to conclude, that Myxine is generally or always (?) in its young state a male; whilst at a more advanced age it becomes transformed into a female. Indeed, I have not yet found a single female that did not show traces of the early male stage.

Upon the whole, it must be admitted that there is a strange irregularity in the occurrence and extension of the male and female organs in Myxine. Myxine seems to me to be an animal which, in sexual respects, is just at present in a transition stage; from what and to what it is, however, not easy to say. It seems still to be seeking, without yet reaching, that mode of reproduction which is most profitable for it in the struggle for existence.—FRIDTJOF NANSEN, *in Bergen's Museums Aarsberetning for 1888.*

Birds Killed by Electric Lights at Girard College, Philadelphia.—During the spring and fall migrations of birds many dead birds are seen near the electric towers in the grounds. In the last three weeks quite a number have been found, though not so many as last year, when a whole flock struck the electric tower at Ridge and South College avenue, in their migration to their winter quarters to the South.

It is now an established fact that most birds migrate at night, and during a dark stormy one they are more likely to be attracted by the electric light.

Among those dead or crippled were the Whip-poor-Will, *Caprimulgus vociferus* (a very rare bird with us), pewee fly catcher, *Sayornis fuscus*, American robin, *Turdus migratorius*, Maryland yellow-throat, ground warbler, *Trichas marylandica*, brown tree creeper, *Certhia familiaris*, wood thrush, *Turdus mustelinus*, white-breasted nut-hatch, *Sitta carolinensis*, hermit thrush, *Turdus solitarius*, song finch, *Melospiza melodia*, sometimes called song-sparrow.

Many woodpeckers and tree creepers are in the grounds at present, more than were ever noted before.

The downy woodpecker is busy at work making his ring of holes around the *Ulmus ruba*, red elm. The tree creepers have been his faithful assistants, though not having the power to make the holes he does. Both, no doubt, have done much good in ridding the grounds of the eggs and larva of worms that feed on the trees.

The barn owl, *Strix americana*, has put in an appearance this fall (a whole family of them). They are rare in Girard College grounds.

Quite a number of kinglets and viroes, or greenlets, were seen, but they were too shy to be approached, so they could not be named.

The Towhe ground-finch, *Pipilo erythropthalmus*, has also paid us his visit and departed. By the length of his name he might have paid us a longer one.

The fox-colored finch, *Passerella iliaca*, and many other birds of all the species above spoken of as killed, were also seen flying around, except the Whip-poor-Will.—F. H. DANENHOUR.

Zoological News.—Cœlenterata.—The greater portion of Vol. XXXI. of the Challenger Reports is occupied by E. P. Wright's and Th. Studer's account of the Alcyonaria, the Pennatulacea excepted. This report extends to 386 pages and 49 lithographic plates. All the Alcyonaria save the small family Haimeidæ, which may be primitive, tend to produce colonies by gemmæ. The Gorgonacea, in which a large number of individuals are so distributed that each receives an equal share of the nutritive supply, and favored also with a supporting skeleton, are regarded as the highest of the class.

Vermes.—*The Archiv für Naturgeschichte* for 1887, issued August 1886 (1 Band, 2 Heft) has a notice upon the fauna of Spitzbergen by Dr. W. Kükenthal, giving the results of a voyage undertaken in 1886. The work of description is divided between Dr. Marenzeller, who takes the annelida; Dr. E. Meyer, the terebellina; Dr. Trautzsch, the polynoidæ; Dr. Kükenthal, the opheliidæ; Dr. Cobb, who describes the parasitic nematodes; Dr. Vosseler, who works out the amphipods and isopods; Dr. Giesbrecht, who describes the copepoda, and finally Dr. Kükenthal, who gives notice respecting *Hyperoodon rostratus* and *Beluga leucas*. A new polynoid is *Harmethoë vittata;* and an *Ammotrypane,* two forms of Ascaris (one from the Beluga, the other from *Phoca barbata*), and a Strongylus from the beluga are described. The number of new amphipods is five.

Arthropoda.—"The Maturation of the Ovum in the Cape and New Zealand species of Peripatus," forms the subject of Miss Lilian Sheldon's contribution to the *Quar. Jour. Microp. Soc.*, XXX., pt. I.

Petrarca bathyactidis is the title given by Mr. H. Fowler to the curious crustacean parasite described by him in the *Quart. Jour. Microp. Soc.* XXX., pt. 2. It is a member of that family of crustacean parasites upon Anthozoa of which the only other species known are the *Laura gerardiæ* of Lacaze-Duthiers, and the *Synagoga mira* of Norman. The specimens were all found in the mesenteric chambers of a single *Bathyactis symmetrica* from a depth of 2300 fathoms. It seems to be an internal commensal rather than a parasite. Mr. Fowler accepts for the group the title of Ascothoracida, suggested by Lacaze-Duthiers, and states that the characters are markedly shared between the Cirripedia and the Ostracoda.

Mr. M. Narayanan, of the Biological Laboratory of Madras, furnishes figures of the external sexual organs of *Scorpio fulvipes,* which is common at Madras, and shows that the division into two parts of the genital operculum is, in this species at least, a sexual character peculiar to the male. In this species the chelæ are narrower than those of the female, but this character is not universal.

One of the most extensive entomological collections that have been made of recent years is that of Herr Frühstorfer, who has visited Ceylon in the interest of certain German museums, and, with the aid of fourteen other collectors, has now at least 25,000 coleoptera, 7000 lepidoptera, 3000 orthoptera, at least as many dragon-flies, a thousand arachnids, and a good collection of snakes of all kinds.

Mollusca.—M. Bouchon Brandely has recently inspected some of the oyster-beds of the north of France, and reports much reckless fishing. On the river Roma, near St. Malo, the industry is almost ruined; at the Bay of St. Brieac the beds have been destroyed by the reckless use of the dredge, and at Trequir, where the beds produce the famous Breton oyster, the fishermen, spite of all official warning, have fished to excess. Everywhere the rapacity of the dredgers and the constant disturbance of the young shells has caused a decline in the Breton oyster-beds.

Dr. E. V. Marteus describes the molluecs of Greece, collected by E. V. Ortzen. A sketch map accompanies the article, some new species are admitted, and a chart shows specific distribution. Three plates accompany the memoir.

Pisces.—Volume XXX. of the Challenger Reports also contains Dr. A. Gunther's third and concluding Report on the Fishes, the other reports being Volume I., on the shore fishes, and Volume XXII., on the deep-sea fishes. The species here contained are pelagic or ocean surface fishes, and six new forms are described. Many specimens were too immature for determination. The pelagic faunæ not only consist of truly pelagic fishes, but of deep-sea fishes which have the power of ascending to the surface, and of young and undeveloped littoral fishes driven out by currents. Forty-seven pages and six plates.

Reptilia.—A catalogue of the Chelonians, Rhyncocephalians and Crocodiles of the British Museum has been put forth by G. A. Boulenger, and is criticised by Mr. Lydekker in *Nature* of May 2. The family Crocodilidæ is made the type of a super-family Emydosauria, and though Hatteria and Sphargis are replaced on account of priority by Sphenodon and Dermochelys, the families containing these forms bear the names of Hatteriidæ and Sphargidæ. The Crocodiles are divided into two genera, Crocodilus and Osteolæmus, according to the presence or absence of a forward prolongation of the nasals to divide the anterior nares; and a similar feature is made use of to separate Alligator and Caiman. The Cryptodira are made into six families, but while the Emydidæ and four other families of Gray's Hand-list are included in the Testudinidæ, Staurotypus and Dermatemys are made into the family Dermatemyidæ, and Cinosternum and Platysternum are also erected into families. Testudo includes no less than forty-one species. Only four kinds of Chelonidæ or true turtles are recognized, two species of Chelone, and two of Thalassochelys.

The aquatic Carettochelys of New Guinea, which has no epidermal shields on the shell, is formed into a family.

Mammalia.—*The Archiv für Naturgeschichte* for 1887, issued August, 1889, contains lists of the publications relating to mammalogy in 1886, also those relating to ornithology for the same year (Ant. Reichenow). Dr. O. Boettger gives the herpetological works of 1886; Dr. F. Hilgendorf the ichthyological, and Drs. G. Pfeffer and W. Kobett the malacological.

Captain Fielden of the English army has discovered that the African monkey *Cercopithcius callitrichus* has become wild in the island of Barbadoes, W. I.

EMBRYOLOGY.

Extra-Ovarian Primordial Ova in the Human Embryo.—Dr. W. Nagel[1] reports the discovery of primordial ova in the strip of epithelium which is present on the outer side of the Wolffian body of human embryos. This discovery renders it pretty certain that the reproductive tissues were at one time much more extensively developed than in the present human species, probably in some premammalian type from which man and other mammalia, birds, reptiles and batrachia have descended. It is certain, at any rate, that the only living forms in which the reproductive or germinal tissue is developed throughout almost or quite the whole of the extent of the dorsal portion of the body cavity are some of the fishes. This discovery compares in importance and significance with that of Rathke made about forty years since, when that brilliant investigator announced the presence of branchial clefts during the early embryonic condition of all the higher vertebrates. Embryologists will await the publication of Dr. Nagel's completed studies upon extra-ovarian primordial ova with great interest.

Karyokinesis in Larval Amblystoma.—Last spring, through the kind offices of Miss Fanny R. M. Hitchcock, of New York City, the present writer came into the possession of a lot of the living ova

[1] Ueber das Vorkommen von Primordialeiern ausserhalb der Keimdrüsenanlage beim Menschen. *Anat. Anzeiger, IV.*, 1889, No. 16, pp. 496–498, 2 figs.

of a species of this genus of Urodele batrachians. They were placed in the aquaria of the biological school, and a goodly number were hatched out, but some of the ova were attacked by a unicellular green alga, which multiplied rapidly upon the zona radiata, and between the latter and its thick gelatinous covering, in a single layer. These algæ probably intercepted the oxygen. At any rate the embryos in all the eggs thus affected eventually died before their escape from the egg.

The embryos which had just hatched were found to be exceedingly interesting subjects in which to observe karyokinesis, or indirect cell-division. Nuclear spindles could be readily detected in all the tissues of the body in the greatest variety of stages. A few days after hatching the nuclear spindles became far less abundant and not so easily found. In sections of just-hatched embryos one could find nuclear spindles in all the tissues of the body, though most rarely in the muscles. They were particularly well-shown in the tissues of the brain, spinal cord, cranial ganglia; the prochondral tissue masses, from which the cartilaginous branchial bars are formed; in the blood corpuscles both in the vessels and heart; in the connective tissues, and in the epidermis, as well as even in the notochord. The epidermis of the young Triton or Salamander has been commended for the purpose of illustrating karyokinesis in the laboratory by European teachers of histology. It is, therefore, with much pleasure that I point out the occurrence of a type in this country which is tolerably abundant and accessible, which serves even a better purpose, as it illustrates the fact that karyokinesis is universal, or holds with respect to all of the tissues of the body during the early stages of development.

This type is also well adapted for the purposes of elementary teaching, in that the cells and muscle-fibres are very large, so that the spindles are likewise very large. The filaments of chromatin are also very large, thick and sharply defined, so that all of the phases of nuclear metamorphosis may be readily traced with moderate powers of the microscope.

The method of preparation which I found to serve my purpose very well was as follows: The embryos were killed and hardened with corrosive sublimate or Kleinenberg's picro-sulphuric acid. After hardening and thorough washing in repeated changes of weak alcohol, if corrosive sublimate is used, or in 70 to 80 per cent. alcohol if picro-sulphuric acid is used, the embryos are stained *in toto* in a dilute solution of hæmatoxylin ; Kleinenberg's or Delafield's answers admirably, though even a simple saturated solution of extract of logwood in alcohol, saturated with potash alum, also gives good results, but not so clear and fine as when one uses the best hæmatoxylin crystals. This last solution must be diluted with alcohol saturated with alum if over-staining is to be avoided. And if either of the preceding dyes, Kleinenberg's or Delafield's, is used, it should be diluted until the solution is not too opaque to read through if placed over print in a glass dish to the depth of one-quarter inch. In this the embryos may be left sixteen to twenty-four hours, or until they are dark purple.

The embryos may then be embedded in paraffine and sectioned lengthwise, and some in a vertical and others in a horizontal plane, as well as transversely and mounted serially in the usual way with the aid of a fixative. This gives a complete view of the organization of the larvæ, as well as a good opportunity to study the karyokinetic displays thus rendered visible by the hæmatoxylin. The chromatin threads are deeply stained by the dye and come out very sharply, and contrast with the rest of the substance of the cells.

The connective tissue which forms the cores of the branchial plumes is very interesting at this and later stages, as its cells are vesicular or form a meshwork tensely filled with fluid, which forms a supporting structure similar in function to the vesicular tissue of the axial notochord.

Around the connective tissue cores of the branchial plumes, and overlaid by the epidermis, the branchial vessels form a meshwork which is thus brought close to the surface for purposes of respiration. The tips of the tails of more advanced larvæ are attenuated for a short distance into an upwardly bent point which recalls the opisthure of some larval fishes, as well as the upward flexure of the notochord in those types where the phenomena of heterocercy are almost universal. This fact indicates that some of the types ancestral to the lower Batrachia may have been heterocercal.

The lateral sense organs in just-hatched larvæ are also conspicuous, and form two rows along the sides of the trunk and but one over the sides of the tail. Over the sides and top of the head they are more crowded together and never elongated as in *Amia*. On the inferior side of the head the rows of sense organs follow the direction of the now-closed branchial clefts ; three curved rows of them may be made out on either side of the median line. In surface views a minute circular patch of pigment marks each sense organ, around which there is an annular colorless ring.—JOHN A. RYDER.

PHYSIOLOGY.[1]

Effects of stimulating nerve cells.—A full account of Hodge's work on this subject has recently appeared.[2] The results are highly interesting and important. The author's method was to stimulate for several hours (with regular periods of rest) the nerves attached to several of the spinal ganglia of the frog or the cat. The stimulated ganglion and a resting ganglion of the same animal were then excised and subjected to *identical treatment* in preparation for histological examination and comparison. Corrosive sublimate was the usual hardening reagent, and some or all of the components of Gaule's quadruple stain were used for staining. The chief results of the stimulation are:—

A. For the nucleus: 1. Marked decrease in size. 2. Change from a smooth and rounded to a jagged, irregular outline. 3. Loss of open reticular appearance with darker stain.

B. For the cell protoplasm: 1. Slight shrinkage in size. 2. Lessened power to stain or to reduce osmic acid. 3. Vacuolation.

C. For the cell capsule: Decrease in size of the nuclei.

The effects of the work are exhibited chiefly by the large cells, the small cells showing little or no change. Incidental observations on the connection of the cells and the fibres in the ganglia were made. Careful teasing of ganglia by means of a fine jet of water instead of needles showed that no apolar cells were present; typical bipolar cells and T-cells occur; other suggestive details were made out which are at present being investigated. Careful counting of the fibres of a posterior root and of the cells (*i.e.*, the nucleoli) in the corresponding ganglion showed the cells to be much more numerous—in the most careful count 1340 fibres and 4456 cells. This indicates a complex relation of the two within the ganglion.

Spinal ganglia.—The vexed question of the relation of the nerve fibres to the nerve cells in the spinal ganglia has been subjected to a new investigation by Gad and Joseph.[3] They employed the *ganglion jugulare* of the rabbit, which is attached to the vagus nerve outside the

[1] This Department is edited by Dr. Frederic S. Lee, Bryn Mawr College, Bryn Mawr, Pa.

[2] *American Journal of Psychology*, May, 1889. For preliminary account see the same journal, May, 1888. Cf. also AMERICAN NATURALIST, April, 1889, p. 274.

[3] Du Bois Reymond's *Archiv*, 1889, p. 199.

skull. The central branch of this ganglion is of sufficient length to allow stimulation; the peripheral branch, the vagus nerve, has the great advantage that its functions are well known. The effects which cutting of the central and the peripheral branches and the consequent degeneration have upon both the structure and function of the nerve fibres of the vagus were studied, together with the time occupied by the passage of the nerve current through the ganglion. The authors feel justified in drawing the following conclusions from their work:—Most centripetal nerve paths are interrupted in the spinal ganglia by bipolar nerve cells. The function of these nerve cells is to exercise a trophic influence over the nerve fibres joining them. For the maintenance of the normal structure and function of centripetal nerve fibres connection with the spinal ganglia is necessary and sufficient. Every excitation wave of a centripetal nerve fibre must pass through a nerve cell in the spinal ganglion. Whether the difference of time in the reaction from stimulating peripherally and centrally from the ganglion is due to retardation of the nerve current in its passage through the ganglion, or to a special summation of subminimal stimuli there taking place, is uncertain. (The former time was .036 sec. longer than the latter, the centripetal fibres being stimulated and the reaction being the effect on the respiration movements.) The loss of function of both centripetal and centrifugal nerve fibres that have been separated from their trophic centres is fully developed in animals at the end of the second or the beginning of the third day. The vascularization of the spinal ganglia is sufficiently provided for by the vessels accompanying the nerve stems and nerve roots.

Voluntary impulses and inhibitions.—The nerve process originating in the gray matter of the central nervous system stands in a two-fold relation to muscular activity,—it either calls forth that activity or it puts a stop to it, it is either impulsive, motor, or it is inhibitory. What relation do these two varieties of the process bear to each other? Are they similar in nature? Are they similarly localized? Is their difference due to different directions of their wave motion? These questions and others have remained unanswered. Orschansky[4] thinks to throw light upon them by studying the time reactions of the two processes under various conditions. The masseter muscle was used, its great advantage being that, when the teeth are closed, the muscle can be made to contract and relax without the intervention of antagonistic muscles. Munk's idea that the impulse to relaxation of a muscle, *i.e.*, inhibition,

[4] *Archiv für Anat. und Phys.*, Physiol. Abtheil., 1889, p. 173.

is identical with the impulse to activity of its antagonist, was thus excluded. The subject of the experiment contracted or relaxed his masseter muscle upon feeling an electric stimulus upon the wrist, the movements with time curve being recorded upon a revolving drum. The results show practical equality in the two forms of will activity (*e.g.*, the contraction reaction time=.15 sec., the relaxation reaction time=.14 sec.), the slight differences being attributable to the method of experimentation. Exercise shortens both; increase of intensity of stimulus shortens both alike; both are similarly affected by alteration in the intensity and amplitude of the muscle contraction; alcohol at first shortens, then lengthens both; in short, the experiments argue against the dualistic theory of the two processes. If then voluntary impulses and inhibitions are physiologically identical, the anatomical localization of the interference of the two processes must be in the psychomotor centre. The effects of attention were studied, but have not yet been completely formulated.

PSYCHOLOGY.

History of the Owl, continued.—To the readers of the AMERICAN NATURALIST it may not be amiss to know something more of the final history of the two owls, the great horned and the barred, whose habits were described in the January number.

The lively disposition of the "bubo" increased as he grew older, and at times he would jump and fly about his room with a waggish air that was very amusing.

The Syrnium, on the contrary, became more sullen and morose, and seemed to be constantly in the "sulks" about something.

Their combined hootings at early dawn and twilight were music indeed to the ear of a naturalist. Cloudy days or an approaching storm would also excite the barred owl into uttering his peculiar notes; his mate not infrequently joining in the chorus.

One day in March, while driving on the prairie, I shot and winged a fine specimen of the American rough-legged hawk (*Archibuteo lagopus sanctijohannis*). Not having time that day to make a specimen of him, I put him for safe keeping in with the owls. The next morning, upon presenting myself at the door, I was greeted by a regular pandemonium of hoots and screeches, which at once struck me as presaging no good to my hawk, and, in fact, the latter was nowhere to be seen.

The peculiar actions of the bubo directed my attention to a dark corner of the building. Going through a peculiar "marking time" motion with his feet, swaying his body from side to side, his head revolving in a circle, he would look at me, and then peer into the corner. Going to this place I discovered my hawk, and a sorry specimen he was; tail pulled out, one wing gone, and presenting a generally dilapidated appearance. The miscreants had killed him, and then dropped his body behind a barrel in this corner. Lifting the body into view, the owls again broke out into excited hootings, saying as plainly as owl language could make it: "We are the fellows that did it." "We killed the bear."

It is well known that some of the hawks and kites will catch and devour reptiles.

One day while the owls were quietly eating their rations of Spoon river suckers, without any warning I threw on the floor beside them a large live pilot snake (*Coluber obsoletus*). The effect was magical, and almost threw them into owl hysterics.

They flew about the room, wildly uttering frightened hootings. The barred finally, much to my discomfiture, perched upon my shoulder, as if seeking my protection; his whole body was in a tremor, and he constantly uttered low, cat-like growls. Nor did their fright and excitement abate until the reptile was removed from their sight. Nor did they soon forget this trick, and for many days afterwards, on my entering their apartments, they would eye me sharply, as if suspicious that there were more snakes about me.

Being unusually busy for several days in early June, the owls were somewhat neglected, and did not receive their usual allowance of "bait." One morning the Syrnium was missing, and a search revealed the fact that he had been killed and eaten by his mate, the bubo, nothing being left of him to tell of his tragic end except the wings and one leg.

Soon after this I gave the great horned his liberty, but he seemed in no hurry to leave the old haunts. For several mornings in succession he would be returned to me by some one of my neighbors, saying that my "hooter" had got loose and was after their chickens; becoming impatient at these nightly raids, they handled him more roughly, and stones and sticks in no gentle hands were used to drive him from their premises. Not fancying this rough usage, he left the town, and I have good reason for believing took up his abode with a family of owls residing in a tract of woods two miles north of the village.—W. S. STRODE, *Bernadotte, Ill.*

ARCHÆOLOGY AND ETHNOLOGY.

Mound Explorations by W. K. Moorehead.[1]—MOUND NO. 36.—This mound is situated on high ground, overlooking the Scioto River, in Ross County, Ohio. We commenced work upon it March 21, 1889, by making a trench twenty-two feet wide on the smooth side, cutting entirely off that side. At a point about ten feet distant from the south edge we came upon a group of fifteen skeletons deposited in black earth on the original surface of the ground. They were not buried with any regularity. The mound above the skeletons was composed of yellow clay. It was with the greatest difficulty that we preserved two of the skulls entire. Near the south side of these bones, or where they commenced, was found a deposit of two hundred pottery fragments. When buried, the vessels which these fragments represent were evidently whole, but the pressure of the earth above had broken them into small pieces. To the west was found the skeleton of a child, tolerably well preserved. Above this was a layer of charcoal nearly a foot thick which extended northeast through the mound. All the other skeletons were placed about a foot below this. The charcoal was in pieces about as large as one's fist, and laid regularly, as if short logs had been thrown in and covered while burning.

There were no objects placed with these skeletons save in two instances. One skeleton situated in the centre of the mound had, between the thigh bones (femur), a number of objects; a stone tube in an unfinished condition, a slate ornament with two perforations, a banded slate ornament with one perforation, and a stone celt. Just above these, and laid in two rows, parallel with the bones, were ten flint arrowheads made of the black chalcedony found at Flint Ridge. These arrows were placed in two rows lying against the bones on each side. With another skeleton was found another deposit of the following objects, in the order in which they were found:

A large hematite celt, about four inches long, three inches wide, and weighing half a pound; a stone tube of steatite, five inches in length, with large perforation lengthwise drawn to a small aperture at one end (this is similar to those figured by Squier and Davis, who opened mounds in this neighborhood forty years ago); two beautiful leaf-shaped chalcedony spear-heads; above them was a celt and chisel of

[1]This department is edited by Thomas Wilson, Esq., Smithsonian Institution, Washington, D. C.

greenstone. We continued down nearly ten feet further and were then at the centre of the mound. We found no more large deposits of objects. On the east side we found, on the base line, the skeleton of a child with three shell beads and two copper rings on the left hand. On the north side of the mound was found a layer of fine white ashes under the charcoal, then a small patch of burnt clay, but it was not regular enough to be called an altar. The wood of this charcoal was sufficiently well preserved to be recognized as white oak, hickory, poplar and chestnut.

There were no distinct layers in this mound, and no evidence of cremation. The charcoal had been placed there in a cold state, as the earth around it was not burned. Five men were employed two days in opening this mound.

MOUND NO. 37.—This mound is on the farm of Jesse James, three miles east of Chillicothe, Ohio, and situated on the third river terrace. Its dimensions are 50 x 76 x 13 feet. We began operations by starting a 22-feet trench on the east side, following the longest diameter of the mound. This was continued for fifty-nine feet, or until we were ten feet beyond the centre. Finding nothing of importance we stopped work. After we worked about twenty feet from the outer edge we came upon a bed of burnt bones and ashes three inches thick and extending eighteen feet toward the centre of the mound. We found by digging under the walls, on each side of our trench, that this layer ran further than the width of our trench. At about fifteen feet from the centre and on the base line of the mound was a skeleton, and 159 shell beads made from ocean shells. One hundred and two of these beads lay near the head, the rest near the lumbar vertebræ. The bones were too fragile to be preserved. Six feet from the base line and seven and a half feet from the summit, was a second skeleton in a better state of preservation. It lay above and to the west of the other skeleton.

The right femur lay with the lower articulate end far to the left. The tibia of the right leg lay in natural position, but the fibula lay far over to the left. The fibula of the left leg lay under the tibia of the left leg in an unnatural position, and both too much to the left.

ANATOMICAL PECULIARITIES.

1. Shoulder to shoulder measurement, 19 inches.
2. Head slightly crushed.
3. Lumbar vertebræ gone (in part).
4. Pelvis overlaps the hands.

6. Sacrum gone.

6. End of ulna nearly under the vertebræ (right ulna).

7. Right femur out of position.

8. Tibia and fibula of right and left legs out of position.

9. Not all the feet bones present.

Near the second skeleton was the skull of a panther, and at the west end of the trench, near the surface, we found the skull of a wolf. There were no relics whatever in this mound save the beads.

We had five men working six days.

MOUND NO. 38.—This mound is on the farm of Mr. Till Porter, one quarter of a mile west of Frankfort, Ohio, and is nine feet high, and seventy by seventy-five feet in extent. Its greatest diameter is N. E. and S. W. We began work by opening a trench twenty-three feet in width on the south side; but Mr. Porter wishing the entire mound taken out, we engaged three teams and widened our trench so as to include all the mound except the northern part. The sides of this trench were irregular because we followed the "leads" of charcoal and ashes. It is in deposits of this nature that we find the skeletons. All our finds were on the east and south sides of the mound; nothing on the west side.

The ground on which this mound is built was cleared and leveled, and then burned. By keeping on this floor, shoveling was easy and the objects found without difficulty. At the base, and twelve feet from the outer edge, we came upon a mass of charcoal and animal bones. The latter were found at frequent intervals throughout the mound. For the next thirty feet the finds were unusually rich, and yielded us more skeletons and relics than any heretofore opened.

Two feet beyond the animal bones to the north, lay a skeleton with head to the south. It lay on the bottom of the mound, and was taken out in good condition. The shell and jaw found were intended to accompany this skeleton. On the same level lay another skeleton, much decayed, but which had, near its right hand, three copper buttons, a copper celt, and, above the head, a copper plate. The latter had an imprint of cloth upon it, and is similar to that figured by Foster in his work on Pre-historic Races of the United States. The metal coming in contact with the bones of the skull had colored them green. The bones and teeth indicated a person less than twenty-five years of age.

The next skeleton found lay on the base line, with its head toward the west. We took out all of its bones entire. No relics were found near it. Nearly all of these bodies were buried with the flesh on, about seven feet from the centre, and at a point where the stratification showed to good advantage. The following enumeration of layers shows how the mound was put up:

IRREGULAR LAYERS.

A. Clay, ...	1 ft.	
B. Dark clay, ...		6 in.
C. Gravel, ...		6 in.
D. Clay, ...	1 ft.	
E. Coarse gravel, ...		4 in.
F. Clay, ...		8 in.
G. Patch of gravel, followed by a thin streak of clay, very irregular, ...		4 in.
H. Gravel, ...		6 in.
I. Coarse clay, ...	1 ft.	8 in.
K. Soft dark spots, of very irregular shapes, which held the skeletons and extended upwards one and one-half feet, ...	1 ft.	6 in.
Total, ...	8 ft.	

L. The altars found on each side, shown in the vertical section, and which extended upwards about one foot.

M. The burnt floor of the mound.

Near the centre of the mound was found a large skeleton, better preserved than most of the others, and which seemed to be the most important individual buried there. It lay on the base line, with head to the north. The head was about six inches higher than the feet, which were much decayed. About six inches from the extremities of the left foot we found a large copper plate, with a print of wood on one side, and coarse cloth on the other. This plate was thirteen by seven inches, and its weight over a pound, and was probably the largest ever taken from a mound in this country. Near the right femur were found twenty-two pearl beads, and at the shoulder eight large bear teeth. Three copper buttons lay against one of these bear teeth and had colored it green. At the neck of this individual we took out five hundred and eighty-four pearl beads, large and small. These were well preserved, and, but that each one had been perforated, their commercial value would be several thousand dollars.

Eight feet west of this last body, and in a little hollow, supported by burnt stones, was an altar of large size and regular outline. This altar is identical with those figured by Squier and Davis, in Vol. I. of

"Smithsonian Contributions to Knowledge." Altars have been occasionally found in the mounds, but there has never been but one taken out entire. This altar has a broad rim extending around it eight inches wide. The central depression is four inches deep, twenty inches long, twelve inches wide; making the total length thirty-six inches.

On the east side of the mound, in the gravel layer, five feet from the summit and three feet from the base line, were found three copper celts and seven copper ear-rings. With these were three human ribs. The copper was in three rows; the celts in the lowest row, four of the brooches in the second row, and three in the third row. Three more skeletons were found on the base line just north of this copper, but they had nothing with them.

Northeast of this last deposit is a spot of dark earth, which contained the ashes and calcined bones of six cremated individuals. With five of these copper had been buried, but the heat of the fire had melted it. Though damaged by heat, I obtained one celt, two large plates, eleven copper beads, and a cracked clay pipe. The burned bodies occupied spaces ranging from sixteen to twenty-four inches. A pipe, cracked by the heat, was found with the copper celt.

With the next skeleton found was a small copper celt, unhurt by the fire, which showed traces of both cloth and wood. The skeleton lay with head to the north on the base line, and was not very well preserved. Two more decayed skeletons were found which had copper buttons placed with them. They were placed with heads to the south and on the base line of the mound.

In the centre of this mound nothing whatever was found. Twelve feet from the centre, to the west, were two cremated bodies which had broken flint arrow-heads buried with them. To the north of these was a small, irregular altar. In this altar was a small black thornpipe, said by Squier and Davis to be the true mound pipe. Ten feet eastward was a small pit, with nicely squared edges, eight inches deep, twelve inches long, and ten inches wide, containing the skeleton of a child. The bones were well preserved, and with them were two perforated panther teeth. We found the bones of three more individuals in this mound. They were a little northeast of the small pit last mentioned, but nothing whatever was found with them. One of the skulls was saved whole. It is a very good representative of one of four types taken from this mound. One of these three skeletons was placed in a shallow pit, and near the group was an irregular mass of hard-burned clay beveled and without depression. It could not therefore have been an altar.

This mound was seven days in being excavated, and six men were employed. It was hauled out by three teams and dumped in a gravel pit at the owner's request, so that it is now only three feet high, whereas it used to be over nine.

MICROSCOPY.

On a method of preparing blastoderms of the Fowl.—Hasnell (*Proc. Linn. Socy. New South Wales, 1889*) has found the following method of great value in expediting the process of removing and preparing the blastoderms of early stages (up to the third day), and also in diminishing the risk of injury. The fixing fluid used is ten per cent. nitric acid, as employed by Whitman and others. The novel point in the method is the mode of getting rid of the entire white without any trouble, and without risk of damaging the blastoderm.

An ordinary *conical* measuring glass of a capacity of 100 c.c., with the edge turned out with a large "lip," is placed in a flat dish, and is filled to the very brim with nitric acid. The egg shell is then broken, and the entire contents poured into the glass in exactly the method adopted in the kitchen, except that the egg is held when being opened close over the glass so that there may be as little disturbance as possible. The glass being brim full, when the contents of the egg are added to it a quantity of the fluid runs over the sides; with this there begins to run some of the external, more fluid, part of the white; as this runs over, it by its weight gently draws the firmer part of the white with it, and finally the firm layer which immediately invests the yolk is peeled off as one might peel off the outermost coat of an onion, leaving the yolk and blastoderm with the investing vitelline membrane quite entire and perfectly clean in the glass—the entire white having in this way spontaneously thrown itself off. The whole process takes only two or three seconds. If, as occasionally happens, owing to some of the fluid having been splashed out of the glass in pouring in the egg, the white does not begin to run over the edge, a little of it should be pushed over the lip, and left to draw the rest after it in the manner described.

The entire yolk with the blastoderm should be left for half an hour in the glass with the nitric acid; it may then, part of the acid having been poured off, be returned into a large dish full of water, which has to be changed several times. After the yolk has been for a few minutes in the water the blastoderm has to be cut out with scissors, when it will readily peel off from the underlying yolk, and the vitelline membrane readily comes away. The blastoderm is then to be left for half an hour in water, which should be renewed, and then transferred to weak alcohol (60 per cent.), in which it should remain for twelve hours; it should then be placed for two days in 90 per cent. alcohol, and then stained by immersion for three or four hours in Ehrlich's hæmatoxylin (crystallized hæmatoxylin 2 grms., water 100 c.c., glycerine 100 c.c., acetic acid 10 c.c.), followed for a few minutes by acidulated alcohol (97 c.c. 70 per cent. alcohol, 3 c.c. hydrochloric acid), and that in turn for half an hour or more by alcohol diluted to 70 per cent. by the addition of ordinary tap-water or water artificially rendered slightly alkaline. The specimen will then be ready, after passing through 90 per cent. and absolute alcohol, for mounting as a whole. For sections it is better to omit the acidulated alcohol, and to allow the specimen three days further hardening in 90 per cent. and absolute alcohol.

The important point here is, of course, the ease and rapidity with which the white is got rid of, so that a large number of blastoderms may be prepared in a comparatively short time. But the mode of subsequent treatment described above, which is applicable to blastoderms prepared in other ways, gives results, particularly for whole blastoderms, such as are not obtained by any other of the many methods tried.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

American Association for the Advancement of Science.— The 38th meeting of the A. A. A. S. was held at Toronto, Ontario, from August 17th to September 3d, 1889. There were 421 members registered; 190 new members were elected; and 72 names were added to the list of fellows. The meeting was remarkable for the number of Past Presidents in attendance, these embracing Professors Dana, Hall, Newberry, Barker, Dawson, Newton and Morse. The retiring President, Major J. W. Powell, was absent, and his address upon "The Evolution of Music" was read on Wednesday evening, August 28th, by Mr. G. K. Gilbert, of the U. S. Geological Survey. The vice-presidents were all on hand except Prof. Arthur Beardsley, of Section D, and the Secretary of that section, James D. Denton, was elected to preside in his stead. The subjects of the vice-presidents' addresses were as follows:

Section A.—Mathematics and Astronomy:—"Mathematical Theories of the Earth," by R. D. Woodward.

Section B.—Physics:—"A Review of Theories of Electrical Action," by H. S. Carhart.

Section C.—Chemistry:—"The Nature of Amalgams," by William L. Dudley.

Section E.—Geology and Geography:—"The North American Mesozoic," by Chas. A. White.

Section F.—Biology:—"The Protoplasm of Organisms," by George L. Goodale.

Section H.—Anthropology:—"The Israelites and the Indians," by Garrick Mallery.

Section I.—Economic Science and Statistics:—"Economic and Sociologic relations of Canada and the United States, prospectively considered," by Chas. S. Hill.

Of these addresses, that of the vice-president of Section I received an extended notice by the Toronto *Mail.* The editor naturally disagreed with Prof. Hill on many points, more especially in regard to the effect of protection on the cost of manufactured goods. The following is a list of the papers entered to be read before the various sections. Some were only read by title because of the absence of the authors.

SECTION A.

The New Dearborn Observatory.—10 min.—By G. W. Hough.

Astronomical Observations made with the Great Telescope of the Lick Observatory since June, 1888.—25 min.—By Edward S. Holden.

A Desideratum in the Presentation of Mathematical Truth.—5 min. —By Charles H. Chandler.

Automatic Photographic Transits.—15 min.—By Frank H. Bigelow.

A Method of Finding Factors.—10 min.—By James D. Warner.

On the Graduation of Meridian Circles *in situ.*—10 min.—By Wm. A. Rogers.

On the Use of a Floating Mirror as an Auxiliary to a Meridian Circle.—12 min.—By G. C. Comstock.

The Relation Between Stellar Magnitudes, Distances, and Motions, —15 min.—By J. R. Eastman.

On the Proper Motions of the Stars in the Harvard College Observatory Zone, between the limits 50° and 55° Declination.—8 min.—By Wm. A. Rogers.

Formula for the Probability of any Fact or Occurrence about which any Number of Witnesses Testify.—10 min.—By J. E. Hendrick.

On the Solar Parallax and its related Constants.—30 min.—By Wm. Harkness.

Double Star Discoveries and Measures made at the Lick Observatory, August 1st, 1888, to August 1st, 1889.—10 min.—By D. W. Burnham.

A proposed Catalogue of Declinations.—45 min.—By Henry Farquhar.

The Solar Corona, a phenomenon in Spherical Harmonics.—5 min. —By Frank H. Bigelow.

On the Automatic Eclipsograph.—15 min.—By David P. Todd.

Errors in Star Catalogues.—15 min.—By E. Frisby.

The Peruvian Arc.—30 min.—By E. D. Preston.

New Arrangement for an Astigmatic Eye-piece.—3 min.—By J. A. Brashear.

The Jena Optical Glass.—5 min.—By J. A. Brashear.

The Centrifugal Catenary.—15 min.—By J. Burkitt Webb.

The Polar Tractrix.—10 min.—By J. Burkitt Webb.

A Precession Model.—10 min.—By J. Burkitt Webb.

The Hastings Achromatic Objective.—5 min.—By J. A. Brashear.

Annual Parallax of South 503.—4 min.—By F. P. Leavenworth.

SECTION B.

Exhibition of a new Spectroscope Slit.—3 min.—By Romyn Hitchcock.

Exhibition of a Thermometer with constant Zero Point.—3 min.—By Romyn Hitchcock.

The Measurement of Magnification in the Microscope.—15 min.—By W. Le Conte Stephens.

Concerning Thermometers.—20 min.—By Wm. A. Rogers and R. S. Woodward.

Experimental Proof of Newton's Law of Cooling.—8 min.—By Wm. A. Rogers.

On the Partition of the Mean Kinetic Energy of a perfect gas between the rotary and translatory motions of its molecules.—8 min.—By H. T. Eddy.

Note on the Magnetic Rotation of Polarized Light according to the Electro-magnetic Theory.—10 min.—By H. T. Eddy.

Researches on Sonorus Sand in the Peninsula of Sinai (with lantern views).—By H. Carrington Bolton.

Relative Merits of Dynamometric and Magnetic Methods of Obtaining Absolute Measurements of Electric Currents.—30 min.—by Thos. Gray.

A Quadrant Electrometer.—5 min.—By Harris J. Ryan.

Magnetic Leakage in Dynamos.—10 min.—by H. S. Carhart.

An Improved Standard Clark Cell with Low Temperature Co-efficient.—15 min.—By H. S. Carhart.

On Globular Lightning.—By T. C. Mendenhall.

A Preliminary Report on the Influence of Temperature upon the Color of Pigments.—15 min.—By Edward L. Nichols and B. W. Snow.

The Solar Condition upon which the Aurora Depends.—5 min.—By M. A. Veeder.

The Determination of the Amount of Rainfall.—12 min.—By Cleveland Abbe.

The Hydro-Electric Effect of Stretching Metals.—15 min.—By Carl Barus.

Additional Experimental Proof of the Constancy of the Relative Co-efficients of Expansion between Jessop's Steel and Bronze, between the limits of minus 5° and 95° Fahr.—5 min.—By Wm. A. Rogers.

Experiments in Duplex Telephony in 1883.—5 min.—By A. M. Roseburgh.

Recent Progress in Storage Batteries.—10 min.—By George F. Barker.

A Mode of Suspension for Foucault's Pendulum.—5 min.—By R. B. Fulton.

A Modification of the "Pascal's Vase" Experiment.—3 min.—By A. L. Arey.

Experiments for Demonstrating that the force of a Detonating Explosion is exerted in all directions about the explosive center.—5 min. —By C. E. Monroe.

Effects of Electrostatic Discharges on Photographic Plates.—10 min.—By Thomas French, Jr.

A Meuntain Study of the Spectrum of Aqueous Vapor.—25 min.—By Charles S. Cook.

An Exhibition of Photographs, taken in 1864, of the Living Eye (*a*) The retinal vessels; (*b*) The retinal inverted image of an object placed in front of the eye.—8 min.—By A. M. Roseburgh.

An Exhibition of Photographs of the Fundus of the Eye of the Cat taken while under the influence of Chloroform.—5 min.—By A. M. Roseburgh.

Experimental Determination of the Periodic Pulsations of a Thermometer made of the new "Jena" glass.—By Wm. A. Rogers and J. B. Webb.

SECTION C.

Dynamical Theory of Albuminoid Ammonia.—50 min.—By Robert B. Warder.

Molugrams and Molugram Liters.—2 min.—By Chas. E. Monroe.

The Explosiveness of the Celluloids.—10 min.—By Chas. E. Monroe.

The Chemical Composition of the Mica Group.—40 min.—By F. W. Clarke.

Spectrum Photography.—40 min.—By R. Hitchcock.

New Bottle for Hydrofluoric Acid.—5 min.—By Edward Hart.

Some Peculiarities of Butter.—20 min.—By H. W. Wiley.

Composition of the Seed of *Calicanthus glaucus* (Illustrated).—20 min.—H. W. Wiley.

The Action of Light on Silver Chloride.—10 min.—R. Hitchcock.

A Method of Mounting Photographic Prints on Paper.—5 min.—R. Hitchcock.

Some Notes on the Estimation of Nitrogen by the Kjeldahl Method. —10 min.—M. A. Scovell.

Succinylo-succinic Acid.—15 min.—Adolph Bayer, Munich, Germany, and A. W. Noyes.

Estimation of Bromine in Presence of Chlorine.—10 min.—Albert B. Prescott.

On the Acquisition of Atmospheric Nitrogen by Plants.—20 min.—W. O. Atwater.

Discussion of the Report of Committee on the Formation of a National Chemical Society.

Food Preparation.—10 min.—By Fred. Hoffman.

The Composition of Ontario Oats.—10 min.—By C. C. James.

Jadeite and Nephrite.—15 min.—By L. P. Kinnicutt.

Continuation of the Discussion upon the Report of the Committee upon the Spelling and Pronunciation of Chemical Terms.

SECTION D.

Results of Recent Experiments to Determine the Resistance of Air to Inclined Planes in Motion, with applications to the problems of Soaring Pigeons.—20 min.—By O. Chanute.

Experimental Comparison of the Performance of Steam Injectors *vs.* a Duplex Steam Pump.—35 min.—By E. B. Perry.

On the Preservation of Timber.—15 min.—By O. Chanute.

On the Relative Economy of Modern Air Compressors. Illustrations by Lantern.—40 min.—By J. E. Denton.

Note on Performance of a Pumping Engine.—10 min.—By M. E. Cooley.

New Device for Autographic Registry of Extension in Tension Tests.—15 min.—By Thos. Gray.

Notes on Anti-friction Construction for Revolving Mechanism for Observatory Domes.—10 min.—By W. R. Warner.

Note on Performance of a Vibrating Piston Engine.—10 min.—By M. E. Cooley.

Probable Principal Cause of Superior Economy of Multiple Expansion Engines.—10 min.—By J. E. Denton.

Exhibition of a Novel Motor.

SECTION E.

Topographic Types of Northeastern Iowa.—25 min.—By W. J. McGee.

The Lake Ridges of Ohio and their Probable Relations to the Lines of Glacial Drainage into the Valley of the Susquehanna.—30 min.—By G. F. Wright.

The Moraines of the Wabash–Erie region. The Irondequoit Glacier.—15 min.—By C. R. Dryer.

Glacial Phenomena of Northern Indiana and Northeastern Illinois.—20 min.—By Frank Leverett.

The Attractive Scenery of our own Land.—20 min.—By A. S. Bickmore.

The Mastodon of Kent and What We Know About It.—20 min.—By Ed. Jones, Esq.

On Certain Remarkable New Fossil Plants from the Erian and Carboniferous, and on the Characters and Affinities of the Paleozoic Gymnosperms.—20 min.—By Sir Wm. Dawson.

Mammoth Cave.—20 min.—By H. C. Hovey.

The Devonian System of North and South Devonshire.—25 min.—By H. S. Williams.

A Classification of the Topographic and Geologic Features of Texas, with remarks upon the Areal Distribution of the Geologic Formations.—20 min.—By R. T. Hill.

The Eagle Flats—Formation and the Basins of the Trans-Pecos or Mountainous Region of Texas.—5 min.—By R. T. Hill.

The Ancient Volcanoes of Central Texas.—5 min.—R. T. Hill and E. T. Dumble.

The Geology of the Staked Plains of Texas, with a Description of the Staked Plains Formation.—5 min.—By R. T. Hill.

The Geology of the Valley of the Upper Canadian from Tascosa, Texas, to the Tucumcari Mountains, New Mexico, with notes on the age of the same.—10 min.—By R. T. Hill.

The Reality of a Level of no Strain in the Crust of the Earth.—30 min.—By E. W. Claypole.

The Geological Position of the Ogishke Conglomerate.—30 min.—By Alexander Winchell.

The Origin of Gneiss and other Primitive Rocks.—15 min.—By Robert Bell.

Observations on the Trap Ridges of the East Haven (Conn.) Region.—30 min.—By E. O. Hovey.

On a Possible Chemical Origin of the Iron Ores of the Kewatin in Minnesota.—20 min.—By N. H. Winchell and H. V. Winchell.

Notice of some Zircon Rocks in the Archæan Highlands of New Jersey.—8 min.—By F. L. Nason and W. F. Ferrier.

Trap Dykes in the Region about Lake Champlain and the Adirondacks.—10 min.—By J. F. Kemp.

Field Studies of Hornblende Schist.—10 min.—By C. H. Hitchcock.

Remarks on the Cretaceous of Northern Mexico.—10 min.—By C. A. White.

Notes on the Mapping of the Archæan Northwest of Lake Superior.—10 min.—By A. C. Lawson.

On the Structural and Chemical Differentiation of certain Dykes of the Rainy Lake Region.—20 min.—By A. C. Lawson.

Natural Gas in Fredonia, New York.—15 min.—By H. T. Fuller.

The Petroleum Belt of the Terre Haute.—10 min.—By C. A. Waldo.

Preservation of Glaciated Rocks in Worcester, Mass.—5 min.—By H. T. Fuller.

Two New Faunas from the Lower Cretaceous Formation of Texas; (*a*) Caprina Limestone Fauna. (*b*) The Shoal Creek Limestone.—5 min.—By R. T. Hill.

On the Origin of Diagonal Trends in the Earth's Crust.—15 min.—By D. S. Martin.

Casts of Scolithus Flattened by Pressure.—5 min.—By A. Wanner.

Origin of Boulder Pavements and Fringes.—10 min.—By J. W. Spencer.

Section of the Makoqueta Shales in Iowa.—10 min.—By J. F. James.

History of the Formation of the Great Lakes.—20 min.—By J. S. Newberry.

SECTION F.

On the Position of the Nectar Glands in Echinops.—5 min.—By Thomas Meehan.

On the Epigynous Gland in Diervilla and the Genesis of Lonicera and Diervilla.—10 min.—By Thomas Meehan.

On the Conditions of Molluscan Life in the Deep Sea.—30 min.—By W. H. Dall.

Some Peculiarities of the Antennal Structure in the Deltoids.—10 min.—By John B. Smith.

History and Migration of the American Crow in Nebraska.—10 min.—By W. Edgar Taylor.

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SYNOPSIS OF THE FAMILIES OF VERTEBRATA.

BY E. D. COPE.

IN the following pages the attempt is made to bring together the information which we possess as to the characters of the divisions of the Vertebrata above families which are available for the determination of their relations by the paleontologist. These characters must be of the first importance to the discovery of the phylogenies, since the soft parts are unavailable. It is, however, true that the relations of these to the hard parts are close enough to render our inferences from the latter generally safe. Fortunately, also, the living remnants of extinct groups are sufficiently numerous to enable us to check our studies of the osteology. Thus we have the Branchiostoma, the lampreys, the Ceratodus and Lepidosiren, the Sphenodon, and the Monotremata, to which to refer when we desire to learn approximately the characters of the soft anatomy of ancient forms.

All the characters of the various divisions are not given. In fact, when all extinct forms come to be known, no division is likely to be defined by more than one character. At present several characters may be often ascribed to various divisions, but one of these will ultimately prove to be the essential one. It is the object of the present synopsis to bring these definitive characters into prominence; hence they are always stated first. The method of keys is adopted as the most perspicuous method of exhibiting them.

We are embarrassed in the endeavor to present the relations of the earliest and lowest Vertebrata by a want of knowledge of their structure, and by the absence from our collections of numerous intermediate forms which must have existed. Until our knowledge is more complete the arrangement, especially of the contents of the class Agnatha, must be regarded as largely provisional.

The ossification of the skeleton of the Vertebrata has developed first on the exterior of the head and body, and in the sheath of the chorda dorsalis, and has then penetrated inwards. The limbs have preceded in time the arches (scapular and pelvic) to which they are, in the higher forms, attached. Hence we find in such genera as Cephalaspis and Bothriolepis, pectoral limbs without a scapular arch, but with merely dermal ossifications to which they are attached. This is parallel to the general absence of pelvic arch in most fishes. The limbs themselves are supposed to be radial ossifications in primitive longitudinal folds of the body integument, some of which remain in large part, as the dorsal fin of various fishes; while more frequently but few of the radïi remain, as in the limbs of most Vertebrata.

The branch Vertebrata is divided into the following superclasses:

No skull nor skeleton; notochord short, anterior, temporary; nervous center a longitudinal cord;	*Hemichorda.*
No skull nor skeleton; notochord caudal only; nervous center a ganglion;	*Urochorda.*
No skull; notochord extending throughout the body, included in a membranous sheath, as is the cord-like nervous axis above it;	*Cephalochorda.*
A cartilaginous or bony skull and skeleton, which extends throughout the body; central nervous system a longitudinal cord terminating in a brain within the skull;	*Craniata.*

HEMICHORDA.

There is but one class of Hemichorda.

Not metameric; no mantel; respiratory fissures on each side of the pharynx; alimentary canal with openings at opposite extremities of body;	*Enteropneusta.*

ENTEROPNEUSTA.

But one order of this class is yet known.

No appendages to the body except an oval mass extending in front of the head; *Helminthophya.*

The order HELMINTHOPHYA embraces but one family, the Balanoglossidæ.

UROCHORDA.

There is but one class of Urochorda; viz.:

Not metameric; a mantel covering the body; respiration pharyngeal; heart distinct, saccular; *Tunicata.*

TUNICATA.

There are two orders of Tunicata.

Inhalent and exhalent openings close together; alimentary canal elongate; *Ascidiæ.*

Inhalent orifice and anus at opposite extremities; alimentary canal crowded into a body termed a nucleus; *Thaliacea.*

To the ASCIDIÆ belong the families Appendiculariidæ, Clavellinidæ, Ascidiidæ, Botryllidæ, Didemnidæ, Polyclinidæ, and Pyrosomidæ. To the THALIACEA are referred the families Salpidæ and Doliolidæ.

CEPHALOCHORDA.

The only class of the Cephalochorda is the following:

No mantel; walls of the body muscular myotomes; no jaws nor extremities; pharyngeal walls fissured; heart a longitudinal vessel, which gives off branchial vessels, which unite into an aorta; a liver and vena cava present; *Acrania.*

Of the class *ACRANIA* but one order as yet know.

Pharyngeal fissures enclosed externally by a fold of the integument, which encloses a chamber (atrium) which opens inferiorly; openings of alimentary canal at opposite extremities; heart tubular; *Leptocardii.*

The only family of the LEPTOCARDII is the Branchiostomidæ.

CRANIATA.

I. No lower jaw nor pectoral arch.

Internal skeleton not ossified; *Agnatha.*

II. Lower jaw and pectoral arch present.

a. Basicranial axis not ossified; vertebral column consisting chiefly of intercentra.

Limbs represented by many-radiate fins, which are also present on the median lines of the body; a coracoid bone; heart with two chambers; no internal nares; *Pisces.*

Limbs consisting of one basal element, two propodials, and metapodials and digits; no median fins; no opercular bones; a coracoid; heart with three chambers; two occipital condyles; internal nares; *Batrachia.*

aa. Basicranial axis ossified; vertebral column consisting chiefly of centra. An amnion and allantois.

Limbs as in Batrachia; one occipital condyle; a suspensorium of the lower jaw; mandible segmented; heart with three chambers; *Monocondylia.*

Limbs as in Batrachia; two occipital condyles; no suspensorium of the lower jaw; mandible not segmented; heart with four chambers; *Mammalia.*

AGNATHA.

The known members of the class AGNATHA are a very small representation of those that once existed; and they present a great variety of character, having little affinity with each other. Two sub-classes are most distinctly indicated.

An osseous dermal skeleton with lateral limb-like appendages; *Ostracodermi.*

No osseous skeleton, nor lateral limb-like appendages; *Marsipobranchii.*

OSTRACODERMI.

The orders of this division are two.

Orbits well separated; no nostrils; *Arrhina.*

Orbits separated by a plate which is pierced by two orifices, possibly nostrils; *Diplorrhina.*

To the ARRHINA belong the families of the Pteraspididæ and Cephalaspidæ, and to the DIPLORRHINA that of the Mycteropidæ. The latter has some affinity to the Pterichthyidæ, which has similarly approximated orbits, or orifices which correspond with those provisionally termed orbits in Mycterops. They are separated in the Pterichythidæ by a movable plate which is not perforated. Pterichythidæ differ in the possession of a peculiar dorsal shield, which resembles that of the Tunicate germs Chelyosoma. The tail, present in Pterichthys, is wanting in Bothriolepis, calling to mind the absorption of the tail in the Tunicates. The lateral appendages resemble, those of the Tunicate genus Appendicularia. For the above reasons I have placed the Pterichyidæ in the Tunicata, as the type of a distinct order, the Antiarcha. This order may belong to the Ostracodermi.

MARSIPOBRANCHII.

This subclass has two orders.

Branchial fissures communicating directly with the pharynx; nasal sac perforating the palate; *Hyperotreti.*

Branchial fissures communicating with a common branchial passage which opens into the pharynx; nasal sac not perforating palate; *Hyperoarti.*

To the HYPEROTRETI belong two families, the Myxinidæ and the Bdellostomidæ; to the HYPEROARTI one, the Petromyzontidæ.

PISCES,

This class is divided into four subclasses.

I. No suspensorium of the mandible.

No dermal cranial ossifications; ventral claspers; no opercular bones; no maxillary arch; *Holocephali.*

Dermal cranial ossifications and opercular bones; no claspers; no maxillary arch; *Dipnoi.*

II. A suspensorium of the mandible.

No dermal cranial ossifications nor opercular bones; claspers present; *Elasmobranchii.*

Dermal cranial ossifications and opercular bones; no claspers; a maxillary arch; *Teleostomi.*

HOLOCEPHALI.

But one order of this subclass known.

A single external branchial fissure; actinotrichia present; basilars, axonosts and neural spines articulating with each other; pectoral fin with three axonosts and numerous basilars; ventrals with elongate axonosts and basilars; *Chimæroidei.*

The order CHIMÆROIDEI embraces only the family Chimæridæ.

DIPNOI.

There is but one order of this subclass known as yet.

Actinotrichia; baseosts and axonosts of median fins continuous with neural spines; paired fins with a single basal axonost and numerous segments continuous with it; swim-bladder cellular; *Sirenoidei.*

Three families represent our knowledge of the order SIRENOIDEI; the Dipteridæ, the Ceratodontidæ, and the Lepidosirenidæ.

ELASMOBRANCHII.

There are two orders of this subclass.

A basioccipital and exoccipital elements; actinotrichia; baseosts and axonosts continuous with neural spines; paired fins with a single basal axonost, and numerous others in line with it; claspers simple; *Ichthyotomi.*

No basi or exoccipital; median baseosts and axonosts continuous with vertebral spines; several axonosts to paired fins, and numerous baseosts; claspers complex; actinotrichia; *Selachii.*

To the order ICHTHYOTOMI belong the families Xenacanthidæ and Cladodontidæ. To the SELACHII belong the following: (*Squali,*) Psammodontidæ, Petalodontidæ, Cochliodontidæ, Cestraciontidæ, Spinacidæ, Notidanidæ, Lamnidæ, Carchariidæ, Squatinidæ, Rhinobatidæ, Pristiophoridæ; (*Rajæ*,) Pristidæ, Squatinorajidæ, Rajidæ, Trygonidæ, Myliobatidæ.

TELEOSTOMI.

There are four superorders of this subclass, which are distinguished by the fins.

Dorsal, anal, pectoral, and ventral axonosts present, represented by a single element to each fin; *Rhipidopterygia.*

Dorsal, anal, pectoral, and ventral axonosts present, the dorsal and anal numerous, the pectoral in variable number, articulating with numerous well-developed baseosts; the ventral axonost single, with numerous baseosts; *Crossopterygia.*

Dorsal and anal exonosts as in the last; no pectoral exonost; pectoral and ventral baseosts elongate, numerous; *Podopterygia.*

Dorsal and anal axonosts present; no pectoral axonost; pectoral baseosts few and small; ventral baseosts rudimental; dorsal, and generally anal baseosts rudimental or wanting; axonosts not corresponding with neural spines; *Actinopterygia.*

RHIPIDOPTERYGIA.

Two orders of this superorder are known

Basseosts present in dorsal and anal fins; pectoral fin? *Rhipidistia.*

Basseosts wanting to dorsal and anal fins; caudal axonosts present, each one articulating with a neural spine; pectoral fin? *Actinistia.*

To the RHIPIDISTIA belongs the single family of the Tristichopteridæ; and to the ACTINISTIA the Cœlacanthidæ.

CROSSOPTERYGIA.

I. Dorsal baseosts present; pectoral axonosts uniserial.

Pectoral fins a simple axis, when present; body with dorsal and ventral shields; axonosts articulating with neural spines; [1]*Placodermi.*

Actinotrichia present; axonosts articulating with neural spines; *Haplistia.*

Median fin radii equal in number and articulating with baseosts; *Taxistia.*

II. No dorsal baseosts (or rudiments only); pectoral axonosts triserial.

Median fin radii equal to and articulating with baseosts; axonosts not articulating with neural spines; *Cladistia.*

The PLACODERMI includes the families of the Coccosteidæ, and Dinichthyidæ.

The Phaneropleuridæ is the only known family of the HAPLISTIA; while two are known to belong to the TAXISTIA, viz., the Holoptychiidæ and the Osteolepididæ. To the CLADISTIA belongs only the existing family of the Polypteridæ.

PODOPTERYGIA.

One order of this superorder is known.

Median fins with actinotrichia, and with baseosts and axonosts corresponding with each other and with neural spines; scapular arch suspended to cranium by a post-temporal element; a precoracoid arch and interclavicles; no preoperculum nor symplectic; a notochord; *Chondrostei.*

To the order CHONDROSTEI belong three families, the Polyodontidæ and Accipenseridæ without, and the Chondrosteidæ with, branchiostegal radii.

ACTINOPTERYGIA.

Two tribes pertain to this superorder.

Ventral fins abdominal; a ductus pneumaticus; no spinous dorsal fin; parietal bones usually in contact; scales usually cycloid; *Physostomi.*

[1] The position of this order is not yet certain.

Ventral fins usually thoracic or jugular; no ductus pneumaticus; usually a spinous dorsal fin; parietal bones usually separated by the supraoccipital; scales usually ctenoid; *Physoclysti.*

PHYSOSTOMI.

I. Median fin rays with actinotrichia.

Intercentra distinct, small; no centra. [2]*Lysopteri.*

II. Median fin rays equal to and articulating with axonosts.

a, Vertebræ complex, the pleurocentra and intercentra distinct.

Anterior vertebræ similar; *Merospondyli.*

aa, Vertebræ with centra and intercentra both complete on part of the column at least; amphicœlous;

Anterior vertebræ similar; *Halecomorphi.*

aaa, Vertebræ (intercentra) opisthocœlous.

Anterior vertebræ similar; a precoracoid arch and a coronoid bone; *Ginglymodi.*

aaaa, Vertebræ (intercentra) amphicœlous.

β A, Precoracoid arch.

γ, No symplectic bone.

Pterotic simple; anterior vertebræ modified, and with ossicula auditus; parietals not distinct; *Nematognathi.*

Pterotic annular, including a cavity which is closed by a distinct bone; anterior vertebræ simple, without ossicula auditus; parietals distinct; *Scyphophori.*

γγ, A symplectic bone.

Anterior vertebræ coössified and with ossicula auditus; pterotic simple; *Plectospondyli.*

Anterior vertebræ not modified; pterotic simple; parietals distinct; *Isospondyli.*

ββ, No precoracoid arch.

γ, Scapular arch suspended to cranium.

δ, A symplectic.

Anterior vertebræ and pterotic simple; parietals separated by supraoccipital; *Haplomi.*

Anterior vertebræ modified; parietals not separated; *Glanencheli.*

[2] This order may belong to the Prodopterygia.

δδ. No symplectic.

Anterior vertebræ simple; a preoperculum and palatine arch; *Ichthyocephali.*

γγ. Scapular arch free from cranium.

δ. A symplectic bone.

Hyoid arches developed; *Holostomi.*

δδ. No symplectic.

Opercular bones and five osseous branchial arches, with ceratohyal; *Enchelycephali.*

Opercular bones, and one osseous branchial arch, ceratohyal; *Colocephali.*

No opercular bones, nor ceratohyal, nor osseous branchial arches; *Lyomeri.*

The families of the Physostomi are as follows:

LYSOPTERI; Palæoniscidæ.

MEROSPONDYLI; Sauropsidæ; Pycnodontidæ; Stylodontidæ; Sphærodontidæ; Macrosemiidæ.

HALECOMORPHI; Amiidæ.

GINGLYMODI; Lepidosteidæ.

ISOSPONDYLI; Dapediidæ; Lepidotidæ; Aspidorhynchidæ; Saurodontidæ; Osteoglossidæ; Heterotidæ; Galaxiidæ; Clupeidæ; Chirocentridæ; Salmonidæ; Thymallidæ; Alepocephalidæ; Gonorhynchidæ; Sauridæ; Lutodiridæ; Aulopidæ; Elopidæ; Albulidæ; Hyodontidæ; Notopteridæ.

ACTINOCHIRI; Pelecopteridæ.

PLECTOSPONDYLI; Characinidæ; Sternopygidæ; Cobitidæ; Cyprinidæ; Catostomidæ.

SCYPHOPHORI; Mormyridæ; Gymnarchidæ.

NEMATOGNATHI; Siluridæ; Hypophthalmidæ; Aspredinidæ.

HAPLOMI; Esocidæ; Stratodontidæ; Umbridæ; Cyprinodontidæ; Amblyopsidæ.

GLANENCHELI; Gymnotidæ.

ICHTHYOCEPHALI; Monopteridæ.

HOLOSTOMI; Symbranchidæ.

ENCHELYCEPHALI; Nemichthyidæ; Anguillidæ; Congridæ.

COLOCEPHALI; Muraenidæ.

LYOMERI; Saccopharyngidæ; Eurypharyngidæ.

PHYSOCLYSTI.

I. Basilar bones of median fins well developed;

Scapular arch suspended to cranium; pectoral fin with numerous basilar bones; *Docopteri.*

II. Basilar bones of median fins rudimental or wanting. Pectoral basilars few.

A. Scapular arch suspended to the anterior vertebræ.

Maxillary bone distinct; no interclavicles; epibranchials and pharyngeals present; inferior elements distinct; *Opsithomi.*

AA. scapular arch suspended to cranium by a posttemporal bone.

a. Ventral fins abdominal.

Branchial arches developed, third superior pharyngeal enlarged; gill fringes linear; no interclavicles; *Percesoces.*

Epibranchials and superior pharyngeals reduced in number; interclavicles; gill-fringes linear; *Hemibranchii.*

Epibranchials and superior pharyngeals wanting; gill fringes in tufts; *Lophobranchii.*

aa. Ventral fins thoracic or jugular.

β. Anterior (spinous) dorsal fin expanded into transverse laminæ sessile on cranium.

Cranium normal; branchial bones present; *Discocephali.*

ββ. Spinous dorsal fin not traversely expanded.

γ. Posttemporal projecting freely from skull.

First vertebra united by suture to cranium; intercalaria united behind supraoccipital; basilar pectoral bones elongated; *Pediculati.*

Posterior cephalic region normal; the anterior twisted so as to bring both orbits on one side; inferior pharyngeals distinct *Heterosomata.*

Cranium normal, premaxillaries usually coössified with maxillaries behind, and the dentary with the articular; pharyngeal bones distinct; *Plectognathi.*

Cranium normal; bones of jaws and pharyngeals distinct; *Percomorphi.*

Cranium normal, bones of jaws distinct; third superior pharyngeal much enlarged and articulated with cranium; inferior pharyngeals coösified; *Pharyngognathi.*

$\gamma\gamma$. Posttemporal an integral part of the skull.

Cranium normal; bones of jaws distinct; pharyngeals separate; *Craniomi.*

The families of the preceding order are the following:

DOCOPTERI; Dorypteridæ (possibly Physostomous.)

OPISTHOMI; Mastacembelidæ; Notacanthidæ.

PERCESOCES; Opheocephalidæ; Mugilidæ; Atherinidæ; Sphyraenidæ; Scombresocidæ.

HEMIBRANCHII; Pegasidæ; Gasterosteidæ; Fistulariidæ; Centriscidæ; Amphisilidæ; Dercetidæ.

LOPHOBRANCHII; Solenostomidæ; Syngnathidæ; Hippocampidæ.

DISCOCEPHALI; Echeneididæ.

PEDICULATI; Antennariidæ; Lophiidæ.

HETEROSOMATA; Pleuronectidæ.

PLECTOGNATHI; Triacanthidæ; Balistidæ; Tetrodontidæ; Diodontidæ; Ostraciidæ.

PERCOMORPHI; (Anacanthini) Ophidiidæ; Gadidæ; Macruridæ; (Haplodoci) Batrachidæ; (Cyclopteroidea) Cyclopteridæ; (Epilasmia) Acroneuridæ, Chætodontidæ; (Distegi) Scorpænidæ; Cottidæ; Blenniidæ; Gobiidæ; Platycephalidæ; Rhamphocottidæ; Agonidæ; Heterognathidæ; Gerreidæ; Carangidæ; Sillaginidæ; Pristipomatidæ; Scienidæ; Sparidæ; Percidæ; Berycidæ; Scombridæ; Trichiuridæ; Xiphiadidæ; (Labyrinthici) Osphromenidæ; Anabantidæ.

PHARYNGOGNATHI; Embiotocidæ; Cichlidæ; Labridæ; Scaridæ.

CRANIOMI; Triglidæ; Dactylopteridæ.

BATRACHIA.

The eight orders of the class Batrachia are defined as follows:

I. Basioccipital, supraoccipital, intercalary and supratemporal bones present; propodial bones distinct (*Stegocephali*).

a. One occipital cotyloid articulation.

Vertebral bodies represented by basal and lateral elements (intercentra and centra); *Ganocephali.*

aa. Two occipital condyles.

Vertebræ represented by distinct and incomplete intercentra and centra (pleurocentra); atlas segmented; *Rhachitomi.*

Centra and intercentra complete, making two vertebral bodies to each neural arch; *Embolomeri.*

No centra; intercentra, each supporting a neural arch; *Microsauri.*

II. Basioccipital, supraoccipital, and supratemporal bones wanting; propodial bones distinct; no urostyle (*Urodela*).

a. An os intercalare.

Palatine arch and vomer present; *Proteida.*

aa. No os intercalare.

A maxillary arch and vomers; *Pseudosauria.*

No maxillary arch or vomers; *Trachystomata.*

III. Basioccipital, supraoccipital, intercalare, and supratemporals wanting; frontals and parietals connate; propodial bones connate; lumbosacral vertebrae united into a urostyle (*Salientia*).

A palatine arch and vomers; *Anura.*

STEGOCEPHALI.

Of the GANOCEPHALI two families are known, the Trimerorhachidæ without, and the Archegosauridæ with neural spines of the vertebræ.

The RHACHITOMI possess but one family, the Eryopidæ. To this family belongs the Labyrinthodontia.

Of the EMBOLOMERI one family is known, the Cricotidæ.

The MICROSAURI embraces the following families; Branchiosauridæ; Hylonomidæ; Molgophidæ; Phlegthontiidæ.

URODELA.

Under the PROTEIDA the only family known is the Proteïdæ.

The PSEUDOSAURIA embraces the following families: Cryptochidæ; Amblystomidæ; Hynobiidæ; Plethodontidæ; Thoriidæ; Desmognathidæ; Salamandridæ; Pleurodelidæ; Amphiumidæ; Caeciliidæ.

The TRACHYSTOMATA includes only the family of the Sirenidæ.

SALIENTIA.

The ANURA has the families arranged under the following sub-orders:

Internal nostrils opening together on the middle line; no tongue; coracoids connected by a cartilage on each side; *Aglossa.*

Internal nostrils separate; a tongue; coracoids connected by a separate cartilage on each side; *Arcifera.*

Internal nostrils separate; a tongue; a single median cartilage connecting all the coracoids; scapular arch free; *Firmisternia.*

As in Firmisternia, but scapular arch articulated to skull; *Gastrechmia.*

(Aglossa): Xenopidæ; Pipidæ.

(Arcifera): Discoglossidæ; Bufonidæ; Dendrophryniscidæ; Asterophydidæ; Pelodytidæ; Scaphiopidæ; Hylidæ; Cystignathidæ; Amphignathodontidæ; Hemiphractidæ.

(Gastrechmia): Hemisidæ.

(Firmisternia): Engystomidæ; Phryniscidæ; Dendrobatidæ; Cophylidæ; Dyscophidæ; Colostethidæ; Ranidæ; Ceratobatrachidæ.

MONOCONDYLIA.

There are two subclasses of Monocondylia.

Anterior limbs ambulatory, with numerous carpal and metacarpal bones; two aorta roots; integument consisting partly of scales; *Reptilia.*

Anterior limbs volant, with the carpals and metacarpals more or less coössified and reduced in numbers; integument consisting in part of feathers; one aorta root; *Aves.*

REPTILIA.

Nine orders of Reptilia are known.

I. The quadrate bone united with the adjacent elements by suture.

A. Cranium with one postorbital bar.

a A paroccipital bone.

A supratemporal bone; ribs two-headed on centrum; carpals and tarsals not distinct in form from metapodials; *Ichthyopterygia.*

No supratemporal; sub- and post-pelvic ossifications; interclavicle and clavicles separated from and below scapular arch; ribs one-headed; coracoid large, free; *Testudinata.*

aa No paroccipital bone.

Ribs mostly two-headed, capitulum intercentral; clavicles and interclavicles forming part of shoulder-girdle; no sub- or post-pelvic bones; pelvic elements below plate-like, obturator foramen small or none; *Theromora.*

Ribs one-headed; scapula triradiate; no clavicles; coracoid large, distinct; no sub- or post-pelvic bones; *Plesiosauria.*

AA. Cranium with two postorbital bars.

a. No paroccipital bone; (no supratemporal).

Ribs two-headed; no interclavicle; external digits greatly elongate to support a patagium; *Ornithosauria.*

Ribs two-headed; no interclavicle; acetabulum perforate; feet ambulatory; no patagium; *Dinosauria.*

Ribs two-headed; an interclavicle; acetabulum closed; feet ambulatory; no postfrontal bone; *Crocodilia.*

Ribs one-headed; an interclavicle; acetabulum closed; feet ambulatory; *Rhynchocephalia.*

II. The quadrate bone loosely articulated with adjacent elements, and only proximally.

The quadrate bone in contact only with adjacent elements; no intercalare; supratemporal pies-ent; ribs one-headed; *Squamata*

The order ICHTHYOPTERYGIA embraces the families of Ichthyosauridæ and Mixosauridæ.

Two families enter the ORNITHOSAURIA, viz., the Pteranodontidæ and the Pterodactylidæ.

The DINOSAURIA embraces two suborders, as follows:

Inferior pelvic elements directed downwards; *Saurischia.*

Pelvic elements directed backwards; *Orthopoda.*

The families of the *Saurischia* are the Cetiosauridæ, Cœluridæ and Megalosauridæ. Those of the *Orthopoda* are the Agathaumidæ, Omosauridæ, Scelidosauridæ, and Iguanodontidæ.

The order CROCODILIA embraces one suborder, as follows:

Nareal canal underoofed to behind larynx; no epipterygoid, nor clavicle; pelvis excluded from acetabulum; *Eusuchia.*

Under the *Eusuchia* we know the families Crocodilidæ, Goniopholidæ, and Teleosauridæ.

The RHYNCHOCEPHALIA is a varied order. Its contents fall into two suborders:

Premaxillary region forming a toothless beak; ribs with uncinate process; *Sphenodontina.*

Premaxillary region not beaked; uncinate processes wanting; *Choristodera.*

To the *Sphenodontina* belongs the Sphenodontidæ. The Champsosauridæ from the suborder Choristodera, on account of their many peculiarities, the most important of which now known is the separation of the *os dentatum* from the axis.

The order TESTUDINATA presents four subordinal modifications, as follows:

I. No descending processes of the parietal bones.

Vertebræ and ribs free and separated from a bony exoskeleton; no descending processes of the parietals; *Athecæ.*

II. A carapace and plastron, and descending process of parietals.

a. Sacral and caudal ribs articulating with neural arches only.

Neck bending in vertical plane, last cervical articulating with first dorsal by zygapophyses only; pelvis not anchylosed; marginal bones wanting or rudimental; *Trionychoidea.*

aa. Sacral and caudal ribs articulating with body of vertebræ only.

As the last; but marginal bones present and connected with ribs, and last cervical and last dorsal vertebræ articulating by bodies; pelvis not anchylosed to plastron. *Cryptodira.*

Neck bending in horizontal plane, the last cervical and first dorsal vertebræ articulating by bodies; pelvis anchylosed to carapace and plastron; marginal bones present and connected with ribs; *Pleurodira.*

The *Athecæ* includes the single family of the Dermochelydæ.

The *Trionychoidea* includes only the Trionychidæ.

The *Cryptodira* embraces the Cheloniidæ, Testudinidæ, Cinosternidæ, Dermatemydidæ, Chelydridæ, Baënidæ and Adocidæ.

The *Pleurodira* includes the Pleurosternidæ, Sternothæridæ Pelomedusidæ, Plesiochelydidæ, Chelydidæ and Carettochelydidæ.

The order THEROMORA includes six suborders.

I. Palate closed except posteriorly.

A temporal foramen; *Placodontia.*

II. Palate open anteriorly for nares.

A. The coracoid bone large, reaching sternum.

Dentition abundant; pubis and ischium plate-like; ribs one-headed; *Proganosauria.*

Dentition abundant; ribs two-headed; *Parasuchia.*

Four or five sacral vertebræ; centra not notochordal; no intercentra; dentition imperfect or wanting; obturator foramen minute; *Anomodontia*

AA. The coracoid reduced, not reaching sternum.

Ribs two-headed; two or three sacral vertebræ;

centra generally notochordal; intercentra generally present; dentition abundant; *Pelycosauria.*

Ribs single-headed; temporal fossa overroofed; dentition abundant; intercentra; *Cotylosauria.*

The *Placodontia* include the Placodontidæ only. The *Parasuchia* include the Belodontidæ, and probably the Aëtosauridæ. The *Progansauria*, the Mesosauridæ, the Procolophonidæ, Palæohatteriidæ, Homœosauridæ, Proterosauridæ and Rhynchosauridæ. The *Cotylosauria* include the Pariasauridæ and the Diadectidæ.

The *Pelycosauria* embraces the families of the Clepsydropidæ, Pariotichidæ, and Bolosauridæ. The *Anomodontia* includes the single family of the Dicynodontidæ, and perhaps the Endothiodontidæ.

The PLESIOSAURIA embraces the following families: Plesiosauridæ, Nothosauridæ, and Lariosauridæ.

The SQUAMATA is an extended group, which is represented by three sub-orders, which are defined as follows:

Alisphenoid modified as epipterygoid, or wanting, leaving brain-case open; parietals flat; an interclavicle and clavicle; teeth with dentinal roots; *Lacertilia.*

Epipterygoid present; parietals decurved, partially enclosing brain-case; no clavicle nor interclavicle; teeth with osseous roots; *Pythonomorpha.*

No epipterygoid; brain-case enclosed in front; no clavicle nor interclavicle; no fore-limbs; *Ophidia.*

The LACERTILIA embraces the following superfamilies.

I. Proötic not produced beyond arched body; acrodont; olfactory lobes not underarched; two suspensoria.

No clavicle nor interclavicle; no columella; tongue papillose, extremity sheathed; *Rhiptoglossa.*

A clavicle proximally simple; an anchor-shaped interclavicle; a columella; tongue papillose, not sheathed; *Acrodonta.*

II. Proötic bone not produced beyond arched body; dentition pleurodont; olfactory lobes not underarched; two suspensoria.

A clavicle proximally simple; an anchor-shaped interclavicle; a columella; tongue papillose, not sheathed; *Iguania.*

III. Proötic bone not produced beyond arched body; dentition pleurodont, or nearly so; two suspensoria.

a. Clavicle simple proximally; olfactory lobes not underarched by frontal.

Interclavicle cruciform; tongue papillose; *Diploglossa.*

aa. Clavicle proximally simple; olfactory lobes underarched by frontal.

Vertebræ procœlous; tongue smooth; *Thecaglossa.*

Vertebræ amphicœlous; tongue papillose; *Geccovarani.*

aaa. Clavicle proximally expanded; olfactory lobes underarched by os frontale.

Tongue papillose or smooth; *Nyctisaura.*

aaaa. Clavicles, when presen t, expanded proximally; olfactory lobes not underarched.

Clavicles, interclavicle, and sternum present; surangular distinct; tongue scaly; *Leptoglossa.*

Clavicles, interclavical and sternum absent; tongue scaly; *Typhlophthalmi.*

IV. Proötic bone produced beyond arched body; one suspensorium (=supratemporal wanting); pelvic arch rudimentary or wanting.

Frontal bone underarching olfactory lobes; supraoccipital gomphosis internal; no orbitosphenoid; *Anguisauri.*

Frontal bone underarching olfactory lobes; supraoccipital gomphosis external; an orbitosphenoid; *Opheosauri.*

The families of these suborders are the following:

Rhiptoglossa; Chamæleonidæ.

Acrodonta; Agamidæ.

Iguania; Iguanidæ, Anolidæ.

Diploglossa; Zonuridæ, Pygopodidæ, Anguidæ, Xenosauridæ, Helodermidæ.

Thecaglossa; Varanidæ.

Geccovarani; Uroplatidæ.

Nyctisaura; Eublepharidæ, Gecconidæ.

Leptoglossa; Xantusiidæ, Teidæ, Lacertidæ, Gerrhosauridæ, Scincidæ.

Typhlophthalmi; Acontiidæ, Anelytropidæ.

Anguisauri; Aniellidæ.

Opheosauri; Chirotidæ, Amphisbænidæ, Trogonophidæ.

The PYTHONOMORPHA embraces two families, the Plioplatecarpidæ, and the Mosasauridæ.

The OPHIDIA include the following superfamilies.

A. Supratemporal intercalated in the cranial walls. (*Angiostomata.*)

a. No ectopterygoid; palatines bounding choanæ posteriorly; ethmoturbinal forming part of roof of mouth; rudiments of a pelvis. (*Scolecophidia.*)

Maxillary bone fixed to perfrontal and premaxillary; a pelvis; *Catodonta.*

Maxillary bone vertical and free from all others; no pelvis; *Epanodonta.*

aa. An ectopterygoid; palatines not bounding choanæ posteriorly.

Maxillary bone free, horizontal; *Tortricina.*

AA. Supratemporal attached scale-like to cranial walls, produced freely posteriorly; ectopterygoid present (*Eurystomata.*)

Maxillary bone horizontal, in contact with the premaxillary, and furnished with solid teeth; no rudiments of pelvis; *Asinea.*

Maxillary bone horizontal, thickened in front, and not reaching premaxillary, and bearing a perforate tooth; *Proteroglypha.*

Maxillary bone vertical, not reaching premaxillary, articulating with the prefrontal by a ginglymus, and to the ectopterygoid without imbrication, and bearing a perforated tooth; *Solenoglypha.*

The families embraced by these superfamilies are as follows:

Catodonta; Stenostomidæ.

Epanodonta; Typhlopidæ.
Tortricina; Tortricidæ, Uropeltidæ.
Asinea; Xenopeltidæ, Pythonidæ, Boidæ, Charinidæ, Achrochordidæ, Nothopsidæ, Colubridæ.
Proteroglypha; Hydrophidæ, Najidæ, Elapidæ, Dendraspididæ.
Solenoglypha; Causidæ, Atractaspididæ, Viperidæ, Crotalidæ.

AVES.

There are four superorders of the birds, as follows:

Metacarpal and carpal bones all distinct, the digits with ungues; caudal vertebræ numerous, unmodified; clavicles united; pelvic elements distinct; teeth present; *Saururæ.*

Metacarpals and carpals coössified; digits without ungues; caudal vertebræ moderately numerous, without ploughshare bone; clavicles distinct; pelvic elements coössified; teeth present; *Odontolcæ.*

Metacarpals and pelvic elements coössified; caudal vertebræ reduced, with a pygostyle or plowshare bone; vertebræ biconcave; teeth present; *Odontotormæ.*

Metacarpals and carpals coössified; pelvic elements coössified; clavicles coössified; caudal vertebræ few, terminating in a plowshare bone; vertebræ mostly saddle-shaped; no teeth; *Eurhipiduræ.*

The SAURURÆ includes but one order, which is defined as follows:

Vertebræ biconcave; feathers arranged in one series on each side of the caudal vertebræ; *Ornithopappi.*

To this order but one family belongs, viz., the Archæopterygidæ.

The superorder ODONTOLCÆ includes also but one order.

Teeth in a grove; sternum without keel; wings rudimental; pelvic bones free posteriorly; *Dromæopappi.*

The DROMÆOPAPPI has but one family, the Hesperornithidæ.

To the ODONTOTORMÆ one order only is referred. It is thus characterized:

Teeth in sockets; sternum keeled; wings well developed; ischium and pubis free posteriorly; *Pteropappi.*

The family of the Ichthyornithidæ is the only one known to belong to the PTEROPAPPI.

The superorder EURHIPIDURÆ includes all recent birds. There are three orders, which are defined as follows:

Palate dromæognathous; pelvic elements free posteriorly; *Dromæognathæ.*

Palate not dromæognathous; pubis free from ischium; integument covered uniformly with feathers, which are not differentiated on the wings; *Impennes.*

Palate not dromæognathous; vertebræ mostly saddle-shaped; ilia and ischia anchylosed behind; ilia anchylosed to sacrum; mandibular rami coössified at symphysis; feathers with definite local distribution, those of the fore limb much deferentiated; *Euornithes.*

The DROMÆOGNATHÆ include the following suborders:

Sternum without keel; clavicles; wings rudimental; *Struthiones.*
Sternum without keel; no clavicles; wings rudimental; *Apteryges.*
Sternum with keel; clavicles; wings rudimental; *Gastornithes.*
Sternum with keel; clavicles; wings functional; *Crypturi.*

The families belonging to these orders are the following:

Struthiones; Struthionidæ, Rheidæ, Casuariidæ, Dromæidæ, Dinornithidæ, Aepiornithidæ.

Apteryges; Apterygidæ.

Gastornithes; Gastornithidæ.

Crypturi; Crypturidæ.

To the IMPENNES but one suborder belongs. This is the Ptilopteri.

Ilium not anchylosed with sacrum; bones of wing not foldable on each other; metacarpals not separated; hallux directed forwards; feathers scale-like; vertebræ opisthocœlous; *Ptilopteri.*

The Ptilopteri includes the single family of the Aptenodytidæ or penguins.

The EUORNITHES include numerous suborders, which are defined as follows:

I. Maxillopalatines united across the middle of the palate. (*Desmognathæ*).

A. Four toes directed forwards (pamprodactylous).

Toes webbed; no basipterygoids; *Steganopodes.*

Toes free; vomer unossified; no basipterygoid processes; *Colioïdei.*

AA. Three toes directed forwards.[1]

Short basipterygoid processes; toes generally webbed; præcocial; *Chenomorphæ.*

No basipterygoid processes; bill and legs slender; toes generally free; altricial; *Herodii.*

Bill and claws hooked; toes free; altricial; vertebræ saddle-shaped; *Accipitres.*

Bill hooked; toes free; vertebræ opisthocœlous; rostrum movably articulated with skull; basipterygoids; *Heterospondyli.*

Toes free; vertebræ saddle-shaped; rostrum fixed; *Coccygomorphæ.*

AAA. Two toes directed forwards and two backwards.

Rostrum freely articulated with the skull; vertebræ opisthocoelous; *Psittaci.*

II. Maxillopalatines not united across the palate; vomer narrowed and acute in front. (*Schizognathæ.*)

A. Toes three forwards (anisodactylous).

Schizorhinal; toes webbed; *Cecomorphæ.*

Toes free; legs long; feathers with after shaft; præcoces; *Grallæ.*

No basipterygoids; lachrymal bones coössified with rostrum; toes free; *Opisthocomi.*

Toes free; hallux rudimental; *Gallinæ.*

Toes free; hallux well developed; two carotids; *Pullastræ.*

Toes free; hallux well developed; one carotid artery; basipterygoids; *Micropodioidei.*

[1] Except Cuculidæ, which are zygodactylous.

AA. Toes two in front (heterodactylous).

Toes free; hallux well developed; basipterygoids present; *Trogonoidei.*

III. Maxillopalatines not united on median line; vomer single, truncate, and excavated in front. (*Ægithognathæ.*)

A. Toes three in front (anisodactylous).

Toes free; hallux well developed; tarsometatarsus with five tendinous canals; basipterygoids wanting or rudimental; sternum with two notches; no cæca coli; one carotid artery; *Passeres.*

AA. Four toes directed forwards (pamprodactylous).

Toes free; no basipterygoids; sternum entire posteriorly; tensor patigii brevis muscle attached to a tendon which extends to the manus; no cœca; *Micropodioidei.*

IV. Maxillopalatines separate; vomer double, represented by two laminæ. (*Saurognathæ.*)

A. Two toes directed forwards.

Feet zygodactylous; no cœca coli; no interclavicle; one carotid artery; *Picoidei.*

The arrangement of the above orders is not expressive of their true affinities in all cases. Thus the Colioidei, Cocygomorphæ, Micropodioidei, Trogonoidei, and Picoidei, are more or less related, and sometimes brought together into a single heterogeneous order called the Picariæ.

The families of the EUORNITHES are as follows:

Steganopodes; Phætonidæ, Fregatidæ, Pelecanidæ, Sulidæ, Phalacrocoracidæ, Plotidæ.

Chenomorphæ; Palamedeidæ, Anatidæ, Phœnicopteridæ.

Herodii; Ibididæ, Ciconiidæ, Balænicipitidæ, Ardeidæ.

Accipitres; Cathartidæ, Falconidæ, Pandionidæ, Strigidæ.

Psittaci; Psittacidæ.

Cecomorphæ; Colymbidæ, Heliornithidæ, Alcidæ, Laridæ, Procellariidæ.

Grallæ; Chionidæ, Thinocoridæ, Glareolidæ, Dromadidæ, Charadriidæ, Otididæ, Eurypygiidæ, Rhinochetidæ, Cariamidæ, Psophiidæ, Gruidæ, Rallidæ.

Opisthocomi; Opisthocomidæ.

Gallinæ: Tetraonidæ, Phasianidæ.

Pullastræ; Cracidæ, Megapodiidæ, Pteroclidæ, Dididæ, Columbidæ.

Colioidei: Coliidæ.

Heterospondyli; Steatornithidæ.

Coccygomorphæ; Cuculidæ, Coraciidæ, Alcedinidæ, Upupidæ, Musophagidæ, Todidæ, Momotidæ, Bucerotidæ, Rhamphastidæ, Caprimulgidæ, Bucconidæ, Indicatoridæ.

Micropodioidei; Cypælidæ, Trochilidæ.

Trogonoidei; Trogonidæ.

Picoideæ; Picidæ.

Passeres. This order is divided into five superfamilies as follows:

Tensor patagii brevis picarian;			*Menuroidei.*
Tensor patagii brevis passerine; syrinx,	Mesomyodian,	desmopelmous;	*Eurylæmoidei.*
		bronchiotracheal; schizopelmous,	*Tyrannoidei.*
		tracheal; schizopelmous.	*Formicaroidei.*
	Acromyodian schizopelmous;		*Passeroidei.*

The families of these superfamilies are the following:

Menuroidei; Menuridæ, Atrichornithidæ.

Eurylæmoidei; Eurylæmidæ.

Tyrannoidei; Xenicidæ, Philepittidæ, Pittidæ, Tyrannidæ, Cotingidæ, Phytotomidæ.

Formicaroidei: Conopophagidæ, Pteroptochidæ, Formicariidæ.

Passeroidei; Alaudidæ, Motacillidæ, Timaliidæ, Liotrichidæ, Muscicapidæ, Turdidæ, Cinclidæ, Troglodytidæ, Chamæidæ, Hirundinidæ, Artamidæ, Laniidæ, Paridæ, Paradisiidæ, Corvidæ, Sturnidæ, Meliphagidæ, Nectariniidæ, Certhiidæ, Ploceidæ, Tanagridæ, Icteridæ, Fringillidæ.

MAMMALIA.

Two subclasses are known to belong to this class.

An interclavicle; a large coracoid articulating with the sternum; *Prototheria.*

No interclavicle; coracoid very small, coössified with scapula; not reaching sternum; *Eutheria.*

Of the PROTOTHERIA, there are probably three orders of which species are known, but the location of the two first enumerated below is not certain.

Incisors reduced; molars with compressed cutting crowns, and undivided roots; *Protodonta.*

Incisors enlarged; molars with tubercular grinding surfaces, and distinct roots; *Multituberculata.*

No true teeth at maturity; *Ornithostomi.*

The families are the following:

Protodonta; Dromatheriidæ.

Multituberculata; Tritylodontidæ, Plagiaulacidæ, Chirogidæ, Polymastodontidæ.

Ornithostomi; Ornithorhynchidæ, Echidnidæ.

Thc EUTHERIA are represented by the following numerous orders.

I. Marsupial pelvic bones (generally); palate perforated; (vagina double; placenta wanting; corpus callosum rudimental; cerebral hemispheres small.) (*Didelphia.*)

One deciduous molar tooth; *Marsupialia.*

II. No marsupial bones; palate generally entire; (one vagina; placenta and corpus callosum well developed.) (*Monodelphia.*)

A. Posterior limbs wanting, or represented by minute rudiments; anterior limbs oar-like. (*Mutilata.*)

Elbow joint inflexible; carpals discoid, and, with the phalanges, separated by cartilage; lower jaw without ascending ramus; *Cetacea.*

Elbow joint flexible; carpals and phalanges with close articulations; mandible with ascending ramus; *Sirenia.*

AA. Posterior limbs present; ungual phalanges compressed and curved on one or all the feet.[3] (*Unguiculata.*)

[3] Except Mesonychidæ, some Glires, and posterior feet of some Edentata.

β. Carpal and tarsal bones generally in linear series.

γ. Teeth without enamel; no incisors.

Limbs ambulatory; hemispheres small; *Edentata.*

γγ. Teeth with enamel; incisors present.

No postglenoid process; mandibular condyle not transverse; mastication proal; limbs not volant; hemispheres small; *Glires.*

Anterior limbs volant; hemispheres small; *Chiroptera.*

A postglenoid process; mandibular condyle transverse; mastication orthal, no scapholunar bone;[4] hemispheres small, smooth; *Bunotheria.*

A postglenoid process; limbs not volant, with a scapholunar bone; mastication orthal; hemispheres larger, convoluted; *Carnivora.*

ββ. Carpal and tarsal bones alternating; faceted.

Anterior limbs prehensile; mandibular condyle, and mastication transverse; *Ancylopoda.*

AAA. Posterior limbs present; ungual phalanges not compressed and hooked.[5] (*Ungulata.*)

β. Carpal, and usually tarsal bones in linear series.[6]

Limbs ambulatory; teeth with enamel; *Taxeopoda.*

ββ. Tarsal bones alternating; carpals linear or reversed diplarthrous.

Cuboid bone partly supporting navicular, not in contact with astragalus; no canine teeth; *Proboscidea.*

βββ. Both tarsal and carpal series more or less alternating; the distal row inwards.

Os magnum not supporting scaphoides; cuboid supporting astragalus; superior molars tritubercular; *Amblypoda.*

Os magnum supporting scaphoides; superior molars quadritubercular;[7] *Diplarthra.*

4 Except Talpa and Erinaceus.

5 Except in the Hapalidæ.

6 Except in Dendrohyrax.

7 Except Pantolestidæ.

The families embraced in the above orders are the following:

MARSUPIALIA; (*Polyprotodontia*); Triconodontidæ, Amphitheriidæ. Myrmecobiidæ, Dasyuridæ, Didelphidæ, Peramelidæ; (*Diprotodontia*); Phascolomyidæ, Phalangistidæ, Tarsipedidæ, Diprotodontidæ, Macropidæ, Thylacoleontidæ.

CETACEA; (*Archæoceti*); Zeuglodontidæ; (*Odontoceti*); Squalodontidæ, Platanistidæ, Physeteridæ, Delphinidæ, (*Mystacoceti*); Balænidæ.

SIRENIA; Prorastomidæ, Halitheriidæ, Manatidæ, Halicoridæ, Rhytinidæ.

BUNOTHERIA; (*Pantotheria*); Amblytheriidæ; (*Creodonta*); Mesonychidæ, Esthonychidæ, Arctocyonidæ, Miacidæ, Hyænodontidæ, Leptictidæ, Centetidæ; (*Insectivora*); Galeopithecidæ, Tupæidæ, Solenodontidæ, Macroscelididæ, Talpidæ, Adapisoricidæ, Mythomyidæ, Scalopidæ, Chrysochloridæ, Erinaceidæ, Myogalidæ, Soricidæ; (*Tæniodonta*); Ectoganidæ, Stylodontidæ; (*Tillodonta*); Tillotheriidæ.

EDENTATA; Orycteropodidæ, Manidæ, Bradypodidæ, Megatheriidæ, Myrmecophagidæ, Dasypodidæ, Glyptodontidæ.

GLIRES; (*Simplicidentata*); Sciuridæ, Muridæ, Hystricidæ; (*Duplicidentata*), Leporidæ.

CHIROPTERA; (*Animalivora*); Phyllostomidæ, Desmodontidæ, Rhinolophidæ, Noctilionidæ, Vespertilionidæ, Emballonuridæ; (*Frugivora*), Pteropidæ.

CARNIVORA; (*Fissipedia*); Cercoleptidæ, Procyonidæ, Æluridæ, Canidæ, Bassarididæ, Mustelidæ, Protelidæ, Arctictidæ, Viverridæ, Cynictidæ, Suricatidæ, Cryptoproctidæ, Nimravidæ, Felidæ, Hyænidæ; (*Pinnipedia*); Phocidæ, Otariidæ, Odobænidæ.

ANCYLOPODA; Chalicotherriidæ.

TAXEOPODA; (*Condylarthra*); Periptychidæ, Phenacodontidæ, Meniscotheriidæ; (*Toxodontia*); Proterotheriidæ, Mesotheriidæ, Toxodontidæ, Macraucheniidæ; (*Hyracoidea*); Hyracidæ; (*Daubentonioidea*); Chiromyidæ; (*Quadrumana*); Mixodectidæ, Adapidæ, Anaptomorphidæ, Tarsiidæ, Lemuridæ, Hapalidæ, Cebidæ, Cercopithecidæ; (*Anthropomorpha*); Simiidæ, Hominidæ.

PROBOSCIDIA; Dinotheriidæ, Elephantidæ.

AMBLYPODA; (*Taligrada*); Pantolambdidæ; (*Pantodonta*); Coryphodontidæ; (*Dinocerata*); Uintatheriidæ.

DIPLARTHRA; (*Perissodactyla*); Lophiodontidæ, Triplopidæ, Cænopidæ, Hyracodontidæ, Rhinoceridæ, Tapiridæ, Lambdotheriidæ, Menodontidæ, Palæotheriidæ, Equidæ; (*Artiodactyla*); Pantolestidæ, Eurytheriidæ, Anoplotheriidæ, Dichobuniidæ, Cænotheriidæ, Anthracotheriidæ, Xiphodontidæ, Suidæ, Hippopotamidæ, Merycopotamidæ, Dichodontidæ, Oreodontidæ, Poëbrotheriidæ, Protolabididæ, Camelidæ, Eschatiidæ, Tragulidæ, Moschidæ, Bovidæ, Cervidæ.

NOTES ON THE ARCHEOLOGY AND ETHNOLOGY OF EASTER ISLAND.

BY WALTER HOUGH.

EASTER Island forms the southwesterly extremity of the Polynesian Archipelago, in S. lat. 27°, W. long. 109°, about 1900 miles west of Santiago, Chili. It is roughly twelve miles long by four wide, volcanic in origin. It is inhabited now by a remnant of Malayo-Polynesian stock.

From an archeological point of view, this island is very interesting; stone images, carved stones, subterranean dwellings, weapons, tools, cave ossuaries, etc., abound. One of the last acts of the late Professor Spencer F. Baird was to induce the Navy Department to send a vessel to explore the island, and bring back representative specimens. The U. S. S. Mohican, then at Tahiti, was detailed, and the fruits of the successful twelve days' exploration are to be seen in the North and West halls of the National Museum, consisting of several stone images, carved stones, painted slabs, and the fine collection of smaller objects procured by Paymaster W. J. Thomson, U. S. N.

The museum is indebted to the latter gentleman, and to Surgeon Geo. H. Cooke, U. S. N., for information concerning the specimens and the people of the island.

The largest figure collected is a torso and head (Fig. 1) weighing three tons, and standing over eight feet high, made of a porous volcanic rock, probably friable basalt lava, or tufa. The

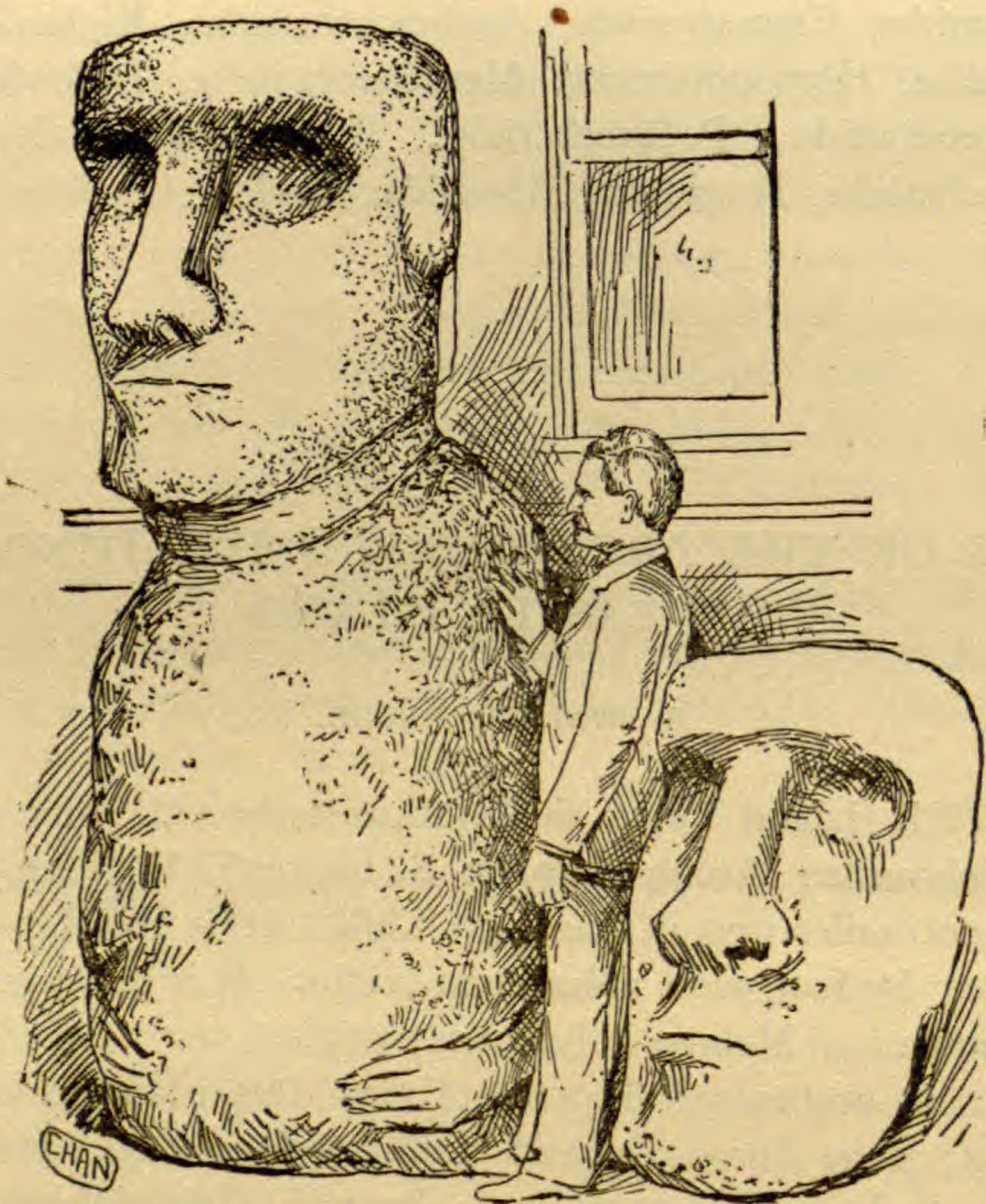

FIG. 1.—EASTER ISLAND IMAGES IN NATIONAL MUSEUM.

face is very broad, with crude features. Large eye-sockets are cut out for the reception of pieces of obsidian representing eyes. The arms clasped over the breast are only outlined; all the statues have only the face modeled, that part being worked out with the highest skill possessed by the artists. In detail, this is shown by the nose. The septum is wide, as in the Papuan nose, and the alæ are prominent. The lips protrude with a pouting expression. The oval eye-sockets measure 13 by 8 inches. The ears are 21 inches long, not modeled except in general outline, and having a few shallow grooves. The edges of the lower jaw are sharp, and the neck is cut squarely into the breast. A necklace is apparently marked out. The pectoral mammæ are obscurely shown. The back of the figure is nearly flat, and parallel verti-

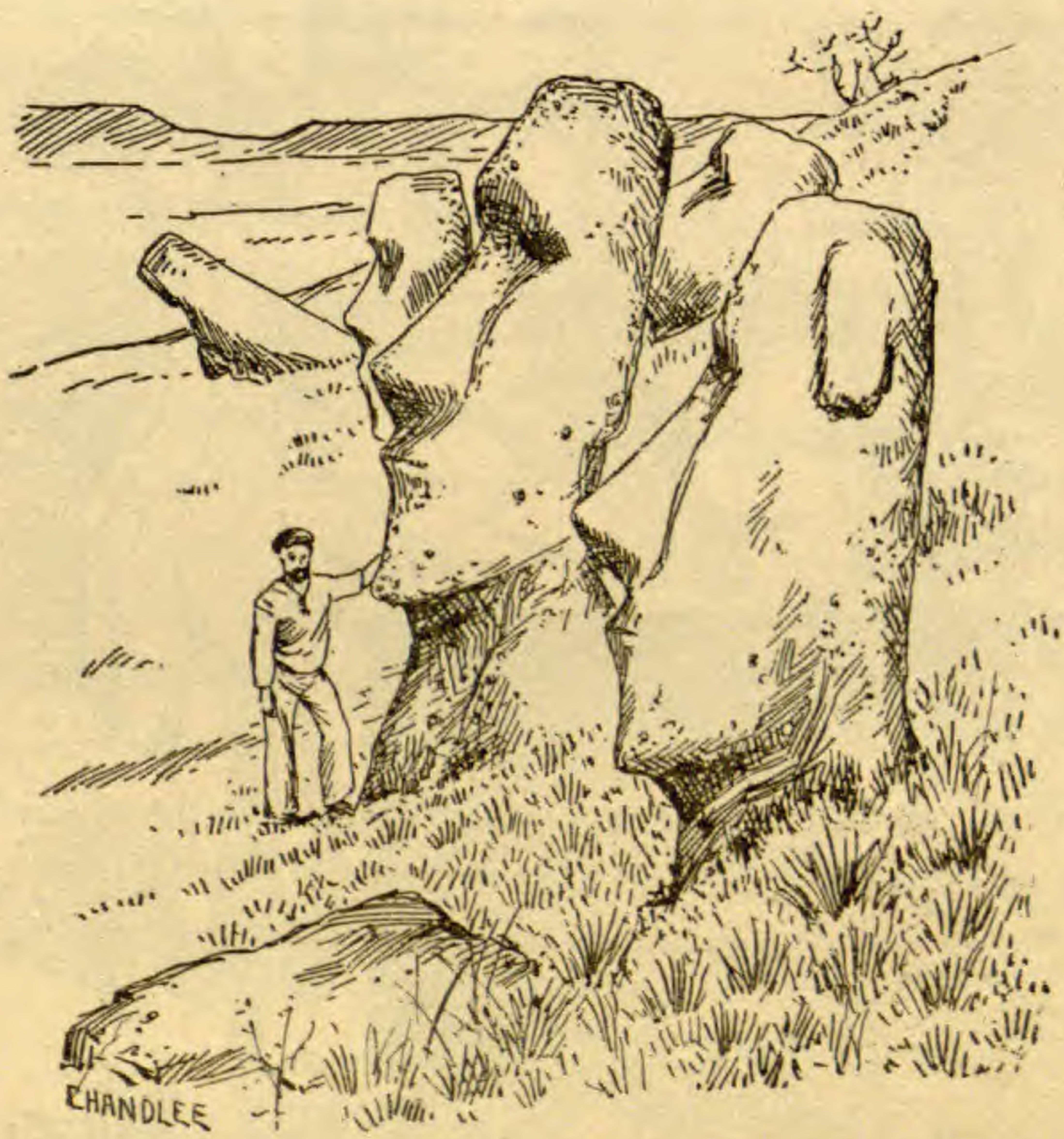

FIG. 2.—IMAGES PARTIALLY BURIED IN THE DEBRIS IN CRATER OF RANAKAU.

cal grooves show how the image was chopped out. The stone is wreathed and covered with lichen, so that there are scarcely any traces of tool marks. Certain rounded blocks of very vesicular rock are crowns that were placed upon the flat heads of the figures. Characters are seen carved on the side of the crown.

Originally from six to fifteen colossi were set upon long but narrow platforms or terraces of stone. There are various conjectures as to their meaning. Mr. Thomson thinks they were merely commemorative, and that the platforms were burial places of the chiefs. Nearly all the six hundred figures on the island are prostrate, it is not known through what agency. The platforms are 113 in number, and the largest found was 150 feet long, 9 feet high, and 6 feet wide. With the original wings, it would

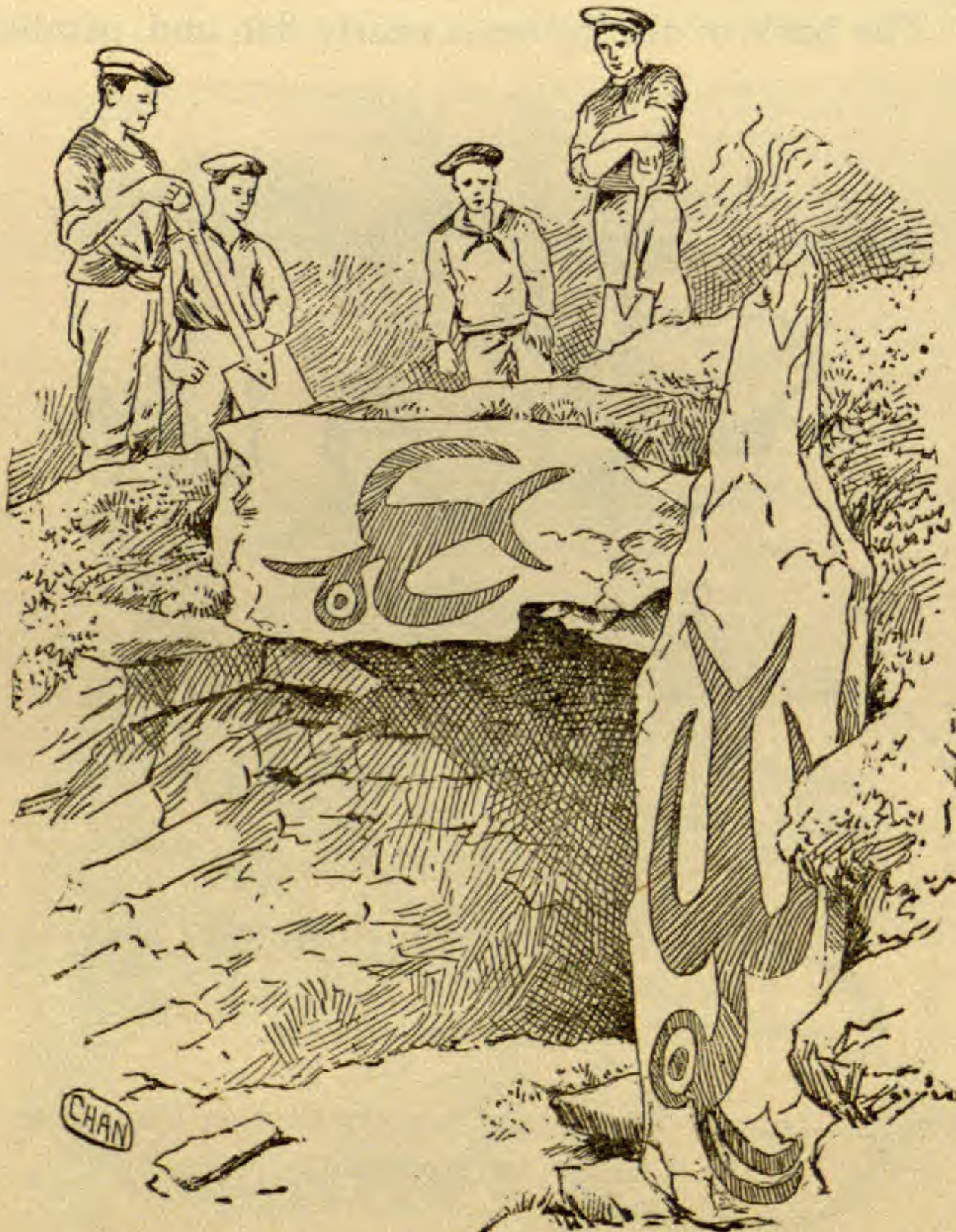

FIG. 3.—MOHICAN PARTY UNCOVERING A HOUSE.
(Slabs in the National Museum.)

have been 340 feet long. The images are of various sizes, the largest 70 feet in height.

The workshop and quarry where the workmen got these figures out was in the crater of the extinct volcano of Ranakau, now partially filled with a marsh, and showing in places the cavernous cliff of its ancient rim. There are dozens of images yet in the crater. (Fig. 2.) No metal was known; the tools were chisels and adze blades of tough volcanic rock. They cut into the cliff, outlining and rounding the figure until it was detached, then probably mounted it on skids, and dragged it to its destination.

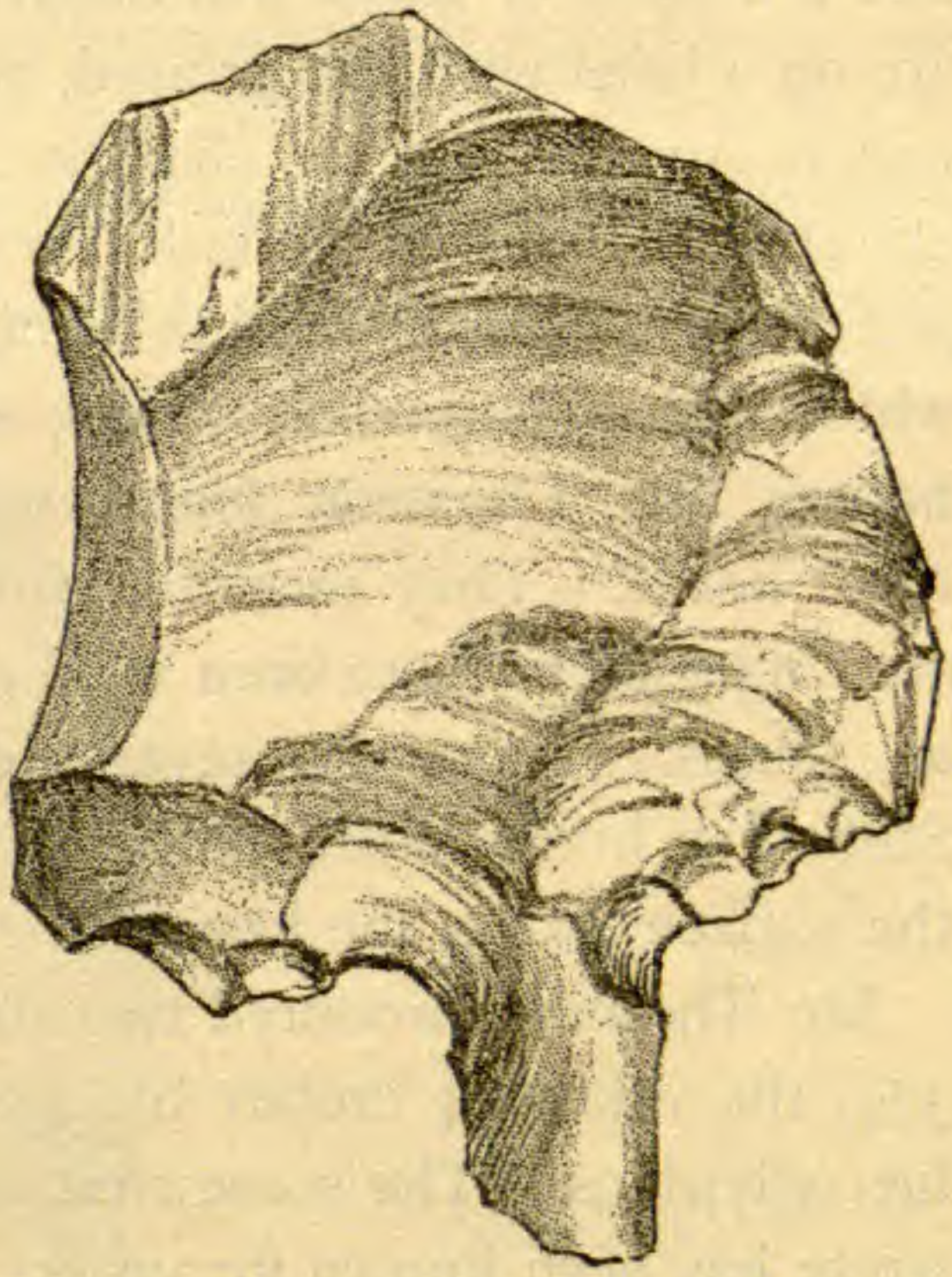

FIG. 4.—SPEAR HEAD OF OBSIDIAN.

Though the volcano is 1400 feet in height above sea-level, the crater is easily accessible over a low, sloping place in its rim. How these people moved these images over the singularly difficult topography the island presents, is a problem. They moved monoliths 60 feet high, weighing at least 50 tons, twelve miles, and set them up! This, too, without any timber, except driftwood. Many of the images were abandoned, however; they are strewn all the way from the crater—the only place where suitable rockwas found—to the platforms.

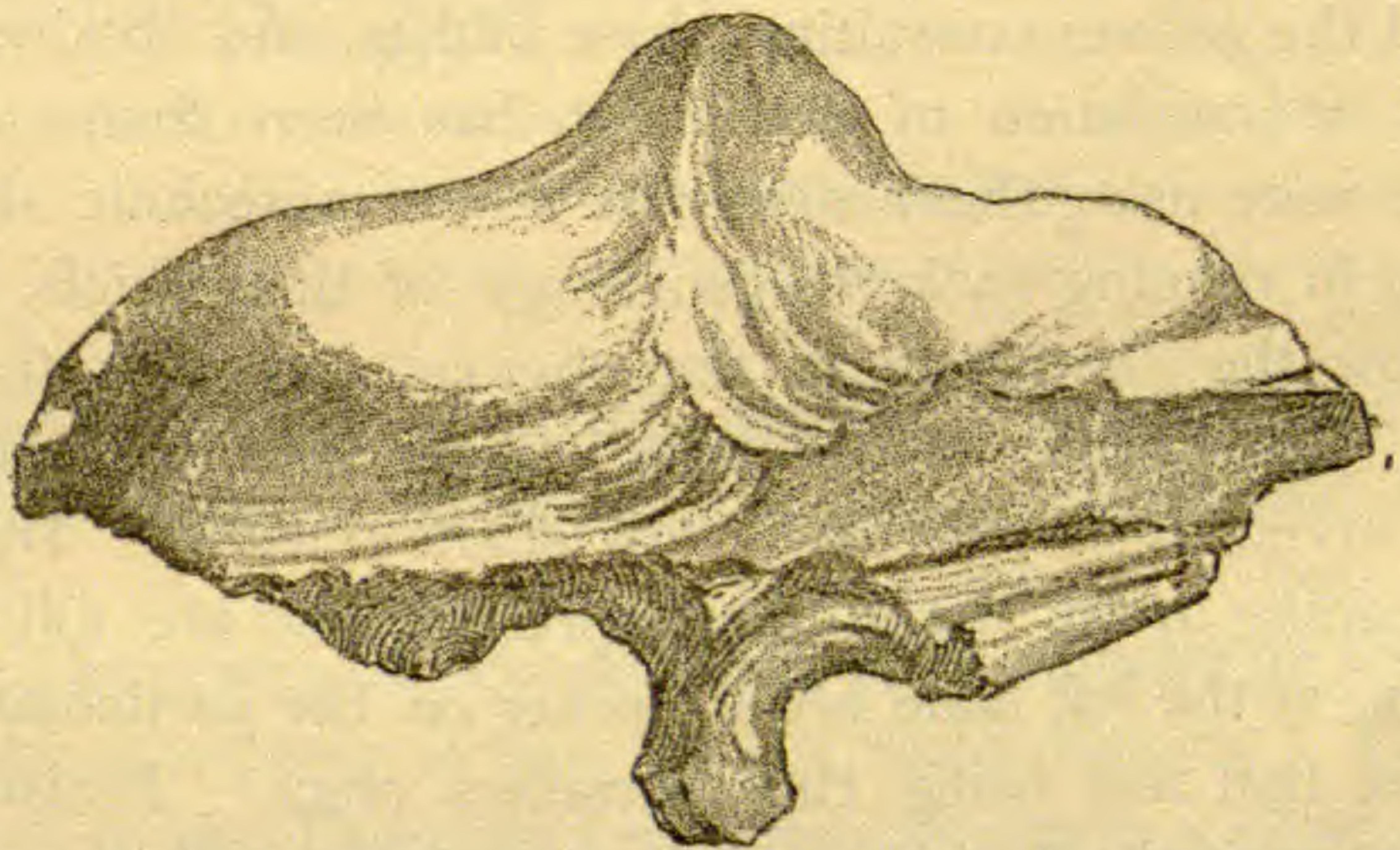

FIG. 5.—SPEAR HEAD OR BATTLE AXE MADE OF OBSIDIAN.
(From specimens in the United States National Museum.)

The houses found on the island were arranged in parallel rows facing the sea, built of small irregular slabs of stone. They have one room, usually measuring fourteen feet long by six in width, and five feet two inches high, with walls in some cases five feet thick. They are lined and roofed with pictured slabs (Fig. 3), and a mound of earth was heaped over the top. The doorways are on a level with the ground, and are so narrow that it is difficult to squeeze into the chamber. One of these slabs, weighing about six hundred pounds, brought in the Mohican, has the picture of a bird, or marine animal with a bird's head, in red and white, with outstretched wings, upon it. In these subterranean houses Mr. Thomson found many peculiarly-shaped obsidian spear heads. They resemble, somewhat, ancient battle axes, and are supposed to have been used as missiles, and, hafted on poles, as spears. There are several distinct forms (Figs. 4 and 5). Stone fish hooks, adze blades, round stones, are found also on the surface and in the houses.

Mr. Thomson procured two slabs of wood, one 9½ inches by 3½, the other 24 inches by 4½ inches, covered with rows of hieroglyphics. The somewhat remarkable fact that these people wrote has been known for years. These tablets were said to have been numerous on the island some years ago, but were destroyed through the zeal of Catholic missionaries. There are now but some seven or eight in existence, held by the Bishop of Tahiti, the British and the U. S. National Museums. The Bishop of Tahiti observed the natives consulting these tablets, and obtained, as he thought, a translation of them. It has been found that the islanders were using them merely as a mnemotechnic device to aid them in running back the genealogy of their chiefs, and did not follow the characters in the obvious way that they were written. The characters are about half an inch in height, beautifully carved, it is supposed with shark's teeth. They carry their meaning in the thing they represent, and are followed by beginning at the left hand lower corner on the particular side of the tablet that will bring the characters erect. Finishing the lower line with the figures turned toward the reading, and going to the next line above, the reading is continued from right to left (boustrephodon). In order to have the images face the same way, it is necessary, in reading a new line, to turn successively the right side of the tablet to the left.

The native traditions state that their ancestors came from Rapaiti (27° 35′ S. lat., 144° 20′ W. long.) under Chief Tocuyo, and that twenty-two chiefs have succeeded him up to twenty years ago (about 500 years).[1] They say that Tocuyo knew the language of these tablets, and brought with him sixty-seven tablets containing allegories, proverbs, and traditions of the country from

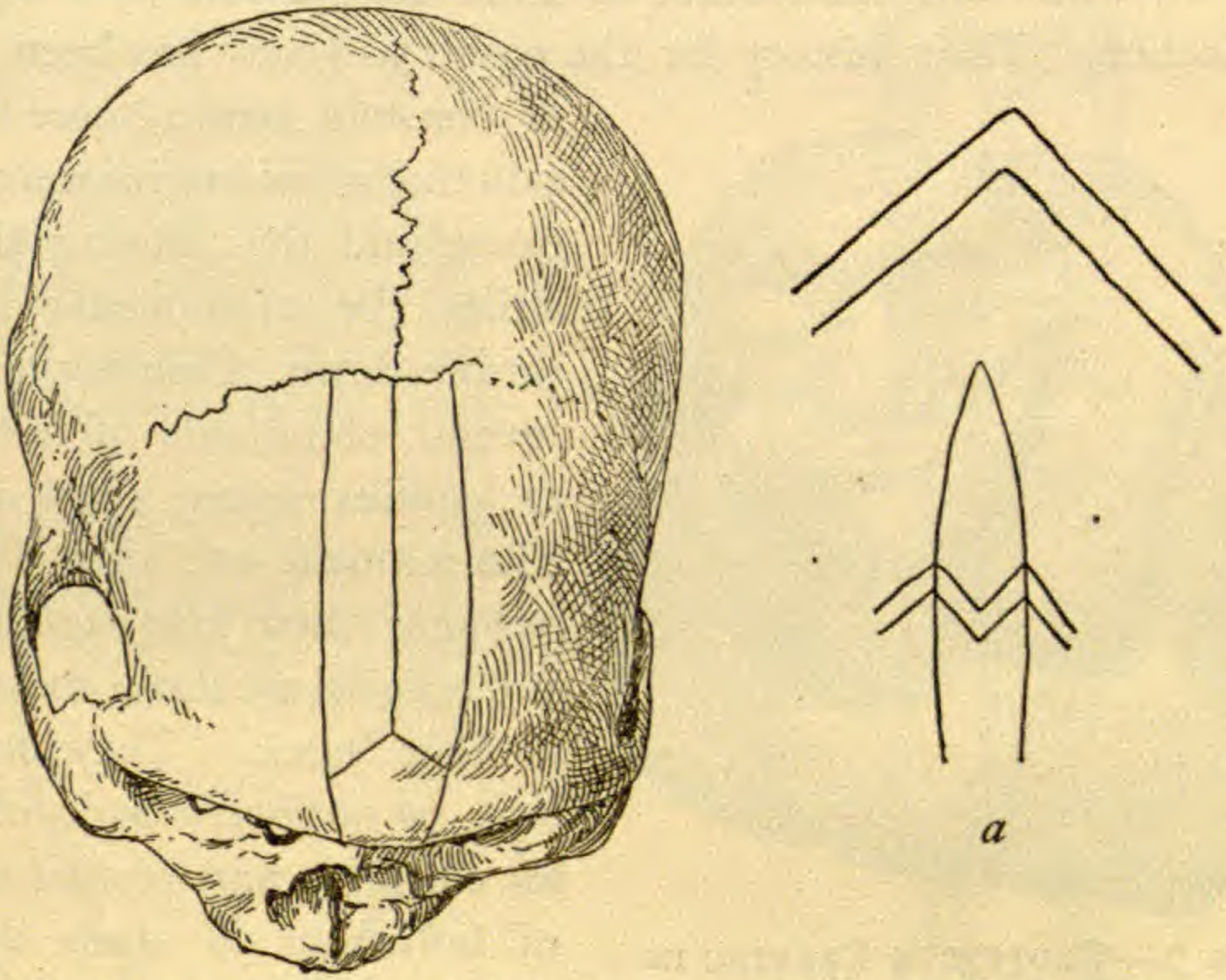

FIG. 6.—SKULL WITH SIGN ENGRAVED ON FRONTAL BONE, (*a*) DESIGNS FROM OTHER SKULLS.

(From specimens in the United States National Museum.)

which they came. A certain number of youths from each clan were instructed in the reading of these writings, and on a great fête day, once a year, the people assembled to hear them read Some characters like those on the tablets appear on the platforms and the doorposts of the ancient stone houses. Three skulls (Fig. 6) in the Thomson collection have each a character deeply cut in the frontal bone. These skulls were said by the natives to have been of their chiefs.

[1] Palmer, Visit to Easter Id. *J. Roy. Geog. Soc.*, XL., 1870.

Hieroglyphs like those of the tablets also appear on the door-posts, slabs, and in other places. Near the platforms and houses are many curiously-carved stones, sometimes on rock masses and again detached grotesque carvings. Fig. 7 represents one of the latter.

THE NATIVES.—The natives number at present about 155; it is supposed that on the discovery of the island by Roggeween in 1722 there were 20,000. Having lived so long in isolation, they were peculiarly ill-adapted to stand the pressure of a higher civilization. Their history for the past 150 years has been one of constant wars: some have said that missionaries were the cause, and that during these strifes the monuments were thrown down. Chili impressed several ship-loads of natives as coolies some years ago. The remnant are pure Polynesians; their language, arts, and religion are those common to that stock. They make tapa, or mulberry bark cloth, for clothing, and plaited mats of bulrushes to sleep upon. In Mr. Thomson's collection there are several crownless hats made of the feathers of fowls. There are six different styles. The hat worn by the dancing women is small and narrow, with feathers of bright color overlapping all the way around. The married women's hat, worn upon the ceremony connected with a bethrothal, is broad, made of black feathers about six inches long, clipped evenly all the way around. The men at their food feasts wore a small hat of feathers, with long tail feathers hanging behind. The hat of the chief, worn as an insignia of office, is large and heavy, clipped evenly, the back ornamented with the largest and finest feathers to be had. The minor officials and chiefs (*ex officio*) wear a lighter hat, made

FIG. 7.—GROTESQUE CARVING IN STONE, EASTER ISLAND.
(From specimens in U. S. National Museum.)

of short black feathers, with four tail feathers on end, and tending outward at regular intervals. The head-dresses are highly regarded.

There seems always to have been a scarcity of timber; this accounts for the houses differing from the Polynesian dwelling in being made of stone.

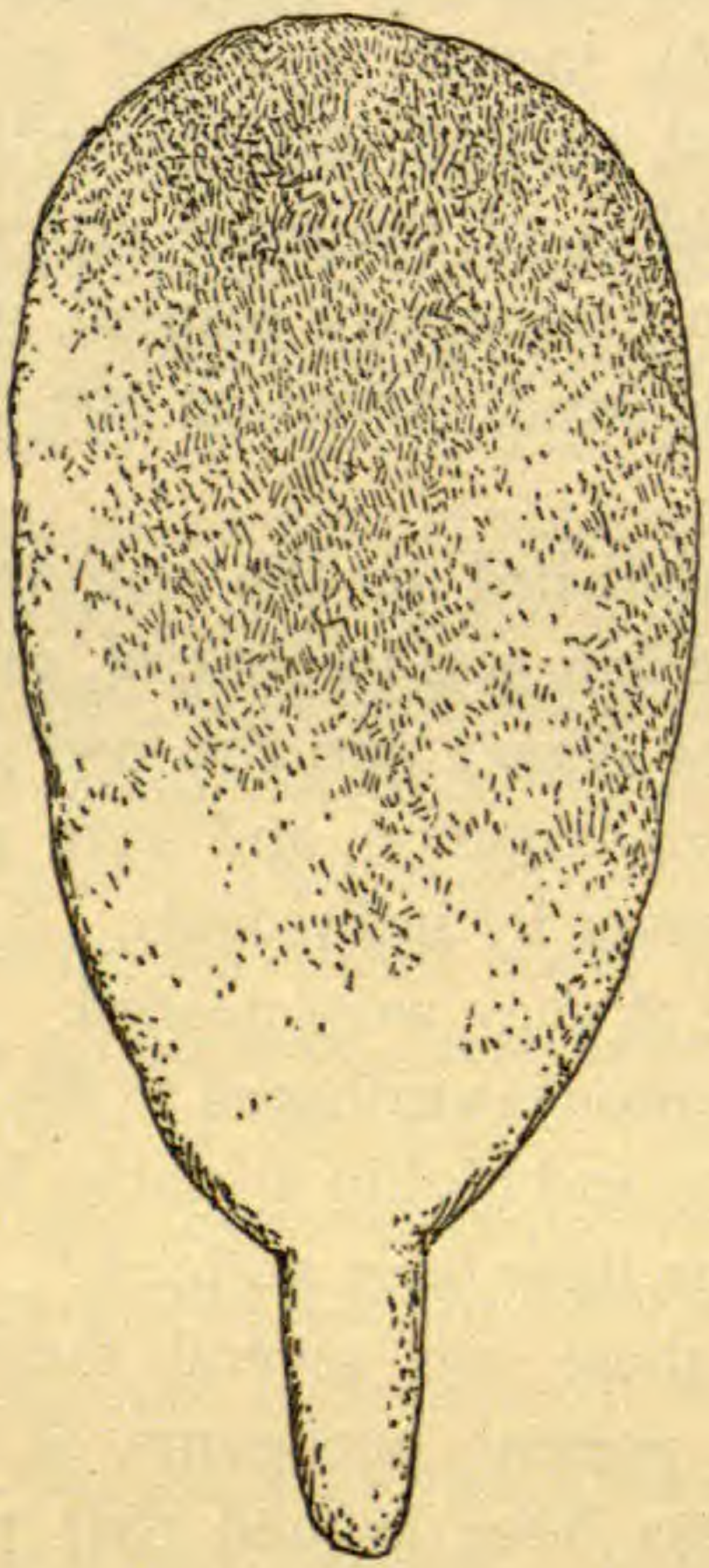

FIG. 8.—CONJURING PADDLE MADE OF BONE OF WHALE.

FIG. 9.—POTATO FETISH OF WOOD CARVED AND PAINTED IN RED.

(Both from specimens in the United States National Museum.)

They lived principally on fish, though the yam, taro, bread-fruit, banana, and other food supplies were drawn upon. Hooks were made of bone; nets were made of hemp. The bonito, a mackerel, was the principal fish caught.

Weapons were clubs and spears; it is presumed that the bow and arrow were not in use. Mr. Thomson says that hemp nets were used in fighting.

Conjuring wands were used by the natives. One, a broad paddle of bone of the whale, 30 inches long (Fig. 8), is supposed to possess power to work a charm on an enemy. The shaman working the spell performs a convulsive dance, making mysterious movements with the wand, and muttering incantations. Such charms are believed to bring speedy death upon their victim. A special potato paddle, called *raha*, was stuck in the ground to protect the potato crop from drought, insects, and evil spirits (Fig. 9). These paddles are of wood, painted red, and with a blade on each end. Ceremonial paddles of the same shape as the latter, but larger, with one blade grotesquely painted, were used, as were long clubs with a double head carved on one end, by chiefs when addressing assemblies.

Rude, unshapen stones were distinguished by the natives as gods of three varieties. These are the fish god in general, called *Mea Ika;* the bonito's god, called *Mea Kahi;* and the fowl god, called *Mea Moa*. The gods were never common, and were possessed by clans or communities, and never by individuals. They were moved about from place to place as they were needed. An especial god being set apart for the bonitos is attributed to the fact that that fish has always been abundant and highly prized as food.

Who were the people whose remains have been noticed?

This question is asked because there are several theories that rule out the ancestors of the present occupants of the island as authors of the works. It has been argued that they were not:

1st. Because the Polynesian, as we know him, is averse to sustained labor. This argument would perhaps apply at present, but it is evident from all accounts that all groups of the island race were energetic in building houses, canoes, in seafaring, and in many places (a list is given in Waitz's Anthropologie, Vol. V.) made stone edifices and sculptures of great extent. There is a pyramid in Tahiti 260 feet long, 90 broad and 40 high, made of squared stone.

2d. Because the present Easter Islanders do not know about the ruins, but say, "The gods made them." This failure or incompleteness of record is a matter of common observation.

3d. The strange facies of the remains. While some local modifications exist in the island, these monuments were no doubt built under the same impulses that prompted the erection of megalithic structures everywhere.

4th. The fact that writing was known. The discovery of the engraved slabs brings out an unique phase of progress not known elsewhere in the units that go to make up the Polynesian race. Until the tablets are read there is doubt as to the character of the record, whether they are lists of chiefs or a sequence of ideas in written language. There seems to be a pretty clear tradition as to the introduction of the tablets, and those that I have seen, from their state of preservation do not appear to be very ancient. However, it would seem but a small step from the plaiting of hieroglyphic tabu signs, spoken of by Turner among the Samoans (Samoa, p. 185), to the delineation of them on surfaces, and this step may have been taken in this case.

In the dry caves of the island are skulls of the supposed former inhabitants, that might, if craniometry were of any value in race classification, throw some light on the inquiry.

A people who have been thought possibly to have been the builders of the Easter Island remains, are the Papuans. It is said that they are more energetic than the Polynesians, and are hence more likely to have undertaken the difficult works. The art has also been thought to have a Papuan appearance.

Conclusions of this kind are very unstable, because based on an uncertain premise. It is probable that a judicial review would show the facts equally pointing to the agency of the ancestors of the miserable remnant of Easter Islanders in the works. The presumption should always be in favor of an existing tribe against unknown peoples; but it is one of the sins of ethnologists that they have "gone after strange gods," and dealt too much in mere speculation. The language of the Easter Islanders should be closely examined for words derived from other sources; language shows admixture more convincingly than arts, but not more in reality to those who are in a position to make comparisons.

The remark of Prof. O. S. Mason is a reliable statement of the question for the present, that "the Easter Island images are the most interesting of the archeological enigmas." Mr. Thomson is preparing a monograph on Easter Island for a forthcoming Smithsonian Report, from the material gathered on the Mohican survey and from other sources, which will allow a judgment to be passed on these questions, and which will give all that is known about the archeology and ethnology of this interesting field.

ARE THE GERMAN SCHWEINE-SEUCHE AND THE "SWINE PLAGUE" OF THE GOVERNMENT OF THE UNITED STATES IDENTICAL DISEASES?

ONE of the most valuable and interesting contributions to the literature of the German Schweine-seuche is that of Bleisch and Fiedeler.[1]

The investigations of these observers appear to have been most carefully made, and every necessary precaution used. They extended over fifty-two swine, in an outbreak in which sixty of sixty-three died. According to their statement, the same micro-organism to which the name "Loeffler-Schütz" has been given, was found in every case, of which they say: "While the dispersion of the bacteria in the organs and blood of the inoculated rabbits and hens is in general about equal, these investigations show that in swine they are most numerous in the mucus filling the bronchial tubes which lead to the diseased portions of the lungs, and less numerous in the caseous parts, while equally scarce or wanting in the gray-red hepatized portions as well as in the spleen and liver.

[1] "Beitrag zur Kenntniss der Schweine-seuche." *Zeitschrift für Hygiene* (Koch's), Vol. 5, p. 400, and *Archiv für wiss. und prac. Thierheilkunde*, Vol. 5, 1889.

The most interesting and important point regarding these observations is the relation of the lesions in the intestines to epizoötic swine diseases in this country. *In the fifty-two hogs examined we do not find intestinal lesions mentioned once;* but do meet with such expressions, over and over again, as, "*Nothing abnormal* in the intestines." On the contrary, pulmonary changes varying in degree were present in each case, and formed the essential lesion.

Summing up the results of their microscopical observations, these investigators say that "the skin and sub-cutis showed no changes," which is somewhat contradicted by Schütz and Loeffler's experience, both of whom frequently mention the presence of "enormous œdema." Going on they say, "In most cases the diseased changes were limited to grayish-red hepatization of the inferior portion of the anterior lobes of the lungs and medullary swelling of the lymph-glands. Further lesions were also present in the middle and inferior lobes; the bronchial tubes always formed the central point of these consolidations. Where the disease had become more progressed the hepatized tissues were more dry, and yellowish-red in color; coseation was present in still older centers. *In the other organs, especially the cutis and sub-cutis, liver, kidneys, bladder and gastro-intestinal canal, no pathological changes were to be seen.*

"Our investigations show that we have had to do with an exceedingly infectious disease of the lungs having a chronic course, *which can extend to healthy animals without any contact with diseased ones* (hence not contagious), and that the infecting element, in almost all cases, finds its way into the infested organism by means of the lungs. *In all cases the pathological changes do not extend much beyond the point of invasion. The disease retains, almost invariably, a local character. Especially do we entirely miss any mentionable changes in the spleen and intestines.*"

The authors also quote Schütz upon this point as follows:

"Schweine-seuche (swine plague) is an inflammation of the lungs and pleuræ which is found with necrosis of the diseased portions of the lungs and mild phenomena of infection, little or no swelling of the spleen, slight swelling of the parenchymatous organs, and gastro-intestinal catarrh. When the disease assumes a chronic course caseous conditions in the lungs are produced."

"*Caseous changes in the mucosa of the stomach and intestines have not yet been observed.*"

The desperate attempts which have been made to graft a second "*wide-spread epidemic disease*" upon the porcine interests of this country, under the name of swine plague, which should be a pest, something which sweeps life away, both by the Agricultural Department, and its notorious "Board of Inquiry," as well as by Prof. Welsh, of Johns Hopkins University, Baltimore, and to establish the identity of this hypothetical and totally non-existent "pest" with the Schweine-seuche," demand some attention here.

As is well known, it has been the writer's endeavor to protect the hog-growers of the country from the absolutely baseless assertions of their government, and it is appropriate to call attention to the fact that this second "wide-spread epidemic among the hogs in this country," this terrible bureaucratic pest, never made its appearance until the author had made public the results of his earlier investigations in Nebraska. The report in which this second pest is first described is dated 1886, but was not published until 1887..

In a recent letter sent to the agricultural press of the country and in which the Agricultural Department of this country cries "baby," it is claimed that the work of that department has been honest and scientific. If it has, then, why cry for support? In that report of 1886, this second terrible pest is described as a pulmonary trouble pure and simple. In the next report, of 1887 (issued 1888), we cannot tell what it is, for though honest and scientific in its work, the government so mixes up things that no human being can tell what this pest really is. We are told that "the lung lesions point to the existence of swine plague, and that the intestinal lesions indicate that of hog cholera," also in the same pig; that this pest is an "infectious pneumonia;" of "the difficulties attending investigations of diseases which have their seat in the lungs," though the government does say that "*in none of these experiments was the disease reproduced*," and then it says, when speaking of its correct "diagnosis," "The disease just described cannot fail to be recognized, as it seems to be the only severe disease of the lungs among swine of which we have any knowledge."

Now, when we read all those quotations, and compare them with the statements of the essential lesion of the German "Schweine-seuche," and when we read that the government claims the germ of its second "wide-spread plague" is identical with that of the German disease, it does certainly look as if the government work has been honest and scientific; even more so, in fact, than when it carelessly claimed of its non-existing micrococcus of 1880 to 1885, that "the evidence furnished is all that should be necessary to decide a scientific question of this kind." But as then, so now, the work of the government is not and has not been either careful or scientific, if we can believe a single one of its assertions, for though it did give "evidence which should decide a scientific question of this kind," although it does seem to show in what we have quoted that the German and government plagues are really and truly pulmonary in character, and nothing else, still they make other equally honest and scientific assertions which, if the German evidence of Professors Loeffler and Schütz, and these two later observers, can be taken as correct, must certainly force any honest man to see that the government's assertion as to its "swine plague" being an "infectious pneumonia," and identical with the German disease, is neither careful nor scientific; for, in that same report of 1887, these honest (?) observers tell us of *Intestinal lesions!* "In the severe types of this disease there are very extensive lesions of the large intestines." And a government observer did say, in April, 1888, that some investigators think that the bowel lesions of hog cholera and the lung lesions of infectious pneumonia are caused by the same germ.

Do such assertions look like true, honest, and scientific statements? Can any ordinary layman see any signs of identity between a disease in which "there are very severe lesions in the large intestine," and this German disease, in which there was not a single disturbance in the intestines in a single one of 52 hogs most carefully examined, as well as in those studied with perhaps still greater exactness by both Professors Schütz and Loeffler?

I am perfectly well aware that lesions similar to those found in the large intestine have also been found in hogs in Germany, but think they require an entirely different interpretation. These intestinal lesions were first described by Roloff in 1875, under the name of "Chronic Caseous Enteritis in Swine;" and it is a very singular fact that from that time until now not one single case of such lesions in swine has been described by German observers. Professor Schütz was inclined to the opinion that these so-called "characteristic lesions" in the large intestine, so common n, but not necessary, to the true American swine plague, might also be found to belong in the pathological picture of the German Schweine-seuche, and in my earlier writings in several periodicals I inclined to the same opinion, being misled by the more or less close resemblance in the description of the germs of the German disease to the morphological appearances of those of the American. I, however, entirely changed my opinion as to identity between the German Schweine-seuche and the true swine plague of this country, called by the Government "Hog Cholera," in my full report published in the spring of 1889. Notwithstanding this latest and only real authentic publication of my ideas on this subject, a late writer, Prof. Welsh, of the Johns Hopkins University, says, in a "Bulletin" of that institution, December, 1889: "Much confusion has resulted from Dr. Billings' attempts to identify this organism (of 'Hog Cholera') with that of the Schweine-seuche."

I pronounce that assertion to be unequivocally false. The "confusion" has been raised entirely by careless, unqualified or ignorant writers who have endeavored to prove that the government swine plague is identical with the "Schweine-seuche."

To show how prejudiced and biased this committee may be, and how weak a man can be, though honored with a responsible position in a respectable university, and how economical of the truth such a person may be, I quote a few lines from my report on swine plague, where I am endeavoring to show that the German Schweine-sueche cannot be identical with the real American swine plague, but is really nothing more or less than the " Wild-seuche," a disease differentiated by Bollinger from anthrax by the absence of *B. anthracis*, though he did not discover its germ, the microscopes and methods of investigation not being equal to that task at the time.

I said that the Schweine-seuche was not the swine-plague (" Hog Cholera ") because, first, enormous œdema and deformation of the body thereby does not occur in swine plague; second, because the tendency to hæmorrhagic effusions is not a constant phenomenon, though frequently present, but seldom to such an extended degree as in the German disease; third, because the so-called " characteristic " intestinal lesions seem to be entirely absent.

Hence it seems to me that my conclusion is correct, that the organism discovered by Loeffler in swine, and the disease resulting from its action, has no important relation whatever to the origin and nature of the cosmopolitan swine plague.

It seems to me that the above language is plain enough to be understood by anybody.

That even foreigners can read the English language more correctly than one native to a country where it is spoken, I quote from the *Jahresbericht über pathogenen Microorganismen*, 1889, p. 130, where the reviewer of my work says: " While in a previous work I had the opinion that the American swine plague and the German Schweine-seuche were identical diseases, in this book (my Swine Plague) I most emphatically contradict this opinion, and claim the Schweine-seuche to be identical with the Wild-seuche," which latter assertion the reviewer questions.

Having thus most completely disposed of the careless inaccuracies of my critics, I will say that I am still of the same opinion, and it remains for German observers to show that I am not correct.

It will be remembered that the observations of Bleisch and Fiedeler extended over fifty-two diseased swine, not one of which presented anything abnormal in the intestinal canal. I will not take the trouble to refer to the exact number of swine examined by Loeffler and Schütz, but it was about ten.

Now I make bold to say, and do it with an experience extending over 1500 swine, on every one of which careful autopsies were made, that no man can examine not sixty but ten swine in this country in a large outbreak, where a pestiferous disease is raging and the loss anywhere from thirty to seventy per cent., and not find a majority of the cases presenting some form of a caseous, ulcerative or follicular lesion in the large intestines.

This should be evidence enough that the two diseases are not identical.

This Baltimore authority (who, by the way, is an almost entirely unknown quantity in the annals of bacteriology, for which assertion I refer the reader to the Annual Report previously quoted), and the scientific Department of Agriculture of this country, as well the members of the celebrated "Board of Inquiry," have, as is well known, done their utmost to injure the swine interest of the west by publishing to the world that the Government swine plague is identical with the German Schweine-seuche. It has been shown that had the government stuck to its original text, that its swine plague was a pneumonia only, it had all the evidence on its side. But it has also been shown that the government did not stick to its text, that its assertions have been neither accurate nor scientific, and that in its swine plague there were to be found fully as severe intestinal lesions as in the real hog-cholera, and the Board of Inquiry even went so far as to endorse this view. It even asserted that both the germs of the government pest and the hog-cholera produce almost identically the same lesions (I cannot see where they differ), and they both can be in one and the same hog at one and the same time.

Poor piggy!

Compare this latter statement with all the examinations of German observers.

Can we find anywhere a particle of evidence in favor of any such peculiar condition of things?

Thus far we have been unable to find any evidence of but one disease and one form of micro-organismal etiological life, and all the evidence goes to show that pulmonary lesions are its specific complication, while intestinal are conspicuous by their absolute absence.

Nowhere do we find any description of any such organism as the hog-cholera germ being mixed up with the Schweine-seuche bacterium.

There is, however, another side to this question, and as I am not writing as an advocate, but as an honest searcher for the truth, it is but right to present it here. It has been previously mentioned that Roloff described intestinal lesions the exact counterpart of those frequently met with in the true American swine plague, and that Schütz, in 1886, thought that they might also belong to the Schweine-seuche.

It is also known that Schütz looked upon the "Schweine-pest" of Denmark as identical with the English "swine fever," and our true swine plague or hog-cholera, and that he did not think it identical with the Schweine-seuche, and that he did think intestinal lesions its chief characteristic in contradistinction to the pathognomonic pulmonary lesions of the Schweine-seuche is evident when he says the "*Schweinepest* is a disease of the digestive tract, by which especially the cæcum and colon are complicated."—B. & F., l. c., p. 434.

This certainly should go to show that Schütz had no actual knowledge of any swine disease in Germany with marked intestinal lesions up to the date of publication, July 3, 1889, or else those authors would have known of it, except the historical description of Roloff's in 1875.

Since B. and F.'s contribution, however,—in fact very recently—there have been published in Germany,[2] some observations which again describe the presence of the lesions observed by Roloff in a most exact manner, and, singular to say, with scarcely any mention of pulmonary complications being present.

From the title selected by Peters, "Schweine-seuche," and from the entire context, it is very evident that he came to the same conclusion which I did on first reading Schütz's descriptions, for he quotes Schütz on this subject as follows: "In an-

[2] "Die Schweine-Seuche." Peters. *Archiv für wissen. und pract. Thierheilkunde.* Berlin, 1890.

ticipation of the future I will draw attention to a disease of swine described by Roloff, under the name of caseous enteritis, which most probably should be recognized among the pathological processes caused by the the ovoid bacteria" of Schweine-seuche. Peters seems to be well aware of the fact that Schütz did not meet with these lesions in any of the hogs he examined, for he says: "We distinguish two etiologically different diseases, the Rothlauf of swine, and the Schweine-seuche: the first is pure septicæmia, caused by a bacillus, the last a general disease caused by an ovoid bacterium, in the course of which, so far as known, a multiple mortifying pneumonia is developed. The anatomical picture of such a pneumonia was at least presented by all the swine examined by Prof. Schütz."

The work of Bleisch and Fiedeler seems to have been unknown to Peters. Aside, then, from the before-mentioned reference to Roloff's observations in 1875, it is evident that the German investigators acknowledge but two specific swine diseases in that country, and while I do not desire to be a special pleader for my own hypothesis as to the conditions there, still it is only fair to call attention to a peculiar result of the appearance of the Loeffler-Schütz Schweine-seuche in the pathological arena, and that is, we hear no more of the "Wild-seuche." As previously noted, Peters follows Schütz implicitly, and assumes the latter's hypothesis as to the Roloff lesions in the intestines to be unqualifiedly correct, and says, "for the correctness of the assumption that the caseous enteritis should be classed with the Schweine-sueche, I am in a position to furnish the necessary material.

"The necroscopies which I have made upon such swine did not all give a corresponding result, *on the contrary, the bacterial results were the same in every case, namely, the presence of ovoid bacteria.* In four of the cadavers the pathological changes were exclusively in the large intestine, in one other alone, besides these, there was a multiple necrotic pneumonia."

It is not necessary to quote the details of the microscopical examination of these five hogs, of the results of which Peters says: "Through the previous examinations it can well be considered as proven that all the swine examined had suffered from one and the same disease which was caused by the Schweine-seuche bacteria. We may also conclude that the multiple inflammation of the lungs, which was exceptionally and only present in the cases investigated by Schütz, is not an integral element of the pathological picture of Schweine-seuche, and that the hypothesis of that observer has been proven. Inflammation of the lungs occurs in this pest, as it presents itself here, probably much more frequently than caseous enteritis, as in the five cases examined by me it was only present in one, and there as a secondary local infection. To this assertion I find myself the more justified in that at the time I did not know of the identity between the caseous enteritis and Schweine-seuche. I had met with the first much the more frequently, without its being complicated with pulmonary lesions."

Let us consider this evidence as unprejudicedly and carefully as we can.

1. What have we in favor of the identity of the disease studied by Peters and that investigated by Loeffler, Schütz, Bleisch, and Fiedeler?

Nothing but that most unreliable of all evidence, the presence of a morphologically (apparently) identical micro-organism.

This kind of evidence is the most misleading and dangerous which can possibly be relied upon.

Let us suppose that it were possible to infect five hogs with the germ of ether Texas Fever, as it is called, the hen-cholera, rabbit-septicæmia, the weasel pest, or the corn-stalk disease, all of which are ovoid and belted bacteria, morphologically not safely to be diffentiated from those of the Schweine-seuche—what then?

But the germs of the last disease have no movement, and do not grow on potatoes, say some!

Well, what then?

There is no evidence that Peters made any such examination of a culture, as he certainly would have mentioned it.

2d. What have we against any such identity between the disease investigated by Peters and the Schweine-seuche?

In the Peters case we have four hogs with no pulmonary lesions whatever in comparison with over 60 examined by the other observers, in none of which was there a single intestinal lesion.

To my mind, this is conclusive evidence that, notwithstanding the apparent resemblance between the microorganisms, as concluded by Peters, the disease studied by him was the hog-cholera of this country; and even if we take Schütz's conclusions, not the Schweine-seuche, but the Schweine-pest of Denmark, which is now generally admitted to be the same thing as the pest that decimates our herds.

If any value can be placed upon the testimony from Germany as we now have it before us, it must be admitted that it is still all in favor of my own conclusions as published in my complete report upon swine-plague in this country; that is, that the Germans are blessed with three distinct swine-plagues, varying, according to present evidence, in extent as follows:

1st. The Rothlauf, or Rouget (erysipelas).

2d. Hog-Cholera, or the Swine-pest, or genuine swine-plague.

3d. Schweine-seuche or the Wild-seuche.

While according to present evidence the third is more prevalent than the second of this series, I have placed it last because I desired to quote some peculiar testimony given by Bleisch and Fiedeler.

The Wild-seuche takes its name from the fact that attention was first called to it from its occurring among the wild animals in the Royal preserves, especially deer, which in Germany are called "das Wild." Up to the time of Bollinger's investigations this disease was classed with anthrax, but as said before, Bollinger did not discover its germ at that time. Whether or not future investigations will justify my hypothesis (see my report) that this Wild-seuche and the Loeffler-Schütz Schweine-seuche are one and the same disease I know not, but it is positively certain that all the evidence is at present in my favor.

It is very singular how limited the study of this question has been in Germany, since Schütz's first investigations in 1885, notwithstanding the extraordinarily favorable conditions for such work in the veterinary schools and laboratories of that country.

The fact that the Wild-seuche attacks cattle and hogs on the same territory and under the same circumstances is absolute proof that it has no identical connection with our real swine-plague.

The investigators of the government of the United States assert that its peculiar swine-plague is identical with the German, and mainly upon bacteriological resemblances. I freely admit that should Peters' assertions become proven these observers would have a strong case against me, but I place equally strong reliance that they have none upon the previously noted fact that in no other reported investigations in Germany have we mention of intestinal lesions with or without pneumonia in a single case of the Loeffler-Schütz disease, and also upon Schütz's conclusions upon the Danish swine-pest and the disease in England.

On the other hand, in all the practical experiences of the past forty years in this country among our farmers we have no record of a single pestiferous disease of a "wide-spread" character attacking cattle and hogs at the same time and under the same conditions.

Have we any such evidence with regard to the German Schweine-seuche ?

Although not so exact as could be desired, we have some.

Bleisch and Fiedeler say that "the owner of the stable (in which the hogs they had examined had died of Schweine-seuche) placed fourteen calves therein, and that some of them died, which caused them to investigate whether the disease Schweine-seuche was transmissible to calves.

"In order to prove this they inoculated two calves with a bouillon culture of known virulence, the one subcutaneously with 1 ccm., the other in the right lung with ½ ccm. of the same.

"The first died six hours after the inoculation."—P. 429.

The same microorganism as those injected was found in all the organs, and controlled in the necessary manner.

The second calf was not seriously affected. Insignificant in extent as this evidence is, it points in support of my hypothesis and assertions.

1st. The identity between the Schweine-seuche and the Wilde-seuche.

2d. The non-existence of the Schweine-seuche in this country.

The case would be strengthened had Bleisch and Fiedeler had opportunity to examine one of the calves reported to have died by the owner, and made the necessary control experiments from the same.

Another point must not be overlooked, and which contradicts the assertion of the Government that the Swine-plague and the German Schweine-seuche are identical, is the immense difference in the results following subcutaneous inoculations of the respective germs directly in the lungs of healthy swine.

The Government admits that "in none of these (its) experiments was the disease reproduced," even though they injected as high as 5 ccms. of a culture "directly into the lungs," (Report, 1887.) The German investigators were positively successful with so small a dose of culture as one-third of a ccm., the animal dying in ten hours, while the Government swine lived "forty-one days" and were killed, having been seriously ill. The Germans also produced the same lesions in their inoculated swine as they found in those infected under natural conditions, and say: "Confirmatory also was the presence of grey-red hepatization in the lungs, which in nothing, not even in the bacteriological results, differed from the natural disease as seen in its earliest stages."—P. 438.

It is but common honesty to admit that the Government investigators do report having finally killed a hog by the injection of 9 cubic centimeters"!!! of culture into the lung, but what kind of a germ with any virulence in swine would not kill in such doses as that. Prof. Welsh also reports similar results following the injection of 8 ccms. into the right lung of a pig, of the same germ.

Such experiments as that are more contradictory than confirmatory as to any identity between the swine plague of the government and the German Schweine-seuche. On the other hand, all attempts on the part of the government investigators to produce the German Schweine-seuche by subcutaneous inoculation have utterly failed. Prof. Welch does not mention any such experiments. On the contrary, we may find some reported by Loeffler and Schütz as to the Schweine-Seuche.

First, as to Loeffler, who says on July 5 (year not given) he injected two young swine in the skin of the belly and leg respectively. One of them was dead in the stable on the morning of July 7 (and this by subcutaneous inoculation). Enormous œdema of the skin, lungs, hypostatic, etc. The second swine was not seriously sick.

Schütz injected 2 ccm. of a bouillon culture under the thin cutis of the inside of the hind leg of two young swine on the 26th, at 5 P. M. One died twenty-four hours after the inoculation; the other died exactly forty-eight hours after inoculation.

On the 14th of July Schütz inoculated subcutaneously another hog with 1 ccm. of a bouillon culture. It died on the night of the 16th, about two and one half days.

On the 16th of June, at 11 A. M., Schütze injected 1 c.cm. of a bouillon culture into the lung of an old hog. It died on the night of the 18th, about two and one-half days.

Let us compare these results, following the subcutaneous and intrapulmonary injection of the Schweine-seuche germ, with some others reported by the government where less than 9 ccm. were used.

"Dec. 6, two pigs, Nos. 43 and 47, were inoculated in the thorax as already described (into the lung, with a hypodermic syringe having a needle about three inches long), No. 43 receiving 1½ ccm., and No. 47, 3 ccm. No. 47, inoculated Dec. 6, *killed* Dec. 11th,—five days. No. 43, inoculated Dec. 6, lived to Jan. 23,—forty-eight days.

There seems to be too vast a degree of difference between this government germ and that of the German disease, even with the amount injected vastly in favor of the bureaucratic organism, to warrant any very strong claims for identity between the two.

Pathobiological Laboratory, Chicago, Ill.,
Feb. 13, 1890.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Notes on the Dinosauria of the Laramie.—PTEROPELYX GRALLIPES gen. et. sp. nov. This dinosaur is represented in my collection by the greater part of the skeleton of an individual found by Mr. J. C. Isaac near Cow Island, Montana, on the upper Missouri, in 1876. I have, as yet, detected no part of the skull or teeth in the collection. The generic characters are seen especially in the pelvis, of which the right half is nearly completely preserved. The ilium is quite elongate and compressed, terminating in flat, narrow plates both fore and aft. The pubis is slender, and its shaft is very small and short, while its pectineal process is extremely long, and expanded distally in a vertical plane, reaching in the specimens anterior to the line of the anterior extremity of the ilium. The inferior border of the acetabulum is thin. The ischium is also very slender, and is coössified proximally with the pubis, and is thence in close contact with it for the rest of its length. The astragalus is not united with the tibia, and the latter has no facet for the fibula on its distal surface. The feet are robust and constructed like those of Hadrosaurus, and there is a fourth digit, which is much shorter than the others on the posterior foot. Long bones solid.

This genus differs from the known Agathaumidæ in the very different form of the ilium, which is hadrosauroid in form. From both Hadrosaurus and Diclonius it differs in the probably elongate anterior limbs, which are indicated by the very large pectineal processes, which resemble the pelvis of Crocodilus, while the pelvis and ischium are so slender as to be almost functionless. The animal was thus apparently quadrupedal. The absence of the fibular facet of the tibia distinguishes it from the *Diclonius mirabilis*, but this is apparently wanting in the *Hadrosaurus foulkei* Leidy. The genus Pteropelyx displays characters between the Hadrosauridæ and Agathaumidæ. The genus Cionodon Cope, which is principally known from teeth, remains to be compared with it, as well as Dysganus, which is also known only from teeth.

Char. specif. This reptile is about the size of the *Hadrosaurus foulkei* Leidy, as the measurements below given will indicate. The anterior process of the ilium is rather longer than the posterior, is more compressed, and narrow vertically. It is perfectly flat in the vertical plane, and not rounded as in *Hadrosaurus foulkei*, and has some superficial longitudinal ridges. The superior border of the ilium is narrow, except where it expands into an external angle above the point of junction of the ischium. The borders of the acetabulum are not expanded as in the Agathaumidæ, and the acetabular border of the ischium is acute. The neural spines of the dorsal vertebræ are elongate, and some of them are so wide anteroposteriorly as to touch each other. The bones of the posterior leg are very long (see measurement of the fibula), and the fibula is very slender. The metatarsals are very robust, and the phalangeal faces have the usual concavity in the transverse section.

As compared with the *Diclonius mirabilis* this species is as tall, but less robust. The scapula is longer and more slender, especially in its proximal portion. The distal part of the tibia is less robust, as are also the metatarsals. The heads of the mts. 2–4 are not as much compressed as in *Diclonius mirabilis*.

MEASUREMENTS.

		MM.
Length of scapula,		850
Width at neck,		100
Width at blade,		195
Length of ilium,		1000
Length of anterior process of ilium,		450
Length of posterior process of ilium,		280
Depth of ilium at acetabulum (about),		200
Length of pectineal process from base,		385
Width of pectineal process distally,		250
Diameters distal end tibia,	transverse,	250
	greatest fore and aft,	145
Diameters distal end mt. 3,	transverse,	115
	fore and aft (oblique),	70
Length mt. 4,		135
Diameters distal end mt. 4,	anteroposterior,	65
	transverse,	75
Length of fibula,		890

This is more slender than any of the Hadrosauridæ known, but yields to none of these in dimensions. Its posterior legs are much longer than those of the *Monoclonius crassus*.

Diclonius pentagonus Cope. Proceedings Acad. Nat. Sciences, Philadelphia, 1876, p. Oct. A lower jaw closely resembling that of this species has been figured by Marsh (*Amer. Jour. Sci. Arts,* 1889, p. 336), under the name of *Hadrosaurus breviceps.* The lower jaw is figured as the upper, and is printed upside-down on the page.

AGATHAUMIDÆ. It is now evident that the genus Polyonax Cope (Triceratops Marsh) had elongate frontal horns, a relatively short one on the nasal bones, while Monoclonius Cope (Ceratops Marsh) has shorter horns on the frontals, and an elongate one on the nasals. The three coösified cervical vertebræ which I described in 1876 (Proceedings Academy, Phila., October,) occupy a position below the posterior prolongation of the parietal bone in Monoclonius. This coössification is appropriate to the immovable condition of these vertebræ in the position mentioned. Marsh (*Amer. Jour. Sci. Arts,* 1890, Jan.) denies postacetabular pubes to the members of this family. I find them, however, in Monoclonius.—E. D. COPE, *March 5, 1890.*

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—In a most excellent paper, so full of information as to defy any attempt to do it justice in these notes, Lemberg[2] has given the results of his experiments on the stability of many rock-forming minerals when treated with water at high temperatures, and their power of resistance when subjected to the influence of solutions of various salts. The object of the experiments was to determine the cause of the widespread existence of certain minerals like leucite and hauyne in effusive rocks, and their entire absence from intrusive rocks, and also to determine the conditions that gave rise to the properties of elæolite and orthoclase on the one hand, and to nepheline and sanidine on the other. The only conclusions that can be referred to in this place are those with reference to hauyne and leucite. The existence of the former mineral in effusive rocks is ascribed to the oxidizing effects of the oxygen of the atmosphere upon the sulphur compounds of these rocks, and the reactions set up between the solutions thus produced and the constituents of the rocks. The non-existence of this mineral in irruptive rocks is regarded as due to the protection from atmospheric oxygen which these rocks enjoyed as a

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Zeits. d. deutschen geol. Gesell.*, XL., 1888, p. 625.

consequence of their mode of formation. Its absence from all effusives is the result of the comparatively small quantity of oxygen in the air of early geological ages. The absence of leucite from intrusive rocks is thought to be due to the fact that the mineral can separate from a magma only under low pressure. The great stability of elæolite and orthoclase as compared with nepheline and sanidine is supposed to be the consequence of their formation under great pressure. So many other conclusions of equal interest are indicated throughout the paper, that it will well repay reading by any one interested in chemical geology or in the study of altered phases of rock masses.——The eruptive rocks[3] west and south of Sarn, Caernarvonshire, Wales, comprise granites, gabbros, diorites and gneissic diorites, diabase, picrite and dolerite. The gabbros and diorites are intimately related, the gneissic varieties of the latter having been derived from the former by pressure alteration. In the diabases augite is found in idiomorphic crystals and in ophitic plates. The hornblende occurs, (1), as an original constituent, enclosing grains of augite; (2), as a secondary product surrounding augite cores; (3), as a zonal growth around augites with a corresponding orientation; and (4), as a secondary fringe around original hornblende crystals. ——Harker[4] describes from Mynydd Mawr, three miles west of Snowdon, a bluish-gray compact rock, with porphyritic black crystals, without idiomorphic outlines, and twinned crystals of feldspar. The groundmass of the rock is a fine grained mixture of quartz and orthoclase, in which are the above mentioned phenocrysts and small acicular colorless crystals, with a faint blue tint when their long axes are parallel to the vibration planes of the nicols. They have a high index of refraction and nearly parallel extinctions, and are arrayed in flow lines. The large black crystals are pleochroic in blue tints, and upon close examination are found to be riebeckite, to which species the small acicular crystals are thought also to belong.——Mr. Diller[5] has separated the mineral supposed to be anatase in the periodotite from Elliott Co., Ky., and has had it analysed. Its composition is found to correspond with that of perofskite.

Mineralogical News.—Prof. Clarke[6] objects to Tschermak's theory with respect to the composition of the micas, in that, of the four fundamental molecules assumed by this mineralogist as the basis of his theory, three of them are unknown in nature, and two are chemi-

[3] Harker, *Quart. Jour. Geol. Soc.*, 1888, p. 442.

[4] *Geol. Magazine*, May, 1888, p. 224.

[5] *Amer. Jour. Sci.*, March, 1889, p. 219.

[6] *Amer. Jour. Sci.*, November, 1889, p. 384.

cally improbable. Further, each belongs to a different type, and therefore would not be expected to be pseudomorphic. Clarke suggests that all of the true micas are isomophous combinations of derivatives of aluminium orthosilicate [$Al_4(SiO_4)_3$] and of the corresponding polysilicic compound [$Al_4(Si_3O_8)_3$]. The different micas are taken up seriatim, and it is shown how each may be regarded as a compound produced by the isomorphous mixture of derivatives of these. *Muscovite*, for instance, may be looked upon as $Al_3(SiO_4)_3KH_2$, in which one atom of Al has been replaced by potassium and hydrogen, and *lepidolite* as a mixture of $Al_3(SiO_4)_3KHLi$ and $Al(Si_3O_8)_3K_3Li_3(AlF_2)_3$. The members of the *clintonite* group are also regarded as related to the micas, and to have the general formula $R'_3{\equiv}SiO_4{-}Al{=}R''O_2$. The formulas suggested by Prof. Clarke certainly have the advantage over those of Tschermak as far as simplicity is concerned, but whether they will prove of more value in the discussion of the composition of the micas, it remains for further work to determine.——Among a few minerals[7] recently described from Brazil the following present some points of interest. *Zircon* from the sands of Rio Verdinho, near Caldas, Minas Geraes, shows on cleavages parallel to ∞P two systems of striations, one parallel to the diagonal of the cross sections, and another nearly normal to the P face. Sections perpendicular to the optical axis are uniaxial in some parts, and in others show a biaxial figure, probably due to a very fine system of twinning lamellæ. Fine large *apatite* crystals from the red orthoclase of a coarse-grained gneiss from Pedreira de Sandade, near Rio Janeiro, resemble very closely the apatites of Renfrew, Canada. They are of various colors, and possess the rounded contours of the Canadian specimens. Green *fibrolite* from Diamantia owes its color to the inclusion of numerous needles of tourmaline.——Miers and Prior[8] have recently made a very thorough examination of *proustite* and *pyrargyrite*. Their article begins with an historical and critical review of the work previously done on these interesting minerals. It continues with a discussion of the morphological and physical properties of all the crystals in the possession of the British Museum, and a review of the work of former mineralogists. The paper concludes with the results of analyses of ten specimens of pyrargyrite and five of proustite, and is accompanied by a plate on which are represented twenty-eight figures of crystals. Their results may be briefly summed up as follows: (1), proustite and pyrargyrite are distinct species, the former with a rhombohedral

[7] Dom Pedro Augusto, *Min. und. Pet. Mitth.*, X., p. 451.

[8] *Zeits. für Kryst.*, XV., p. 129, and XIV., p. 113.

angle of 72° 12′, a sp. gr. of 5.57, and a cinnabar—red streak; the latter with 71° 22′ as the rhombohedral angle, a specific gravity of 5.85, and a purplish red streak. (2), Pyrargyrite twins parallel to ¼R, R, ∞P2—½R, and oR, proustite parallel to ¼R, R, oR and —½R. (3), Both minerals are rhombohedral, and none of the typical forms exist at the same time in both plus and minus positions. (4), Pyrargyrite is $3Ag_2S.Sb_2S_3$, with a small percentage of As, and $a : c = 1 : .7892$; and proustite is $3Ag_2SAs_2S_3$, with occasionally a small amount of Sb, and $a : c. = 1 : .8038$. Many new forms are described in pyrarygrite and a few in proustite.——Fine crystals of *gold* from the placers of the Senarka and the Kamenka rivers, Gouvernement Orenburg, Russia, are described by Jeremejew[8] in the *Goruyi Journal* for 1887. Combinations of ∞O∞, O, and other more complicated forms are beautifully twinned parallel to an octahedral face. Pseudomorphs of limonite after pyrite, anatase, rutile, and many other interesting minerals associated with the gold, are also carefully described and figured.——Molengraff[9] has contributed to the study of quartz an interesting article on the rounded faces on many crystals. Since these are nearly always covered with concavities of the shape of the etched figures characteristic of quartz, the author regards them as having been produced by natural etching. The effect of alkaline carbonates, hydrofluoric acid, and potassium hydroxide upon crystals has been studied, resulting in the discovery that alkaline carbonates at 125° quickly produce etched figures in such a way that the etched faces are rapidly rounded.——According to Valentin[10] the abnormal crystallographic development of certain *barite* crystals from the Kronthal, in Alsace, is also due to natural etching. Concavities occurring on $P\breve{\infty}$, oP, and $\frac{1}{2}P\bar{\infty}$ are identical with those produced by artificial means.——After discussing the analyses of *atacamite* that have been published within the past ninety years, together with new analyses published by himself, Darapsky[11] concludes that the substance called by this name is probably an isomorphous mixture of molecules varying within the limits $CuCl_2.3CuO.3H_2$, and $CuCl_2.4CuO.6OH_2O$, just as plagioclase is an isomorphous mixture of the albite and anorthite molecules. ——Having obtained a few large, pure crystals of *pseudobrookite* from Havredal, Bamle, Norway, Cederström[12] has analyzed them, and found

[8] Ref. *Zeits. für Kryst.*, XV., p. 526.

[9] Ib., 1888, XIV., p. 173.

[10] Ib., XV., 1889, p. 576.

[11] *Neues Jahrb. f. Min.*, etc., 1889, II., p. 1.

[12] *Zeits. f. Kryst.*, 1889, XVII., p. 13-3

their composition to be simpler than has been supposed. The figures obtained by him are: $Fe_2O_3 = 56.42\%$, $TiO_2 = 44.26\%$, corresponding to $Fe_4(TiO_4)_3$. The author thinks that *brookite* may be $Ti_4(TiO_4)_3$.——At the temperature of melting copper the mineral *cyanite*, according to Vernadsky,[13] loses its color, and its characteristic physical and optical properties, and assumes those of *sillimanite*. Hence it is regarded as a triclinic form of Al_2SiO_5, whose orthorhombic variety is the last-named mineral. The rocks in which cyanite is found (the crystalline schists) can therefore not have been formed at high temperatures where this mineral is an essential, original component.——Hamberg[14] has discovered well-developed crystals of *lead* in the iron and manganese mines of Harstig, at Pajsberg, Sweden. The silver-white crystals are imbedded with arsenates in calcite nests. They show the forms O, $\infty O \infty$, ∞O, $2O2$, $5O$, and $\infty O4$, and have a specific gravity of 11.37. The author explains the origin of the lead by supposing the reduction of lead compounds by arsenious acid in its oxidation to the arsenic form. Igelström[15] records the same mineral as occurring in thin plates and fine veins in an amorphous blood-red neotokite-like mineral, abundant at the manganese and iron mine Sjögrufvan, in the Parish Grytthyttan, Örebro, Sweden.——An analysis of a manganese ore from the Crimona mine, Augusta Co., Va., yielded Mr. Jarman:[16]

MnO	O	Fe_2O_3	CaO	NiO	CoO	K_2O	Na_2O	H_2O	Lers.
78.27	17.61	.62	.09	.22	.27	.18	.23	2.08	.29

a result which indicates a remarkably pure ore.——In an article on the minerals from the Tyrol, Cathrein[17] mentions the discovery of the two new planes— $\left[\frac{\infty O4}{2}\right]$ and $\left[\frac{4O2}{2}\right]$ on *pyrite*, and $\frac{7}{6}O$ on *pleonast* from Monzoni, and describes a pseudomorph of *quartz* after apophyllite from the Fassathal.——Pseudomorphs of *hematite*, after pyrite, found in the calcareous red slate of Torquay, England, are described by Solly.[18]——Mr. Yeates[19] describes a *copper* pseudomroph, after azurite, from Grant Co., New Mexico, as consisting of spongy copper, into which kaolin has been pressed.——A pseudo-

[13] *Bull. Soc. Franc. d. Min.*, XII., p. 447.

[14] *Zeits. f. Kryst.*, 1889, XVII., p. 253.

[15] *Neues. Jahrb. f. Min.*, etc., 1889, II., p. 19.

[16] *Amer. Chem. Jour.*, XI., p. 39.

[17] *Min. u. Petrog. Mitth.*, 1889, X., p. 395.

[18] *Min. Magazine*, 1889, May, p. 183.

[19] *Amer. Jour. Sci.*, Nov. 1889, p. 405.

mroph of *pyrolusite* after manganite, has been obtained by Gorgeu[20] upon heating crystals of the latter mineral to a temperature of about 300°.——Dick[21] finds the kaolin from near Porth-yr-hwch, Anglesey, to be monoclinic, with $a : b : c = .5748 : 1 : 4.7267$, and the face $\infty \breve{P} \infty$, ∞P, P, oP prominent. Its specific gravity is 2.62, and composition: $SiO_2 = 46.53$, $Al_2O_3 = 38.93$, $H_2O = 14.54$.——Des Cloizeaux[22] pronounces the mazapilite of Koenig to be orthorhombic.

BOTANY.

On the Hypophyllous, Epiphyllous, or Amphigenous Habits of Uredineæ.—Whether the *Uredineæ* are hypophyllous, epiphyllous, or amphigenous is, I think, determined largely by the character of the leaf. On those leaves which have stomata on the lower surface only, they are with few exceptions hypophyllous. They seem to normally infect the lower surface of the leaf, and spread in age, or in later stages, to the upper.

Taking Dr. Burrill's pamphlet on the *Uredineæ* as a basis for estimation, we may draw some interesting conclusions. Of the some one hundred and thirty species there given only *three* are epiphyllous, and these furthermore are frequently amphigenous. By far the greater number of species are hypophyllous only, while still a large number are amphigenous (about 48 amphigenous to 74 hypophyllous). Of the forty-six species and varieties of *Æcidium* all are hypophyllous but three, and these are amphigenous. This fact indicates that the teleutospores and their sporidia, when they germinate in the spring, must, in almost every case, enter the tissue of the host-plant through some stoma on the lower surface of the leaf, irrespective of whether the stomata occur on the upper surface also or not; and that here, in the looser soft tissue of the lower surface, more sheltered from the sun than if on the upper surface, the mycelium grows, giving rise to the first stage, the *Æcidium*, which, springing likely from the older, more compact hyphæ, bursts through the nearest and least firm, compact lower surface. In *Uredo*, the middle stage, the examination of one

[20] *Bull. Soc. Franc. d. Min.*, XI., p. 196.

[21] *Min. Magazine*, May, 1888, p. 15.

[22] *Bull. Soc. Franc. d. Min.*, XII., p. 441.

hundred species taken in order, in Saccarda's Sylloge Fungorum, shows fifty-five to be hypophyllous, thirty amphigenous, and fifteen epiphyllous, the proportion of amphigenous species having slightly increased. We also notice here a decided increase in epiphyllous species. This may likely be accounted for from its being an intermediate stage, springing from the germination of the æcidiaspores. These, produced, as we have seen, with but few exceptions, on the lower surface of the leaf, would tend to drop their spores on the upper surface of the leaves below them, thus perhaps giving rise to this more frequent epiphyllous character of the uredo.

In the teleutospore stage of species in Burrill's Uredineæ (Puccinia, Uromyces, etc.), the amphigenous species predominate by a small majority.

The increasing frequency of amphigenous position from the first stage to the last thus seems to be due to the older and more extensive growth of the fungus in the tissue of the host. Its continued growth likely injures and somewhat softens the upper more firm palisade tissue, thus allowing a breaking out above.—HERBERT A. WEBBER, *Lincoln, Neb.*

ZOOLOGY.

Gastrotricha.—Carl Zelinka, of Gratz, has recently monographed the Gastrotricha of the world (*Zeitschr. wiss. Zool.*, XLIX., Pt. 2, 1889). These are small aquatic forms the position of which is very uncertain. They are defined by Zelinka as follows: Without retractile ciliated wheels on the anterior end; with two ciliated bands extending the length of the ventral surface; with two coiled water-vascular canals each bearing a rod-like ciliated funnel and terminating separately on the ventral surface; a simple brain, not completely separate from the ectoderm; simple muscle cells; paired ovaries; fore-gut muscular, Nematode-like, without jaws, with straight glandless mid-gut and pear-shaped hind-gut, rectum and dorsal anus; with primary body cavity. With these points Zelinka is inclined to place them near the Rotifiers. He describes the anatomy, dealing especially with the skin and its appendages (scales, hairs, etc.), water-vascular system, nervous system, sense organs (tactile hairs, eye spots?), muscular system, alimentary tract, and genital organs. In all, thirty-two species are enumerated. The following key serves to separate the genera:

With caudal fork ;	1.
Without caudal fork ;	2.
1. With bristles ;	3.
1. Without bristles ;	4.
2. Head with tentacles, hinder end slightly lobed ;	*Gossea.*
2. Head without tentacles, hinder end rounded ;	*Dasydytis.*
3. Caudal fork simple ;	*Chætonotus.*
3. Caudal fork dichotomous ;	*Chætura.*
4. Skin smooth ;	*Ichthydium.*
4. Skin with scales or hooks ;	*Lepidoderma.*

AMERICAN SPECIES.

Ichthydium podura (O. F. Muller).
Ichthydium sulcatum (Stokes).
Lepidoderma squamatum (Dujardin).
= *Chæt. squammatus*, Stokes.
= *Chæt. tessellatus* Stokes.
= *Chæt. loricatus* Stokes.
Lepidoderma rhomboides (Stokes).
Lepidoderma concinnum (Stokes.)
Chætonotus maximus Ehr.
= *Chæt. gracilis* Stokes.
Chætonotus similis Zelinka.
= *Chæt. maximus* Stokes.
Chætonotus formosus Stokes.
Chætonotus acanthodus Stokes.
Chætonotus brevispinosus Zelinka.
= *Chæt. lanis* Fernald and Stokes.
Chætonotus acanthophorus Stokes.
Chætonotus spinulosus Stokes.
enormis Stokes.
longispinosus Stokes.
spinifer Stokes.
Dasydytes saltitans Stokes.
goniathrix Stokes.
Gossea antennigera (Gosse).

Homologies within the Group of Echinoderms.—Richard Semon (*Morphol. Jahrbuch,* 1889) discusses the homologies which occur within the group of Echinoderms. He thinks that in their broader features the alimentary canal, enterocœle, water-vascular system and nervous system are to be regarded as truly homologous throughout the group,—that is that they have had a common origin and descent (are homophyletic). Other structures which appear very similar, and have often been regarded as homologous, are but analogous, and are to be regarded as homoplastic. Besides these there are others which are intermediate in position, being partly homophyletic and partly homoplastic. Among these are to be enumerated the musculature, a part of the nervous and water-vascular systems of the Holothurians. Semon also refers to the unanimity of results arrived at by him in his previous work on the Synaptidæ (*Jenaische Zeitschrift*, 1888), and those of the brothers Sarasin in their studies of the Echinotheridæ, both concluding that the Holothurians represent the stem form within the group of Echinoderms. Semon does not agree with Newmayr in assigning this position to the Cystidians.

The Ontogeny of Pelvic and Shoulder Girdles.—R. Wiedersheim has studied the development of the girdles in *Scyllium canicula*, *Mustelus lævis*, *Pristiurus melanostomus*, *Torpedo ocellata*, *Thymallus vulgaris*, *Triton helveticus*, *T. alpestris*, *Siredon pisciformis*, *Salamandra maculata*, *Alytes obstetricans*, *Rana temporaria*, *R. esculenta*, *Lacerta agilis*, *Chelone midas*, and *Crocodilus biporcatus*. His genera conclusions (*Ant. Anz.* IV.) are as follows: l

1. The pelvic and shoulder girdles are strictly homologous; both possess the same Anlage.

2. Both are phylogenetically and ontogenetically later formations than the free limbs.

3. The free limb is to be regarded as the mechanical principle under the formative influence of which a yoking apparatus or fixation point must arise in the body wall. These structures are the s oulder and pelvic girdles.

4. In the Selachii, and apparently in all fishes, the primitive continuity of the girdle and appendage persists into the cartilaginous condition. From the Amphibia on this continuity can only be recognized in the precartilage condition. The cartilaginous Anlage are separate in each region, though there may be in the Amphibia a secondary (transitory or permanent) fusion of the free-extremities with the girdles.

5. From the Amphibia on there is a marked tendency for the separate elements of the girdles to appear separate in the cartilaginous stage. The fusion is secondary, and earlier authors have been in error when describing a single hyaline cartilage blastoma.

6. The pars ischio-pubica and the pars scapularis are phyletically the oldest portions in their respective girdles.

7. In the Fishes and Dipnoi (also in Ichthyosaurus) the pars iliaca does not reach the vertebræ.

8. The pars iliaca first reaches the vertebræ when the vertebrate in question wholly or partially gives up its swimming existence, and its hinder limbs, from being swimming organs, begin to serve as supports. From this moment the weight of the body in the pubic region must be prevented from sinking, and the strong processes of the ventral bones must provide a support for the body weight on the free extremities. A similar support is formed in part by the pectoral fins.

9. A fusion of the partes ischio-pubicæ of both sides to form an unpaired lamina ischio-pubica as in Dipnoi, Ichthyoidea and Derotrema, recurs now and then in the larval stages of the salamanders ; *i.e.*, at a time when the tail gives the locomotor impulse.

10. The old question whether the fishes and Amphibia possess only a pars ischiada or also a pars pubica, is to be decided by these later views. The pars pubica is not a structure first appearing in the Reptilia, but is characteristic of the fish and amphibian pelvis. The certainty of this lies first in the relations of the nervus obturatorius, and second in the relationships shown by the embryonic chelonian and crocodile pelvis. In these lie the key for the interpretation of the urodele pelvis, which is repeated ontogenetically in this reptile.

11. Not only is the pelvis not composed of one or more pairs of ventral ribs, but the parts of the pelvis formerly compared by me with such (pars iliaca) are actually the last phylogenetically to appear.

The Segments of the Vertebrate Head.—Van Wighe has recently attacked this problem in the light of the facts afforded by Amphioxus. He finds (*Anat. Anzeiger*, IV., p. 558) that in the adult the gill slits extend back to or even beyond the 27th myotome, while in early specimens the liver empties in the 13th myotome. He also thinks that still earlier specimens would show the liver two segments farther in front. Now if the liver be taken to indicate the line between the head-gut, and that of the body, it follows that the number of segments which in Amphioxus corresponds to the head of the Craniatas is probably nine and cannot be much greater. Amphioxus also affords no difficulty to the view derived from the ontogeny of the sharks that the vagus is a complex of two dorsal nerves. He concludes that the skull never consists of metamerically arranged cartilaginous elements ; only in the occipital region behind the vagus is there a possibility of separate cartilaginous neural arches. The parietal musculature and the peripheral nervous system (except the three higher sense nerves) are segmented in the head as in the body region. The number of head myotomes is in general nine, and in those Craniata which have no hypoglossus as a cranial nerve (unless the same and its myotome is aborted), is smaller. To each body and head segment belong a dorsal and a ventral nerve. These are primitively separate, as is shown by Amphioxus and the embryos of the Craniata. In case the ventral nerve is lacking, the corresponding myotome is lacking. The vagus is a complex of two nerves. There is no ground for the view that the Craniata ever possessed more than eight gill pouches (apart from one possibly aborted in the hyoid arch). This number is reached in Heptanchus, Chlamydoselachus, the embryos of the Petromyzons and probably in the Carboniferous genus Xenacanthus.

Horny Teeth in the Marsupialia.—Teche, in studying the skull of a young Myrmecobius (*Anat. Anzeiger*, Aug., '89) finds that a bony ridge runs parallel on either side to the alveolar process of the upper jaw, while in older skulls it exhibits a retrograde development. In sections of the mucous membrane covering this ridge, he found several clusters of tooth-like structures, which upon examination with a higher power were resolved into a large number of rows of teeth, each containing several (as many as 8) horny teeth, nested within each other. In older Myrmecobii no traces of the teeth were found.

On the Genus Clevelandia.—In the NATURALIST for Jan., '90, page 85, occurs the statement that "Clevelandia is reduced to synonomy (by Jenkins and Evermann, Proc. U. S. Nat. Mus., 1888), as was done some time ago in this journal."

The genus Clevelandia was based on a specimen in the collections of the Museum of Comparative Zoölogy, and the diagnosis published in the Proceedings of the Calif. Acad. Sci., second series, Vol. I., Jan., '88.

At the time the diagnosis was written we could not, on account of Museum regulations, examine the skull of the type of Clevelandia. Later, Mr. Evermann sent us specimens of his *Gillichthys guaymasiæ*, requesting us to re-examine the type of Clevelandia. We did so, examining the skull, which was found to be smooth and regularly convex in transverse profile, without ridges or crests. The skull of Gillichthys is depressed, with a strong median crest. These notes were sent to Mr. Evermann. This was in the early part of the summer of '88.

Nevertheless, Jenkins and Evermann, in their rafinesque paper, quoted above, which was issued Jan. 5th, 1889, do not mention this fact, but state that "an examination of the material at hand leads us to believe that the newly proposed genus Clevelandia was based upon characters that are not of generic value, and cannot therefore stand. In Gillichthys the number of dorsal spines has been invariably given as six. The fact that the number of dorsal spines in Clevelandia and in our specimens, which *will agree otherwise with*[1] Gillichthys as limited by Cooper, are four and five respectively, would seem to indicate that the limits of the genus Gillichthys should be extended. This is evidently preferable to basing a new genus upon so slight a character as a difference of one or two dorsal spines." This statement occurs under the head of *G. guaymasiæ.*

These statements of Jenkins and Evermann deserve some comment. The "material at hand" (1) was the types of guaymasiæ, including a prepared skull; (2) a series of skeletons prepared by me in the collections of the Indiana University, where Jenkins and Evermann's hastily prepared paper was written; (3) the notes furnished Mr. Evermann on the types of Clevelandia. Of this material Jenkins and Evermann have seen fit to ignore all but the types of *guaymasiæ* (a description of the skull of this species is conveniently omitted.)

The second sentence quoted above was copied from Jordan and Eigenmann's Review of the Gobiidæ, and may stand. The third sentence needs modification. The type of Clevelandia was described by Steindacher, Ichthyol. Beitr., VIII., 27, as *Gobiosoma longipinne* with four to six dorsal spines, so it is hardly probable that we should have based the new genus of "dorsal spines," as Jenkins and Evermann have supposed.

We have been in hopes for some time of obtaining duplicates of the types of the gobies described by Jenkins and Evermann, in order to determine their generic relations, and figure them for a paper on the gobies of the West coast.

It is perhaps well to state that we have found *Clevelandia longipinne* to be the commonest fish in San Diego Bay. *Gillichthys y cauda* J. & E., is also found in San Diego Bay. To the diagnosis given by Jenkins and Evermann should be added "shoulder with dermal flaps." The statement, "teeth in *a single* series on premaxillaries and mandible," etc., should read "teeth *in broad bands*," etc.

A revision of the diagnosis of the genus Clevelandia is in press.

[1] The italics are ours.

The genera of West Coast gobies may be distinguished as follows:

a. Eyes normal, functional throughout life, body scaly.

b. Shoulders without dermal flaps.

c. Skull depressed.

d. Skull without distinct median keel, abruptly widened behind eye; scales permanently ctenoid; *Gobius*.

dd. Skull with a strong median keel, not abruptly widened behind the eye, triangular behind; scales cycloid. (Skull and scales in young as in Gobies); *Gillichthys*.

cc. Skull strongly convex in transverse profile, perfectly smooth, without ridges or crests; scales minute, cycloid, imbedded; *Clevelandia*.

bb. Shoulders with one or two small dermal flaps; skull resembling that of the adult Gillichthys;[2] *Lepidogobius*.

aa. Eyes mere vestiges, functional only in the young skull; greatly modified, brain case quadrate; body naked; *Zyphlogobius*.

The intention of reducing to synonymy all species described by other authors is undoubtedly laudable as long as it does not lead an author to shut his eyes to facts, or even wilfully to ignore them.—C. H. EIGENMANN.

Ribs of Salamandra.—Iversen has been studying the skeletons of *Salamandra atra* and *S. maculosa*, and finds (*Anat. Anz.* IV.) on the second vértebræ a strong rib-like outgrowth, which distally expands into a large kidney-shaped plate of hyaline cartilage, which is connected with the shoulder-girdle by fibrous tissue. He recognizes the same element in the "scapula" of the extinct Stegocephali; and if this view be true, the so-called clavicula is the true scapula.

Reptiles and Batrachians from the Caymans and Bahamas.—Mr. S. W. Garman contributes to the Bulletin of the Essex Institute, Vol. XX., an account of these forms, collected for the Museum of Comparative Zoölogy by Mr. C. J. Maynard. Seventeen species are enumerated, of which the following are new: *Sphærodactylus argivus*, from Cayman Brac; *S. corticolus* and *S. decoratus*, from Rum Key; *Anolis luteosignifer*, from Cayman Brac and Little Cayman; *A*.

[2] *Gillichthys y cauda* probably is a genus distinct from Lepidogobius, but as we have no specimens of the type of Lepidogobius, it perhaps should not be named at present.

maynardii and *A. leucophæus*, from Little Cayman; *Alsophis fuscicauda*, from Cayman Brac; *Ameiva maynardii*, from Inagua; and *Sphærodactylus asper*, from Andros Island. The paper is more valuable from the fact that it contains many notes upon habits, color, etc., made by Mr. Maynard.

The Mammalian Carpus.—Baur shows (*Anat. Anz.* IV.) that in the turtle foot there are two centralia, and claims that if this be true the scaphoid of the mammalian carpus is not a radiale but a centrale, while the "radial sesamoid bone" is a true radiale. He also claims that the "heptadactyly" of Wiedersheim and others has no existence in the mammalian extremity. The prehallux is the radiale, while the pisiform is not the representative of a digit, but a structure which has developed more and more from the Batrachia, where it is unossified.

Zoological News.—Protozoa.—Dr. Joseph Leidy (Proc. Acad. Nat. Sci., Philadelphia, 1889) describes the following species of Gregarinida: *Gregarina philica*, from the proventriculus of *Nyctobates pennsylvanicus; G. actinotus*, from the proventriculus of *Scolopocryplops sexspinosus; G. megacephala*, from *Scutigera forceps;* and *G. microcephala*, from *Hoplocephala bicornis.* The first named species was remarkable in conjugation as the individuals united by the head, the bodies lying side by side.

Mr. G. E. Mainland calls attention (*Jour. Quecket Club*, IV.) to the fact that in Actinosphærium the polariscope reveals "thousands of minute but highly refractive particles vibrating and scintillating throughout the entire sarcode."

Echinoderms.—J. E. Ives presents a study of the color variations of *Ophiura panamensis* and *O. teres.* In the first-named species specimens from the northern localities are the darkest. It does not appear that either species is more variable than our northern brittle stars.

Vermes.—*Brachidnus quadratus* is a new Rotifer described by C. Rousselet (*Journ. Quecket Club*, IV.), from Epping Forest, England.

The second part of the work of M. le Baron St. Joseph upon the Polycheta of the coast of Dinard occupies about 200 pages of the *Annales des Sciences Naturelles*, 1888, and contains descriptions of 23 new species and one new genus. The work is prefaced with an account of the habits of the Aphroditaceæ, which often have ectoparasites, and are themselves at times epizoarians or commensæ of other annelids or of echinoderms.

Mollusca.—H. A. Pilsbry describes the following new molluscs (Proc. Acad. Nat. Science, Philadelphia, 1889): *Holospira elizabethæ*, Guerrero, Mexico; *Pœcilozonites reinianus* var. *goodei*, Bermudas; *Bythinella æquicostata*, Florida; *Amnicola peracuta*, Texas; *Sphærium singleyi*, Texas. He also gives notes on *Microphysa hypalepta*, *Zonites dallianus*, *Z. singleyanus*, *Pœcilozonites bermudensis*, and *Hydrobia monroënsis*. In the same volume W. D. Hartman describes ten new species of shells from the New Hebrides.

Crustacea.—Dr. Leidy describes from a specimen of *Leptocephalus* taken at Beach Haven, N. J., a copepod under the name *Chalimus tenuis*.

Arachnids.—Dr. Leidy records under the generic name Solpuga (Proc. Acad. Nat. Sciences, Philadelphia, 1889) *Galeodes cubæ*, as taken in Florida.

Mr. J. E. Ives has found (Proc. Acad. Nat. Sciences, Philadelphia, 1889) a large number of *Linguatulina diesingii* encysted in the great omentum of a Sooty Mangabey, *Cercocebus fuliginosus*, which died in the Zoological Gardens, at Philadelphia.

Dr. Geo. Marx (Proc. Acad. Nat. Sciences, Philadelphia, 1889) catalogues twelve species of spiders collected by Mr. Heilprin in the Bermudas. The spider fauna is cosmopolitan, only four being restricted to the island. *Lycosa atlantica* is the only new species.

Myriapoda.—C. H. Bollman catalogues (Proc. Phila. Acad., 1889) four species of myriapods collected by Mr. Heilprin in the Bermudas. *Spirobolus heilprini* is regarded as new.

Vertebrata.—Dr. John T. Bowen describes in the *Anatomischer Anzeiger*, Bd. IV., the epitrichial layer in the human epidermis, which was briefly mentioned by Dr. Minot in a former volume of the AMERICAN NATURALIST. Dr. Bowen's conclusions are (1) that the outermost epidermal cells of young embryos form a distinct histological layer; (2) that this layer disappears by the sixth month over most portions of the body; (3) that in certain places, as in the region of the nail, this layer undergoes a keratosis, and forms a part of the stratum corneum; (4) that there are good reasons for regarding this layer as homologous with the epitrichium of animals; (5) that the nail is a modified portion of the stratum lucidum, and becomes exposed by the loss of the epitrichial layer. Whether the cells overlying the stratum lucidum in all parts are homologous with the epitrichium must be decided by further investigations.

Ostroumoff makes the following homologies between the embryos of Lizards and Selachians: In both an embryonic anus, which closes and later opens to form the permanent anus; the allantois anlage with the post-anal gut; the neurenteric canal; the primitive groove, with the split between the caudal lobes; the primitive streak with the caudal lobes.

Prof. Bardeleben has discovered traces of a prepollex and a prehallux in certain Reptilia, and also records the existence of a two-segmented prepollex bearing a nail in Pedetes, and a two-segmented pisiform in Bathyergus.

Fishes.—Mr. S. Garman describes (Bulletin Essex Inst., XX.) a new Murænoid eel from the Marshall Islands (*Rhinomuræna quæsita*) which is remarkable in the fact that the anterior nostrils are prolonged into tubes, each terminating in a broad flap. The snout is also acute, and the lower jaw possesses three barbels. The length is thirty-three inches, of which two-thirds is occupied by the tail.

Mr. F. C. Test describes and figures (Bulletin Essex Inst., XXI.) certain problematical organs in the skin of the Californian fish Porichthys which are supposed to be phosphorescent in character. Each consists of a lens, reflector, and nerve supply, but none are like any form described by Ussow or Von Lendenfeld. The organs in question are interesting from the fact that they occur in a shore fish, while all other phosphorescent fishes are abyssal in habitat.

Batrachia.—Perenyi thinks, from observations upon Bombinator (*Anat. Anz.* IV., 587), that the notochord is not as has been supposed a derivative of strictly entodermal tissue, but is to be regarded as formed by the lips of the blastopore, tissue which is neither ecto- or entodermal. He regards, farther, the mesoderm as but the duplication of the lower layer cells.

Reptiles.—Junglöw (*Anatom. Anzeiger*, IV.), contrary to Hoffman, states that the heart in *Lacerta agilis* has a double or paired origin, the halves being about the same size, and uniting very soon.

Aves.—M. K. Marage (*Ann. des. Soc. Nat. Zoöl.*) describes the anatomy of the sympathetic nerves in birds, with reference especially to the connections which exist between them and the spinal nerves. He divides his work into four portions, treating respectively of the cephalic, the cervical, the thoracic, and the abdominal nerves, and his work in each of these departments comprises a historic resumé, the structure to be found in the domestic duck, and a comparison of that of the latter with that of other birds. His conclusions are that it is at the level of the thorax that the sympathetic receives most nervous fibres from the spinal cord ; that above the thorax there is a single sympathetic trunk, with numerous ganglia terminating in the superior cervical ganglion, while below the thoracic region the sympathetic consists of a single nervous thread, bifurcating only when it encounters an obstacle ; some branches put this part in relation with the spinal cord. The arrangement is analogous to that which obtains in reptiles.

Dr. R. W. Shufeldt concludes from a study of the skulls of a large series of forms that the families of Passerine birds should be arranged as follows : Tyrannidæ, Laniidæ, Ampelidæ, Hirundinidæ, Alaudidæ, Certhiidæ, Viveonidæ, Motacillidæ, Sylviidæ, Cœrebidæ, Mniotiltidæ, Cenclidæ, Troglodytidæ, Turdidæ, Paridæ, Tanagridæ, Fringillidæ, Icteridæ, Sturnidæ, Corvidæ, the latter being placed at the top of the scale largely upon the extremely uncertain grounds of psychology.

Dr. Shufeldt has also described the pterytography of the burrowing owl, Ipeotyti, and contributed some other facts regarding the same animal. Both papers are in the *Journal of Morphology* (Vol. III).

Miss Julia B. Platt has been studying the primitive metamerism in the chick. Her first problem was the solution of, Which is the first protovertebra to be formed ? and she concludes that the first incision separates the second from the third protovertebra, the second incision completes the third muscle plate, and that later there is found in advance of the first incision one complete protovertebra and a second partial one. She also has studied the primitive segmentation of the brain, where she differs somewhat from other observers. In the chick, according to her observations, there are seven neuromeres found in front of the first protovertebra, and from the *first* of these are developed Pros-thalam and Mesencephalon ; the *second* gives rise to the cerebellum, and the other five to the medulla. There are also other points made upon the origin of the nerves, especially the fifth, and Miss Platt is inclined to regard the neuromeres of the medulla as homologous with those of the rest of the cord.

Mammals.—The domestic cat serves as the basis of several studies by Dr. T. B. Stowell. In the *Proceedings of the American Philosophical Society* he continues his studies of the cranial nerves, tracing out the finer branches of the glosso-pharyngeal, accessory, and hypoglossal nerves. Neither paper is capable of abstract, while the adoption of the Wilderian adjectives and adverbs renders them somewhat pedantic and obscure.

Dr. Frederick Tuckerman has recently published several articles upon the taste organs of mammals. In the *Anatomischer Anzieger* occur descriptions of these organs in *Putorius vison*, (Vol. III., p. 941), *Arctomys monax*, (Vol. IV., p. 334), *Perameles nasuta*, (Vol. IV., p. 441). In the latter he finds lateral taste areas overlooked by Poulton. In the *American Journal of Science* for October, 1889, he describes the organs in the common hare. In the *Journal of Anatomy* occur accounts of the taste organs in *Vulpes vulgaris* (Vol. III., p. 201).

Leboucq (*Anat. Anz.*, IV.) finds that on the digits of the fins of fœtal Sirenia and Cetacea there are evident traces of claw-forming epithelium. On the dorsal surface of each digit there is an insinking of the epidermis like that which precedes the formation of nails and claws in other mammalia, but no claw is formed by it.

EMBRYOLOGY.

The Development of Micrometrus aggregatus, one of the Viviparous Surf-perches.—At a recent meeting of the San Diego (Cal.) Medical Society, Dr. C. H. Eigenmann presented the results of his further studies upon the early viviparous development of the very minute ova of *Micrometrus aggregatus*. The differences in the modes of segmentation were pointed out, and a comparison of the embryonic membranes of the different major types of amniotic vertebrates was made. The effect of the loss of a large food-yolk, as illustrated upon comparing the egg of a mammal and a bird, was shown to resemble a similar loss of food-yolk in the eggs of Micrometrus as compared with other large-yolked oviparous fish eggs. [The eggs of *Micrometrus aggregatus* are the smallest fish ova yet described, measuring only a little over 1-140th of an inch, or less than those of most mammalia, thus showing the profound influence of viviparity in causing a diminution in the size of ova.]

The following are Dr. Eigenmann's most recent observations:—

The average pelagic fish egg has a diameter of about 1 mm.; only a very minute portion of which segments and takes part in the formation of the embryo. The egg is deposited by the mother in the water, where it lies or swims unprotected. As the tail of the young fish is formed it begins to move, first feebly and then vigorously, until the membrane surrounding the egg is burst and the young fish swims out. At the time of hatching the intestinal tract is still very rudimentary, the food, until the intestines are more fully developed, being supplied by the large mass of yolk stored in the egg. The tail is at this time quite free from the yolk, and it is usually fringed by a broad, thin membrane which serves as a fin.

The development of Micrometrus differs from the usual mode in some very essential characters, as this form belongs to a family of viviparous fishes almost exclusively confined to the west coast of North America. All the members of this family give birth to their young in an advanced stage. Micrometrus has gone further in this peculiar line of development than the other members of the family with the exception of *Abeona minima*. The ovary of the former consists of a spindle-shaped tube, from the dorsal wall of which are suspended six broad, thin sheets of membrane, in which are scattered comparatively few ova. At the time the eggs are ripe the ovary is no thicker than a goose quill, and the oviferous tissues are folded upon themselves. With the growth of the embryos the walls of the ovary become greatly distended, the oviferous sheets unfolding at the same time.

To follow the development of a single egg: While still in the tissues in which it was developed it measures .24 mm. in diameter, is opaque, and contains a germinal vesicle. At the time of ripening the egg contents shrink to less than half their original volume, the germinal vesicle disappears, and the protoplasm of the ovum is separated from the yolk or food material, the whole contents of the egg measuring at the end of this shrinking but .18 mm. in diameter. By comparing this diameter with that of the average fish egg, it will be noticed that the volume of this is more than 100 times less than that of the ordinary fish egg. This reduction is not merely mechanical; it is due to the non-formation of yolk, which has been reduced to a small particle lying at one side of the comparatively large mass of protoplasm, forming the germinal mass, which segments at once after impregnation.

This non-formation of food yolk may be explained in the following manner; taking it for granted that the embryo will be supplied with all the necessary food by the mother. The ovary of the typical fish passes through a state of physiological rest and a state of physiological activity. The resting stage begins immediately after the spawning; the active stage begins a few months before spawning and culminates at spawning. During the resting period the eggs contained in the ovary do not perceptibly increase in size, while during the active stage they double their volumes many times.

In Micrometrus the active period begins when the eggs are ripe, and culminates at the time the young are set free. In other words, the eggs become ripe when in ordinary fishes they only begin their most active growth. Now the yolk of normal fish eggs is found chiefly during the time of rapid growth; maturation of the egg of Micrometrus being hastened several months, and occurring at the beginning of active growth, it is matured with but little yolk.

In the young eggs of Micrometrus there lies a small nucleus exterior to the germinal vesicle. This nucleus increases in size, and in the ripe egg lies directly at the vegetative pole of the egg. A similar structure is seen in Abeona.

At or near the time of the shrinking of the egg it is freed from the ovarian follicle in which it was developed. By the shrinking of the egg a large chamber is formed between it and the membrane surrounding it. About this time fertilization probably takes place.

The spermatozoa deserve more than a passing notice. They are composed of a rod-shaped head and a long vibratile tail. Large numbers of them are found in the ovary, and the conditions for their continual activity being favorable they live in the ovary several weeks, very probably until they are digested by the young fish. They seem to increase in activity with their stay in the ovary. Their rapid motion keeps the fluid secreted by the ovary in constant circulation. This circulation is undoubtedly taken advantage of by the young, it bringing a large amount of oxygenated mucus in contact with them. If the spermatozoa were not present other arrangements for the circulation of the mucus would have to be provided, or the embryos and early larvæ would undoubtedly be asphyxiated.

The spermatozoa seem to have a triple function. First, the normal one of fertilizing the egg; second, to circulate the mucus and thereby to ærate the embryo; third, to act as pabulum to the larvæ as soon as the digestive tract is sufficiently developed.

The segmentation as far as observed is normal. It is apparent, however, that *inherited tendencies only keep the egg from segmenting totally*. The stages from the completion of segmentation to hatching are not yet understood.

The embryo at hatching is in a very rudimentary condition. The tail is not yet free from the yolk and is in contact with the head. The tissues over the base of the yolk lengthen and the embryo begins to straighten itself. The tail does not begin to grow out until some time later. Several days are undoubtedly consumed after hatching in reaching the equivalent stage of oviparous fishes at the time of hatching.

The hastening in hatching is due to the absorption by the embryo of food supplied by the ovary. The embryo thus soon fills the cavity left between the egg and the membrane at maturation, and the membrane then bursts. The hatching process is therefore decidedly different from the hatching of oviparous fishes.

If the newly-hatched oviparous fish is compared with the corresponding stage in Micrometrus another ancestral trait will be discovered in the latter. While the yolk in the latter is minute as compared with that of the former, the *yolksack is just as large.* The yolk fills but a very small portion of it; almost all the yolksack is occupied by the enormous pericardial chamber through which the thin tubular heart passes upward and forward.

The development of the whole family of fishes of which Micrometrus is a representative (the Ditremidæ) is characterized by the hypertrophy of the hind gut, first pointed out by Ryder. This is already well developed at hatching, and at the time Kupffer's vesicle appears it very probably extends considerable beyond the point where the latter is situated. In all stages until the last this hind gut protrudes greatly from the ventral profile.

Yolk absorption is not completed until quite late in the development, that is, not until the embryo has reached a stage homologous with the corresponding stage of oviparous fishes at the time of the completion of yolk absorption. That the yolk is not sufficient to account for a tithe of the growth of the embryo during this time goes without saying. The delay in the total absorption of the yolk is simply another trait inherited from oviparous ancestors.

The food absorption is of considerable interest. The earliest absorption is undoubtedly similar to the preplacental absorption of food by the embryos of placentalian mammals. At the time the embryo has developed a tail and circulation, and before the mouth is open, the first gill slit is open, and *a continuous stream of mucus mixed with spermatozoa enters the intestinal tract at this point, and passes out of the anus apparently unchanged.*

With the opening of the mouth villi appear in the hind gut. Food secreted by the ovary is now taken in through the mouth, and can be seen to fill the anterior intestine and extend into the posterior intestine as a solid rod, usually terminating in a knob. It is very probable that the primitive absorption does not cease with the opening of the mouth, and that even after the villi are formed it is carried on by the now highly vascular fins. The larvae are at no time connected with the ovary.

Next to the feeding, the aeration is of great importance. The ovarian structures are well supplied with blood vessels, and the mucus contained in the ovary is undoubtedly oxygenated by osmosis, while spermatozoa keeps the mucus in circulation. There is, then, nothing further to explain as respects the early stages, the conditions being similar to those obtaining in pelagic eggs. With the growth of the fins they become highly vascular, the blood vessels occupying much more space than the remaining structures of the fin membrane. The fins also are several times as large as they are in the adult, and the tips of the membranes are continued beyond the ends of the rays. The fins therefore offer a very large surface in which osmotic action may take place. A similar network of capillaries is formed over the whole surface of the body. At this time also the ovary has become greatly distended, and the inner oviferous sheets have become unfolded. The fins can therefore lie directly against the vascular structure of the ovary, and osmosis takes place directly between the blood of the mother and the blood of the young.

About twelve young are born at one time. Seven or eight months after the young are born they are sexually mature, and contain embryos.—C. H. Eigenmann, *San Diego, Cal., Feb 8, 1890.*

On a Brood of Larval Amphiuma.—During the last two or three years the writer has been endeavoring to obtain larval Amphiumidæ. Recently, Prof. Edmond Souchon, of Tulane University, New Orleans, La., has been enabled to obtain some advanced larvæ for me, in the egg, which he has very generously placed at my disposal. As already described by Hay, the eggs are joined together by a narrow cord formed of the same material as the egg-coverings. Most of the embryos had escaped from the eggs when they reached me, and, owing to the long journey they had made, were dead, though they were in a fairly good condition for study after proper treatment with Kleinenberg's fluid.

What has surprised me is the variation in size of these embryos. Though all have evidently only just escaped from the egg, and have not had any opportunity to feed, there is a marked diversity in their length and size. The smallest specimens measure 38 mm., while the largest measure 54 mm., and are correspondingly robust as compared with the smaller individuals. All have apparently absorbed the yolk, since there is no external evidence of a yolk sack in any case. Whether this indicates that the egg varies in size when laid, cannot, of course, be determined until further opportunity is afforded to obtain still earlier stages.

In those specimens which are best preserved, the skin presents certain features which do not appear to have been noticed by others, viz.: the presence of a system of lateral line organs, which differ somewhat in arrangement from those of other urodelous batrachia. There are three rows of end organs on the sides, as in other Urodeles. Of these the uppermost one is faint, and lies close to the middle one. The median one extends along the entire length of the sides, and over the sides of the tail. The lowermost row is most widely separated from its fellows of the same side, and extends only from the axilla to the groin, as usual in other forms.

With respect to the terminal or end organs on the head, they are much less conspicuously developed than in other Urodeles, and there appear to be no distinct rows of them externally along the course of the hyoid and branchial arches, as in *Amblystoma*.

The smallest as well as the largest individuals have the limbs developed, and all have three toes, so that the limbs are evidently as fully developed as they will ever be at the time of hatching. In this respect *Amphiuma* differs not only from all other limb-bearing Urodeles, but from the *Anura* as well. The fore and hind limbs also seem to be developed almost or quite synchronously, a feature which is unusual also.

There are three short, slightly plumose branchiæ set in an oblique row on either side of the back part of the head. There is nothing to indicate that they differ very widely from those of the larvæ of *Amblystoma* in their histological structure.

The general color of the smaller individuals is darker than that of the larger ones. The smaller specimens are blackish brown, the largest ones somewhat paler and also lighter on the under side of the body. Some specimens have a very narrow colorless stripe running along the median line of the belly.—JOHN A. RYDER.

The Acquisition and Loss of Food-Yolk, and Origin of the Calcareous Egg-shell.—The discovery of a form of *Peripatus* with a minute egg, without yolk, and a sort of placental development, as well as the discovery made by Mr. Eigenmann that the ovum of the viviparous surf-perches is almost completely yolkless, resulting in a reduction in volume of the whole ovum to such an extent as to be paralleled in size only by the ova of the more prolific lower forms and those of mammals, goes far toward giving us the requisite data for a reinvestigation of the causes leading to the diminution and loss of the food-yolk, after the latter had once been acquired, as must have been the case in *Peripatus*, *Micrometrus*, and the *Mammalia*.

The ova of primitive types were almost wholly without yolk. The surplus nutriment of such forms was at once elaborated into a great number of small ova, so that the chances of survival were augmented by the great fertility thus attained by a species, which was without the means for affording its young any protection.

If, however, owing to some such circumstance as an unusual abundance of food, the individual ova of the same species would either tend to be multiplied in number in the ovary, or the individual ova would tend to increase in size, it might even happen that they would become the depositories in which surplus oils or other hydrocarbons would be stored up, as actually happens in the case of fish eggs, thus leading through a common histological process, such as that witnessed in the formation of ordinary adipose tissue, to the evolution of an egg capable of floating at the surface of the water as happens in the case of pelagic fish ova. Such a result doubtless would contribute powerfully toward favoring the survival of a species provided with such floating ova, which we thus perceive may have arisen as a consequence of the action of natural causes, not having specifically as their end the salvation of the species, but rather the disposition of a surplus of material elaborated by the female organism and sent to the ovary.

If, further, the parent female organism became more highly developed, more intelligent, circumspect, and alert, the ability to obtain nutriment would be increased, but with this increase of powers the ovary becomes, as a matter of fact, reduced in dimensions, and there is further nothing to prevent one's assuming that the most favorably situated ova would receive the most nutriment and reach the largest size. Diminution of the ovary would tend to limit the number of ova to be nourished, and thus increase their size. If, furthermore, the female parent became circumspect, the tendency would be to retain the eggs in the oviduct until a favorable opportunity was offered for their deposit. If such retention were prolonged, as occurs in reptiles, for a considerable time, there would first of all tend to be deposited albuminous or plasmic secondary deposits, or secondary membranes, or even a calcareous shell would tend to be formed as the result of the normal secretory activity of the oviduct, inherited from still lower forms. In this way alone is it possible to conceive of the evolution of the egg-shell of such forms of reptiles and birds. The secretory activity thus diverted from depositing surplus nutriment in the ovary would inevitably tend to diminish the fertility of the individual female, and starve the remaining ova in the ovary, unless active feeding went on during and after the period of the retention of the already formed ova in the oviduct.

Now suppose a still further advance on this process, as a result of which not only the egg but the embryo is developed and nourished in the reproductive passages. Any further ova which are now detached from the ovary after fertilization has occurred under these new circumstances, and as a result of copulation, cannot be fertilized, but must be resorbed. The growing embryo in the oviduct is also now diverting the whole of the spare nutriment to itself from the ovary, and thus tending to starve any other young ova which it may still contain. The consequence is that the physiological conditions established by either the retention of ova for an unusual period, or the viviparous development of the embryo through its retention in the oviduct, would directly tend to bring about, first of all, a diminution of fertility, and secondly, as a consequence of viviparity, check the future production of ova or germs for the time being. The result is obviously one which would tend to be self-perpetuating, and at the same time advantageous to the species. For, while the fertility of the species is diminished, the chances of survival are increased, so that the loss suffered in one direction is compensated in another.

Maturation of the ova in the ovary, and their dehiscence in in forms in which the ova are small, is simultaneous for very large numbers. On the other hand, where a large amount of yolk is added, besides an abundance of albumen and one or more secondary egg-envelopes, this simultaneity gives place to a sequence in the maturation of the ova, either singly, one after the other, or a sequence which is expressed in the serial arrangement of the ova in a row or rows in one or both oviducts. The effect of the delay of the ova in the oviducal passages, where they acquire additional material, must be such as to tend to put not only an end to simultaneity of maturation of ova in the ovary, but also from that very circumstance to diminish the absolute fertility of the species as determined by the number of ova matured. That the ovary, as well as testes, have been reduced in length and volume in the higher forms, is certain from the fact discovered by Nagel that the germinal epithelium in the mammalian embryo is much greater in extent than is required for the rudiments of either ovaries or testes. Similar facts are known respecting the development of the ovaries and testes of other forms. In the human female at puberty there are potentially 72,000 ova in the ovaries, yet of these only about 400 can by any possible chance ever become mature in a lifetime, while an average fertile marriage would, instead of increasing, actually reduce the number to 350. This is due to the interference of the process of gestation. So pronounced is this interference in its physiological effects that it leads to the development of a marked difference between the corpus luteum formed in the ovary in the pregnant and that formed during the non-pregnant condition.

To sum up, the secondary processes of ova-gestation, viviparity, and utero-gestation have tended to diminish the fertility of a species as measured by the whole number of ova produced in a lifetime; but at the same time a great gain was made in the strength, vigor, and opportunity for survival of the offspring. Ova-gestation, all forms of viviparity, except the parthenogenetic, and utero-gestation, are probably the consequences, in the first place, of the acquisition of the ability to effect a fertile union or copulation of the sexes, the impulse toward which probably came originally from the male, where the sexes were distinct.

These processes have also tended to direct nutriment from the ova and ovary to be built up into the embryo in other ways, thus tending to intensify the alecithal or yolkless condition of the other eggs remaining in the ovary; or where a brief ovo-gestation only occurs, as in birds, reptiles, and monotremes, the surplus nutriment has been concentrated upon the few serially matured ova, thus increasing the actual volume of the latter rather than diminishing it. If, however, prolonged utero-gestation supervenes, the opposite effect must follow, and nutriment be continually diverted from the ovary to the uterus, and thus tend to diminish the size of the ova remaining in the ovary. The subsequent period of lactation would tend to prolong this diversion of surplus nutriment from the ovary in mammals.

The fertility of the marsupialia is much greater than that of other mammalia, and the eggs, as was to have been expected from the shorter period of gestation, are also much larger. I have myself removed twenty-two ripe ova from the uteri of a single female of the common Virginia opossum. Other facts with which I have become familiar in a study of the gestation of mice and rats, tend to show that an embryo may develop to a certain extent and then undergo histolytic disintegration and total resorption within the uterine coruna, even after an advanced stage of development has been reached. Dr. Arthur V. Meigs has shown me a series of fine preparations showing such a process, and one of my pupils, Mr. Edward Bancroft, has prepared a series of sections from the uterus of a mouse showing much earlier abortive stages of the embryo, which also indicate that absorption takes place subsequently.

These facts indicate that the fertility of an individual may be reduced by processes of absorption of the whole embryo within the uterus. These phenomena may be associated with the resorption of ova in the ovary, as described by Ruge, to which I can add that such a process of resorption of ova is a common occurrence at the end of the spawning season in the ovary of common sturgeon. These facts further indicate how complex the physiological factors are which determine the size and number of the ova matured by a species during a single season. They also go far toward showing how important it is to consider the effect of the acquisition of certain habits upon the result, such as those of copulation, nidification, stealth, and care in hiding the ova, the latter often being retained for a greater or lesser period of time, until it is convenient or safe to deposit them.

Finally, it may be affirmed that the solution of the question of relative fertility of a species, the acquisition and loss of a food-yolk, is completely beyond the reach of the current "*Ding an Sich*" morphological method. It is also clear that the neglect to study the reproductive habits of a species in connection with its physiological and morphological characteristics is to be condemned. Unless the contrary method is followed, there is no possible clue to the origin of the calcareous egg-shell in the ova of oviparous land vertebrates. There is, moreover, otherwise no hope of connecting the phenomena of ova-gestation with those of utero-gestation; the one must have preceded the other, otherwise the remarkable fact that no well-authenticated case of placentation has ever been made out where there is a large amount of yolk present, also loses its obvious significance, while the development of an outer layer of nutritive epiblast in mammals (trophoblast of Hubrecht, *Deckschicht* of other authors) loses its adaptive import and becomes a mere morphological "*Ding an Sich*," to be shelved and labeled like a rare *bon mot* in the mental cabinet of the specialist.

It may be added, in conclusion, that the *membrana putaminis* of eggs of birds and reptiles is a reticular but cuticular membrane, which is to be regarded as the homologue of the keratose cuticular secondary oviducal membranes of still lower forms,[1] and that it would tend to take up calcareous matters in the same way as similar membranes in other parts of the body of a vertebrate. (See my paper "A Physiological Theory of the Calcification of the Skeleton," *Proc. Am. Philo. Soc.*, Vol. XXVI., 1889.)—JOHN A. RYDER.

PHYSIOLOGY.

THE American Physiological Society held its annual meeting for 1889 on December 27th and 28th at the College of Physicians and Surgeons in New York. H. P. Bowditch, J. G. Curtis, H. H. Donaldson, H. N. Martin, and S. W. Mitchell were elected as the Council for 1889–1890. The following communications were presented:

1. J. G. Curtis, Methods of demonstrating to a large class: *a.* The automatism of the heart of the turtle; *b.* The contraction of the diaphragm of the dog; *c.* The beating of the heart of the calf in opened thorax.

2. W. P. Lombard, The effect of fatigue on voluntary muscle contraction.

3. R. H. Chittenden, *a.* The influence of alcohol on proteid metabolism; *b.* Some observations on the relative formation of albumose and peptone in gastric digestion.

4. S. J. Meltzer, On the self-regulation of respiration.

5. H. N. Martin, The normal respiratory movements of the frog.

6. G. T. Kemp, *a.* Exhibition of a new chronograph clock; *b.* Exhibition of photographs illustrating the coagulation of blood.

On the Origin of the Central Nervous System of Vertebrates.[1]—Gaskell reviews the work of Leydig and other workers on the homologies between the arthropod and vertebrate nervous systems, and considers the resemblances between these systems, both from an anatomical and a physiological point of view, too strong to be disregarded. As to the brain, all researches indicate the anatomical separation of the brain of the crustacean into three parts, which correspond in relative position to the fore-brain, the mid-brain with the

[1] In which chalazæ are also developed, as in the egg of the common skate of our Eastern coast.

[1] *Brain*, July, 1889.

optic thalami, and the hind-brain of vertebrates. In the spinal cord we see another parallelism, for this structure in vertebrates closely resembles the ventral chain of ganglia in crustaceans.

One difficulty stood in the way of further work on the homology between the nervous system of vertebrates and the arthropod nervous system, *i.e.*, the question of the invertebrate alimentary canal. Gaskell's theory that this canal is still existent in the vertebrate nervous system removes the difficulty. The remains of the old alimentary canal are found in the non-nervous tube which is mixed up with the nervous system proper. "This alimentary canal was of the type of the crustacean canal, a large cephalic stomach, and a straight simple intestine opening by means of an anus. The remains of the non-nervous cephalic stomach are well seen in the cephalic region of the nervous system in the shape of non-nervous epithelial structures, which are so freely found here as part of the walls of the central tube, and which by being thrown into folds form on the dorsal side the choroid plexus, on the ventral side the saccus vasculosus. Remains of the mouth and œsophagus are found as a folded down tube forming the infundibulum with the lobi infundibuli. In this way an explanation is given of non-nervous structures found in connection with the nervous tube of vertebrates." Now, if Gaskell's theory be true, we ought to find in connection with the canal of the vertebrate nervous system in the cranial region, some trace of the so-called liver of crustaceans, a large and important organ opening by a duct into the pyloric end of the cephalic stomach. In man nervous material entirely fills the cranial cavity, while in the fish the brain lies in a case, the greater part of which is filled by a jelly-like material. Gaskell does not consider this jelly a packing material, but the remains of some pre-existing organ, and this organ he thinks to be the so-called liver. In the study of Ammocœtes he finds this material to be arranged in a definite mass composed of glandular looking cells, and in a hilus formed in the mass he finds the remains of a tube passing from the commencement of the fourth ventricle to the surface. The spot where it leaves the fourth ventricle is in the region of the *ganglion interpedunculare,* which according to Ahlborn contains within itself the remains of a diverticulum from the central cavity of the nervous system. The duct opens into the central cavity at the posterior limit of the fourth ventricle,—*i.e.*, into the pyloric end of the cephalic stomach.

Gaskell discusses several structures whose functions are unknown. The interpretation of the hypophysis is so closely bound up with the question as to whether it is a paired organ or not, that he disregards it.

The epiphysis is the remains of an eye which is not vesicular, and can therefore be derived from the crustacean eye. The substantia nigra, as pointed out in a previous paper, represents the remains of the stomatogastric ganglia which are found on the œsophageal commissure. In the ganglion habenulæ the author sees the remains of a very prominent part of the supra-œsophageal ganglion. The taenia thalami, "which form a system of fibres passing from the ganglion habenulæ into the cerebral hemispheres, represent the original connection between two parts of the supra-œsophageal ganglion. Meynert's bundle represents the connection between the middle segment and some part of the sub-œsophageal ganglion, probably the ganglion interpedunculare."

Finally, this theory explains the formation of the cerebral vesicles in the embryo.—L. G.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

(Continued from page 847.)

Some physiological traits of the solid-stemmed grasses, and especially of Indian Corn (maize).—30 min.—By F. L. Stewart.

On the genus Eleocharis in America.—10 min.—By N. L. Britton.

On the tropical distribution of certain sedges.—15 min.—By N. L. Britton.

Alimentary apparatus of the Honey Bee.—13 min.—By A. J. Cook.

A suggestion concerning scientific work.—15 min.—By Wm. A. Dudley.

A newly-imported Elm insect.—15 min.—By L. O. Howard.

Notes on seedlings of Elymus virginicus.—5 min.—By W. J. Beal.

Notes on Bird's-eye Maple.—15 min.—By W. J. Beal.

On the assumption of floral characters by axial growths in Andromeda catesbæi.—5 min.—By Thomas Meehan.

On the significance of dioecism as illustrated by Pycnanthemum.—10 min.—By Thomas Meehan.

On the higher division of the Pelecypoda.—40 min.—By W. H. Dall.

On the flora of New Jersey.—20 min.—By N. L. Britton.

The House-fly: Hæmatobia cornicula Will.—10 min.—By John B. Smith.

Reserve food substances in twigs.—10 min.—By Byron D. Halsted.

Notes upon stamens of Solanaceæ.—7 min.—By Byron D. Halsted.

The relation between temperature and the number of vertebrae in fishes.—10 min.—By D. S. Jordan.

The new botanical laboratory of Barnard College.—5 min.—By N L. Britton.

A bacterial disease of Indian Corn.—15 min.—By T. J. Burrill.

A bacterial disease of Carnations.—15 min.—By J. C. Arthur.

Revision of the United States species of Fuirena.—10 min.—By Fred. V. Coville.

On the intentional importation of parasites and natural enemies of Insects injurious to vegetation.—15 min.—By C. V. Riley.

Preliminary report on reproductive characteristics of the Hydroid Eudendrium.–Sp.—5 min.—Chas. W. Hargitt.

Grasses of Roan Mountain.—8 min.—By F. Lamson Scribner.

An observation on Calaminth anuttalli.—5 min.—By David F. Day.

Fermentation of Ensilage.—15 min.—By T. J. Burrill.

The Palæontological evidence for the transmission of acquired characters.—10 min.—By Henry F. Osborn.

Modern teaching appliances in Biology.—30 min.—R. Ramsey Wright.

On a convenient method of subjecting living cells to coloring agents.—15 min.—By George L. Goodale.

Notes on the local distribution of some birds.—5 min.—By A. W. Butler.

A new departure was made in Section F, by the passage of a resolution to have appointed a special subject for discussion at the meeting in 1890. The subject chosen was the "Geographical Distribution of Plants," and the persons selected, and the topics for each, were as follows:

Sereno Watson—"The Relations of the Floras of Mexico and the United States."

John Macoun—"The Ligneous Plants of Canada."

C. S. Sargent—"The Ligneous Plants of the Rocky Mountains."

John M. Coulter—"The Umbelliferæ."

L. M. Underwood—"The Hepaticæ."

Byron D. Halsted—"American Weeds."

N. L. Britton—"General Distribution of North American Plants."

SECTION H.

Notes on Aboriginal Fire-making.—10 min.—By Walter Hough.

Shinto, the religion of the Japanese.—30 min.—By Romyn Hitchcock.

Siouan terms for "Mysterious" and "Serpent."—5 min.—By J. Owen Dorsey.

Gens and Sub-gens as expressed in four Siouan languages.—5 min.—By J. Owen Dorsey.

Some Principles of Evidence relating to the Antiquity of Man.—25 min.—By W. J. McGee.

On the Evolution of Ornament: the American lesson.—25 min.—By W. H. Holmes.

Aboriginal Mounds of North Dakota.—30 min.—By Henry Montgomery.

The Iroquois White Dog Feast.—23 min.—By W. M. Beauchamp.

The Mission and Mission Indians of California.—40 min.—By Henry W. Henshaw.

Evidences of the successors of Palæolithic Man in the Delaware River Valley.—25 min.—By C. C. Abbott.

The Winnipeg Mound Region.—15 min.—By George Bryce.

Artificial Languages.—25 min.—By David R. Keys.

New Linguistic Family in California.—15 min.—By H. Henshaw.

The Parsee Flowers of Simea.—10 min.—By Mrs. R. Hitchcock.

Seega, an Egyptian game.—5 min.—By H. C. Bolton.

Onondaga Shamanie Masks.—20 min.—By De Cost Smith.

Gold Ornament from Florida.—30 min.—By A. E. Douglas.

The Phonetic Alphabet of the Winnebago Indians.—20 min.—By Miss Alice C. Fletcher.

The Middlewiwin, or Grand Medicine Society of the Ojibwoo.—45 min.—By W. J. Hoffman.

Algonkin Onomalotology.—35 min.—By A. F. Chamberlain.

Indian Personal Names.—30 min.—By J. O. Dorsey.

Huron—Iroquois of the St. Lawrence and Lake Region.—20 min.—By D. Wilson.

Gesture Language of Blackfoot Indians.—15 min.—J. McLean.

The African in Canada.—40 min.—By J. C. Hamilton.

Indian Burial in New York.—23 min.—By W. M. Beauchamp.

Portrait Pipe from Central America.—15 min.—By A. E. Douglas.

Government of the Six Nations.—40 min.—By O-ji-ja-tek-ha.

Ancient Japanese Tombs and Burial Grounds.—30 min.—Romyn Hitchcock.

Result of Explorations about the Serpent Mound of Adams Co., Ohio.—20 min.—By F. W. Putnam.

Aboriginal Monuments of North Dakota.—30 min.—By Henry Montgomery.

Little Falls Quartzes.—20 min.—By Franc E. Babbitt.

A Mississagua Legend.—15 min.—By A. F. Chamberlain.

Places of Gentes in Siouan Camping Circles.—20 min.—By J. O. Dorsey.

Onomatopes, Interjections, etc.—45 min.—By J. O. Dorsey.

Ancient Pit Dwellers of Yezo.—15 min.—By R. Hitchcock.

Steatite Ornaments from the Susquehanna River.—5 min. — By Atreus Warner.

Notes on the Eskimo of Cape Prince of Wales, Hudson's Strait.—15 min.—By F. F. Payne.

Contents of Children's Minds.—10 min.—By Harlan H. Ballard.

The Accads.—30 min.—By Virginia H. Bowers.

SECTION I.

The Fall in the Rate of Interest.—15 min.—By Geo. Iles.

What shall we do about Silver?—40 min.—S. Dana Horton.

Economic Notes regarding Luxury.—40 min.—A. G. Warner.

Food moulds the Race.—15 min.—Mrs. Nellie S. Kedsie.

Certain Aspects of Agriculture in the Arid Regions.—20 min.—J. Richards Dodge.

Development of Trade Channels.—30 min.—Henry C. Taylor.

Statistical Results of the Examination of Eyesight of five thousand Public School Children.—20 min.—Dr. G. Stirling Ryerson.

The Abolition of Slavery in Upper Canada.—20 min.—Wm. Houston.

The Science of Economic Engineering.—40 min.—Gustav Lindenthall.

Industrial Education.—15 min.—By Laura Osborn Talbot.

National Interest in Material Resources.—30 min.—By B. E. Fernow.

The Sociologic position of Protection and Free Trade.—40 min.—By Lester F. Ward.

Agricultural Experiment Stations.—20 min.—By W. O. Atwater.

A Plan for a Census of Fisheries.—15 min.—Chas. W. Smiley.

Inutility of the Desert Land Act.—12 min.—J. R. Dodge.

Scientific and Economic means of Protecting Life by Signal Lights.—30 min.—William Franklin Corton.

How shall we Protect our Forests?—20 min.—By R. W. Phipps.

The scientific application of heat to the cooking of food.—30 min—By Edward Atkinson.

Relation of Manual Training to Body and Mind.—40 min.—By C M. Woodward.

Concluding remarks upon the Economic and Sociologic relations of Canada and the United States.—15 min.—By Chas. S. Hill.

It was decided to hold the next meeting of the Association at Indianapolis, on the third Wednesday in August. The officers elected were as follows:

President, George L. Goodale.

Section A.—S. C. Chandler, Vice-President; Wooster W. Beman, Secretary.

Section B.—Cleveland Abbe, Vice-President; W. Le Conte Stevens, Secretary.

Section C.—R. B. Warder, Vice-President; W. A. Noyes, Secretary.

Section D.—James E. Denton, Vice-President; M. E. Cooley, Secretary.

Section E.—John C. Brauner, Vice-President; Samuel Calvin, Secretary.

Section F.—C. S. Minot, Vice-President; John M. Coulter, Secretary.

Section H.—Frank Baker, Vice-President; Joseph Jastrow, Secretary.

Section I.—J. Richards Dodge, Vice-President; S. Dana Horton, Secretary.

Permanent Secretary, F. W. Putnam.

General Secretary, H. C. Bolton.

Secretary of the Council, James London.

Treasurer, William Lilly.

Reported by Prof. Jos. F. James.

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THE

AMERICAN NATURALIST

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WALKS UNDER THE SEA BY A CORAL STRAND.

BY F. H. HERRICK, PH.D.

I VIVIDLY recall a scene which suddenly presented itself upon entering one of the broad bights which indent the eastern shore of Andros Island, Bahama. Once within the reef, which here leaves a wide channel between it and the shore, the prospect immediately changed like the shifting of scenery. We now sailed in a transparent, almost colorless medium, which stretched far away on every side. The sea just left behind seemed to rise up and enclose this water-island with a black, impenetrable wall, so great was the change in depth, and so intense was the light reflected from the mirror of coral sand on all the submerged reefs and banks. Ever and anon this dark ocean-line was broken into bars of silver—the glistening foam of breakers, which betray unseen and treacherous rocks. These radiant fields were pied with dark patches of sea-weed, and dappled with sombre masses of coral and sponge. By this celestial gate one imagines himself to be entering a city, the tops of cocoa-palms and other trees which alone are visible on yonder shores, answering to the spires and masts of some inland port.

The scale of colour ever changes with the altitude of the sun, with the character of the sea-bottom, and with the clouds, now flashing green fire on the horizon, and reflecting many intermediate tints between it and the crystal water at our feet. The storm-clouds rising fast, and blackening all the sky, are thus doubly felt by their effects on the sea, which transmits the deepest shades that are possible in the ultramarine. Their high colour effects are due not only to the clarity of the sea, but also to those white calcareous particles, the coral sands, which the ceaseless grinding of the breakers on the reef is ever producing and ever sifting far and near over the wide sea floor. The sands which fill every lagoon and bay, are tossed up in long dazzling lines of smooth beach, and in course of time may become hardened into coral limestone like that out of which these islands are formed. The depth of coral waters is singularly deceptive, owing to the light reflected from the bottom, and there results that wonderful distinctness with which a varied host of living forms like the coral, the starfish and the sponge, can be clearly seen even at great depths. The remorseless green of the sturdy tropical bush which covers all the shores, and which knows no change of seasons, is thus relieved by a wide sea-girdle of ever varying tints.

The Bahama Islands are all coralline; that is they are due (primarily) to the life and growth of coral polyps, insignificant animals when contemplated singly, but able to girdle the globe, only give them time and the right conditions.

New Providence, where I spent several months in the study of marine life, is the geographical as well as the commercial and political centre of the group. It is a small, compact island, 17 miles long east by west, and 7 in greatest breadth. Its southerly half is cut by the 25th parallel of latitude, and the longitude of its capital, Nassau, is 77° 22′ W., which is a little west of Washington. While it is just without the tropic line, it is nevertheless considerably within the northern borders of tropical life.

The Bahama Islands, though widely separated, are yet remarkably alike in their animal and plant life, and this simularity, which is doubtless shared by all coral rocks and isles in West Indian seas, is due to like physical conditions. All of them are essentially rocks formed by the hardening of coral sands, usually low and flat, but sometimes rising into undulating hills, or making precipitous bluffs and shelving cliffs.

A slight eminence commands a wide prospect on a coral island, and I was particularly impressed with this fact one June day upon climbing the slope of a ridge which skirts the north-easterly shore of New Providence. Leaving the clean coral street at Dix Point, where an old gate guards the entrance to a disused lane, and where the crumbling walls of a cottage on the hillside above bear witness to better days, a momentary scramble through the thick bush brings you to the top. Far along the shore winds the emerald bay, hemmed in by long narrow islands, which, as we glance down the reef, gradually fade into the blue of the sky and of the sea. On the other hand lies New Providence, a vast mosaic in greens, the darker settings of the pine and of the palm mingling with the light new growth of this ever-springing vegetation. This wilderness of color, this green mantle of perpetual spring, is thrown into long folds, some eight of which I can count at this height, all of them running nearly parallel with the ridge on which we stand. They resemble lines of sand dunes, now hardened into stone and clad with vegetation, as possibly they are, such as may be seen on some of the island reefs, over which the ocean occasionally breaks in violent storms.

Much as these coral islands may interest us from their animal and plant life, which has also a story to tell, yet those *gardens under the sea*, the living coral reefs, to which these green specks at the surface owe their origin, introduce us to an entirely new world, to a fairy-land of strange forms and bright hues, far more populous and varied than that which fired the enthusiasm of its first discoverer.

Dix Point, of which I speak now more particularly, since it is an admirable specimen of a living, growing reef, forms the southern arm of a small winding bay not far from the north-eastern extremity of New Providence. The point is a low spit of land, or more specifically *rock*, covered with a growth of tropical bush, in which we notice the mangrove, the stilt-walker of the tropical swamp, the fragrant flowered logwood, the hoary conocarpus, and the round-leaved sea grape (*Coccoloba*). Some stone ruins on the eastern side, gray with age and half concealed by the encroaching bush, mark the abode of former and long forgotten residents. Here as elsewhere the tide touches the threshold of vegetation, and with the ebb the exposed shallows make a wide beach-way, and the eroded rocks of the point are laid bare. The latter represent *hard-pan*, the stone foundation of the islands, which are capped with at most a very thin and discontinuous layer of soil. The extension of this Point under the sea is the reef which we are going to explore.

Nassau Bay is here less than a mile wide, and presents in strong lights a clear green surface, streaked and flecked with dark beds of sea-weed, which contrast strongly with the lights reflected from its clean white bottom.

Having no diving-bell or boat of the Jules Vernian type at our command, we will enter the sea garden in true native fashion with water-glass and sponge-hook, with a light suit, and above all with a shoe which is proof against the venomous darts of the black sea urchin.

With the water-glass in hand you are equipped for the voyage. With this clear eye you can read the secrets of the sea bottom at any depth you please—2, 10, 20 fathoms. The crystal water is like a lens, and the sandy bottom like a white screen, which reflects and diffuses a soft light through the ocean depths. We behold a tropical forest in miniature as in a Claude Lorraine glass, in richness of color, in variety of form and in wealth of animal and plant life far surpassing anything that the shores produce. The quivering fans and gay plumes of gorgonia, the delicate sprays and wide branching arms of living corals, are the trees of this submarine garden, while sea anemones and algæ of many hues are the flowers and sward. Here and there are large mushroom-like masses of the brain coral. Sheltered beneath the coral boughs lie innumerable sea urchins, bristling all over with black, shiny needles. Splendid fishes dart in and out among the tremulous fans, while a myriad of smaller animals dwell unseen at the bottom of the reef.

Studying more closely the revelations of the water-glass, we see that the prevailing colors are shades of brown with bold touches of purple, red, yellow and green, not to speak of the resplendent hues of the many forms of animal life which make their home on the reef, the mere naming of which would read like the inventory of a museum.

The sea fans (*Gorgonia flabellum*) are not to be mistaken. They stand erect, firmly anchored to the stony floor, and are forever repeating the slow undulating movements of the water. Their lace-like texture distinguishes them at once from the related "sea-feathers" (*Pterogorgia*), whose graceful nodding plumes, sometimes six feet tall, are the branching foliage trees of the coral garden.

Fish swim amid the waving fans, and thread the maze of the coral caves, as much at home as the birds in the neighboring bush, and far surpass the latter in the brilliancy of their colors. It is a memorable though common sight to meet a school of fish moving leisurely over the reef. Through the softened light and clear perspective of the water you see a hundred shining forms pass slowly across the painted screen, amid lilac fans and coral-sculptured rocks. Some are armored with a coat of burnished cerulean scales, or banded with black and blue, or, like the grotesque trunk-fish (*Ostracion*), dappled with a variety of tints. A blue fish (not the market fish, but a very different and very much bluer species, from whose iridescent, cobalt scales, the natives of New Providence make pretty ornaments) may be seen lazily swimming over a sand-bottom, which they frequently probe with their blunt noses, their bright coats gleaming with every lash of the tail and movement of the body.

The *turbot*, as he passes, ogles you with his large, glassy eye, or pokes his inquisitive nose into a sponge, — an odd fish from every point of view. He is about as broad as long, and has an ugly looking mouth with projecting teeth, and a deeply forked tail, the ends of which are drawn out into long streamers. The dorsal fin is peculiar, and has given rise to its nickname, the "trigger-fish." By a simple anatomical arrangement, the foremost spine of this fin, which is a sharp, dagger-like weapon, when once erect cannot be pressed down, but touch the smaller spine next to it, and down it falls like the trigger to a gun.

Perhaps one of the most striking fish we meet on a coral reef, although it is hard to decide which is the most striking, is the "hog fish," as it is called by fishermen on account of the grunting sound it makes when taken from the water. Its general shape is that of a sun fish or bream. It is jet black, excepting the head and tail, which look as if they had been dipped in a golden-yellow dye.

The brain corals (*Diploria cerebriformis*) already referred to, whose rounded surfaces are stamped with those peculiar, intricate patterns, take a high rank among reef-building polyps. They form masses from a few inches to several feet in diameter, or cover the bottom with large convoluted plates (*Meandrina*.) These help largely in building up the "coral-heads," the highest points on a growing reef, where the word is synonymous with *dangerous rocks*. A dozen different species may contribute to the growth of the head. Sponges and gorgonias attach themselves. You may see the bright rosette of a sea-anemone fastened to a stone, or detect the long "feelers" of the spiny lobster projecting from some niche in the wall. Boring sea-urchins, mollusks and barnacles perforate the living stones and thus assist the destructive action of the waves. This explains the detached fragments of coral which we see strewn everywhere over a reef. They fall an easy pray to the waves, and are slowly pounded into fine coral sand like that of the beach. This beach-sand is then endlessly rocked and shifted about, mixed with pieces of coral, conch shells, and with the bones or stony remains of countless marine organisms which inhabit the neighboring sea, until the whole is sometimes cemented into compact sand-stone, the ultimate building material of reef or island. By thus continually extracting matter from the sea water, and yielding it up in the form of solid particles of carbonate of lime, the insignificant polyp contributes to the growth of continents.

The delicate madrepores (*Madrepora arbuscula*) resemble deer's antlers or the forms of some branching shrubs, which the least blow shivers in pieces. In the water they have a light lavender hue, but bleach to snowy whiteness in the sun. The "propeller coral," as it is called by the natives, resembles clusters of brown leaves. In some places the bottom is fairly peppered with small coralline masses, the size of paper weights, their surface deeply indented with vermiform characters, well named "*chenille-stones*"

(*Manicœna areolata.*) In the "lancet coral" the partitions or thin plates lining the folds are beset with sharp cutting teeth.

The floor of a coral reef is a mosaic of living stones. The prevailing hues are browns, yellows and greens, which are relieved, as we have seen, by touches of bright colors. As the back ground of a forest enhances by the contrast the bright liveries of the birds and insects and the painted petals of flowers, so the sombre coral masses are illumined by purple alcyonaria, by scarlet actinia, by the vermilion heads of worms, and by the varied colors of the throng of animal and plant life.

On the land as in the sea the greatest harmony of colours seems to prevail among those forms which are capable of the least motion, like the stationary trees and the solid coral-stocks, while the restless fish, the crabs and worms which crawl at will over the bottom or thrust their heads from their burrows, the sea-anemones which, however incapable of active locomotion, can so retract their bright bodies that only an obscure disc is seen, may all wear the richest and most varied hues.

The meaning of colors in the organic world, if they have a meaning, is a subject of great interest, and it is commonly believed that the color of many animals has been acquired by natural selection, and has a protective significance, which is probably true. It has been discovered that certain insects are protected by the extraordinary and forbidding brilliancy of their colors, and by assuming the colors of common poisonous species, thus sharing the latter's immunity from harm. But many phenomena which we constantly meet with are not to be thus explained. A case in point of much interest is that of the West Indian shore crab (*Gregarinus ruricola*). This beautiful crab burrows in the mangrove swamps at about the level of high water, and is common throughout the Bahamas. I happened to land at the eastern extremity of Hog Key one day in April, just after heavy rains had flooded the island and routed the shore crabs from their dwellings. Nearly every green spray and bough was ornamented with these handsome crabs, which were decorated in the brightest and most varied hues. Some of them have the legs crimson and the body a dark purple, with a large yellow spot like an eye on each side of the back. In others these tints are reversed, the spots being purple on a light ground. Others again are nearly black, or the carapace is orange or straw color flecked or marbled with purple, or the body is purple tinged with orange, in an endless series of patterns so that no two are alike. These fickle colors seem to be all for show. They plainly have no protective meaning, but are due to some subtile physiological cause of which we are ignorant.

A negro was living near this spot above a little stretch of white beach, and under the shade of a beautiful grove of cocoanut palms. About his cabin were strewn the telling remains of many crab dinners. He told me that these animals "begin to crawl" after rain at about 8 o'clock in the morning, and disappear again about 4 in the afternoon. Their legs are fringed with sharp spines or climbers, by the aid of which they readily ascend trees, and the large pincers which they brandish, not without effect, show plainly that they are able to protect themselves.

The crabs have many queer habits. An odd freak is that of tucking little stones in their ears after moulting the skin, but what is more surprising is the apparent indifference and address with which they will sometimes amputate their own limbs. I saw a good piece of this invertebrate surgery one day when I captured a shore crab which was crossing the road. A crab always cuts a comical figure as it runs sidewise, eying you with its optic organs raised aloft like a pair of opera glasses. As Charles Kingsley says of the four-eyed fish, he who sees a crab scuttling across the road for the first time without laughing must be much wiser or much stupider than any man has a right to be. I had pinioned this crab with my foot, and held him as I supposed securely by the "great pincers," one in each hand, when he suddenly dropped both claws, and scuttled off with apparent unconcern, although he had parted with his most valuable weapons. [1]

[1] This is a genuine amputation, and is not due merely to accident or to the fragility of the legs. Experiment has proved that it is caused by a vigorous muscular contraction, and that it is a reflex act. The limb of a dead crab, or of one in which the nervous system has been paralyzed, will lift a weight of several pounds. Any profound nervous shock like that given by rapidly cuttting off part of a leg with sharp scissors, or by electrical or chemical stimuli, produces the same result.

The comparison of a coral reef to a garden of plants or of the branching coral to a tree has a significance which it is interesting to notice. The tree and coral agree in being plant and animal communities, leading a composite or corporate life of mutual benefit. That the tree is a community is seen by its reproducing by buds, by cuttings and roots, as in the case of the Banyan or Pagoda Fig Tree of India, where a whole forest may arise from a single seed. The life of the tree is moreover near the surface, in the sap wood, while the heart is practically dead and useless, except for support.

So the coral starts as a simple egg or cell, and by the asexual process of budding builds up a community. The coral stock is alive only at the surface, the superficial polyps resting on the dead skeletons of previous years, as the living wood rests upon the rings of old growth. This comparison fails completely with the feeding of these communities, since the tree takes its food not only by the leaves but by its new roots, while a coral has no living roots, but gets all its nourishment from the water through the mouths of the individual polyps,

An abraded skin and lacerated fingers await the diver on a coral reef, for its wonders cannot be explored without cost. The indescribable glimmer which pervades the transparent waters, subdues and blends all distant objects, and plays in a green light at the surface. This is the veil which the sea nymphs hold before the eyes of the visitor to their realms.

A light cream-colored species related to the fan-corals are the "nettles" of the reef, which one is sure to meet on his first visit thither, and equally sure to avoid on his next. They encrust stones or corals of other species, and, being amply provided with poison cells, are like fire to the touch. Most of the common corals and sponges are found at ebbtide in from one half to two fathoms of water or even at less depths. They die quickly when exposed to the sun, and if transferred to the sea again they become skeletons in a few hours.

The black sea urchin (*Diadema*) to which allusion has been made, is the bug-bear of the reefs, and every experienced person gives it a wide birth. The white sand is sometimes blackened by them. The body of the animal, though small, is stuck so full of long black needles that it makes a bristling ball more than a foot in diameter. Each spine is a poisoned dart, and as brittle as glass. At some points on a reef you can hardly turn a stone without encountering this black monster. The Bahaman diver and sponge fisherman know them well. I have heard them tell of several unfortunate men who received a full dose of this animal's poison. As to the pain and cramp which comes from a pin prick in the finger administered by this urchin, I can answer by frequent experience, and can readily imagine the exquisite torture, bordering on madness, which is said to result from closer acquaintance.

If we leave the reef and wander along the shallows of the bay, we see plainly written on its sands evidence of a different though by no means scanty population. Here, for instance, I see the sand-floor dotted with conical elevations like volcanoes on a raised map, with open craters at their tops, or it is there perforated with small holes. Resting on many of the latter I see spherical masses of a transparent jelly, looking as if it had been thrown out by an eruption from below, while long strings of this tremulous substance are protruding from others. These are the submarine dwellings of *annelids*—sea worms, which burrow deeply in the sand, and lay their tiny eggs, much after the manner of frogs, in large masses of jelly, which serve both for food and protection to the young. The number of the marine worms is well nigh countless. They roll out of nearly every sponge or rock which is brought up from the reef. Many are painted in the most delicate and exquisite colors, and suggest nothing that is repulsive. Some species build elastic tubes, a cluster of which is like a bunch of flowers. Each tube, the size of a pencil perhaps (when its tenant is undisturbed), is crowned with a circular fringe of brown or scarlet feathers. Stoop to pick the flower, and presto!—in a wink the worm has drawn in its feathery gills and shut the door, which does not open again for some time to come.

This sand is also dotted with groves and forests of palm-like algæ, whose slender stems, tufted with green, bear every resemblance to toy trees.

There are at least three star-fishes found in this bay, the largest of which (*Pentaceros reticulatus*), the star of the *new* "Curiosity Shop," is of the first magnitude, a foot or more in diameter. It is anywhere a conspicuous object, and its deep brown and yellow patterns show distinctly on the white sea floor. A five-pointed star is the rule, but occasionally a monster appears among them, who abbreviates the number of its arms to 4 or increases them to 6. I once found a small star with only three rays, and one day met with a large fellow, one of whose five normal arms had been amputated, bitten off by an enemy perhaps, and a new one was growing in its stead.

The beds of weed which extend as wide bands up and down the bay are occupied almost exclusively by a large white sea-urchin (perhaps *Hippomœ*), called the "Sea Eggs" from their white papery shells, which are often picked up on the beach. So thick are they it takes some care to avoid stepping on them, to do which with bare feet, to say the least, is certainly not pleasant, although the spines of this species are quite short and without venom. I am reminded of a pasture where the grass is cropped close. Here are forty thousand feeding like one, but not on the grass, for the cropping in this case is not from the herd. The sea weed or alga in question has a narrow blade a few inches long, which ends abruptly as if cut off by scissors. These sea eggs are all of about the same size—that of a flattened base ball, and the question at once arises, Where are the young and intermediate stages? I remember to have seen but one or two undersized sea urchins, although I made daily visits to the reef for many weeks. This is probably but a common illustration of the fact that the struggle for life is far greater with the young than with the adults. Of the newly-born host, a very large number must be overtaken by death before reaching the adult state. But the survivors live through many generations, and thus their numbers increase. If this were not so in the case even of a single prolific animal, the ocean would soon be overrun by it.

The flowers of the coral gardens are the sea-anemones or actinias. They look like bright rosettes, scattered here and there for ornaments, now pinned to a coral tree or wall-side or half concealed in the grass.

The actinian is in fact a greatly enlarged coral polyp, but without a skeleton, and in consequence of this they can retreat so completely within themselves as to become almost invisible. Place one of these contracted discs in an aquarium of sea water, and a beautiful "flower" will soon unfold, to your astonishment, filling the whole jar. When this animal multiplies by budding or by division a new individual is formed like the first, and the two separate, so that the colonial stage is never realized. A common and large species (*Cereactis*) has a vermilion body, and drab, carmine-tipped tentacles. I once saw a patch of white sand bordered like a parterre by a row of these bright flowers on either side.

To one who has not given the subject a thought, it may take some stretch of imagination to associate the corals with the popular idea of animal life, but as we see the living mass, and the individual polyps, opening their mouths and extending their fringes of waving tentacles, any doubt in the matter will probably be removed. The coral stock or the sea fan is in fact a colony of animals, as truly as a hive of bees or an ants' nest is, but the former is composed of individuals united by a peculiar method of growth, while in the latter case the indiviruals are separate and specialized for different labors.

The coral polyp, which, in spite of the protests of naturalists, is commonly called an *insect*, by the popular error of including under this term most small and insignificant beings, is in fact further from the insect than the insect is from man. It starts life as a free swimming oval body, which hatches from an egg smaller than a pin's head. This active embryo acquires a mouth at one end, and is now significantly called a *gastrula* or stomach animal. It soon attaches itself by the opposite end to some rocky support, and thenceforward is a prisoner. This young polyp now develops tentacles or feelers about its mouth, and begins the deposit of lime which is to make its skeleton. This takes the form of a cup in which the animal rests, it being always external to its own skeleton. Thin partitions or septa grow inward from the sides of this cup. They correspond to the tentacles, and with the latter increase in number with the age of the polyp according to definite laws. The animal then begins to reproduce asexually by division and budding, and the method and degree of completeness with which this is carried out, determine the form of the coral stock. The fragile madrepores branch in the most intricate manner, while other forms are massive, the cups of individual polyps being closely crowded and united in a common base. In the brain corals the sides of the neighboring cups unite to form intricately winding valleys.

The fan corals or alcyonaria (named for Alcyone, the daughter of Neptune) have invariably eight tentacles, and usually a horny instead of a calcareous skeleton. Under this head falls the *Corallium rubrum* of the Mediterranean, which yields the red coral stone of jewelry, but it is exceptional as regards its hard skeleton.

It quite as true of the corals as of the flowers of the field, "they toil not neither do they spin," and any metaphor of the poet which implies 'labor' or 'skill' in the polyp community such as we see in the construction of the honey-comb by the bees is rightly objected to as being misleading, since it is false to nature. The white and porous limestone structure which we call "coral," or technically a *corallum*, is in fact the inorganic frameworks of the polyp colony, and it costs the coral animals just as much labor as it does us to make the bones in our bodies.

Reef-building corals occupy a zone about 28° on either side of the equator and in both palæozoic and recent times they have produced important changes on the earth's surface, building up islands in the sea and adding to the coasts of continents. They do not flourish below a depth of 15—20 fathoms, and are absent from the mouths of rivers, since they require the pure sea water.

Once let the waves throw up a sand bar on the reef, and a new island is therewith born. A thousand and one objects attach themselves, and the constructive processes get the upper hand. The mangrove tree is an early visitor, and its peculiar methods of growth fit it admirably as a pioneer in the vegetation of the new island. The seeds of this plant develop in the calyx, before they fall from the tree, each sending out a curved cylindrical stalk (radicle or caulicle) several inches long. These float like corks on the water, and the little plant, which now resembles a cigar loaded at one end, is ready to strike root wherever it touches soil. The young tree grows apace, and further shows that it has come to stay by sending down roots from the branches, which serve as little guy ropes to anchor it firmly in the sand, This new land is in a state of constant ebb and flow, until its sand bars and dunes have been firmly cemented into coral limestone. The sea and the rain eat away the soft rock, carving it into fantastic forms. A soil however will gradually accumulate in little pockets at the surface, where the seeds of plants brought thither by birds, by wind or wave, immediately germinate, and cover the already old yet new island with a mantle of green.

The whole subject of the formation of coral islands is now being vigorously discussed.

Before Darwin's day it was generally believed that coral islands were incrustations on the top of lofty sub-marine mountains. But when, 50 years ago, Darwin made his celebrated "Beagle" voyage (1832-1836), and afterwards published his account (second only in fame to his later theory of the origin of species), of the origin of these wonder-islands in mid-ocean, the older view was at once discarded. The key to his explanation was subsidence, the sinking of the ocean bottom. What were once table lands and mountains rising out of the Pacific and Indian Oceans, are now only sunken peaks crowned with coral limestone. The coral animals themselves impose, as we have seen, peculiar conditions. They require pure and warm sea-water and a bountiful supply of oxygen, and die if subjected to cold currents, to sediments, and if carried to a greater depth than 100 to 120 feet. With these conditions the problem seems simple enough. The land, a volcano we will say, is very slowly sinking in a tropical sea. The coral polyps will attach themselves to its shores, will grow within the zone of their bathymetrical life limits, and will gradually build up a fringing reef. As the mountain sinks this reef grows out from the land, since the outer corals exposed to the wash of the waves from the open sea, are in a better environment than those next the shore, and hence grow the fastest.

Then if the mountain sinks out of sight, the same processes continuing *pari passu*, the atol is produced, the last link in the chain of development. We begin with the fringing reef; we end with the atol, a ring of coral, with a central lagoon just over the mountain top. This is a brief and partial statement of the theory, which Dana substantially corroborates.

But in recent years much new light has been shed upon this fascinating subject, and it now appears as if Darwin's theory of coral reefs and islands, simple and plausible as it is, is destined to be set aside. It can be certainly said that it is not of general application. Agassiz found evidence of elevation in the Florida reefs, and later Murray, of the Challenger Expedition, has given an entirely new explanation of the Pacific coral reef and atol. This expedition, sent out to explore the deep seas, was equipped with all the appliances which modern science could command, and the importance of its results to the scientific world can hardly be overestimated. According to this observer, the principal factors in the formation of coral structures are the elevation in the deep sea of suitable platforms in which corals may build, either by volcanic action or by the deposit of organic sediments; the abrasion and solution of the coral rock itself. Of the subsidence which Darwin's view requires, there is no certain proof, while on the contrary in the Pacific and Indian oceans there has been in many cases an elevation of land. No trace of a sunken mountain peak as the base of a coral island has ever been discovered. The outer wall next the sea is usually not precipitous except for the first few fathoms. It then slopes off gradually to great depths. Oceanic islands are usually volcanic, and in moderately shallow waters there is a constant rain of minute solid particles to the bottom. These consist of siliceous and calcareous shells of the minute organisms with which the surface waters of the tropical seas are teeming. Having then a suitable base on which the corals may build, then the greater growth of the margin of the reef, and the erosion of the dead inner parts, will account for all the phenomena. As already said the coral island is formed by the accumulation of its own débris.

The ocean and especially the tropical ocean is, as it has always been, the great home of life. The forces which in cooler climates tend to repress and retard animal and plant life, here favor and force it onward. The battle for existence is here most incessant, its phenomena most marked. There results that boundless range of form and color, that exhaustless spring of individual life, which may well excite our wonder and our love.

THE ETIOLOGICAL CLASSIFICATION OF DISEASES.

BY FRANK S. BILLINGS.

BEFORE discussing this part of nosology it may be well to say a few words on the classification of diseases in general. First, we differentiate them according to that tissue of an organ in which the initial stage of the disease occurs, or in which the lesions predominate, or in other words, as to whether the active, or the stromatous, or supporting tissues are first complicated; that is, into interstitial or parenchymatous. It is well that this point be completely understood.

Those who are engaged in giving instruction in our medical schools, as well as those members of the profession who have an especial fondness for pathology, generally find that not only the students per se, but a great many practicing physicians, either have, or obtain, the idea that the above classification is something absolute, and that the processes are entirely limited to the tissues indicated in the differentiation. This is an error, but it seems to be a necessary failing of the text books to keep up this sharp differentiation, which would not be so serious had the authors but called attention to the fact that, while the pathological processes may begin in one kind of tissue, for instance the parenchymatous, if severe and prolonged in action they must eventually com-plicate the interstitial also. This condition of things is far more common in regard to the extension of interstitial disturbances to the parenchyma, than the contrary, especially if parenchymatous disturbances are of short duration. Again, it is far more common in some organs than others, For instance, a parenchymatous pneumonia may exist to an excessive degree without any proliferation to speak of occurring in the stroma of the lungs; or a chronic bronchitis, which is partially parenchymatous and partly interstitial as to the bronchial tubes, may be present without any very serious disturbance of the alveola-epithelium, but a well-diffused and active interstitial pneumonia cannot occur without the most severe parenchymatous complications resulting in the complicated parts, due principally to the encroachment of the interstitial processes upon the walls of the blood-vessels circulating through the interlobular spaces, thus leading to severe circulation disturbances, and, eventually, stasis in many parts of the lungs. The condition seen in contagious pleuro-pneumonia in cattle is a striking example of this kind of extension. On the contrary, it is very seldom that we have severe and prolonged disturbance of the active substance in the dense glandular organs, such as the liver or kidneys, without more less extension of the processes from the parenchymatous to the interstitial tissue, especially in the vulnerable spots around the larger blood-vessels, or where bifurcation of vessels is present. Hence it is better to look upon this classification as having reference to the tissues in which the disease began, or where the disturbances have been initially the most severe, rather than that they have been, or are, limited to a certain tissue, as the names selected appear to indicate.

Again, we classify diseases according to the product, the nomenclature being self-explanatory, such as, caseous, fibrinous, or catarrhal pneumonias; a fibrinous or a serous effusion; a hæmorrhagic, or purulent, process, and so on. Such other means of differentiation as acute or chronic, or the various critical sub-divisions, need not be here mentioned.

With these few and imperfect remarks as an introduction, let us turn our attention to the etiological classification.

On this point we have the altogether antiquated classification of diseases into "Contagious, infectious and sporadic," which should be replaced to-day by speaking of them as :

Extra-organismal, or exogenous ;

Intra-organismal or endogenous ; and,

Sporadic ; that is of undemonstrable origin ;

or, in other words, from the etiological point of view we can logically classify diseasesonly according to the primary origin of their specific cause.

A recent reviewer in the New York *Medical Record* says of my "Investigations of Cattle Diseases in Nebraska," which includes some researches made upon alcoholic material from yellow-fever patients, that said work "contains much that is interesting, but is, unfortunately, very controversial in tone."

What nonsense! How can one ever hope to establish truth in the face of error but by controversy? To my mind, the more grievous the error, the more grievous the necessity for correct controversy, and there are some very grave reasons in this country why the controversy should be turned into a very severe battle for the truth, so far as original research is concerned.

Going back to our original differentiation for a moment, Hueppe has come to the same idea when he speaks of the micro-organismal causes of disease as "obligatory parasites," by which he means that such etiological moments are primarily bound on the conditions offered by some form of animal life for their existence and continuous development; or, in other words, such diseases are "endogenous" in origin, to speak with Pettenkofer, or intra-organismal in origin, as I have termed it. An endogenous disease is one which, so far as we can historically trace its genesis, has found and still finds its locus of primary origin for each new outbreak or extension of the disease, in a diseased individual of some given species of animal life (and never in any other way); and then passes directly from the diseased individual to another susceptible healthy one, either by direct contact, or cohabitation, or by contact with some effluvia which has either come directly from, or been in immediate contact or relation with, such a diseased individual.

Speaking in the old sense, such a disease would be "contagious." Speaking acccording to the nonsensical usage of that word at present, no one can tell what its true origin might have been.

In contradiction to his obligatory parasitic diseases, Hueppe has given us the term of "faculative parasites," by which he means to indicate diseases of parasitic origin, but in which the focus of primary development (of the germs) is invariably outside the animal organism; still, that they have the faculty of living, for a time, within the organism of certain species of animal life, becoming parasitic or disease-producing for the time, when such animal organisms offer the necessary nutrient conditions to their life. To this class Pettenkofer has given the name of "exogenous," while I have termed them "extra-organismal," or diseases which found their primary origin in internal or surrounding conditions; or, in other words:

An exogenous disease is one which invariably finds its locus of primary origin not in, but outside of, an animal organism, that is, in the earth, or in the surroundings of animal life, where its micro-organismal cause develops under certain conditions of climate and soil which offer the necessary nutrients to its life and continuous development.

The infected earth or locality bears the same relation to animal life in the origin of exogenous disease that the infected animal organism does to healthy susceptible animals in endogenous diseases. That is, they each form centres of primary origin in their relation to specific diseases in their respective class, but with this difference: the focus of primary generation, or infection, is fixed in exogenous diseases, while it is movable in endogenous.

The *locus infectionis*, that is the point of primary infection or origin, is contagious in either case. In the one a healthy susceptible individual must come in direct contact, be upon or in such an infected locality, or come in contact with material derived directly from such a locality; while in an endogenous disease the same occurrences must take place in reference to some form of animal life. Hence it is to be readily seen that the word contagious has no logical use or place in the nosology of diseases, according to the results of modern investigation. Yet we find members of "Boards of Health" and other hygienic organizations, and physicians, rolling off the word "contagious" with the utmost nonchalance in connection with Actinomycosis, a disease due to a fungus which invariably finds its primary origin outside any form of animal life, and primarily infests some form of vegetation in our fields and pastures. We find such authorities speaking of this disease as "contagious," because, by intentional inoculation of the Actinomyces from diseased to healthy animals, it has been found that, under favorable nutrient conditions, it will continue its development in the same. This absurd idea, that contagiousness and transmissibility are one and the same thing, has found its chief support in the teachings of Robert Koch and his school. So long as Koch keeps himself confined to the exact observational and descriptive ground of bacteriology his reputation is unquestionable, but the moment he touches the field of general pathology he shows the utmost incapacity for his work, and, as intimated above, has done more to mislead the medical profession of to-day regarding a logical understanding of the true nature of diseases genetically, than all other writers combined. Even the great authority of the world's greatest epidemologist, Pettenkofer, and the generally sharp and logical teachings of Hueppe, seem to have been utterly unable to stem the tide of misconception set flowing in full flood through the teachings and example of Robert Koch and his school.

They have spoken of the "contagium" of anthrax, black-leg, cholera, schweineseuche, and such diseases, all of which are faculatively parasitic; all of which find their locus of primary origin invariably outside of any and every animal organism.

Why?

Because such diseases are transmissible to healthy from diseased animals by artificial (or accidental) inoculation. The same is true of endogenous diseases if we have susceptible animals.

Anthrax can be transmitted to a man from the dirt where a diseased sheep, or ox, may have been buried. Syphilis can be transmitted from a diseased to a healthy man by an accident with a scalpel. What is the difference, then? According to Koch and his followers they are both alike. They are, in one sense, both infectious diseases, but they are vastly different in point of origin, the one originating in and from infected earth, the other in and from a diseased individual. The source of primary origin alone decides this question. Accidental or experimental extension has nothing whatever to do with it.

But take another case which at the outset looks somewhat complicated. An ox is confined in a stable; it becomes diseased with anthrax; a fly stings it and then lights on the attendant and bites him; the man dies of malignant pustule. In this case the diseased ox was "contagious" to the fly and the latter to the man, but is anthrax a contagious disease? By no means; the fly was the accidental transmitter, the living syringe which filled itself from the blood of the ox and then introduced the infection to the man by its needle-like proboscis. The ox, however, became primarily infected from some source having no connection with animal life.

These statements of the case as to "contagion" and "contagiousness" should settle the question in every logical mind.

Remember, transmissibility of an inficiens either artificially or accidentally has nothing to do with the differention of infectious diseases as to class. The locus of primary origin and continuous natural development can alone decide as to whether a given disease is exogenous or endogenous in character.

Let us return to the question of the pathogenic nature of actinomycosis again for a moment. Actinomycosis is not an infectious disease in any true sense of the word, every authority to the contrary notwithstanding. An infectious disease, be it exogenous or endogenous in character, is one which is invariably accompanied at some time in its course by one general symptom, —fever, which is an invariable symptom of general or constitutional disturbance. The very word infection means that something has been produced which is of a general polluting character to the infected organism. Nothing of this kind occurs in actinomycosis per se. There is not necessarily any fever in this disease. Actinomycosis is always local, never general. Unless the disturbances are of such a character, or so situated, as to mechanically interfere with the functions of the organism, the individual does not necessarily emaciate. Aside from pulmonary actinomycosis the invasion is dependent on the presence of some lesion in the mouth or pharynx, be it a diseased tooth or distended ostia to glands or ducts. Not even a diseased tooth is alone sufficient. There must be follicular disease also, or the actinomyces do not gain entrance. Wherever the symptoms of general infection are present in man or animal,—far more common in man,—it will be invariably found that the invading actinomyces are accompanied by one or more of the pus-producing cocci, *Streptococcus pyogenus albus* or *aureus*, or some really infection-producing organism. In such a case, then, we have a "mixed invasio-infectious pathological complex." I do not believe that a single case of actinomycosis in man was ever necessarily due to the presence of a diseased animal. Men have been exposed to a common cause, that is all, and have unfortunately presented some lesion which acted as an atrium to the actinomyces. A recently reported case where a veterinarian is said to have been dressing a "big jawed steer," and then scratched his own tongue with his thumb nail and acquired actinomycosis linguæ (if true), was but a fitting punishment for so filthy an individual, and proves nothing but the possibility of accidental transmission, which was known well enough previously without such a disgusting and crucial test.

If actinomycosis is so "contagious," what about the thousands of horses pastured annually and stabled with "lumpy jawed" cattle? If so terribly dangerous to man, why do we find so few cases when hundreds of men, not one with sound mouths, have been in contact with diseased cattle for years?

Another class of diseases of exogenous origin, but which differs from that previously considered, is known as malarial infectious diseases. They differ from all other exogenous diseases in that, while, like the others, local in origin, they always remain local; their cause cannot be transported in the body of a diseased individual, and secondary centres of infection be caused thereby, nor have they ever been transmitted by inoculation. Febris intermittens is a striking example of this class.

As of other exogenous diseases the micro-organismal cause of malarial infectious diseases also belongs to Hueppe's class of "faculative parasites," yet one is surprised and almost shocked to see that an observer generally so logical as Hueppe, and one for whom I have the greatest admiration and respect, should, in a late article upon the "Etiologie der Cholera Asiatica" (*Berliner Klinische Wochenschrift*, No. 9, 1890) speak of this disease, of which he describes the cause to be a "faculative parasite," in the following absurd, illogical, and most decidedly contradictory manner, when he says, "*Die Cholera asiatica ist wirklich eine miasmatisch-contagious Krankheit*,"—Cholera Asiatica is truly a miasmatic-contagious disease. A "miasmatic-contagion" is an unsupposable thing. A disease of faculative-parasitic origin cannot be contagious in any logical sense. The parasite finds its primary focus of development invariably outside of any animal organism, or it could not be faculative; and hence cannot be contagious. When will this absurdity be driven out of the minds of otherwise close observers and logical thinkers? A person affected with intermittent fever is neither dangerous to others, nor can such an individual infect new localities,—at least neither of these phenomena has ever been observed in the history of such diseases.

Invasion or Mixed Infection.

The time has certainly come in connection with micro-organismal-etiological research where most exact attention must be given to the pathological differentiation of germs which are not in any direct way connected specifically with the etiology of a given disease, and yet may be the cause of secondary or complicating lesions. Although I have not as yet published anything in detail upon this subject, still it has called for a large amount of very exact study and much experimentation. The one question which has been entirely overlooked is, that if an investigator desires to decide upon the specific infectious quality of a given germ when he finds it as a complicating phenomenon in a given disease caused by a well-known micro-organism, he must make his tests in that species of animals in which he found it, and not in any others. It must be understood that by infection we can only mean one thing, and that is the pollution of the blood by some specific septic or toxic producer, let it be that that specific producer finds general distribution over the organism and develops or carries on its work in the blood, let it be that the producing organism is locally confined to its point of introduction (as in rabies, tetanus, etc.), where it produces the toxic (or septic) material, and from whence it is taken up by the circulation (lymphatic or blood) and distributed over the system, or let it be produced in some organ from whence the same effect is produced in the same way as in Asiatic cholera. Infection means the pollution of the system by something produced either generally, or locally, within it, and presupposes the continued production of such material for a given period by the producer, and its accumulation in the system both as a septic material and chemical irritant.

I cannot accept a late attempt at differentiating diseases in which the production ofsuch an irritant takes place from the point of entrance to the organism as intoxicating diseases (tetanus, rabies), in contradistinction to septicæmic diseases, where the germs do not remain local. It might be well to call these forms of infection toxæmic, in order to distinguish them from the strictly septicæmic, where the polluting micro-organisms develop in the blood itself and thus pollute it. We have also others in which both phenomena take place, of which anthrax is an example. For me, intoxication diseases are those in which the organism is saturated by a given poison, which may be introduced in any way, but which is not generated either by any part of itself, or any parasitic organism which has been introduced. Poisoning, in the common acceptation of the term, is intoxication, let it be by morphine, nicotine, alcohol, or what not. Intoxication does not presuppose a poison-producer lodged in the organism. Infection does. Naturally, such a definition has no reference to uræmic or physiological intoxication, the nature of which should be self-evident. This form can well be called intra-organismal or cumulative intoxication, while the first-named could be termed extra-organismal, keeping in view our previously-considered classification of infectious diseases. Or, to speak with Hueppe, the one is obligatory intoxication (when the kidneys do not act), the other faculative, or acquired by the individual. Or, in other words, the one form cannot be presented by the individual, hence is obligatory, while in the other he acquires the "faculty" of intoxicating himself.

To return to invasive complications: Correctly speaking, every lesion of parasitic origin must be considered as invasive in which specific pollution of the blood is not directly produced by the invader.

It has been said, and must be repeated, that the experimental test of this point must be made on healthy individuals of the same species in which the parasite was discovered, and if a micro-organism, by sub-cutaneous injection only.

I insist on the latter point with as much intensity as on the others that have been raised.

For instance, there are many micro-organisms found in the respiratory tract of animal life, or in the intestines, some of which under circumstances cause local lesions, and yet not one of them need necessarily be specifically infectious in or to the species of animal in which it was discovered. On the other hand, they may be violently so—septicæmic in rabbits, mice, guinea-pigs, or some of the many animals used in experimentation, the celebrated sputum coccus for example, and the majority of such organisms lately described by Miller in his work on "Bacteria in the Mouth." There are quite a number of such in the intestinal canal of hogs, but of those which I have thus far tested on rabbits, guinea-pigs, mice and ground-squirrels, and found fatal to one or the other, not one affected pigs in the least in very large amounts when introduced in the same way; that is, sub-cutaneously.

This class of germs is not specific in any sense of the word, according to our present knowledge. Not one of them is known to be the cause of a natural infectious disease in any of the animals in which they have been shown to have septic action by experimental inoculation. They should not even be called "pathogenic," as has been the case, as the word is misleading, and has too much of a specific sense to be used in this connection.

To any mind the only logical term to apply is, experimentally-infecting (not disease, but) micro-organism.

It may be asked why I have not reported upon my experiences with this class of germs? To which I reply, that once I had no interest in them, and not until circumstances made it necessary to bother with them did I give them any attention. Just at present they are having a "cumulative action," to be exploded with an intoxicating effect in certain directions when a suitable time comes.

It is my opinion that the U. S. Government "Swine Plague" is one of those cases of "mixed invasion," and I base that assertion on the fact that those who have tried have utterly failed (according to their published evidence) in sickening or killing a single hog by subcutaneous injection. I utterly ignore results following the injection of 8 or 9 ccm. of a bouillon culture directly into the lungs of a healthy animal. Just how many varieties of germs (absolutely non-specific) would cause pneumonia, and even gain entrance to the circulation and find more or less general distribution over the organism thus maltreated, can be determined by embryo experimenters; but it can be answered beforehand, Just as many as find suitable conditions for continued development in the conditions thus offered.

Welch himself says that not a single epizootic of his Swine Plague has been seen in this country. Then why has he insulted common sense and pathological knowledge by speaking of such an insignificant and completely undemonstrated complication as a new "Swine-Plague?"

It would be equally justifiable to speak of a large bacillus I shall speak of at another time as the cause of certain embolic hæmorrhagic lesions in the kidneys, seen sometimes in Swine-Plague, or as a specific or mixed infectious nephritis, because it often causes a mechanical-foreign-body-pneumonia for the same reason. It is not a specific germ. It does not cause infection. It is an invasion. The germ itself is absolutely harmless from the infection standpoint. It would be as sensible to speak of the filaria broncho-pneumonias in cattle, sheep, or hogs, as infectious, as those caused by these non-polluting germs.

There are many pulmonary complications of germ-parasitic origin of this invasio-non-infectious type, which occur in the lungs, which have not received the attention their merits deserve. In diseases of a specific acute infectious character (exogenous in origin especially), such as typhus abdominalis, the true Swine-Plague, the corn-stalk disease, one of the chief phenomena is a very high fever, and the most essential lesions of such diseases are the extreme parenchymatous changes in the muscles, and dense glandular organs such as the liver and kidneys. Added to these, and of equal importance, are similar changes in the heart-muscles, and the disturbance of the secretive functions of the kidneys. Briefly speaking, the elements of these organs are swollen, their condition, as a whole, is more or less anæmic, due to the pressure of the swollen cells upon the delicate capillary ramifications. These pathological disturbances necessarily lead to pressure, *à vis à frontis*, upon the circulation towards the points of least resistance; that is, to an accumulation of the blood in those organs the structure of which offers the best support to the blood-vessels, and thus favors their distention and engorgement. The two points are, first, the lungs, and next in importance the intestines. The lungs, however, chiefly deserve our attention. This condition of engorgement finds additional support in the weakened propelling power of the heart, due to the parenchymatous disturbance of the muscles. Again, the prostrate position of the individual [in man] in such cases, the inability, or non-desire for movement in both man and animals, increases this condition in the lungs, because the muscles are not called upon to take up any nutrition, and hence all conditions favoring diffusion of the blood are partially stagnated. In such cases what may be termed stagnation-pneumonia (or hypostatic pneumonia—a less correct term) is the physiological result; some might prefer to term it pathological. We will not discuss straws. In such a case we have another very vascular tissue to consider, and that is the mucosa of the bronchioles; this also is engorged, and as in the lung a serous effusion takes place into the alveoli, so in the bronchioles, the same occurs, leading to a complete obstruction of the circulation of the air;

hence atalectosis, then pneumonia; but, in this case, assuming that no micro-organisms are present in the tubes, the cellular plugging up of the alveoli does not begin in those adjoining the tubes, but in those on the extreme limits of the infundibulus. The wonderful provisions of nature are nowhere more marvelously displayed than in the protective function of the cilia of the bronchial mucosa; so long as the mucosa remains comparatively normal, these delicate hairs move all foreign substances, including a surplus of secretion, towards the larynx, whence they are expectorated. This has reference to all forms of micro-organismal life as well. But when the mucosa becomes severely engorged, as in the case in point, the movements of the cilia become heavy and retarded, and when the engorgement of the vessels is so severe as to lead to serous effusion, these movements become completely parralyzed, the natural result being the retention of any foreign elements present at the point where they are caught. This serum and the existing temperature offer the most favorable conditions for the development of any germs which may be present. It can be truly said that in such a case we have a sort of natural " Esmarli Suhe." If such germs are caught at the termination or near there, or along the course of the most delicate bronchioles, they at once commence to develop into colonies, and soon fill up the tube, causing an irritation of the embracing alveolal walls, and set the epithelium of the same into active proliferation, the natural result being broncho-pneumonia. This pneumonia will depend for its character on the specific nature of the germs, which may be simply mechanically irritative in their action, purulent, or gangrenous. According to my experience, the first is the most common variety. In such a case, then, the individual has a pretty poor chance for life. To an already begun stagnation pneumonia is added one of a bronchial type, or vice versa. Again, in such an invasive broncho-pneumonia, the germs soon find their way into the circulation, either by the lymphatics or through penetrating the capillaries, most probably the former, and in such cases we naturally would find a mixture of micro-organisms in the blood.

As said, this occurs in typhus abdominalis. How many times has a physician congratulated himself and his patient that the "typhoid" was over, only to come the succeeding morning to find the temperature again elevated, the face cyanotic, and the patient breathing rapidly and with difficulty. Surely the diagnosis was correct the previous day, and the prognosis justified? What then has happened?

1st. Stagnation pneumonia.

2d. Friedländer's bacillus or Fränkel's pneumococcus, or some other micro-organism, has been caught in the bronchial tubes, as suggested, and the unfortunate patient is again the object of bacterial attack.

As said so many times, the real pathogenic question is, Are the organisms (or germs) at the bottom of this deuteropathic compliplication simply invasive in character, or has a secondary infection taken place? It is of the utmost prognostic importance that investigators truly inform practitioners which of these two is most likely to be the case.

Though not a a clinician, it would seem as if more attention ought to be given to the movements of the limbs by attendants, or massage treatment in such cases by physicians. Of the value of forced movement in an exactly similar case in Swine-Plague, I can speak most emphatically. It will save an otherwise fatal cases, and not only one case, but will lessen the percentage of mortality in a herd. I have proved this by actual experimentation in two different bunches of hogs inoculated at the same time with the same dose of virus. The ones forced to move several times a day, and as actively as they could, with a whip, all lived. The others, kept closely confined all the time from the day they were inoculated, all died.

It has been said that the larger number of these deuteropathic pulmonary lesions of micro-organismal origin will be found to be simply invasive, and due to mechanical irritation. In Swine-Plague, I know of three distinct micro-organisms which thus cause an invasive broncho-pheumonia, only one of which has any experimental virulence in small animals, and neither of them in swine, on subcutaneous inoculation. In the "Corn-Stalk Disease of Cattle," an unquestionable intestinal infection, several varieties have been found which caused broncho-pneumonia, and, so far as

I have pursued them, have no experimental virulence whatever in any of the usual small animals. The large bacillus (already spoken of) which causes embolic hemorrhage in the kidney in some cases of Swine-Plague, also causes broncho-pneumonia in diseased swine, but is harmless otherwise. The specific disease supplies the field, or opens the way, for the action of these adventitious germs through the disturbances of the circulation. That similar lesions may be due to microörganisms which also find their way into the circulation from the intestinal tract I have no doubt, though I am utterly without experience in that direction.

As a termination to this part of my story I will again repeat: It is absolutely necessary to determine whether these deutero-micro-organisms are simply invasively-mechanical in their action, or which of them also cause secondary infection.

THE SILVER LAKE OF OREGON AND ITS REGION.

BY E. D. COPE.

IT took me three days and a quarter to ride to Silver Lake from Fort Klamath, by an indirect road. We came by Sprague river and Siacan Valley. The former runs into Williamson's River and into Lake Klamath.

Before I left Fort Klamath, the soldiers brought in a splendid lot of trout from these rivers, and I secured several in alcohol. They were the *Salmo purpuratus* Pallas, and I have described their numerous variations in the Philadelphia Academy Proceedings for 1882. The largest weighed twelve pounds.

Next day I started out with a four mule team and wagon with provisions. I rode a cavalry horse, "Jim," a heavily-built gray, with a good outfit of saddle-bags and straps. They gave me an old Klamath chief as a guide, from the Agency near by. This was old Chaloquin, who was a great fighter in his day. He was a little man, with fat face, prominent eyebrows, retreating forehead and long hair. He was very good natured, smiling broadly on all interesting occasions, and appears to be of a kindly disposition. He was pleased to find that I knew the Klamath names of some fishes, such as Tswam, Xoöptu, Yehnne (large suckers) Metash (trout), etc. He taught me the names of various wild beasts, as Mitap (bear), Yoho (elk), Lok (puma), and various other words. But he couldn't talk English, and I got very little information from him, and he could not understand me. So on the second day out I found a wild young Modoc, Pete by name, who could speak English pretty well, and I hired him instead. I paid the old man off after a friedly palaver, and furnished him with mucky-mucky (provisions) for the return trip.

I found the Corporal Cronk, who had charge of the army property (animals, horses, wagons, etc.) which carried me and my provisions, to be a very inconvenient man. He was very much afraid that some trouble would befall the property, so he bothered me very much. He lost much time by making camp too early in the afternoon of the first day, and I gave him a talking to about it. So the next day he did better, and made a longer ride. I had plenty of time at the first camp, which was on the edge of a grassy meadow, by a splendid stream, clear as glass, which rose from the ground close by. So I went fishing with a mosquito-bar net I got from Mrs. Colonel Whipple, of Fort Klamath, with old Chaloquin holding the other end. We caught small fishes of five or six species, till it was quite dark. Next day we passed a few houses near the Sprague river, forming a place called Yainax. Then, after going eight miles, we forded the river and turned north, and made a camp four miles further, in a little open valley in the woods. The whole country is hilly and mountainous, and covered with tall woods of *Pinus ponderosa*, except the valleys, which are full of good coarse grass. Old Chaloquin carried his bag of wokus for food. This is the roasted and ground seeds of the yellow water-lily, and looks something like cracked wheat. They carry a cup, and mix the wokus in it with water. It swells up and makes a very agreeable mush, with a taste between farina and coffee.

Modoc Pete started with us on the third day. I was determined to get to Silver Lake on that day, and so I put a can of tomatoes, some hard-tack and some bacon in my saddle-bags to guard against accidents. I left the wagon behind, and rode off through the woods with wild Pete. We soon came across two mule deer, and later three antelope crossed the road before us. Pete called them with a peculiar cry, and they soon turned round and came toward us. Had we had a gun we could have shot one or two of them. Soon after we came down on Siacan Valley, which is ten miles across, and is covered with grass. The creek of that name runs into it, and is lost in a great bed of rushes. Only two houses are in it, and these are close together. The people own numerous cattle.

From this valley we saw a large pointed mountain, N. E., with a naked cone on top. I crossed the first range of hills at its foot, and then got off my horse and had my guide to mark on the ground a sketch of the remainder of the way. I was still twenty miles from Silver Lake. I then sent him back to bring on the wagon, and came on alone. I passed a valley where some horses grazed, but no one lived, and leaving it, I crossed a hill of lava rocks, where I lost the trail, as it did not not show. I found it again, and soon came to a part of the mountain-side where the woods were on fire. This I soon passed, and presently came out of the forest into a great open valley, which seemed to be covered with "sage brush." There were mountains north and west, but east the horizon was like that of the sea. I had reached Silver Lake Valley, which is a branch of the Oregon Desert. Pretty soon the road forked, and I was puzzled. It is necessary to be very careful about traveling alone in a sage brush desert, for one may easily die for want of water. I rode up on a hill and took a better view of the country, but got no satisfaction. The large mountain behind me was evidently an old volcano, and its sides were covered with pumice and vesicular lava, often of a red color; and lava capped the low mountains to the north (Fig. 1.) I chose the principal road, thinking that, right or wrong, it

PLATE XL

Silver Lake, Looking South-East.

would lead me to water. I followed it, say ten miles, and the sun was just going down when to my delight I came on the banks of a cold stream, which I afterwards found was Silver Creek. Horse and I enjoyed a good drink, and I started again. In a few miles I reached the Eugene road, and found a house. The Indian's sketch had not been correct, for I now knew where I was. I asked for pasture for the horse, but could get no satisfaction, the grass of the creek bottom being fenced in. I, however, crossed the creek, passed through a fence, and followed the creek behind a thick growth of willows. I pastured my horse in good grass, and got a nook near the water for a camp. I hunted wood and made a fire, as it was getting cold, and then I opened my provisions. I cut the can of tomatoes and broke my

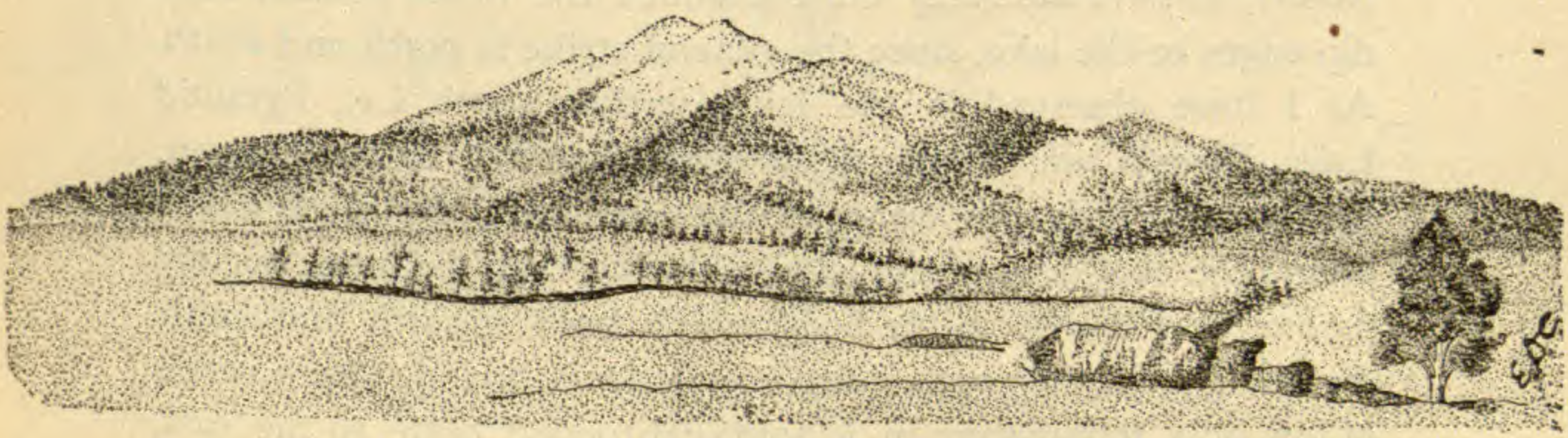


FIG 1.—WINTER MOUNTAIN LOOKING WESTWARD.

hard biscuit in it, and set it on the coals. Then I cut some slices of bacon, and put them on top of the tomato can, which had to serve as a frying-pan. It didn't fry very fast, but finally all was ready, and with a saddle-blanket for a chair, a newspaper for a table, and a biscuit for a plate, I ate a good supper with a great appetite. I had ridden forty-five or fifty miles, and was tired. I soon got into my blankets, but didn't get to sleep as soon as I wished. A pair of small (?) owls took a position near, and cried continually. They were driven off by a pair of huge owls which screamed like a wagon-wheel without grease, horribly, and flew close over my face on a tour of inspection. However, I enjoyed a delightful sleep at last, and woke up early, ate some cold tomatoes, and got on the road. After eight miles through the sage-brush, I reached the house of Mr. George Duncan, on the shores of Silver Lake. The next day after I arrived, the guide and one soldier came in with a note from the Corporal stating that the wagon had broken down, and they could get no farther! So I hired a man to go and bring on my stuff, and then the soldiers hired him to take their part of the load back to Fort Klamathe

Silver Lake measures about twelve miles long by eight miles wide. It is supplied with fresh water from Silver Creek which enters it from the north-west and has a swampy delta. The *Salmo purpuratus* are numerous in the creek, but they do not enter the lake, owing to the alkaline character of its waters. A smaller fresh stream enters at about the middle of the western shore. The lake is bounded on the west and east by precipitous basaltic bluffs (Plate XL.) On the south the bluffs present their dip edges to the lake, since the general strike is north and south. As I have observed in the lakes further south, i. e., Pyramid Lake, Nevada, and Warner's, Abert and Summer Lakes, Oregon, the basaltic beds dip away to the east from the bluffs which bound the east sides of the lakes, showing that the latter occupy fissures or fractures in the beds, which have a north and south direction. On the north side Silver Lake is bounded by a range of low hills, terminating in a bold flat-topped butte to the east, which is composed of volcanic mud more or less irregularly stratified (Pl. XLI.) A low shore and plain separate this range from the eastern bluffs, and at this point, overflow from the lake reaches a low tract to the eastward, which, when it contains water, is known as Thorne's Lake. It was dry at the time of my visit, (1879). On climbing the bluff which bounds the lake on the west, the observer stands on the edge of a plain which extends to the foot of the ancient volcano which I passed on the way to the lake. It is here seen to form but a single mountain with its foothills, forming a line north and south. It occupies the position of the so-called " Winter Range " of the U. S. War Department maps ; but it is rather entitled to be called Winter Mountain than a " range." Its summit is bold, but had no snow on it at the time of my visit (Fig 1). Its slopes are thickly clothed with forests of pine (*Pinus ponderosa*).

PLATE XLI.

Silver Lake, Looking North.

From the summit of the bluffs on the east, the eye ranges over the sage-brush desert of Central Oregon. Its surface is diversified by hills and bluffs, which have generally one slope, and one precipitous side running generally north and south. The surface was everywhere dotted with the ubiquitous sage-brush (Artemisia), with here and there a generally distorted cedar (Juniperus). This scene extended as far as the eye could reach, being bounded on the north-east by the long, low outline of the Wagontire mountain.

The fauna of the lake interested me, and I was curious to know the species of fishes, if any, which inhabited its alkaline waters. These proved to be all Cyprinidæ, and of but one species; viz.: *Myloleucus formosus* Girard, which I found also in Aberts Lake and Warners Lake.

The only Batrachian which I found was the tree-frog, *Hyla regilla* B. and G., which was quite common near the water's edge. I have never known this species to be taken in trees. Of reptiles the most abundant was the *Uta stanbsuriana* B. and G., which occurs whenever it can sun itself or find concealment on the volcanic rocks. A variety of *Sceloporus undulatus* Harl. was also common; but of other lizards I found none. The two snakes were the red spotted garter snake, *Eutænia sirtalis pickeringii* B. and G., and the rattlesnake, *Crotalus confluentus lecontei* Hallow. I found one of the latter near the house, and wrapping my hand well in my pocket handkerchief, I clapped it over his head, and transferred him to a bottle of alcohol in short order.

Birds are abundant on the lake. Geese and swans were always in sight, and pelicans and cormorants were common. The grebe *Podiceps occidentalis* Lawr. was to be seen singly or in pairs on the water at all times of the day, and their musical, finely trilled note was one of the commonest sounds of the day or evening. They possess in a high degree the peculiarity of their tribe, that of immediately sinking from view, and of reappearing at a distance after a submerged swim. Of the land birds, the most noteworthy was the *Myiadestes townsendii.* It is the most beautiful songster of the far west, rivaling in this respect its congeners of tropical America. Its note is not so loud and varied as that of the Mexican "clarine" (*M. obscurus*), but is sweet and subdued. The favorite position of the bird is on the summit of a dead tree, whence it sallies, flycatcher-fashion, after its insect food. The *Turdus naevius* appeared in small flocks, with the manners and movements of our robin; and the mountain mocker, as I supposed it to be (*Oreoscoptes montanus*), was common in the thickets. The woodpeckers were represented by the *Melanerpes torquatus* Wilson, whose peculiar irregular flapping flight is familiar to all persons who have seen the pine woods of the Rocky Mountains.

The Mammalia to be found about the lake are those common to the region. The antelope, coyote (*Canis latrans*), badger, and skunk were easily found by sight or smell. By far the most abundant order is that of the Glires (rodents). I picked up a dead *Thomomys bulbivorus* near to Duncan's house. In the sage desert west of the house the chipmunk (*Tamias asiaticus quadrivittatus* Say), a small Spermophilus, and four species of rabbits abounded. The Tamias has the habit of climbing up the slender stalks of grasses and other plants for the purpose of feeding on the seeds. In such positions, when their attitudes remind one of a bird rather than of a mammal, they are easily secured. The rabbits inhabit the sage-brush in great numbers. The species are the *Lepus campestris* A. and B., *L. callotis* Wagl., *L. silvaticus* Bachm., and the *L. trowbridgii* Baird. The first-named is the largest, and is the least abundant. It is easily recognized by its light colors and its relative long tail. The jackass rabbit (*L. callotis*) is the most abundant, and is the most important as an article of food. The cotton-tail, *L. silvaticus*, has the same characters as elsewhere, and differs from the two large species in its habit of running into holes. A most curious species is the litttle *L. trowbridgii*, which I first detected in this region, its previously known habitat having been the coast of California. Its color is a uniform bright rufous or rusty, and it appears, when running, to have no tail at all. Its movements are most erratic, dodging suddenly from one direction to another, so that it is very difficult to shoot. I failed completely to hit one, after many trials, and my identification was based on specimens sent me afterwards by Mr. Duncan.

After remaining for a few days at Mr. Duncan's, there arrived a guest to whom I became under great obligations. This was Mr. Charles Whittaker, the son of Governor Whittaker, of Oregon. Learning that I wished to visit and explore the remarkable deposit of fossil bones known as Fossil Lake, he placed his conveyance, drawn by two fine horses, and his time, at my disposal. Fossil Lake lies about forty miles to the eastward of Silver Lake, in the desert, and the trail through the sage-brush was passable for a wagon. Water could be had by digging, but food for the horses must be carried.

We left the lake by the low pass on the northeast, and, passing by the flat that held Thorne's Lake when it existed, drove to Christmas Lake, our first stopping-place. This is a small body of water of but few square miles in extent, and is excessively alkaline. Its waters have no appreciable effect on the arid shores, which were dry and dotted with the sage-brush almost to its edge. I found abundance of larvæ of dipterous insects, and crustaceans, as Cyclops, in the water; but a rancher who lived near by, told me that it contained no fishes, a statement which I could readily believe. Avosets (Recurvirostra) and stilts (Himantopus), waded in the shallows, feeding, I suppose, on the invertebrate life which I observed. From the rancher I obtained some beautiful obsidian arrow-heads and scrapers which he had found at Fossil Lake.

By early the next evening we had reached the "bone yard." We dug two holes in a low place, one for ourselves and one for the horses, getting clear water, somewhat alkaline to the taste, at a depth of about eighteen inches. We soon had a brisk fire of dry sage-brush; and bacon and mutton, potatoes and canned tomatoes, were soon in condition to satisfy the appetite which only the camper in the dry regions of the West experiences. We rolled up in our blankets, and my last thoughts before entering dreamland were of what I should find on the morrow.

The "bone yard" was found by cattlemen who were looking up stock which had wandered into this forbidden region, and many of the best specimens were carried off by them and lost to science. The first naturalist who visited it was Professor Thomas Condon, of the University of Oregon, at Eugene, who, with the care for scientific research which has always distinguished him, saved many good specimens and brought them home to his museum. One of these was part of the jaws of the remarkable llama, of about the size of a mule, which I called *Eschatius longirostris.* Subsequently my assistant, Mr. Charles H. Sternberg, of Lawrence, Kansas, visited the place, and made what is probably the largest collection ever made there. In this I found three species of llamas, the *Holomeniscus hesternus* Leidy, previously known from California, as large as a camel; and the *H. vitakerianus* Cope, as large as a vicugna, which I dedicated to my friend Mr. Whittaker. The third was a curious species, the size of a camel, which I also found in the collections made by MM. Castillo and Barcena in the Valley of Mexico. I called it *Eschatius conidens.* There were two species of true horses (Equus) both extinct; and a hugh sloth (*Mylodon sodalis*, Cope) as large as a grizzly bear. The mammoth (*Elephas primigenius* Blum.) was represented, together with numerous smaller mammals of species both recent and extinct. There were coyotes, otters, beavers, gophers (Thomomys), voles and rabbits, and the phalange of a bear; but no peccaries, tapirs, raccoons or opossums, which one would find in similar company in corresponding beds in the eastern states. Then there were multitudes of bones of birds and of fishes. These were all of existing genera and often species. I detected a few novelties, as a swan (*Cygnus paloregonus*); a goose, (*Anser hypsibatus*), and a cormorant, (*Phalacrocorox macropus*). One of the most abundant species was a grebe, which I could not distinguish from the one so commonly seen in Silver Lake, (*Podiceps occidentalis* Lawr.). Other species still await determination. Of the fishes, all belonged to the families of chubs and suckers, and several of them to species still living in the Silver and Klamath Lakes.

The next day I set out early to explore the ground. I found it to be a slight depression, embracing perhaps twenty acres, which was devoid of sage-brush, but was dotted with occasional plants of greasewood (*Sarcobatis vermicularis*), a fact due to the presence of water beneath the surface. The latter was, however, perfectly dry, and consisted of a light-colored mixture of sand and clay, or a dried lacustrine mud of volcanic origin. It was perfectly movable by the wind, and of indefinite depth. Fragments of bones and teeth were not rare. The most abundant were those of the large horse, *Equus occidentalis* Leidy, and the *Holomeniscus hesternus* Leidy. I found also bones and fragments of the *Elephas primigenius*, and the greater part of the skeleton of a Thomomys. I obtained, in fact, representatives of most ot the species previously discovered, including numerous birds and fishes. All were on or in the loose, friable deposit. Portions of the surface were white with the shells of the *Planorbis* (*Carinifex*) *newberryi* Lea, a species which is still living in Klamath Lake. Scattered everywhere in in the deposit were the obsidian implements of human manufacture. Some of these were of inferior, others of superior workmanship, and many of them were covered with a patine of no great thickness, which completely replaced the natural lustre of the surface. Other specimens were as bright as when first made. The abundance of these flints was remarkable, and suggested that they had been shot at the game, both winged and otherwise, that had in former times frequented the lake. Their general absence from the soil of the surrounding region added strength to this supposition. Of course it was impossible to prove the contemporaneity of the flints with animals with whose bones they were mingled, under the circumstances of the mobility of the stratum in which they all occurred. But had they been other than human flints, no question as to their contemporaneity would have arisen. Similar flints have been found by Mr. W. T. McGee in beds in Nevada, which he regards as of identical age with that of Silver Lake (the "Equus Bed"); but whether diagnostic vertebrate fossils are found at that locality, does not appear to be known. The probability of the association is, however, greatly increased by the discovery, by Mr. Wm. Taylor, of paleolithic flints in beds of corresponding age, on the San Diego Creek, Texas. I append a list of the species so far obtained from the Equus Beds of Silver Lake.

MAMMALIA

Holomeniscus vitakerianus Cope.
" *hesternus* Leidy.
Eschatius longirostris Cope.
" *conidens* Cope.
Equus major Dekay.
" *occidentalis* Leidy.
" *excelsus* Leidy.
Elephas primigenius Blum.
Canis latrans Say.
Lutra ?piscinaria Leidy.
Castor fiber L.
Arvicola sp.
Thomomys bulbivorus Licht.
" *; clusius* Coues.
Mylodon sodalis Cope.

AVES.

Podiceps occidentalis Lawr.
" *californicus* Heerm.
Podilymbus podiceps Linn.
Graculus macropus Cope.
Anser hypsibatus Cope.
" *canadensis* L.
" *albifrons gambeli* Hartl.
" near *nigricans* Lawr.
Cygnus paloregonus Cope.
Fulica americana Gmel.
And numerous other species.

PISCES.

Leucus altarcus Cope.
Myloleucus gibbarcus Cope.
Cliola angustarca Cope.
Catostomus labiatus Ayres.
" *batrachops* Cope.

One day we made an exploration of the desert in the direction of Wagontire Mountain towards the north-east. After traversing the sagebrush for two hours we reached the sandy desert of which we had heard. An apparently endless expanse of sand-dunes extended to the west, the north and the east. These dunes were not conical, but had a sloping side to the south-west, and a perpendicular face to the north-east. As the wind blew strongly from the south-west, the sand slowly crept towards the summit, and then fell in a fine shower to the base below. In this way the dunes constantly shift their position north-eastward till they reach the slopes of a range of hills, where they are banked up so as to be visible at a long distance. The sand I found to be soft and difficult for man and beast. At intervals there are shallow ravines lined with bunches of course grasses. Several species of finches inhabit these places, and feed on the seeds. Among these I occasionally saw the desert Pipilo, *P. chlorurus.* At one of them I found a set of Indian domestic implements; a flat dish and several pestless carved so as to have a portion for the hand separated from the head by a shoulder. All were made of the vesicular basalt, and some of them were colored red, like that found on the slopes of Winter Mountain. As no camp could well have continued there, it appeared that these implements had been left or thrown away. This sandy desert is said to be about twenty-five miles from east to west, and half as wide from north to south.

We left the sand and kept the sage-brush until about twenty-four miles east of our camp. Here I climbed a cliff to view the country. It was composed of the same thinly stratified volcanic mud-conglomerate as the hills that bound Silver Lake on the north. Lizards of the genera Uta and Sceloporus abounded. The scene was impressive from its wild desolation. As far as the eye could reach was the same sage-brush desert, the same waterless region of death. Many a man has entered this region never to escape from its fatal drought, especially during the first days of the overland emigration to Oregon. The Wagontire mountain, whose long and gloomy mass made the northeastern horizon, owes its name to the disastrous fate of one of those trains of emigrants. Coming from the east, they reached the mountain with parched mouths, and eyes aching from the heat and dust, expecting to find water for themselves and animals. There is no water in this mountain, and the horses gave out in endeavoring to continue their way through its fastnesses. They lay down and died, and nothing remained of the party but a few whitened bones, and the iron tires of the wagon wheels. Many experienced hunters have been lost in this desert, and two years after my visit, one of the oldest rangers of Oregon entered it, and was never heard of afterwards. And it is indeed easy to miss the few small springs that are found at remote intervals in this desolation of one hundred and fifty miles diameter east and west and north and south.

We mounted our horses, and were glad to retrace our steps before darkness should overtake us. We kept along the southern boundary of the sand dunes as a guide, and at last struck our outward-bound trail. To reach our camp was then not difficult, and we were soon busy housekeeping round the camp-fire. After a night's refreshing sleep we returned by the way we came, to Silver Lake. Thence we took the road north to the Dalles of the Columbia, as already described in the NATURALIST for 1888, p. 996.

CHARACTERS AND DISTRIBUTION OF THE GENERA OF BRACHIOPODA.

BY CHARLES W. ROLFE.

(*Based mainly on external characteristics.*)

I. Valves not united by a hinge, but kept in position by muscular action (*a*).

(*a*) Shell structure horny (*b*).

(*b*) Valves nearly equal, shell hatchet-shaped, or quadrate (*bb*).

(*bb*) Beaks equal, projecting, pointed, without a groove between them for the passage of the foot, — *Lingula* Brg.

Subgenera:

Forms with the beaks unequal, — *Lingulepis* Hall.

Forms with groove, — *Lingulella* Salter.

(*b*) Valves unequal, shell rounded or oval, dorsal valve the larger (*c*).

(*c*) Dorsal valve limpet-shaped, smooth or concentrically striated, ventral valve slightly convex, with a rounded or oval opening behind the beak, which does not reach the margin, — *Discina* Lmck.

Subgenera:

Forms in which the opening for the foot lies at the posterior end of the furrow, — *Orbiculoidea* d'Orb.

Forms in which the ventral valve is flat or concave, and the foramen is narrow and slit-like, — *Discinisca* Dall.

(*b*) Valves unequal, ventral valve the larger (*cc*).

(*cc*) Surface smooth, form somewhat triangular, ventral valve high-conical, with a flattened area running from beak to margin, in the center of which a shallow furrow is impressed, *Acrotreta* Kut.

(*cc*) Surface rough, ventral valve depressed-conical, its beak with a rounded foramen, and a flattened area beneath. Dorsal valve with a curved beak arising from two marginal projections, *Acrothela* Linn.

(*a*) Shell structure horny, or more or less calcareous (*d*).

(*d*) Shell very small (usually 19 mm. or less) (*dd*).

(*dd*) Form long-oval, surface shining, larger valve convex, with a long-pointed beak, smaller valve flat, *Schmidtia* Volb.

(*dd*) Form oval, both valves convex, larger with a short beak, *Leptobolus* Hall.

(*d*) Shell moderate in size, with rounded outlines (*e*).

(*e*) Ventral valve with a marginal sinus, reaching nearly to the beak (*ee*).

(*ee*) Marginal sinus relatively narrow, surface calcareous, with petal-like markings, beak anterior, *Trematis*, Sharpe.

(*ee*) Marginal sinus broad, triangular or semicircular, beak posterior, *Schizocrania*, H. & W.

(*e*) False hinge line straight, nearly or quite equaling the breadth of the shell. *Kutorgina* Bill.

(*e*) False hinge line, when present, short. Shell nearly circular, depressed, smooth, thickened toward the hinge, Valves unequal, the larger with a shallow groove beneath the beak. The central muscle scars converge posteriorly, *Obolus* Eichwald.

(*e*) Resembling Obolus. The central

muscle scars diverge posteriorly, *Obolella* Billings.

(*a*) Shell structure calcareous (*f*).

(*f*) Dorsal valve limpet-shaped, ribbed, ventral less convex (*ff*).

(*ff*) Ventral valve usually adhering to some foreign object. Inner border of both valves rough, *Crania* Ret.

Subgenus.

Free forms, with inner border smooth, *Pseudocrania* McCoy.

(*f*) Both valves convex, the larger with a heavy back, large area, and pseudodeltidium (*g*).

(*g*) Shell circular, or transversely oval, area broader than long (*gg*).

(*gg*) Beak of larger valve high and heavy, that of the smaller somewhat truncated, *Monomerella* Bill.

(*gg*) Beak of larger valve low and heavy, that of the smaller somewhat pointed, *Dinobolus* Hall.

(*g*) Shell somewhat elongated, area longer than broad, beak of larger valve high and heavy, that of the smaller truncated, *Trimerella* Bill.

II. Valves united by a true hinge, shell structure always calcareous, (*h*).

(*h*) Hinge line curved (*hh*).

(*hh*) Beak pierced by a foramen, (*i*).[1]

(*i*) Surface smooth or concentrically striated (*ii*).

(*ii*) Beak closely incurved, surface impunctate. Interior with spires, *Athyris* McCoy.

(*ii*) Beak not closely incurved, *i.e.*, a space between it and the smaller valve. Surface punctate. No spires (*j*).

(*j*) Posterior portion with two

[1] Many young shells have this character, while in adult forms of the same species it is absent.

folds separated by a sinus, on the smaller valve, and a single fold on the larger, or the folds in both valves are replaced by a truncation of the posterior margin. Arm supports reaching not more than one-third the length of the shell, *Terebratula* Llwd.

(*j*) Arm supports long (*jj*).

(*jj*) Both valves convex. Foramen large. Arm-supports united by a loop near the hinge, *Cryptonella* Hall.

(*jj*) Smaller valve usually almost flat, rarely convex. Arm-supports united by two loops which unite posteriorly to form a short, free median plate, *Centronella* Bill.

Subgenera:

Forms with surface ribbed or striated, *Leptocœlia* Hall.

(*ii*) Beak very short. Shell large. Both valves convex, depressed, without fold and sinus, *Meganteris* d'Arch.

(*i*) Surface ribbed or striated (*k*).

(*k*) See Leptocœlia above.

(*k*) Shell punctate, much elongated, without fold and sinus, or spires, *Rensselaeria* Hall.

(*k*) Shell punctate. Interior with spires (*kk*).

(*kk*) Beak closely incurved, no area (*l*).

(*l*) Form more or less elongated. Central ribs narrow. Cardinal plate broad, *Rhynchospira* Hall.

(*l*) Form transverse. Under the beak of the larger valve a triangular opening, which is filled by the incurved beak of the smaller, *Trematospira* Hall.

(*k*) Shell impunctate (*m*).

(*m*) Apex of spires directed towards ventral valve (*mm*).

(*mm*) Shell concavo-convex, *Cœlospira* Hall.

(*mm*) Shell plano-convex, *Zygospira* Hall.

(*m*) Apex of spires directed towards dorsal valve. Shell plano- or biconvex. Surface with ribs and transverse lines of growth, *Atrypa* Dalm.

(*m*) No spires (*n*).

(*n*) Shell plano- or slightly biconvex. Ventral valve with a broad, deep sinus on its posterior margin, which reaches half-way to the beak. Dorsal with a marginal sinus, *Eatonia* Hall.

(*n*) Shell tranversely oval. Surface with cellular impressions arranged in rows, *Eichwaldia* Bill.

(*hh*) Beak not pierced by a foramen, (*o*).

(*o*) Shell punctate (*oo*),

(*oo*) Shell spherical. Surface smooth or covered with hair-like spines. Beak light, sharp-pointed, with an area beneath, *Nucleospira* Hall.

(*oo*) Surface ribbed. Beak heavy, no area, *Amphigenia* Hall.

(*o*) Shell impunctate (*p*).

(*p*) Beak thin and sharp (*pp*).

(*pp*) Valves nearly equal. Shell transverse, smooth or faintly ribbed. Small valve with a sinus, large valve with a fold, *Camerella* Bill.

(*pp*) Shell usually more or less triangular, rarely globose or transversely oval. Beak sharp, directed forward, or sharply incurved. Larger valve with a sinus, smaller with a fold, *Rhynchonella* Fisch.

(*pp*) Like Rhynchonella, but the inside of the ventral shell has converging tooth plates, which unite to form a low median septum, and the dorsal valve has a low, trough-like process, and high median septum, *Camarophoria* King.

(*p*) Beak large and heavy (*q*).

(*q*) Surface smooth, or concentrically striated, rarely with indistinct ribs. Form varying from ovoid to transverse. No area. Interior with spires. Ventral valve with two curiously curved plates, called "shoe-lifter processes," *Merista* Guess.

(*q*) Differs from Merista only in the absence of the shoe-lifter processes, *Meristella* Hall.

(*q*) Differs from Meristella in that the two processes which form the loop connecting the spires do not diverge again after uniting, *Meristina* Hall.

(*q*) Form varying from elongate to gibbous or rotund. Surface ribbed, rarely smooth. Ventral valve very much the larger. Beak very large and prominent. No area. No fold or sinus, *Pentamerus* Sow.

Subgenera.

Forms which have a narrow area in the ventral valve, and a fold and sinus, *Pentamerella* Hall.

Exceedingly short and gibbous forms, having an area in both valves, *Gypidula* Hall.

Forms which have the ventral valve smaller, and less convex, than the dorsal, *Anastrophia* Hall.

See also Amphigenia above, and Spiririferina below.

(*h*) Hinge line straight (*r*).

(*r*) Shell concavo-convex (*rr*).

(*rr*) Surface spinose, especially along the hinge (*s*).

(*s*) Large valve very convex, or abruptly bent " knee form." Beak large, abruptly incurved. Smaller valve more or less concave. Area linear or absent. Hinge toothless, *Productus* Sow.

Subgenera.

Forms with a low area on both valves, and hinge teeth, *Productella* Hall.

Forms with a high area on the ventral valve. Hinge toothless, *Aulosteges* Helm.

(*s*) Shell broadly transverse. Beak not prominent. Low area on both valves. Spines along hinge, *Chonetes* Fischer.

(*rr*) Surface not spinose (*ss*).

(*ss*) Shell semicircular or transverse. Beak not prominent. Area of the larger valve low, with a triangular opening beneath the beak. No deltidium. Area of smaller valve linear or absent, *Tropidoleptus* Hall.

(*ss*) Shell semicircular, often a little longer than broad, flat, sometimes abruptly near the posterior third, widest at hinge. Both valves with an area, that of the ventral slightly larger, with a small triangular area closed by a deltidium. Beak not prominent. Hinge plain, *Strophomena* Blainv.

Subgenera.

Forms with crenulated hinge, *Strophodonta* Hall.

Small, more convex forms, varying from transverse to nearly semicircular, *Leptæna* Dalm.

(*ss*) Shell varying in form and convexity between Strophomena and Orthis. Ventral valve with a relatively high area, pseudodeltidium, and prominent, often recurved beak. Dorsal valve with a linear area, *Streptorhynchus* King.

Subgenus.

Biconvex forms, with an exceedingly high area, and coarse rounded ribs, separated by angular depressions, *Meekella* W. & St. J.

(*r*) Shell biconvex (*t*). (The convexity of the smaller valve sometimes slight).

(*t*) See Streptorhynchus and Meekella above.

(*t*) Shell depressed, nearly flat, radially folded. Valves nearly equal, the larger with an area, and strongly hooked beak, which is closely incurved. No spires, *Stricklandia* Bill.

(*t*) Form quadrate, varying from semicircular. No internal spires (*tt*).

(*tt*) Convexity of the smaller valve

sometimes slight. Both valves with an area and foramen. No deltidium. Area not striated. Hinge line usually less than breath of shell. Sinus and fold usually absent, rarely prominent, *Orthis* Dalm.

Subgenera.

Shell two-lobed through the presence of a sinus in each valve, *Bilobites* Lin.

Very convex forms, with hinge line often exceeding the breadth of the shell, and a prominent sinus and fold, *Platystrophia* King.

(*tt*) Shell with a wide area, foramen, and pseudodeltidium in each valve, *Orthisina* d'Orb.

(*tt*) Larger valve pyramidal. Otherwise Orthis-like, *Skenidium* Hall.

(*t*) Shell nearly spherical, punctate thin hinge line very short. Area small. Beak recurved, *Syntrielasma* M. & W.

(*t*) Shell triangular, varying towards circular. Sinus and fold usually prominent. Hinge line often exceeding the breadth of the shell. Beak usually more prominent than in Orthis. Area in both valves, that in the ventral larger, and striated with horizontal and vertical lines. Spires present, *Spirifer* Sow.

Subgenera.

Forms with punctate shell (*v*).

(*v*) Surface finely spinose. Foramen covered by a deltidium. Hinge line sometimes curved, *Spiriferina* d'Orb.

(*v*) Hinge line long and straight. Larger valve with a broad area, a narrow triangular fissure partly closed by a deltidium, and a broad median sinus. Smaller valve without area, *Syringothyris* Winch.

(*v*) Punctate shells which closely resemble Cyrtia, *Cyrtina* Dav.

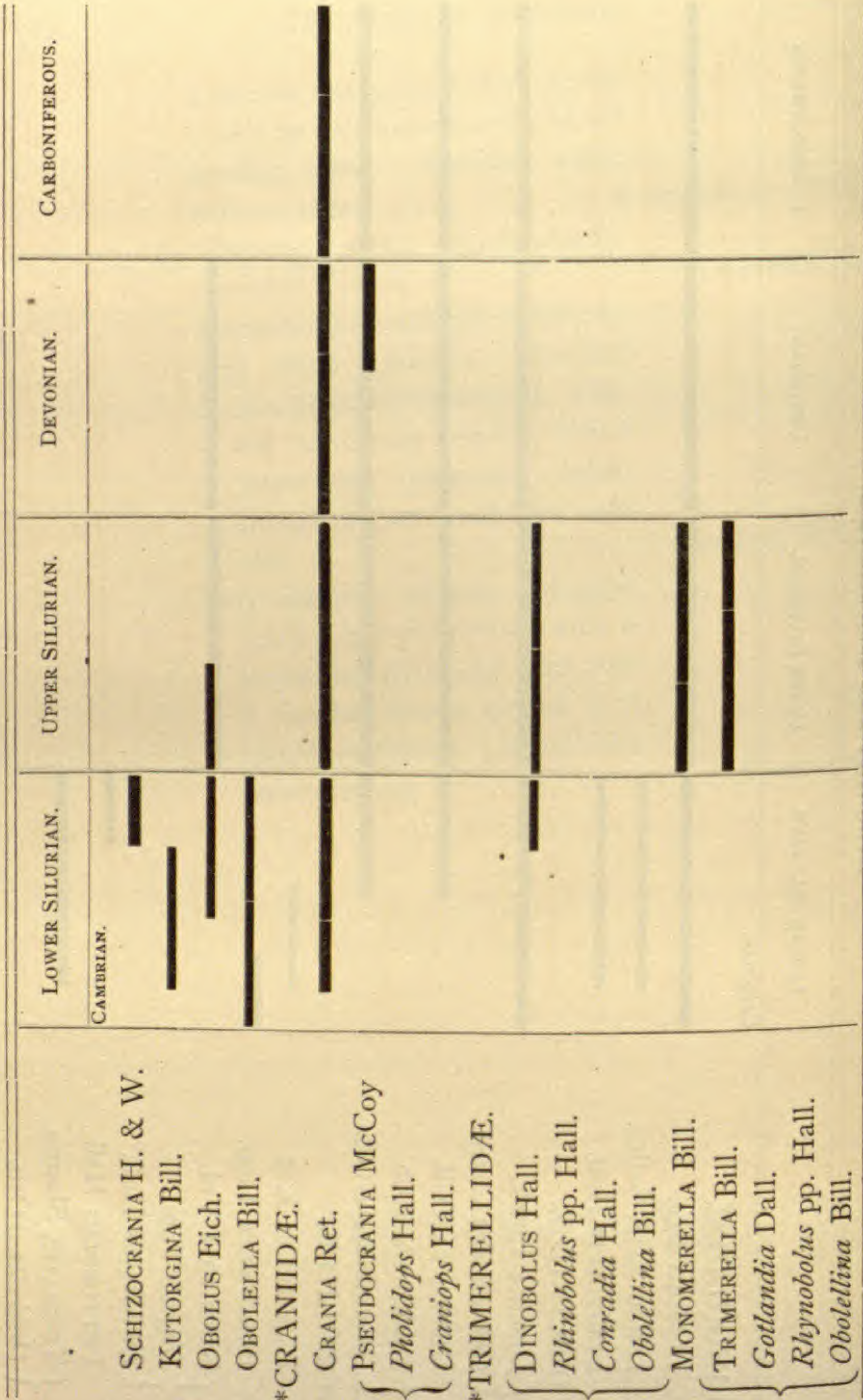
Forms with impunctate shell (*vv*).

(*vv*) Shell gibbous. Surface smooth or finely striated. Ventral valve very convex, with a prominent incurved beak. Dorsal flat, or much less convex, *Martinia* McCoy.

(*vv*) Surface ribbed. Larger valve high pyramidal, with a large, flat, triangular area, and a median fissure closed by a pseudodeltidium. Smaller valve convex, *Cyrtia* Dalm.

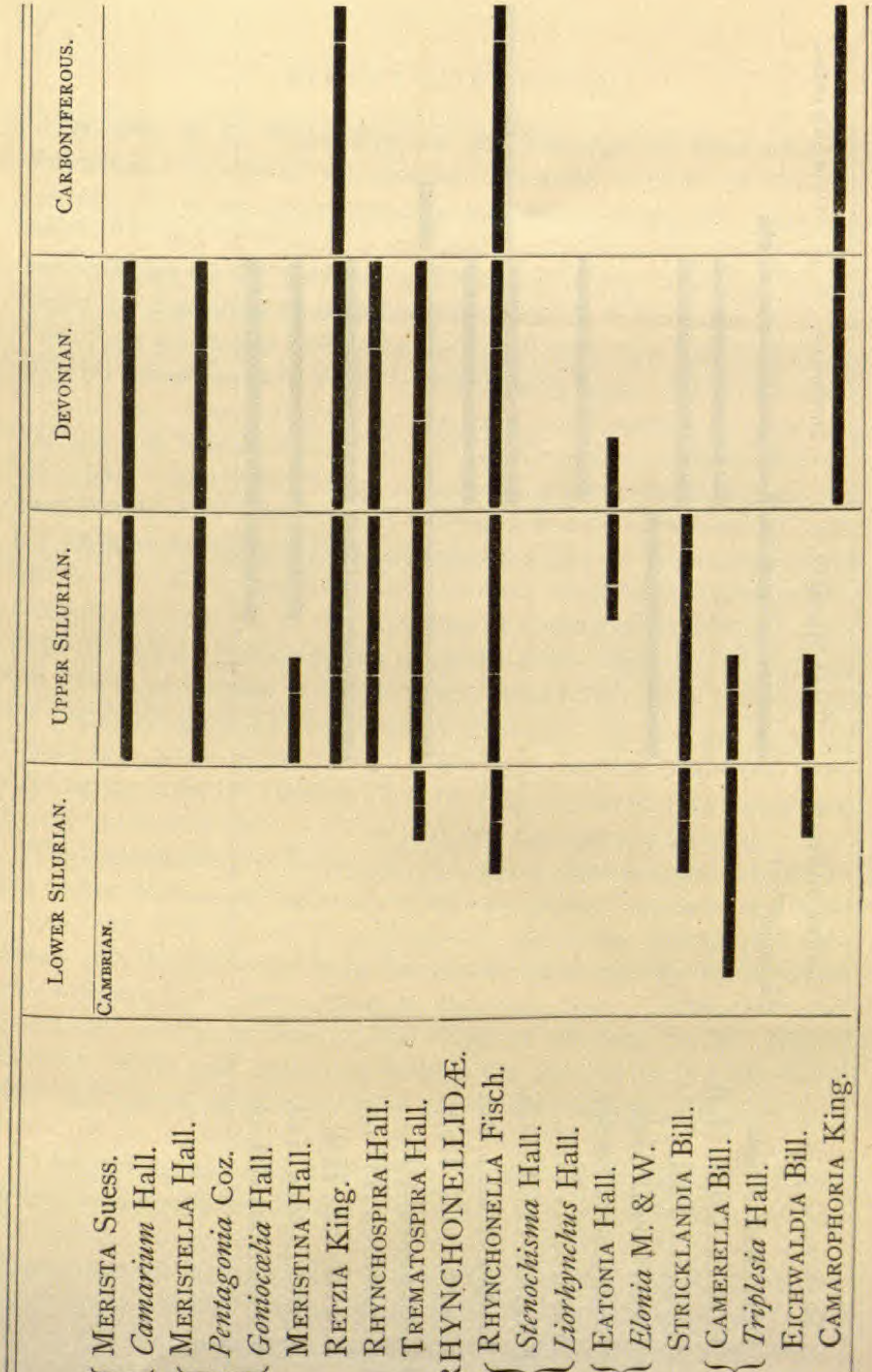
Synonymy and Distribution.

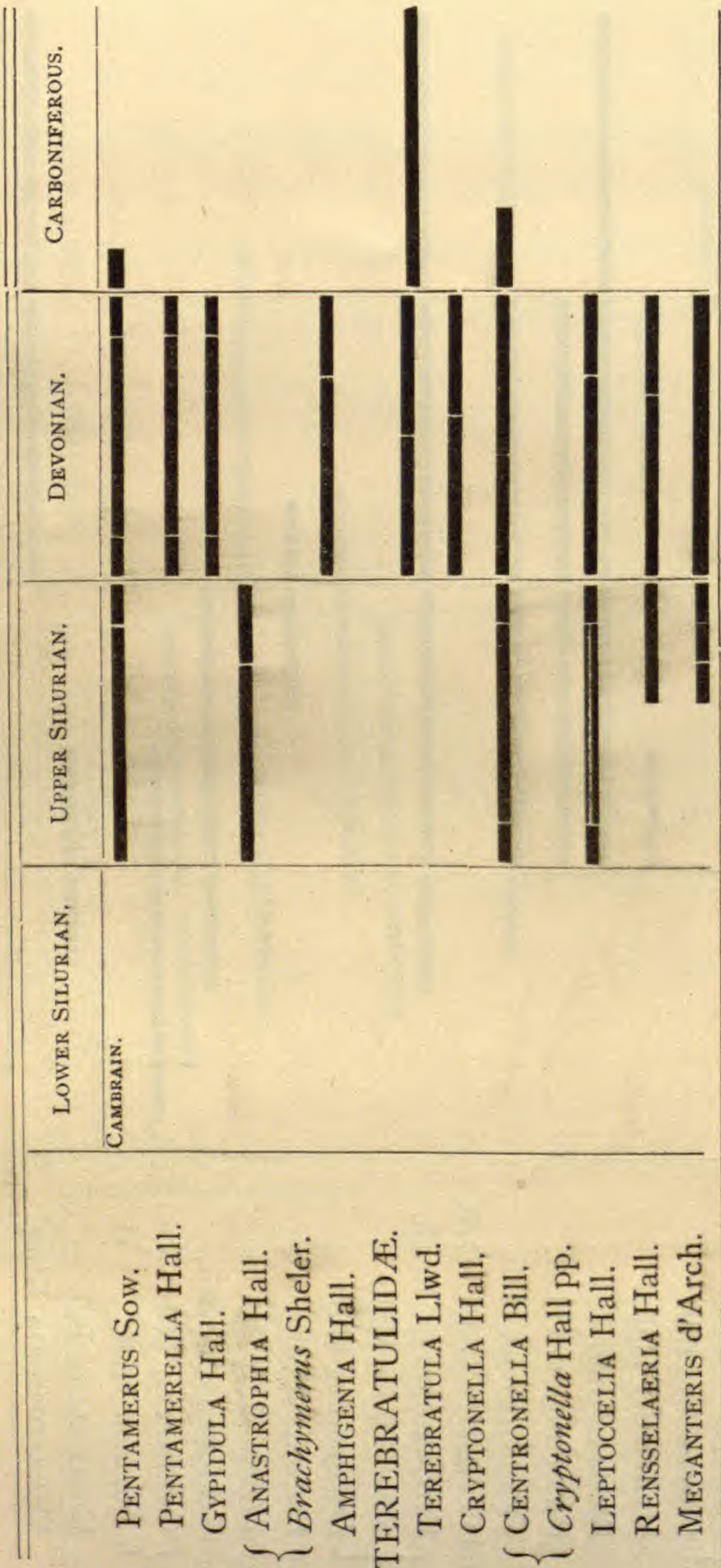
	Cambrian.	Lower Silurian.	Upper Silurian.	Devonian.	Carboniferous.
LINGULIDÆ.					
Lingula Brg.	x	x	x	x	x
Lingulella Saller.	x	x			
Lingulepis Hall.	x	x			
*DISCINIDÆ.					
{ Discina Linck.	x	x	x	x	x
{ *Orbiculoidea* Owen.					
Discinisca Dall.		x	x	x	x
{ *Schizotreta* Kut.					
{ *Orbiculoidea* d'Orb.		x	x	x	x
*OBOLIDÆ.					
Acrotreta Kut.	x				
Acrothele Linn.	x				
{ Schmidtia Vol.			x	x	
{ *Ungula* Pand.					
{ *Dicellomus* Hall.					
Leptobolus Hall.		x			
{ Trematis, Sharpe.	x	x			
{ *Orbicella* d'Orb.					


LOWER SILURIAN.
CAMBRIAN.
UPPER SILURIAN.
DEVONIAN.
CARBONIFEROUS.
SCHIZOCRANIA H. & W.
KUTORGINA Bill.
OBOLUS Eich.
OBOLELLA Bill.
*CRANIIDÆ.
CRANIA Ret.
PSEUDOCRANIA McCoy
Pholidops Hall.
Craniops Hall.
*TRIMERELLIDÆ.
DINOBOLUS Hall.
Rhinobolus pp. Hall.
Conradia Hall.
Obolellina Bill.
MONOMERELLA Bill.
TRIMERELLA Bill.
Gotlandia Dall.
Rhynobolus pp. Hall.
Obolellina Bill.


CARBONIFEROUS.
DEVONIAN.
UPPER SILURIAN.
LOWER SILURIAN.
CAMBRIAN.
PRODUCTIDÆ.
PRODUCTUS Sow.
PRODUCTELLA Hall.
AULOSTEGES Helm.
CHONETES Fisch.
STROPHOMENIDÆ.
ORTHIS Dalm.
PLATYSTROPHIA King.
BILOBITES Lin.
Dicælosia King.
ORTHISINA d'Orb.
Hemipronites Pand.
SKENIDIUM Hall.
TROPIDOLEPTUS Hall.
SYNTRIELASMA M. & W.
STREPTORHYNCHUS King.
MEEKELLA W. & St. J.
STROPHOMENA Raf.
Leptaena p. Dalm.
STROPHODONTA Hall.


Cambrian.
Lower Silurian.
Upper Silurian.
Devonian.
Carboniferous.
Leptaena Dalm.
ATRYPIDÆ.
Atrypa Dalm.
Spirigerina d'Orb.
Cœlospira Hall.
Zygospira Hall.
Stenochisma Hall.
SPIRIFERIDÆ.
Spirifer Sow.
Trigonotreta Koenig.
Spiriferina d'Orb.
Martinia McCoy.
Ambocœlia Hall.
Syringothyris Winch.
Cyrtia Dalm.
Cyrtina Dav.
Athyris McCoy.
Spirigera d'Orb.
Nucleospira Hall.


Carboniferous.
Devonian.
Upper Silurian.
Lower Silurian.
Cambrian.
Merista Suess.
Camarium Hall.
Meristella Hall.
Pentagonia Coz.
Goniocœlia Hall.
Meristina Hall.
Retzia King.
Rhynchospira Hall.
Trematospira Hall.
RHYNCHONELLIDÆ.
Rhynchonella Fisch.
Stenochisma Hall.
Liorhynchus Hall.
Eatonia Hall.
Elonia M. & W.
Stricklandia Bill.
Camerella Bill.
Triplesia Hall.
Eichwaldia Bill.
Camarophoria King.


CARBONIFEROUS.
DEVONIAN.
UPPER SILURIAN.
LOWER SILURIAN.
CAMBRAIN.
PENTAMERUS Sow.
PENTAMERELLA Hall.
GYPIDULA Hall.
ANASTROPHIA Hall.
Brachymerus Sheler.
AMPHIGENIA Hall.
TEREBRATULIDÆ.
TEREBRATULA Llwd.
CRYPTONELLA Hall.
CENTRONELLA Bill.
Cryptonella Hall pp.
LEPTOCŒLIA Hall.
RENSSELAERIA Hall.
MEGANTERIS d'Arch.

RECENT LITERATURE.

Dr. Ph. J. J. Valentine on the Portuguese Discovery of Yucatan.—In view of the coming Centennial, memoirs and treatises referring to the achievements of the immortal Genoese will be eagerly sought for, and be thankfully accepted by the learned public at large. We wish that all the publications belonging to this branch of history might be conceived in so interesting a way as is the memoir of Dr. Valentine, which was printed in the "Bulletin of the American Geographical Society of New York," containing 83 pages, with several maps. The title is "The Portuguese in the Track of Columbus," (1493). It was issued in four sections, running from December, 1888, to September, 1889. The author brings to light the hitherto unknown fact, that immediately after the return of Columbus from his first voyage, Joam II., King of Portugal, secretly dispatched a fleet of four vessels to the islands seen and occupied by the discoverer, enjoining the commander, Almeïda, to push on in the direction of Columbus' "boasted waterway" to India. Following up the given orders, the coast of Yucatan was struck, and a map of it was drawn, embodying pretty correctly all the peculiarities of this three-coasted peninsula. So well was this discovery kept secret by the Crown of Portugal, that the Spaniards, when striking the coast of Yucatan in 1518, really believed they had found a land never trod upon previously by any European individual.

The documentary evidence for the above statement is derived by the author from a correspondence between King Ferdinand and Columbus, and is of but recent publication. As to the cartographic evidence, it is drawn from a large Portuguese *Carta Mundi*, the entries of which do not reach farther than to the year 1501. This chart was discovered in the archives of the Duke of Modena, by Mr. Henry Harrisse, in the year 1884, and without the least doubt it is the same chart that served the editors of the atlases of 1508, 1513 and 1520 as a prototype for the first sketches ever made of the American Continent.

In Section I. the author shows that although intending to do so, Columbus never actually drew a chart that exhibited a summary of his discoveries. In Section II. the story of the expedition of the four Portuguese caravels is given, with additional extracts giving King Ferdinand's correspondence with Columbus on this particular subject. In Section III. the author gives a general survey of the great oceanic chart, the Portuguese Imago Mundi. Under the head of *Stellæ Maris*, he discusses in Section IV. the entry on the chart of three naval stations made by the Portuguese cartographer upon this chart,—a central one on the island of Saint Yago (Cape Verde Islands), a second near the Island of Brazil (Coast of Venezuela), and a third near the Island of Andros (Bahama Archipelago). In Section V. the reader is invited to direct his attention toward a very peculiar coast-line, drawn west of the Island of Cuba, and running from South to North, and given the correct reading of twenty-two names inscribed upon this coast, which names in the above-mentioned first sketches of America had been written in a way challenging sound interpretation, and which names now, on the original chart, come forth in full linguistic purity. Two of these names are those of two Portuguese dignitaries, and personal friends of King Joam II., with whom Columbus, a shipwrecked man, had conversed when arriving at Lisbon. Two other names are those of Çozumel and of Campeche, names known to appertain to ancient as well as to modern Yucatan. The circumstance that the three coasts of the peninsula were straightened out to one single line by the draughtsman of the chart is satisfactorily explained. In Section VII., "Identifications," the author shows that when comparing the characteristics proper to the physical features of the three coasts of Yucatan, they will be found to tally upon both the Portuguese and the modern chart, and that all of them present themselves in their natural order of succession.

Unfortunately, Dr. Valentine's article was not published all at once, but at long intervals.—A. S. GATCHET.

Schroeter's Fungi of Silesia.[1]— The third volume of Dr. Ferdinand Cohn's *Kryptogamen Flora von Schlesien* is to be devoted to the Fungi, which Dr. Schroeter is to elaborate. Of this work, begun in 1885, and issued in "Lieferungen" from time to time, Part I. is now complete. The author gives ninety pages of general description and introductory matter, in which (1) the history of fungology in Silesia, (2) the distribution of fungi in Silesia, (3) the general morphology and biology, and (4) the system of classification of the fungi, are discussed.

Bock appears to have been the first to catalogue the fungi of the region included in Schroeter's book: he enumerated twelve species in 1546. Cæsalpinus, in 1583, and Porta, in 1592, enumerated about twenty fungi, while Clusius, in 1601, brought the number up to one hundred and two species, representing some forty-seven genera. Little

[1] *Die Pilze Schlesiens.* Bearbitet von Dr. J. Schroeter. Erste Hälfte, Breslau, 1889. J. U. Kern's Verlag (Max Müller). 814 pp., 8vo.

more was done until the time of Linnæus, when the names of Batsch, Schaeffer, and Tode appear, and still later (1801), Persoon. During the present century the investigators of the fungi have been rapidly increasing in numbers.

In discussing the distribution of fungi, Schroeter states that about 1885 *Tilletia lævis* Kuhn (= *T. foetens* [B. & C.] Trelease) was first found at Breslau, and that previous to 1870 *Puccinia sorghi* Schw. was not known to him to occur in Silesia. The present wide distribution of both these fungi makes these facts very interesting.

It is interesting also to find that, in discussing the relationships of the different groups, Schroeter regards the teleutospore of the Uredineæ as an ascus containing one or more spores, the ascus-membrane fitting tightly over the spores. His statement of his view is given below in a purposely literal translation :

"The Uredineæ stand in close relationship to the typical Ascomycetes, as is undoubtedly generally recognized from the investigations of Tulasne and De Bary. Indications of this fact are furnished by the various fruit-forms, among which are noticeable the spermogerm and stylospore layers (uredo-fruit) that appear in the Ascomycetes. The Æcidia have hitherto been regarded as the analogues of the Sporangium-fruits. I believe that this view can not be maintained, but that these analogues are plainly to be recognized in the teleutospore-fruits. In these latter is found the characteristic, definitely-fixed spore-member, which (barring occasional variations owing to the stunting of individual spores) appears as a dual (*Puccinia, Gymnosporangium,*) or multiple of the same (*Phragmidium, Coleosporium,*) unless there is but one spore developed, as is the case with *Uromyces* and *Melampsora*. In many cases (very plainly in *Puccinia asphodeli*, of the Mediterranean flora) the structure of the so-called spore-divisions is easily seen to be of the nature of endogenous spores, even in the ripe spores; it is also more or less plainly to be distinguished in *Phragmidium*, especially in the young spores. In all cases, the membrane of the spore fuses with that of the mother cell, yet in such a way that frequently it can be recognized as a separate hull."

This view is identical with that set forth by the writer hereof in 1880.[2]

Schroeter divides the fungi into three divisions or series, viz.: Myxomycetes, Schizomycetes, and Eumycetes; each of which is again subdivided into orders and families. The Myxomycetes contain three orders, viz.: Acrasiei, Myxogasters, and Phytomyxini. The treatment of the Schizomycetes is essentially identical with Cohn's,

[2] Botany for High Schools and Colleges. New York. p. 315.

form-species and form-genera being described as species and genera. Three orders are recognized, viz.: Coccobacteria, Eubacteria, and Desmobacteria.

The orders of the Eumycetes are considered by Schroeter to have relationship indicated by the following disposition:

1. Chytridiei.
2. Zygomycetes.
   Sub-ord. Mucorini.
   Sub-ord. Entomophthorei.
3. Oomycetes.
4. Ascomycetes.
5. Uredineæ.
6. Auriculariei.
7. Basidiomycetes.

In the treatment of these orders, in the body of the book, the Protomycetes and the Ustilagineæ are inserted after the Oomycetes, and the Ascomycetes and imperfect fungi are placed after the Basidiomycetes. The Peronosporacei are divided into seven genera, viz.: Pythium, Cystopus, Phytophthora, Sclerospora (including but one species, the *Peronospora graminicola* of Saccardo), Plasmopora (including *Peronospora nivea* Unger, *P. obducens* Schr., and others), Bremia (including *Peronospora gangliformis* of De Bary), and Peronospora, the latter still containing no less than 44 species, although considerably reduced, as indicated above.

The Agaricacei are referred to many genera, the usual sub-genera of Agaricus being raised to generic rank. This gives us the name *Psalliota campestris* (Linn.) Schröt. for the common mushroom hitherto known as *Agaricus campestris.* The genus Agaricus, as thus indicated, contains 171 Silesian species.

In glancing over the pages we notice that the familiar *Schizophyllum commune* of Fries must give way to *S. alneum* (Linn.) Schröt.

So, too, our well-known *Lycoperdon giganteum* (the giant puff-ball) is to be known hereafter as *Globaria bovista* (Linn.) Schröt.

A most useful host-index is included in the volume, which is provided with full generic and specific indexes. The next volume will include the Ascomycetes and "Imperfect fungi."—Charles E. Bessey.

The Scientific Papers of Asa Gray.[1]—It was fitting that his colleague should edit the scattered papers of the master whose departure the world has not yet ceased to mourn. That the selection of an editor was a wise one is proved by the volumes before us. The mass of material was, as the editor says in the preface, "overwhelming," and the task of selection must have been a most difficult and embarrassing one. When we are told that "more than eleven hundred bibliographical notices and longer reviews were published by Professor Gray in different periodicals," we may realize how hard a task was given the editor in the selection of those to be republished and those to be left. Still more difficult was the task of making the selection present as far as possible "a history of the growth of botanical science" during the past fifty years. The success of the editor in spite of these difficulties is most gratifying.

The reviews begin with "Lindley's Natural System of Botany," published in 1836. It gives one an idea of how the world of science has moved when we read arguments for the natural system. Some of the reviewer's reflections upon a class of botanists still by no means extinct will bear repetition: "A somewhat larger number may perhaps be found in this country who admit the importance and utility of the natural arrangement in the abstract, but decline to avail themselves of the advantages it affords in the study of plants, because, forsooth, it is too much trouble to acquire the enlarged views of vegetable structure which are necessary for the application of its principles." Verily, the indolent conservatism of half a century ago was not different from that of to-day!

In the notice of Endlicher's "Genera Plantarum," we have the following paragraph: "It commences, like the 'Genera Plantarum' of Jussieu, with the plants of the simplest or lowest organization (Thallophyta, Endl.); a plan which is now the most common, and perhaps the most philosophical, but which is attended with many practical inconveniences to the tyro." This is the view held by Dr. Gray throughout his life, and it is doubtless largely through his influence that the reverse plan has become so popular in botanical teaching in this country.

We would like to quote, if space permitted, from the review of Agassiz's "Nomenclator Zoölogicus," some of the pointed remarks which are not yet out of date, and which reappear long after in the

[1] SCIENTIFIC PAPERS OF ASA GRAY, selected by Charles Sprague Sargeant. Vol. I., Reviews of Works on Botany and Related Subjects, 1834–1887, pp. viii., 398. Vol. II., Essays; Biographical Sketches, 1841–1886, pp. iv., 504. Boston and New York, Houghton, Mifflin & Co. The Riverside Press, Cambridge, 1889.

review of "De Candolle's Phytographie." In the notice of Curtis's "Woody Plants of North Carolina," the reviewer says: "We quite like to see the popular names put foremost, but would suggest that the botanist who does this should lead as well as follow the indigenous nomenclature so far as to correct absurd and incongruous local names, and introduce right and fitting ones as far as practicable;" and, in referring to the popular character of the book, "We are well aware how much easier it is, and how much better in such cases, to fit your book to its proper readers than to fit the readers to it."

The Essays of the second volume, fourteen in number, make us wish that more had been selected for publication. Here we have: "Notes on a Botanical Excursion to the Mountains of North Carolina," "The Longevity of Trees," "Do Varieties Wear Out, or Tend to Wear Out?" "A Pilgrimage to Torreya," "Characteristics of the North American Flora," etc., etc., all of which are full of interest.

The biographical sketches constitute in their present form an important contribution to the history of botany during the present century.—Charles E. Bessey.

General Notes.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—An article full of interesting observations on the alteration of olivine and augite, is by Dorr,[2] who describes the minettes, kersantites and melaphyre dykes in the neighborhood of Dresden, in the Plaunischer Grund. The three rocks cut syenite, and the first two contain inclusions of it. The olivine of the minette is frequently twinned parallel to $P\breve{\infty}$. It has often changed into pilite and talc, and has, in some cases, been pseudomorphed by quartz. The augite has given rise to pseudomorphs of calcite and quartz, and has undergone alteration into biotite under the influence of dynamo-metamorphism. The biotite, some of which is primary, has been enlarged since the solidification of the rock. It is intergrown with orthoclase in some instances, and alters into chlorite and talc, with the addition of rutile in the minettes, and of anatase in the kersantite. The quartz inclusions in both rocks are surrounded by rims of green augite, while inclusions of orthoclase have altered on their edges to biotite when solution has not been completed. When the fusion has proceeded to completion, no evidence of the former existence of the inclusion is present. The paper is well illustrated, and it contains full literature of the most important points discussed.—— Bonney[3] has made two traverses across the crystalline rocks of the Alps with the object of determining their age. In the course of his article on the subject he describes the microscopical character of the gneisses, mica-schists and clay slates found there. A mica-schist from the Octroi de Vizille consists of mica, cyanite and quartz. The cyanite occurs in irregular-shaped grains, containing tiny flakes of brown mica, black granules and minute belonites. Calci-mica-schists from the eastern side of the Cottian Alps are composed of granular quartz, calcite, and brown and white mica. These are supposed to have originated from sediments. The other rocks described present no peculiar features, except that they all exhibit the effects of crushing

[1]Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2]*Miner. und Petrog. Mitth.*, XI., p. 16.

[3]*Quart. Jour. Geol. Soc.*, Feb., 1889, p. 67.

and re-cementing.——Analyses of phyllites, amphibolites, porphyroids, quartzites, and a few minerals from interesting localities in Belgium and the Ardennes, France, form the basis of an instructive article by Klement.[4]——Collins,[5] in an article on the nature and origin of clays, divides these into clays produced in situ by the alteration of feldspar, and derived clays. The former are purest, and include the china clays. Derived clays are impure, in consequence of the admixture of unaltered feldspar and other minerals. The composition of a pure clay is about as follows:

SiO_2	Al_2O_3	Fe_2O_3	Alk	MgO	CaO	Org. Mat	H_2O
47.82	41.43	.30	.39	.29	.11	.10	10.50

When washed, it contains no scaly or flaky particles, but possesses a uniform texture. Its composition corresponds very nearly to the formula $Al_2 (HO)_6 SiO_2 + Al_2O_3 3SiO_2$. In discussing the origin of clays, Collins states that the theory based upon the action of carbon dioxide on feldspar is untenable. He inclines to the von Buch and Daubrée view of the action of solutions containing salts of fluorine or fluosilicic acids.——Teall[6] has discovered long, acicular, colorless, rutile needles in several of the clays of England. This observation is interesting from the fact that Thurach was not able to find the mineral in the clays which he examined, although it is well known as a constituent in clay slates under the name "Thonschiefer-nädelchen."——Among some notes on a few rocks from the Salzburg and Tyrolese Alps, Cathrein[7] describes an eclogite in which the garnets are changing to hornblende. He also mentions an amphibolite in which are light-colored apparently prismatic crystals, which, under the microscope, are resolved into aggregates of epidote and zoisite. The author regards them as pseudomorphs of the former mineral after the latter. A second specimen of amphibolite contains garnets that are gradually changing into biotite. ——Mr. Merrill[8] describes in detail the peridotite[9] from Deer Island, Maine, in which augite enlargements have been discovered. The rock is a picrite, composed of olivine, augite and various iron oxides. The enlargement of the augite seems to have resulted in some way through the alteration of olivine, as the added material is found extending from

[4] *Bull. Mus. Soc. Roy. de Hist. Nat. de Belg.*, t. V., p. 59.

[5] *Miner. Mag.*, Dec., 1887, p. 205.

[6] *Min. Magazine*, 1887, Dec., p. 201.

[7] *Ver. d. K. K. geol. Reichs.*, No. 8, 1889.

[8] *Proc. U. S. Nat. Mus.*, 1888, p. 161.

[9] *Amer. Jour. Science*, May, 1887, p.

the augite only into the altered olivine, along what were probably the cleavage cracks of the fresh mineral.——A specimen of the variety of picrite known as scyelite was discovered by Bonney[10] in the island of Sark, British Channel. It consists of serpentinized olivine, altered augite, bleached mica, some of which exhibits a banded twinned structure, one set of bands extinguishing parallel to the cleavage of the mineral, and the second 18° from this. The rock was not found in place.——The separation of large quantities of apatite from the gneiss of Freiberg and the granite of the Kinzigthal has given Steltzner[11] the opportunity of comparing their composition. He found that the apatite from the gneiss corresponds to the formula $10Ca_3(PO_4)_2 + 3CaF_2$, while that from the granite accords better with the formula $13Ca_3(Po_4)_2 + 4CaF_2$.

Mineralogical News.—A number of yellow grains of monazite [(Ce, La, Di) PO_4] having been found in the sands from various localities in Brazil, more particularly in the neighborhood of Rio Janeiro and in the diamond fields, Mr. Derby[12] has sought for the mother rock containing the mineral, and has found it in the biotite-gneiss, granites and syenites of the region. His method of operation was to grind into powder a large quantity of the decomposed rock and wash it in the manner made use of in the search for alluvial gold. A full description of the mineral and the rocks in which it occurred is promised in due time.——Measurements of fifteen crystals of *polybasite* from five different localities afford Miers[13] data for the determination of the axial ratio of this mineral with some degree of accuracy. He finds it to be $a:b:c = 1.7262:1:.6344$. Crystals with an apparently hexagonal habit are in reality twins, with the twinning plane ∞P. The examination of eighteen crystals of *aikinite* from Beresovsk, Urals, affirms the conclusion that the mineral is orthorhombic. The prismatic angle is 82° 22.——Among a few minerals from the Ardennes and Belgium analysed by Klement[14] attention may be called to a chromiferous *mica*, occurring in small flakes on vein quartz from Salin-Chateau, Belgium. The lamellæ are non-elastic, but their composition approaches that of muscovite, viz.:

Si_2O	Al_2O_3	Cr_2O_3	Fe_2O_3	CaO	MgO	K_2O	Na_2O	Li_2O	H_2O
45.68	34.17	.84	2.35	.27	3.84	4.47	2.23	tr	4.65

[10] *Geol. Mag.*, Mar., 1889, p. 109.

[11] *Neues Jahrb. für. Min.*, etc., 1889, I., p. 265.

[12] *Amer. Jour., Sci.*, Feb. 1889, p. 109.

[13] *Miner. Magazine*, May, 1889, p. 204.

[14] *Bull. Mus. Roy. de Hist. Nat. de Belg.*, V., p. 59.

A manganiferous *chlorite* from Villsalen contains

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	H_2O
27.13	24.70	5.84	9.72	1.98	20.52	11.35

——Upon comparing the loss of arsenic consequent upon the heating of *löllingite* and *arsenopyrite*, Loczka[15] concludes that the latter mineral is a compound of $FeAs_2 + FeS_2$, and that its decomposition by heat is effected as follows :

(1) $FeS_2 + FeAs_2 = FeS + S + FeAs_2$; (2) $FeAs_2 + S = FeS + 2As$.

——The mean of a lot of analyses of *pinite*[16] from the conglomerate of Boston yields.

SiO_2	Al_2O_3	Fe_2O_3	K_2O	Na_2O	CaO	MgO	H_2O	Loss
48.16	36.23		8.65	.39	.28	.91	4.51	.38

Meteorites.—Of very considerable interest to students of meteorites are two recent articles by Huntington. It will be remembered that this writer, in 1886, showed[17] that the Widmanstättian figures and Neumann lines on the etched surfaces of meteoric irons are sections of planes of crystalline growth parallel to the cube, dodecahedron and octahedron, which planes are also the planes of easiest cleavage for meteoric iron. In one of his recent papers[18] he shows that in the case of the Butcher meteroite (Coahuila, Mex.) the cleavage is parallel to the faces of an interpenetration cube. The surface produced by fracture of this meteor is very different from the fracture surface of the Saltillo iron, and therefore the two must be regarded as representing different falls. On the other hand, the similarity in structure between the Saltillo, the Allen County, Kentucky, the Chattooga, and Maverick County, Georgia, meteors, is so striking as to lead to the conclusion[19] that they must be parts of a single large body. In the last paper published by Huntington, the author declares that a single piece of the Coahuila iron presents the Widmanstättian or Neumann markings, or is amorphous, according to the portion of the mass from which the etched specimen is taken, and that, therefore, these markings cannot be depended upon as a means of classifying such meteorites. It is further shown that these markings, which have hitherto been regarded as characteristic of meteors, are present also on

[15] *Zeits. f. Kryst*, XV., p. 40.

[16] Crosby: *Technology Quarterly*, Feb. 1889, p. 248.

[17] Proc. Amer. Acad., 1886, XXI., p. 478.

[18] Ib., 1888, XXIV., p. 30.

[19] Ib., XXIV., p. 313.

etched surfaces of spiegeleisen.——Meunier[20] calls attention to the fact that we know almost nothing in regard to the nature of that constituent of certain meteorites which turns black upon being subjected to heat. He has been investigating the subject for many years, and now reports a few facts discovered by him with reference to the properties of the substance.——A meteoric iron found about the year 1880, on the top of the Alleghany Mountains, in Greenbriar County, West Virginia, weighs eleven pounds, has a specific gravity of 7.869, and contains cavities in which are masses of graphite. Upon treating a portion with hydrochloric acid, Fletcher[21] found fragments of chromite crystals in the insoluble residue. The composition is:

Fe	Ni	Co	Cu	P	S	Residue
91.59	7.11	.60	tr	.08	tr	.12

——The same author[22] gives an analysis of the Nejed iron, that fell in Central Arabia, in 1863. His figures are:

Fe	Ni	Co	Cu	P	S	Insol.	Sp. Gr.
91.04	7.40	.66	tr	.10	tr	.59	7.863.

——The tenth meteoric iron whose fall is authenticated by eye witnesses, has been described by Mr. G. F. Kunz.[23] It fell at Lamar, Johnson County, Arkansas, at 3.17 P. M., March 27th, 1886. The mass is in general flat and irregular in shape. It measures 17½ in. by 15½ in., and weighs 107½ pounds. Its analyses yielded: Fe = 91.87, Ni = 6.60, Co = tr, P = .41 C, S, etc., = .54.——A meteoric iron from La Bella Roca, a peak of the Sierra de San Francisco, Durango, Mexico, has been described by Whitfield[24] as containing little nodules of troilite. Those on the surface have been removed by weathering, leaving pits corresponding in size to the original nodules. ——In a very exhaustive chemical article upon the meteoric iron of S. Julião de Moreira, Portugal, E. Cohen[25] has given some valuable analyses of this meteor, as well as of its constituents. He gives also new analyses of the Scottsville, Allen County, Kentucky, iron, and of that of Fort Duncan, Maverick County, Texas.——A brecciated meteorite from the San Emigdio Mountains, California, is described by

[20] Bull. Soc. Franc. d. Min., 1889, XII., p. 76.

[21] *Min. Mag.*, Dec., 1887, p. 183.

[22] Ib., p. 187.

[23] Pro. U. S. Nat. Mus., X., p. 598.

[24] *Amer. Jour. Sci.*, June, 1889, p. 439.

[25] *Neues. Jahrb. f. Min.*, etc., 1889, I., p. 215.

Mr. Merrill[26] as consisting of olivine, iron, pyrrhotite, and minute fragments of a colorless, polysynthetically twinned mineral, probably of the pyroxene group, in an almost irresolvable fragmental ground mass. ——The Fayette County, Texas, meteorite[27] is interesting, because of the existence of a vein in it similar to the vein in the Ställdalen meteor described by Reusch.[28] The stone belongs to the chondrite group of Rose, with chondri composed of olivine or enstatite alone, or of both together. The vein consists of a black amorphous substance with a bronzy lustre, in which are scattered little blebs of iron and pyrrhotite, and a few colorless silicates. The composition of the mass of the stone is:

SiO_2	Fe	FeO	Al_2O_3	CaO	MnO	MgO	Ni.Co	S
37.70	4.41	23.82	2.17	2.20	.45	25.94	1.75	1.30

——To the large number of meteors already mentioned by many writers as having fallen in Chili, Sandberger[29] adds another. It consists of olivine, diopside, a little chromite and troilite as a fine-grained aggregate in which little flecks of metallic iron are imbedded. In this meteor were also found hydrocarbons and small grains of black carbon with a hardness over 9. These occur in the iron, and are, without doubt, forms of black diamond, similar to the substance lately found by Koksharow[30] in a Russian meteorite.——Mr. Eakins[31] gives the result of the analysis of a meteor obtained by Prof. Hill, of Texas. The stone is composed of olivine, enstatite, and probably a feldspar, besides five per cent. of troilite and a little chromite. Its specific gravity is 3.543, and composition:

SiO_2	Al_2O_3	Cr_2O_3	FeO	Fe	NiO	Ni	CaO	MgO	K_2O	Na_2O	S	Aq
44.75	2.72	.52	16.04	1.83	.52	.22	2.23	27.93	.13	1.13	1.83	.84

——Two new masses of meteoric iron have recently been described by Mr. Kunz.[32] The first weighs 428 grams. It was found on Linnville Mt., Burke Co., N. C. The second weighs 25.61 lbs., and was found in Laramie Co., Wyoming. Analyses of the two are as follows:

	Fe	Ni	Co	S	P	C
Linnville,	84.56	14.95	.33	.12	tr	tr
Laramie Co.,	91.57	8.31	tr		.07	tr

[26] Proc. U. S. Nat. Mus., 1888, p. 161. Cp. *Amer. Jour. Sci.*, 1888, p. 190.
[27] Whitfield and Merrill: *Amer. Jour. Sci.*, Aug., 1888, p. 113.
[28] *Neues. Jahrb. f. Min.*, etc., 1886, B. B. IV., p. 491.
[29] *Neues Jahrb. f. Min., etc.*, 1889, II., p. 173.
[30] *Mater. zur Min. Russl.*, X., p. 82.
[31] *Amer. Jour. Sci.*, 1889, p. 59.
[32] *Amer. Jour. Sci.*, Oct., 1888, p. 275.

BOTANY.

The Fresh-water Algæ of the Plains.— North-west of Thedford, Thomas Co., Nebraska, in the valley of the Middle Loup river, are quite a number of small stagnant ponds. They are chiefly portions of the river, cut off by the railroad which runs up the valley, or excavations along the track filled by rain drainage. On the 7th of August, 1889, I stopped here a day for the purpose of collecting algæ. The "Sand Hill region" of Nebraska is not one to which one would naturally turn for collecting algæ, but the list given below, which is the result of our day's work, shows it to contain an interesting algæ flora.

The ponds are shallow (2 to 8 in. deep), and have usually a firm, solid bottom, so that one may easily wade around in searching for specimens. The water is slightly alkaline. The edges of the ponds are usually lined with rank growths of various sedges and grasses, with, frequently, patches of the common arrow-head (*Sagittaria variabilis*, Engelm). One pond was noticeably lined by a thrifty growth of the rare grass *Catabrosa aquatica* (L.) Beauv. It extended into the pond for some distance, to where the water was nearly a foot deep. Quantities of *Potemogeton* and *Zanichellia palustris* L. grow from the bottoms of the ponds, and are frequently mixed with several species of *Chara*. In some of the ponds I collected also the beautiful Bladderwort, *Utricularia vulgaris* L. Its clusters of bright yellow flowers, here and there extending above the surface of the water, had a pleasing effect. At the edge of one pond I discovered also the little Bladderwort, *Utricularia minor* L. I notice that this commonly extends out a foot or so from the water, on the damp or wet bank, around the roots of sedges, etc. The three Duckweeds, *Lemna minor* L., *Lemna trisulca* L., and *Spirodela polyrrhiza* (L.) Schleid., are common in almost every pond. The liverwort, *Riccia fluitans* L. also occurs commonly.

The species of Algæ proper collected were as follows:—

CHROOCOCCACEÆ.

Merismopedia glauca Naeg. Not apparently very common here. In the eastern part of the State I have found it frequently.

Merismopedia violacea (Breb.) Kutz. Quite common, forming violet or purplish slimy masses, which sometimes reach the size of a man's hand. It much resembles in appearance floating particles of decaying flesh, in this respect being similar to *Chlamydococcus pluvialis* A. Br., from which it is with difficulty distinguished without the aid of a microscope. (The latter I collected in quantity in a pond in Wessington Hills, Dakota, last April. The color is a somewhat deeper violet purple.) This interesting little plant has not been found before in America, so far as known. It is distinguished from known American species by its smaller size and violet color. Rev. Francis Wolle has examined specimens of it and confirmed my identification. I have to thank him also for much aid in my study of Algæ.

Chroococcus cohærens Næg. A beautiful blue-green species. Common.

NOSTOCACEÆ.

Oscillaria. Several species were observed.

Nostoc pruniforme Ag. Very common, forming olive or dark brown, nearly regular balls, from one millimeter diameter to the size of a plum. Floating in every pond.

PALMELLACEÆ.

Scenedesmus caudatus Corda. Var. *typicus* Kirch. Usually of two or four cells.

Scenedesmus dimorphus Kg. Not common.

Scenedesmus obtusus Meyen. Very common, presenting a number of forms.

Pediastrum angulosum (Ehr.) Menegh. Common. Cells about 16 μ in diameter.

Pediastrum borganum (Turpin.) Menegh. Common in several stages of development. Empty colonies occur frequently, the zoogonidia having escaped from all the cells.

Raphidium polymorphum Fres. One specimen was observed in the examination of the material, belonging probably to the variety *sigmoideum* Rab.

Polyedrium trigonum Næg., var. *punctatum* Kirch. Several specimens that I take to be this variety were found.

Protococcus viridis Ag. A deep green aquatic variety is quite common.

Euglena viridis (Schrank.) Ehrenb.

DESMIDIACEÆ.

We are usually told that desmids are to be sought in fresh, pure water only. My experience in Nebraska has not confirmed this statement. I have frequently searched running waters and springs for them, but have seldom been rewarded, while I have found them almost exclusively in what I should term stagnant water.

Docidium baculum (Breb.) D. By. Not common.

Cosmarium bioculatum Breb. Not uncommon.

Cosmarium conspersum Ralfs. Not common.

Cosmarium meneghinii Breb. Not common.

Cosmarium nitidum De Not. Not common.

Cosmarium pulcherrimum Nord. Not common.

Cosmarium undulatum Corda. The only specimen found was partially undeveloped, but appears to be this species.

Euastrum verrucosum (Ehrb.) Ralfs. A common form.

Staurastrum gracile Ralfs. Not uncommon.

Staurastrum polymorphum Breb. Not common.

DIATOMACEÆ.

Diatoms are, as in most places, common objects. Species of *Epithemia* predominate.

Cymbella gastroides Kutz. A large form, usually about 130 μ long.

Navicula iridis Ehr., var. *amphigomphus* Ehr.

Navicula major Kutz. Common.

Navicula producta W. Sm. Not common. About 42 μ long.

Pleurosigma intermedium W. Sm. Rare.

Gomphonema clavatum Ehr. Rare. Length about 32 μ.

Gomphonema constrictum Ehrb. Common. Length 32–64 μ.

Cocconeis pediculus Ehr. Common. Elliptical, 13–19 by 18–22 μ.

Epithemia gibba Kutz. Not so common as the next. About 138 μ long.

Epithemia turgida (Ehr.) Kutz. Very common. From 46–91 μ long, usually about 16 μ wide. A very beautiful form.

Synedra ulna (Nitsch) Ehr. Common. A very long variety of this was also found.

Fragilaria harrisonii (W. Sm.) Grun. Only one frustule found. Size 14 by 22 μ.

Melosira varians Ag. Quite common. Forming in filaments from 15–16 μ wide.

Quite a number of other species were observed, of the genera *Nitzschia*, *Ceratoneis*, etc., but their identification remains doubtful.

ZYGNEMACEÆ.

Zygnema cruciatum Ag. Common in some of the ponds.

No attempt was made to collect the larger Algæ. Great masses of what I took to be Spirogyra floated in some of the ponds. Cushions of Vaucheria were common on the wet banks.—H. J. WEBBER, *Botanical Laboratory, University of Nebraska.*

ZOOLOGY.

Animal Coloring Matter.—C. A. McMunn (*Jour. Marine Biol. Assn. United Kingdom*, No. 1,) discusses briefly the coloring matters of several invertebrates. Among the interesting facts are these Spectroscopic examination fails to show the presence of symbiotic algæ in *Antedon*, it being found that contrary results were due to the presence of plants in the food, and that when the stomach was removed neither chlorophyll nor chlorofucin occurred in the extract. The digestive glands of echinoderms and crustacea not only form digestive ferments but exercise a chromatogenic function. Chlorophyll was found in several annelids, while other green worms possessed no chlorophyll. The lipochromes in some cases may act as an absorber of light rays, but its other function is very uncertain. The author shows that a knowledge of invertebrate coloring matter is absolutely essential to a clear understanding of the physiological action of the pigments of the Vertebrata.

The Polynoina.—H. Trautzsch discusses (*Jena. Zeitsch.*, XXIV., p. 61) the Polynoid worms of Spitzbergen. Eleven species are enumerated, of which one (*Harmothaë vittata*) is new. The generic limits are discussed, the genera of Malmgren, Levinsen, Kallenbach being considered. In the second part of the paper the morphology and physiology of the Nephridia are reviewed. The conclusions are as follows: In their simplest form the Nephridia are open saccular organs of the usual polychæte type, perforating the dissepiment, and opening exteriorly at the apex of a murally placed papilla on the hinder margin of the segment. Each nephridium is composed of funnel, inner loop, nephridial sac, outer loop and papilla; there being but a pair of nephridia in a segment, and each having but a single external opening. Nephridia are present in all segments, showing differences in each, and also between right and left. In the young animal all the Nephridia are essentially the same, but before and during the sexual maturity all except the first four pairs become more complex. All of the Nephridia are excretory organs, and the first four have no other function, and become genital ducts at the time of sexual maturity, the sexual products being forced to the exterior through the contractions of the surrounding muscles.

Reproduction of Fishes.—Mr. J. T. Cunningham gives (*Jour. Marine Biol. Assn. of the United Kingdom*, No. 1) the results of his studies of the ova, times of spawning, etc., of a number of British fishes. The paper will prove of considerable value to American students in the identification of the eggs and embryos of fishes. In the case of the mackerel, Mr. Cunningham found that no circulating apparatus served to keep the eggs, the density of the water possibly having considerable to do with the fatality. The mantle of cells which surround the oil globule at a later stage of the egg is regarded as formed of "periblastic syncytium." The egg regarded by Agassiz and Whitman as belonging to the smelt (*Osmerus mordax*) is said to belong to one of the Clupeoids. The fact is noted that fishes with much fat are apt to have oil globules in the eggs, while allied species with dry flesh have no oil globules. Some notes are given on the cœlom and vascular system. . Six plates illustrate the paper.

The Halosauroid Fishes Typical of a Special Order.–Among the numerous representatives of the deep sea, or bassalian, fauna, one of the most characteristic is the family of Halosaurids. This family has been approximated by most ichthyologists to the Notopterids and Alepocephalids and their supposed allies. The external characters are however so peculiar, as manifested in the opercular apparatus and suborbital chain, that in 1883 I was convinced that the family represented a very distinct subordinal or ordinal group. Dr. Günther, in 1868 (Cat Fishes, B. M., vii., 482), assigned to the genus Halosaurus, a preoperculum produced behind into a long, flat process, replacing the sub- and interoperculum. The improbability of such a coalescence of the preoperculum and suboperculum, in view of our knowledge of the genesis and development of those bones, was so extreme that I availed myself of the first opportunity to examine the facts in the case. At Wood's Holl, in 1883, I uncovered the bones sufficiently to detect the true preoperculum, and to recognize that the supposed "preoperculum" of Günther was the exact homologue of the suboperculum. I deferred publication of any conclusions as to the affinities of the genus, however, till I could examine the skeleton. Meanwhile, a notice and illustrations of the skull and scapular arch of the genus have been published by Dr. Günther (Challenger Deep-Sea Fishes, pp. 232-236, Pl. 60, Figs. 1–8.) Dr. Günther at last recognized the true homologues of the opercular apparatus, but has not appreciated the systematic import of the facts disclosed. The peculiarities revealed by the skeleton are however numerous and important. Averse as I am to the multiplication of ordinal groups, it seems to me that in a system of fishes based on morphological facts, the salient differences between the Halosaurids and other fishes must be expressed by an ordinal, or at least a subordinal, designation. I do not see how the group can be referred to any of the existing orders with the characters we now assign to them, and for the present, at least, propose to isolate it as a peculiar order characterized by the following features contrasted with those of the generally recognized orders :

LYOPOMI.

Teleosts with the scapular arch constituted by the proscapula, postero-temporal and post-temporal, the post-temporal discrete from the side of the cranium, and impinging on the supra-occipital; the hypercoracoid and hypocoracoid lamellar, and the fenestra or foramen in the upper margin of the hypocoracoid ; the mesocoracoid absent ; the actinosts normal ; the cranium with the condyle confined to the basi-occipital ; the opercular apparatus characteristic ; the preoperculum being entirely detached from the suspensorium rudimentary, and connected only with the lower jaw ; the operculum normally connected ; the suboperculum enlarged and partly usurping the usual position of the preoperculum, in company with the suborbital chain, which is extended backwards toward the opercular margin ; jaw bones complete and normal ; palatines, entopterygoid, and ectopterygoid normally developed ; the anterior vertebræ separate, and the ventrals abdominal.—THEO. GILL.

The Notocanthid Fishes as Representatives of a Peculiar Order.—The genus *Notocanthus* has long been shifted from place to place without finding a natural resting-place. It was indeed long ago suggested by Dr. Günther that " these fishes will, no doubt, have to be placed in a distinct order ; " but he has neglected to do so, or to give any reasons why he thought so. The facts now known, however, warrant the isolation suggested, and the order may be defined by the following characteristics :

HETEROMI.

Teleosts with the scapular arch formed by the proscapula and post-temporal (or posterotemporal), the latter detached from the sides of the cranium, and impinging on the supraoccipital ; the hypercoracoid and hypocoracoid coalesced into a single lamellar imperforate plate ; the actinosts normal ; the cranium with the condyle confined to the basioccipital (ill defined) ; the exoccipitals coalesced with the epiotics and opisthotics ; the vomer obsolete ; the opercular apparatus complete, but the preoperculum slightly connected with or discrete from the suspensorium ; the suborbitals suppressed ; the jaw bones complete and little aberrant ; the palatines, entopterygoids, and ectopterygoids well developed ; the anterior vertebræ separate, and the ventrals abdominal.—THEO. GILL.

Note on Carettochelys, Ramsay.—Of this very remarkable Chelonian, which was found in Fly River, New Guinea, only a single specimen is known. It was described by Ramsay, in 1886, in the Proc. Linn. Soc., New South Wales, and compared with Emyda, with the remark that it appeared to be a link between the river, and the sea-turtles. Mr. Boulenger has placed it among the Pleurodira, in a new family, Carettochelydidæ.

The question is, Is it really a Pleurodiran ? It is true it belongs to the Papuasian region, in which, so far, only Pleurodira have been found. There are some characters, however, not seen in the Pleurodira, but in another group of Chelonians consisting of the families Cinosternidæ, Staurotypidæ, and Pseudotrionychidæ. It is only in this group that we find 21 peripheralia (marginal bones) as in Carettochelys ; the neural bones are also reduced, and the dermal shields have disappeared entirely in Pseudotrionx ; to the latter character, however, I attach little value, as it may occur in any family.

It seems to me that the systematic position of Carettochelys is far from being clear. How easily could the whole question be settled ! Mr. Ramsay would do a great service to science if he would undertake to have the cervicals and the skull extracted, or the cervicals alone, if he fears for the skull. This could be done without injuring the specimen, and the structure of these parts would show at once the affinities of this peculiar genus.

It is a pity that in some museums of natural history the anatomical knife is still an instrument without use. Rare or unique specimens are not allowed "to show the inside," or, in other words, to show what they really are. They are simply placed in alcohol or stuffed, to be presented to a public which has no understanding of them. There are exceptions, I am glad to say. One of these is seen in *Chlamydosclache,* of a single specimen which came to the Museum of Comparative Zoölogy, Cambridge, Mass., and was "sacrificed" to the anatomical knife. The result is known to every zoölogist.—G. BAUR.

Teeth of Monotremes.—Mr. Oldfield Thomas, (*Proc. Roy. Socy.*, No. 280) has had an opportunity to study the teeth of Ornithorhynchus, and comes to conclusions which essentially modify those of Poulton. He finds that the true teeth are functional for a considerable part of the animal's existence, cutting the gum as usual, and, after being worn down by friction with food and sand, are shed from the mouth as are the milk teeth of other animals. The later cornules, or horny teeth, are certainly developed from the epithelium of the mouth cavity; but from that *under* and *around* instead of over the teeth, and the hollows in the horny plates are the vestiges of the original alveoli of the teeth, from out of which the latter have been shed. A result of this discovery is that we now have perfect calcified teeth large enough to be studied with the naked eye, and hence available for comparison with other forms. Mr. Thomas, aided by Lydekker and Boulenger, fails to find any teeth of recent or fossil reptiles or mammals which quite correspond to those of Ornithorhynchus. He is more and more inclined to believe in the correctness of the view of Prof. E. D. Cope, that the Multituberculata were monotremes, although the resemblances between the teeth are of the most general character.—J. S. K.

Zoological News.—Sponges.—The third and fourth part of the 48th volume of the *Zeitschrift für wissenschaftliche Zoologie* is devoted entirely to sponges. Conrad Keller devotes 95 pages and six plates to the sponge fauna of the Red Sea, and R. von Lendenfeld 296 pages and 15 plates to the physiology of these forms. His experiments consisted in feeding these forms carmine, starch, and milk, and in trying the effects of various poisons upon them. Among the conclusions are the following: The collar-cells absorb all that comes to them, holding the good and rejecting the useless. The canal system is physiologically comparable to that of polyps and medusæ, while physiologically the sponges are the closest of all animals to the plants.

Worms.—Arthur E. Shipley describes (Proc. Roy. Soc., No. 280) the structure of the Bahaman Gephyrean, *Phymosoma varians*. The points elucidated are the existence of skeletal structures at the anterior end of the body serving to support the tentacles and giving insertion to the retractor muscles; the alimentary canal; vascular system; nephridia, nervous system, sense organs, and reproductive organs. He thinks the points found confirm the arrangement of Phoronis near the Gephyrea in Ermis.

Vertebrates.—J. Beard has a preliminary notice of the early development of *Lepidosteus osseus* in the Proceedings of the Royal Society, No. 280. He obtained his material in northern New York. Among the points obtained are these: There is no neurenteric canal.

In the deevlopment of the nervous system there are formed transitory giant ganglion cells which are shut out of the central nervous system and persist for a long time lying outside the cord. They apparently form a transitory larval nervous system, possibly analogous to the sub-umbrellar cells described by Kleinenberg as ushering in the permanent ventral cord in Lopadorhynchus.

In the *Verhandlung* of the third meeting of the German Anatomical Society, Karl Bardeleben presented evidence for the existence of a sixth normal toe in the Mammalia. He finds in the skeletons of several forms bones on the radial side of the hand which he regards as evidence of a finger outside of the thumb, to which he gives the name prepollex; the corresponding structure in the foot is the prehallux. The existence of these additional digits has been seriously questioned, the bones being regarded as sesamoid. In *Pedetes capensis*, however, Bardeleben finds a true sixth finger which is furnished with a nail, and which seems to represent a thumb in function. Tornier, at the meeting, regarded these sixth fingers and toes in the Mammalia as physiologically new structures, not as ancestral features.

EMBRYOLOGY.

Evolution of the Medullary Canal.—Under this head we have to consider, first, what is the primitive vertebrate type of the central nervous system; second, what genetic relation existed between the vertebrate and invertebrate types.

The opinion generally accepted by embryologists is that the typical vertebrate canal is formed by the closure of the medullary groove. This view is advocated by Balfour, and has been so thoroughly accepted by Adam Sedgwick that he has made it the basis of a speculation[1] on the original function of the canal; he supposes that it was open behind and excretory; the cilia which are found in the central canal of the spinal cord originally served to produce the excretory current. This opinion overlooks the serious difficulty of assuming that the canal is primitive, while in the lowest vertebrates it is clearly a secondary modification. In Petromyzon, Lepidosteus and Teleosts, the medullary plate, instead of becoming the floor of an external groove, forms a solid keel-like projection towards the ventral

[1] A. Sedgwick. On the Original Function of the Canal of the Central Nervous System of Vertebrata. Proc. Philos. Soc. Cambridge, Eng. IV., 325–328.

surface. This keel subsequently becomes separated from the superficial layers of the ectoderm, and afterwards a central canal is developed in it. In the ganoids, which approach the elasmobranchs in structures there is, as shown by Selensky[2] a medullary groove of peculiar form, which suggests a transition from the solid keel to the open groove; again in amphibia there is evidence that the delamination is still preserved to a slight extent in that group. These considerations lead me to the hypothesis that the nervous system of vertebrates was primitively a solid axial thickening of the ectoderm, and within the class of ganoids became modified into a groove, perhaps simply by more precocious development of the central canal; the groove type has been kept in elasmobranchs, amphibians and amniota. Balfour (Comp. Embryol., II., 303) thus defends the opposite view: "It seem, almost certain that the formation of the central nervous system from a solid keel-like thickening of the epidermis is a derived and secondary mode; and that the folding of the medullary plate into a canal is primitive. Apart from its greater frequency, the latter mode of formation of the central nervous system is shown to be the primitive type by the fact that it offers a simple explanation of the presence of the central canal of the nervous system; while the existence of such a canal cannot easily be explained on the assumption that the central nervous system was originally developed as a keel-like thickening of the epiblast."

It is not possible at present to decide positively between the two views, but the view which I am inclined to adopt is further justified by the development of the central nervous system in annelids, which is formed by the coalescence of a pair of linear cords: these cords arise each side of a cilated longitudinal furrow, first as a single row of ectodermal cells, subsequently as several rows; while still united to the external ectoderm they extend towards one another below the ciliated cells of the furrow, and unite in a single nervous band. In leeches and arthropods the development is very similar. In all these cases the bands split off from the ectoderm. It appears, then, that in the nearest[3] invertebrate allies of the vertebrates the nervous system developes as a thickening along the inner surface of the ectoderm, and delaminates from that layer. It seems to me very natural to suppose, therefore, that the strikingly similar process in the lowest vertebrates is the primitive one, and that the canalization of the medullary plate was evolved within the vertebrate series.

[2] W. Salensky. Recherches sur le développement du sterlet (*Accipenser ruthenus*). *Arch. de Biol.*, II., 233–341. Taf. XV.–XVIII.

[3] With, of course, the possible exception of Amphioxus.

I have assumed that the ventral nerve cords of annelids are homologous with the medullary canal, a view that is now generally accepted by embryologists. Balfour (Works I., 393, and Comp. Embryol., II., 311) has suggested a more complicated relation in his hypothesis that the lateral nerve trunks which are known in many of the lower worms (*e. g.*, nemerteans) have fused on the ventral side, in annelids on the dorsal side, of the body in the vermean ancestors of vertebrates. In favor of this ingenious surmise no evidence has since been found. Hubrecht denies the homology of the annelidan nerve chain and the vertebrate medulla; he considers [4] that the more primitive condition is represented by certain nemertean worms, which, besides two main lateral nerves, have a small longitudinal median nerve; the lateral nerves gave rise to the nerve chain of annelids by their fusion, the median nerve to the medulla of the ancestors of vertebrates. As no intermediate forms, either adult types or embryonic stages, are known to represent any phase of this double metamorphosis, I cannot admit that Hubrecht's bold speculation invalidates what seems to me the well established homology between annelids and vertebrates.—CHARLES SEDGEWICK MINOT.

ARCHÆOLOGY AND ETHNOLOGY.

The Recent Accessions to the Museum of the Peabody Academy of Science of Salem, Mass.—The accessions to the Museum of the Peabody Academy of Science, in East India Marine Hall, have, from time to time, been noticed in these columns. In no single year since the formation of this institution have these accessions been so numerous or of so valuable a character. Prof. Edward S. Morse, as is well known, was absent for several months in Japan and the east, for the purposes of study and forming collections, one of his chief objects being to obtain for our museum a characteristic and complete collection to illustrate the ethnology of Japan.

The museum previously contained but few specimens from this country, although some of these few were very valuable, while China, India, Africa, and the South Sea Islands, were fully represented. Our mercantile relations with Japan were insignificant during the time of Salem's commercial period, the time when the East India collection was formed, and indeed it is only since the opening of that country to

[4] A. A. W. Hubrecht. The Relation of the Nemertea to the Vertebrata. *Quart. Jour. Micros. Sci.*, *N. S.*, XXVII., 605–644, Pl. XLII.

commerce, after 1854, that it has been made possible to obtain specimens in any considerable numbers. And now a serious danger arises. The sudden influx of foreigners into Japan, and the demands of trade, have changed the character of manufactures, and the customs of the people brought in contact with the foreigners, rendering it more difficult year by year to obtain genuine Japanese articles uncontaminated by foreign influences. The quality of the majority of the exported lacquered ware has vastly deteriorated, the exported porcelain has succumbed to the demands of foreign taste; the screens, fans, lanterns, cloths, and papers which come to us cease to fairly illustrate the best art and forms, and mislead rather than instruct us as to the exquisite tastes of these interesting and refined people.

It is therefore peculiarly fortunate that in Salem, Mass., where already exists one of the finest ethnological collections in the world, there should be added, from Japan, so complete a collection as that recently placed on exhibition. Formed by one having exceptional relations with the Japanese in their inside life, both as friend and instructor, it has been made possible to gather a cabinet at once pure as regards the art and customs of the people, and complete in illustrating all the branches properly included in ethnology.

The catalogue of Japanese accessions enumerates 691 specimens. These have been arranged, temporarily, in one of the new long cases on the eastern side of the hall, and occupy some fifty feet of glass front. The most conspicuous objects are the life-sized figures: a warrior in full armor as used before the late revolution and the introduction of European methods and arms; the gentleman and wife with their two children, a boy and a girl; and the farmer and wife, the latter bearing an infant characteristically tied upon her back. These models were all made for the museum, and are the best ever brought to this country. Looking at them, the visitor is at once struck by what we should term the undersize of the Japanese, and we can readily see how a man of our ordinary height can overlook a Japanese crowd without difficulty, as is often stated to be done.

One section contains a collection of swords and blades, 37 in number, many of great beauty and all of fine workmanship, together with numerous knives and sword guards, the latter objects being greatly valued in Japan for their exquisite finish and design, often bringing large prices at special sales. All of these were presented to the museum by Mr. Machida, a noted sword merchant of Tokio, who says in his letter to Mr. Morse, "I present the swords and implements of war formerly used in Japan, to the museum, thinking that they may do some good for the purposes of scientific inquiries." Many of these swords and knives are 100 years old, and some are from 200 to 300 years.

The Tokio Educational Museum, in exchange for a collection of corals forwarded by the Academy last year, contributed 13 sets of tools (164 specimens), together with pictures illustrating the different trades and professions. They include among others those of the carpenter, cooper, mason, jeweler, turner, lacquerer, lantern-maker, potter, ivory carver, and gardener. The fisherman's nets and lines and the insect collector's outfit are also included. The collection contains garments of coarse and those of finer quality, shoes, hats, hair ornaments and combs, models of the kitchen, tea room, reception room, and shrine; of a fire engine, which by the way is carried about by two men in the manner of a hand barrow, of vessels and firemen's badges. Articles of domestic use include tea cups and sake cups, trays, bowls, baskets, bottles, tea-pots, spoons, moulds, barber's case, smoking apparatus, brushes, dishes, etc. Amusements are illustrated by games, cards, toys, dolls and kites, and these are followed by musical instruments of various sorts, such as harps, guitars, flutes and drums.

It is useless to go into farther details, as the collection is now on public exhibition, and may be seen by all who able to visit the museum. Many of the specimens were given by Japanese friends of Mr. Morse, including even servants, who seemed to fully understand the purpose in forming the collection, and the value of even the commonest object so long as it illustrated the people and their ways. Among other donors the name of Dr. W. S. Bigelow should not be omitted, as the catalogue amply testifies.

In addition to the collection from Japan, a temporary arrangement has also been made, in a case on the western side of the hall, of the objects collected in China, Anam, and Singapore, and those obtained from Korea, Yesso, and Manila. Altogether these collections occupy some thirty feet of case room, and include many rare and interesting articles. There are models of boats from China, and implements, clothing, and articles of domestic use from all of the above countries. The objects from Korea and those from Yesso, it should be remembered, small in number though they may appear, form a larger representation from these countries than has heretofore been obtained by any museum in this vicinity, and besides, many of the articles are of great rarity. One entire section of this case contains a special collection of Chinese implements, ornaments, and utensils, from William Dolan, Esq., of Hong Kong.

The rapid increase of the collections in the museum indicates that at no distant day farther space will be required to exhibit properly even such specimens as can in no way be placed in study collections to be kept in storage cabinets. It would be far better of course to have a special room for the natural history collections, leaving to East India Marine Hall the ethnological collections, so full of interest, and which form, together with the fine building that contains them, a most fitting monument of Salem's commercial period. In this hall, and forming part of this collection, is the proper place for many articles which even now may be found in the houses, in the attics and sheds perhaps, of this neighborhood. These articles are of themselves of little value, and of no use where they are, but placed in the museum they would each contribute their share towards making the finest American ethnological cabinet, and serve to interest and instruct generations of Salemites to come. Our citizens ought to think of this and see that all such objects are added to the museum, an institution we cannot feel too proud to own, and one that is prepared more fully than ever to care for and properly preserve these relics in the future as it has done for eighty years in the past.—*The Salem Register.*

ENTOMOLOGY.

Preliminary Catalogue of and Notes on Nebraska Butterflies.—This list includes species of *Lepidoptera Rhopalocera,* or, properly speaking, diurnal butterflies. It includes only specimens collected by the writer and in the State Normal School collection, excepting where it is otherwise stated. Some few species have been omitted in order to await further study.

The names of localities where we have made collections is given by counties, those mentioned as from Dodge county being made mostly by Mr. E. A. Dodge, of Glencoe. Mr. Dodge has collected in Nebraska during the last fifteen years, and perhaps has the largest and finest collection of butterflies within the State. His list and notes, so far as we are aware, have not been published.

The notes on the dates of appearance of different species were made largely during the spring of 1889,—a spring beginning somewhat earlier than usual,—and are given mostly for Peru, Nemaha county, on the Missouri River.

The specimens collected in the northern and the north-western portions of Nebraska were made during the months of July and August, 1889. The line of counties from which collections were made, it will be noticed, runs from south-east Nebraska, the lowest portion of the State, to north-west Nebraska, the part of the State having the greatest elevation.

FAMILY PAPILIONIDÆ.

1. *Papilio ajax.*—Ajax Butterfly. Adams, Dodge and Nemaha counties. Found from the first of April till the last of October, though at no time abundant. Several forms.

2. *P. philenor.*—Orange-banded Butterfly. Dodge and Nemaha. Somewhat rare. Earliest found about the first of June, though probably may be collected in May.

3. *P. asterias.*—Black Swallow-tail Butterfly. Dodge and Nemaha. Appears about the middle of May, but most plentiful the first of June, though at no time very common.

4. *P. palamedes.*—Olive-black Swallow-tail Butterfly. Dodge. Mr. E. A. Dodge mentions capturing one specimen. Not seen by us.

5. *P. turnus.*—Yellow Swallow-tail. Dodge and Nemaha. Found as early as April 15th, becoming very common the last of this month and the first of May. Rare in the fall, and but few males and some variations in markings of females.

6. *P. cresphontes.*—Yellow-banded Swallow-tail. Dodge and Nemaha. The first brood appear in abundance the last of May and first of June. Second brood common in August, becoming very rare by the last of September.

FAMILY PIERIDÆ.

7. *Pieris protodice*—Banded-white Butterfly. Dawes, Dodge, Lancaster, Nemaha and Sheridan. Found as early as the first of May, and continuing till late in the fall. According to Mr. C. G. McMillan, Nebraska species, as at other points, "commonly appear twice during the season, first in May and last in July or early in August." Somewhat common in eastern Nebraska, but more common in north-western Nebraska, where we have observed it, and in south-western part of the State where it was observed by Mr. McMillan.

8. *P. napi.*—White Butterfly. Lancaster and Nemaha. One specimen taken near Peru, May 16th, 1889, and Mr. McMillan mentions one specimen collected by him in Lancaster county.

9. *P. rapæ.*—Cabbage Butterfly. Dodge, Lancaster and Nemaha. Found as early as the first of April, and abundant by the middle of

this month, remaining till very late in the fall. Mr. McMillan, who has studied this insect in Nebraska, says, "*Rapæ,* however, is sometimes three-brooded,—a last brood appearing some time in September. In rare instances they pass the winter in the perfect state. I have upon two occasions caught males of this species in January, both times in a barn loft. They seemed dead, but upon being brought near the fire soon revived. I have also reared three broods artificially during the summer of 1885. Eggs were taken from the cabbage in May, and from these imagines were reared, appearing the middle of July, and from this second brood other imagines appeared in September. I have also seen fresh insects in September, indicating that this is natural in our climate."

10. *Nathalis iole.*—Saffron-yellow Butterfly. Dodge and Nemaha. Abundant and found rather late in the fall.

11.—*Anthocharis olympia.* Yellow-green-banded Butterfly. Dodge. Mentioned by Mr. E. A. Dodge and by Prof. French, but not observed by us.

12. *Callidryas eubule.*—Citron Butterfly. Dodge and Nemaha. Somewhat rare, but has been found as early as May and as late as September.

13. *C. agarithe.*—Orange Butterfly. Dodge. Mentioned by Mr. E. A. Dodge and by Prof. French as occasional in Nebraska. Not observed by us.

14. *Colias cæsonia.*—Dog's Head Butterfly. Adams, Dawes, Dodge, Nemaha and Sheridan. Does not appear till the last of May or first of June, but remains till late in October. Quite common.

15. *C. eurytheme.*—Bordered Yellow and Orange Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears as early as the first of May, becoming abundant by the middle of this month, remaining till some time in October. Several forms.

16. *C. philodice.*—Bordered Yellow Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears as early as the first and common by the middle of May; remains till some time in October.

17. *Terias nicippe.*—Black-bordered Orange Butterfly. Dodge. Mentioned by Mr. Dodge as uncommon. Not observed by us.

18. *T. mexicana.*—Mexican Butterfly. Dodge. Mentioned by Mr. Dodge as uncommon, and by Prof. French as "occasional in Nebraska." Not collected by us.

19. *T. lisa.*—Little Bordered Yellow Butterfly. Dodge and Nemaha. Somewhat common in certain localities.

FAMILY NYMPHALIDÆ.

20. *Danais archippus.*—Milk-weed Butterfly. Adams, Brown, Dawes, Dodge, Nemaha, Sheridan, and other counties. This well-known butterfly appears by the middle or sometimes the first of April, and remains till cold weather. It undoubtedly hibernates, although we have not found it in winter. At least three points favor this conclusion; firstly, its remaining so very late in the fall; secondly, its appearing very early in the spring; thirdly, the early species invariably have the appearance of old and worn specimens, being decidedly faded in color.

21. *D. berenice.*—Rufous-brown Milk-weed Butterfly. Dodge. Mr. Dodge mentions one specimen as collected by other parties. Not observed by us.

22. *Argynnis idalia.*—Regal Silver-spotted Butterfly. Dodge and Nemaha. Common by the first of July, remaining till the last of September.

23. *A. cybele.*—Yellow-banded Silver-wing. Adams, Dodge and Nemaha. Appears in abundanee by the first of June, but disappears by early fall.

24. *A. aphrodite.*—Silver-winged Butterfly. Nemaha. Not very common.

25. *A. alcestis.*—Yellowish-fulvous Silver-winged Butterfly. Dodge and Nehama. Not very common.

26. *A. myrnia.*—Silver-bordered Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

27. *A. bellona.*—Meadow Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

28. *Euptoieta claudia.*—Pale-red Butterfly. Dawes, Dodge and Nemaha. Appears as early as the middle of May; somewhat common.

29. *Melitæa phaeton.*—Red-bordered Butterfly. Lancaster. Prof. French gives this species as "United States, east of the Rocky Mountains," but Mr. McMillan says, "I once found a pupa of *Melitæa phaeton*, not an indigenous species, attached to a N. Y. C. & H. R. R. freight car, standing on the B. & M. yards at Lincoln." Not observed by us.

30. *Phyciodes nycteis.* — Silver-crescent Butterfly. Dodge and Nemaha. Appears in small numbers about the first of June.

31. *P. carlota.*—Fulvous-spotted Silver-crescent Butterfly. Dawes and Dodge. Have not collected but few specimens.

32. *P. tharos.*—Little Black-bordered Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears about the last of April,

becomes abundant about the middle of May, and is found very late in the fall.

33. *Grapta interrogationis.* — Semicolon Butterfly. Dodge and Nemaha. Found in small numbers from very early Spring till late fall.

34. *G. comma.*—Comma Butterfly. Dodge and Nemaha. Found as early as the last of March and, remains till late fall.

35. *G. faunus.*—Green-banded Comma Butterfly. Nemaha. Found occasionally.

36. *G. progne.*—Gray-winged Comma. Nemaha. Rather common in late summer and fall.

37. *Vanessa antiopa.*—Yellow-bordered Butterfly. Dawes, Dodge and Nemaha. Appears by the latter part of March, or earlier, and remains till cold weather. Somewhat common in August and September.

38. *Pyrameis atalanta.*—Red Admiral. Dawes, Dodge, Nemaha and Sheridan. Appears first about the middle of April, and again appears the middle or last of May. Found the last of September and first of October.

39. *P. huntera.*—Hunter's Butterfly. Dawes, Dodge, Nemaha and Sheridan. Appears as early as the middle of May, becoming rather common a little later.

40. *P. cardui.*—Thistle Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears by the middle of April, abundant by the fifteenth of May, and common in late fall.

41. *Junonia cnœia.* — Buck-eye Butterfly. Dawes, Dodge and Nemaha. Appears the last of May or first of June, but at no time very common.

42. *Limenitis ursula.*—Blue-banded Butterfly. Dodge and Nemaha. Appears about the first of June; somewhat rare.

43. *L. arthemis.*—White-banded Butterfly. Nemaha. Found in May, but very rare.

44. *L. disippus.*—Banded-red Butterfly. Dodge and Nemaha. Appears as early as May 15th, and reappears in the fall, but never very common.

45. *Apatura celtis.*—Rusty-gray Butterfly. Dodge. Mentioned by Mr. Dodge, but not seen by us.

46. *Paphia troglodyta.*—Copper-red Butterfly. Nemaha. September 28th, 1889, we captured a specimen of this butterfly, the only one we have noticed in the State, owing probably to its near resemblance to the Grapta butterflies. It is given by Prof. French.

47. *Debis portlandia.*—Pearly Wood Butterfly. Nemaha. Only one specimen in our collection.

48. *Neonympha canthhus.*—Ten-spotted Quaker Butterfly. Dodge. Mentioned by Mr. Dodge. but not observed by us.

49. *N. eurytris.*—Six-spotted Quaker Butterfly. Dodge and Nemaha. Usually makes its appearance about the first of June.

50. *Satyrus alope.*—Common Wood Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Several varieties are found, some of them quite common. Appears as early as the last of March, and becomes quite abundant by the middle or last of April. The middle of July, 1889, I found them very abundant at the base of Crow's Butte, Dawes county.

51. *Libythea bachmanii.*—Red and Black Beaked Butterfly. Dodge Not observed by us, but mentioned by Mr. E. A. Dodge.

FAMILY LYCÆNIDÆ.

52. *Thecla humuli.*—Gray-streaked Butterfly. Dodge. Not observed by us, but mentioned by Mr. Dodge.

53. *T. acadia.*—Pale-streaked Butterfly. Dodge. Mentioned by Mr. Dodge, but not collected by us.

54. *T. edwardsii.*—Edward's Streaked Butterfly. Dodge. Mentioned by Prof. French and by Mr. Dodge, but not collected by us.

55. *T. calanus.*—Banded-streaked Butterfly. Nemaha. Seems to be somewhat common about the first of June.

56. *T. pœas.*—Nemaha. One specimen collected October the first, 1889.

57. *T. niphon.*—Black and White Banded-streaked Butterfly. Nemaha. Appears about the first of June; very rare.

58. *T. titus.*—Coral-streaked Butterfly. Dodge. Mentioned by Mr. Dodge, but not observed by us.

59. *Chrysophanus dione.*—Dodge. Mentioned by Prof. French and Mr. Dodge, but not observed by us.

60. *C. thaë.* Large Copper Butterfly. Dodge and Nemaha. We have collected but one specimen.

61. *Lycæna pseudargiolus.*—Pale-blue Butterfly. Brown, Dawes, Dodge, Nemaha and Sheridan. Appears abundantly during the month of April, and was found in Dawes and Sheridan counties about the first of July. Forms numerous.

62. *L. comyntas.*—Tailed-blue Butterfly. Dodge and Nemaha. Commonly found, but not abundant.

FAMILY HESPERIIDÆ.

63. *Ancyloxypha numitor.*—Bordered Skipper. Dawes and Dodge. Observed in Dawes county in July.

64. *Pamphila massasoit.*—Yellow-cross Skipper. Dodge. Mentioned by Prof. French and by Mr. Dodge, but not observed by us.

65. *P. zabulon.*—Orange and Brown Skipper. Dodge. Not observed by us, but mentioned by Mr. Dodge.

66. *P. sassacus.*—Pale-spotted Skipper. Given as from Nebraska by Prof. French; not collected by us.

67. *P. uncas.*—Dodge. Mentioned by Mr. Dodge as rare or extinct

68. *P. leonardus.* — Leonard's Skipper. Dodge and Nemaha Seemingly rare.

69. *P. huron.*—Velvet-spotted Skipper. Dodge. Mentioned by Mr. Dodge, but not observed by us.

70. *P. phylæus.*—Dodge. Mentioned by Mr. Dodge; not in our collection.

71. *P. peckius.*—Peck's Skipper. Brown and Dodge. Somewhat rare.

72. *P. cernes.*—Clear-winged Skipper. Dodge. Not collected by us, but observed by Mr. Dodge.

73. *P. metacomet.*—Immaculate Skipper. Dodge and Nemaha. Seems to be rare.

74. *P. bimacula.* — Two-spotted Skipper. Dodge and Nemaha. A few specimens collected in May.

75. *P. pontiac.*—Green-margined Skipper. Dodge. Not collected by us, but mentioned both by Prof. French and Mr. Dodge.

76. *P. dion.*—Dodge. Mentioned by Prof. French, also by Mr. Dodge as rare or extinct; not observed by us.

77. *P. palatka.*—Given by Prof. French, but not observed by us.

78. *P. vitellus.*—Dodge. Not observed by us, but given by both Prof. French and Mr. Dodge.

79. *P. delaware.*—Yellow-winged Skipper. Dodge and Nemaha. A few specimens collected the last of May.

80. *P. hianna.*—Four-spotted Brown Skipper. Dodge and Nemaha. But very few specimens collected by us.

81. *Pyrgus tessellata.*—Brown, Dawes, Dodge, Nemaha and Sheridan. Appears the last of May and is quite common during late fall.

82. *Nisoniades juvenalis.*—Dodge. Not collected by us, but mentioned by Mr. Dodge.

83. *Pholisora catullus.*—White-dotted Black Skipper. Dodge and Nemaha. A few specimens collected the first of June.

84. *Eudamus tityrus.*—Silver-spotted Skipper. Dodge and Nemaha. Found rather abundantly from the first of May till the middle of June, perhaps later.—W. Edgar Taylor, *Nebraska State Normal School, Peru, Neb.*

PSYCHOLOGY.

The Devices of Criminals in India.—The writer of a series of articles in the *Times of India* on "By-paths of Crime in India," mentions some devices of habitual criminals in that country. One curiosity which he was shown on a visit to the Presidency gaol in Calcutta was a heavy lead bullet about three-quarters of an inch in diameter. This was found on an habitual thief, and was being used to form a pouch or bag in the throat for secreting money, jewels, etc., in the event of his being searched. The ball is put into the mouth and is allowed to slide down gently until it reaches some part near the epiglottis, where it is held in position, and is kept there for about half an hour at a time. This operation is repeated many times daily, and gradually a sort of pocket is formed, the time being longer or shorter according to the size of pocket required. In some cases six months have been sufficient, in others a year, while in some cases two years are necessary. Such a pouch as this last is capable of holding ten rupees —about the size of ten florins. The thief therefore can undergo search, and, nothing being found, he goes away with the spoil in his throat, the power of breathing and speech being in no way interfered with. About a score of prisoners in the Calcutta gaol have such pouch formations. In the hospital of the prison the visitor learned some of the malingering practices of Indian criminals. In one case he saw a youth who was a perfect skeleton, with lustrous eyes looking out in a ghastly manner from a worn, haggard face. It was discovered that he had for two years been taking an irritant poison, with a view to produce diarrhœa, in order to shirk work and get pleasant quarters in the hospital. But he had overdone the part, for he had reduced himself to such a condition that recovery was all but impossible. This taking of internal irritants is a common practice amongst the habitual criminals of Calcutta. Castor oil seed, croton seed, and two other seeds, which have no English name, are the agents most commonly employed. One man was pointed out who, in order to get off his fetters, had produced an ulcer by rubbing the chafed skin with caustic lime, and then irritating the sore by scratching it with a piece of broken bottle. The segregation of lepers has long been the practice in Indian prisons, and it is mentioned as an example of the increase of leprosy in India that the disease occurs with much greater frequency amongst the criminals of Bengal than it did ten years ago.

The Home Instinct in Toads.—I originally introduced a few toads into the cellar of my house to destroy slugs, and in a few years they became more of a nuisance than the slugs had been. I had the tenants (my father-in-law and family) to send a lot of them, probably a hundred, over to my greenhouses, all of which were on a level with the ground. The toads came one-half in a tin slop bucket, and the other in a market basket,—both covered. The first day they were to be seen almost everywhere, but restless and excited. Next day very few were to be seen. On the third day none could be found, but on *that* day a large number were seen by several members of the family at the only opening into the cellar,—the cold air flue. None were seen again at the greenhouses (except a few that could not jump the three steps to the surface.) I firmly believe they found their way back, but of course cannot be positive. No toads, except perhaps a single one at a time, had ever before been seen in that yard, and their appearance there in such quantity, in a reasonable time after the disappearance at another place in similar quantity, to my mind is pretty clear. The bee-line distance is about a third of a mile, with two races and the creek between. We have proof of similar home instinct in the cat, carrier pigeon, four-week-old pig, land tortoise, and almost every bird; why not in the toad? I have had the same little owl return to my conductor spout for twenty-five years.—EDWARD TATNALL.

Wilmington, Delaware.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Natural Science Association of Staten Island.—New Brighton, April 11th, 1889.—Meeting called to order at 8.30 o'clock. Dr. N. L. Britton called attention to several specimens of silicified fossils found by Mr. Arthur Hollick in the white Cretaceous gravel on the side of a brook near Prince's Bay. They consisted of a brachiopod mollusk, allied to Pentamerus, a cyathophylloid coral, perhaps Zaphrentis, and a third one, probably a sponge. Dr. Britton remarked as follows: This is one of the most interesting discoveries recently made in our local geology, and is of much more than local importance, inasmuch as it affords valuable evidence towards establishing the origin of the formation known as the Yellow Gravel or Pre-glacial Drift, which has been frequently alluded to in our "Proceedings." I have been especially interested in this latter formation for several years, as it has been a much debated question whence came the yellow gravel, and sand composing it, and from which it derives its name. There were difficulties in the way of accepting hypotheses, advanced by several eminent authorities, that it came either from the northwest or southeast. After a careful survey of a large part of the region where it is found in New Jersey, I had arrived at a conclusion, as long ago as 1883, that it had been derived from the erosion of Cretaceous strata containing gravel outcropping in the vicinity, and that after erosion it had been colored by ferruginous waters. [See Trans. N. Y. Acad. Sci., Vol. IV.] That this coloring is merely more or less on the surface may be seen by breaking the pebbles composing the gravel, and noting the white interior portions. The discovery of these fossils in the Cretaceous gravel goes far towards strengthening the conclusion, for it is a well known fact that similar fossils occur in the Pre-glacial Drift, and we have specimens in our cabinet from the Prince's Bay Bluff and Todt Hill, as previously reported to the Association. The beds of white gravel must lie near the base of the Cretaceous system, and form the exposures at Glen Cove, N. Y., and Camden, N. J. They are known to be of considerable thickness and extent, and as there is unmistakable evidence of some hundreds of feet of erosion from all this part of the country since the Cretaceous era, there is nothing extraordinary about the proposition. The problem still remains, however, Where did these silicified fossils come from originally? We have traced them back one step further, from the Pre-glacial Drift to the Cretaceous gravels, but that is as far as we can go at present. There are ledges of rock from which they might have been derived in Morris county, N. J., but the abundance of silicified fossils in the Pre-glacial Drift seem to require some less remote source.

Mr. Hollick described a recent visit to the Triassic outcrop at Mariners' Harbor, in company with Dr. Britton. This outcrop was mentioned by Wm. W. Mather in "The Geology of New York," where he says (see page 285): "In Richmond county, Staten Island, the red sandstone occupies but a small area where it can be observed * * * * it is believed to range from between Bergen Point and Shooter's Islnad, south-south-westwardly to the Freshkill marshes. It is generally covered by soil, drift deposits, and the sand and clay beds. It may be seen at very low tide, on the shore, about southwest of Bergen Point. It is the slaty, micaceous, fissile, red sandstone and shale." On page 294, in speaking of so-called bird tracks found in the same sandstone in Connecticut, he says: "I have seen no tracks on the red sandstone of Rockland and Richmond Counties, but they may very possibly be found there. My researches were necessarily very limited, in examining this, and in fact all the regions explored in New York." The beach within the limits above described was carefully examined, and although the tide was high the existence of the outcrop was clearly demonstrated. Fully three-fourths of the shingle is composed of red sandstone and shale, and at a point immediately to the west of the foot of South Avenue there is a portion of the beach composed entirely of red clay and decomposed red shale, which is undoubtedly the outcrop described by Mather, although very much broken up by the action of the waves and weather. At this locality a large flat piece of red sandstone was found containing well-defined impressions of some vegetable remains, probably algæ. [The specimen was here presented.] There does not seem to be any other record in regard to this outcrop since Mather so briefly mentioned it, in 1843, and this specimen is probably the only Triassic fossil ever found in place on Staten Island. These facts should be recorded at the present time, as no doubt the shore is destined to be "improved" at no very distant date, and then the outcrop will suffer the same fate as that of the tremolite at New Brighton and the granite at Tompkinsville. There are indications that the Triassic strata are very near to the surface at other localities, especially where a new road is being cut through towards Erastina station. Along one portion of this road the soil is composed entirely of red clay and broken red shale, similar to that upon the shore.

Mr. Wm. T. Davis read the following letter:

NEW YORK, March 27th, 1889.

MR. WM. T. DAVIS.

DEAR SIR:—In reading over the proceedings of your society in the *Standard*, you (the proceedings) say there are no natural butternut trees on the Island. In the town of Westfield, along a stream known as Sandy Brook, there was a natural grove of them extending over nearly half a mile; many of them are there probably yet. This brook is the head-water of Lemon Creek, which runs into Prince's Bay. Part of the trees stood in a wood of my father's; the brook runs in a northerly direction from the Amboy road and crosses the Woodrow road. Yours.

A. WINANT.

Mr. Davis presented further notes upon the locality, and exhibited some butternuts from the trees referred to. Sandy Brook is quite appropriately named. Its course for about a half mile is through a loose sandy soil, and in some of the adjoining fields the yellow drift is sparingly represented, the sand being particularly free from stones of any kind. The yellow gravel is a feature of the neighboring hills. The butternut trees grow in this sand near the brook, and at the present time about ten full grown and a few small ones are standing. A tree leaning over the brook, and to which fence rails have been nailed, measures, at about a yard from the ground, five feet one inch in circumference, and several of the others are nearly as large. They are well known to the people in the vicinity, and one old woman said she had gathered a half a bushel of the nuts last Fall. Further along the brook, when the character of the soil changes, boulders and the usual red drift material prevailing, none of the trees were observed. A colloquy held with a negro elicited the information that he had found one or two trees, years ago, in the woods, so they may be distributed sparingly over the adjacent territory. As might be expected from their character, these sandy fields were favorites with the Indians, and many of their implements are to be found there. Also, it may not be inappropriate to mention this locality as a new one for the yellow pine (*Pinus mitis*), a few trees growing on the neighboring hills, principally in the groves of *Pinus inops*. Of the latter trees there is one clump in particular that deserves to be recorded, on account of the size, number and beauty of the trees, which have grown close together.

Mr. Jas. Raymond presented an Indian axe, found during some excavating on the old Dongan estate at West New Brighton. Also two net sinkers from Tottenville. Mr. Davis presented a hammerstone from the locality above mentioned, near Sandy Brook, and Mr. Hollick reported finding a similar implement and some pottery at the same locality. Dr. Britton showed a skin scraper, found near the Vanderbilt Mausoleum, and two arrow heads from Mariners' Harbor. Also specimens of stilbite, from the upper Graniteville trap quarry—a mineral new to the Island.

May 9th, 1889.—A communication was read from Mr. Joseph C. Thompson, noting the capture of a twenty-one pound snapping turtle on the south side of the Island. It was two feet nine inches in length, with a carapace measuring fourteen inches in lateral and ten inches in transverse diameter.

A specimen of *Labia minor*, a species of earwig new to the Island, also captured by Mr. Thompson, was shown by Mr. Wm. T. Davis. It is found in New England, and occurs commonly in Europe.

Dr. N. L. Britton presented the celt or skin scraper, shown at the last meeting, with the following memorandum: The implement was found by Mr. Booth Davy, assistant superintendent of the Moravian Cemetery, near the Vanderbilt Mausoleum, about eighteen inches beneath the surface of the ground, at the foot of a large hickory tree. No other evidences of Indian occupation were noticed in the vicinity. Mr. Davy desired to present it to the Association.

Mr. E. M. Eadie showed a large lance- or spear-head from Watchogue.

Mr. Arthur Hollick presented specimens of the sandstone containing fossil vegetable remains, from the shore at Tottenville. Also similar stone from the shore at Perth Amboy. At this latter locality it was found in place, in the form of concretions, in an irregular layer at the top of the Cretaceous clay. The rock contained, besides vegetable remains, impressions of mollusca. This find is another important link in the chain of evidence identifying our Tottenville fossil leaves with the Cretaceous formation, and it is probable that the clay is almost at the surface of this locality, where it is covered by the Drift. This supposition is borne out by the fact that a new outcrop of Cretaceous clay was discovered at low tide on the beach, about a quarter of a mile west of the Prince's Bay light-house. The same sandstone occurs there, where the junction of the Drift and Cretaceous may be seen. It has not been found in the Drift under any other circumstances.

A list of Staten Island fungi, named by Mr. J. B. Ellis, from specimens in the cabinet of the Association, was presented for publication.

October 10th, 1889.—Mr. Wm. T. Davis read the following additional notes in regard to butternut trees on the Island.

In addition to the butternut trees growing along Sandy Brook, mentioned in the proceedings of April 11th, 1889, a single large tree was discovered during the past summer on a sand dune, near the Rossville Road. 'Mid the surrounding pines, wild cherries, etc., many little trees, seedlings from this one, are springing up, and if they are not destroyed by fire, there will probably soon be a considerable grove of them on this part of the Island. The dune is some distance to the west of the little swamp where Sandy Brook rises, and is nearly a mile from the trees previously reported. Mr. Wm. S. Page has informed me that trees of this species grew on the Vail place, near the bluff at Prince's Bay, and not far from Lemon Creek. A glance at the map will show, from the localities given, that the trees extend in a belt across the Island from North to South, following in a general way the direction of Sandy Brook.

Mr. George J. Hicks showed a set of five sparrow-hawk's eggs, found last May on Todt Hill, by Spire Pitou, George W. Jewett and J. J. Hicks. The nest was in a hollow tree, almost thirty feet from the ground. In the same tree were nests of the red-headed woodpecker and high holder. This is the first recorded instance of the nest of this bird having been found on the Island.

Mr. James Raymond presented a large stone axe, skin scraper and several arrow heads from Tottenville.

Mr. Arthur Hollick showed fossils, mostly corals, found in the yellow gravel overlying the limonite ore on Todt Hill.

Dr. Britton remarked that an outcrop of Cretaceous clay had been recently reported at the foot of Eltingville road, and Mr. Hollick stated that recent excavations near the railroad trestle beyond Arlington station had exposed Triassic shale in considerable quantity, and that the locality would probably repay careful examination. Other exposures of this formation at Mariners' Harbor and Erastina, were described in the proceedings for April 11th, 1889.

A list of the fungi in the cabinet of the Association, named by Mr. J. B. Ellis, of Newfield, N. J., was presented, which will be published as a special.

SCIENTIFIC NEWS.

THE session of the Marine Biological Laboratory during the past summer was as successful as the most sanguine could wish. Every room and table was occupied, and some applicants were refused merely on account of lack of accommodations. Altogether forty-four persons were at work there during the summer. Among the changes made the following were the more important: The northern side of the investigator's room was divided by partitions into ten small studies for advanced students, who were invited to avail themselves of the facilities of the Laboratory free of expense. Each room was furnished with table, chair, glassware, reagents, aquarium, etc. The iron water pipes were replaced by wooden ones, and a large tank was erected outside the building. The library proved extremely valuable. Through the generosity of Mrs. Evans of Boston the trustees had $1,000 to spend for books, and this was increased by an appropriation from the general fund. The result is that the library is now furnished with sets of the more important journals, while naturalists all over the United States contributed "extras" of their papers.

Twenty-five students occupied the lower laboratory, spending their time at dissecting and microscopical work, while the nineteen others present were engaged in investigation, and soon the world will begin to see the results of their work. Among the subjects studied were the development of Actinoloba, of Edwardsia, the fertilization of echinorderms, the development of a planarian, of Spirorbis, of hydroids, of Polygordius, of Hexapods, of Limulus, of the lobster, and of Alcyonidium, the relation of the first cleavage plane to the axis of the teleosts, the head cavities of the elasmobranchs, the skull and circulation in the sharks, the formation of the germinal layers in the teleosts, the skull of the flounders, the nasal region in teleosts, Kupffer's vesicle, lateral line organs in Batrachus, the development of prosobranchs, and the morphology of the Algæ. An interesting feature was the introduction of evening lectures once a week. Such lectures were given by Drs. Whitman, Minot, Cope, Kingsley, McMurrich, Gardiner, Ayers, Wilson, and Watase.

Among the most pressing needs for the coming season are an addition to the laboratory building to afford room for lectures, library, and students, a steam launch for collecting purposes, and more books for the library.

Recent Deaths.—William Broderick, an English ornithologist, Dec. 21, 1888; Jacques Charles Puls, a Belgian entomologist, Jan. 13, 1889; Eugene Ferdinand von Homeyer, owner of one of the largest collections of European birds, at Stolp, Pomerania, May 31, 1889, aged 79 years; J. Pancie, botanist and entomologist, at Belgrade, March 8, 1888, aged 74; August Emil Holmgren, entomologist, at Stockholm, Dec. 21, 1888; Giuseppe Seguenza, geologist, at Messina, Feb. 3, 1889.

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THE GIGANTIC LAND TORTOISES OF THE GALAPAGOS ISLANDS.

BY G. BAUR.

IN 1877, Dr. A. Günther published his memoir on the Gigantic Land Tortoises (living and extinct) in the collection of the British Museum. The Galapagos Islands were found to be inhabited by six species. Of only three the exact localities were known: *Testudo abingdonii* Günther, from Abingdon Island; *T. microphyes* Günther, from North Albemarle, and *T. vicina* Günther, from South Albemarle. *T. ephippium* Günther was believed to be an inhabitant of Charles Island (in the synopsis, p. 11 of Indefatigable Island). *T. elephantopus* Harl. was attributed with query to James Island; no locality was given for *T. nigrita*, D. and B.

Having been occupied lately with the history of the Galapagos Islands, I have come across two works not mentioned by Dr. Günther, which are of the highest importance to this question. The first work is the "Voyage of the United States Frigate *Potomac*, under the command of Commodore John Downes, during the circumnavigation of the globe, in the years 1831, 1832, 1833 and 1834," by Z. N. Reynolds, New York, 1835. On pages 464-473, the Galapagos Islands are described. Only Charles Island was visited (Aug. 31 to Sept. 10, 1833). The *Potomac* returned to Boston, May 23, 1834. In June of the same year, two gigantic

Galapagos tortoises (living), weighing near three hundred and twenty pounds each, were presented by Captain John Downes, of the *Potomac*, to the Boston Society of Natural History.[1] These two tortoises formed the material for a very extensive paper on the anatomy of the Galapagos tortoises, by Dr. J. B. Jackson, which was printed in the first volume of the Journal of the Boston Society of Natural History, with two plates.[2] This is the second work overlooked by Dr. Günther. It is the best older scientific account of these tortoises. One of these specimens is still in the Museum of the Boston Society in form of a skeleton. The first thing to be done is to examine whether the two tortoises brought by the *Potomac* are really from Charles Island. As stated before, the *Potomac* visited only this island. In the appendix of Reynolds' book we find the following important note, p. 547.

"A large number of the crew were daily on shore after terrapin, and frequently exposed throughout the day to a hot sun, with these immense animals on their backs, travelling over the broken lava." This note proves, I think, that the two tortoises donated by the captain of the *Potomac* to the Boston Society were really from Charles Island. Besides that I believe that Darwin's remark in his journal, that on Charles Island the crew of a certain frigate took down to the shore 200 tortoises on a single day, some years before his visit in 1835, refers to the *Potomac*. Through the kindness of Prof. A. Hyatt I have received for examination five skulls of Galapagos tortoises, among which is the skull of one of the animals presented by Captain Downs, and described by Dr. Jackson. This skull is different from any one described by Dr. Günther. It agrees exactly with three smaller skulls received for examination through the kindness of Prof. A. Heilprin from the Philadelphia Academy.

After this it is evident that the *T. ephippium* of Günther supposed to be the form from Charles Island, must have another locality. The question is, From which Island? The type of *T. ephippium* is an adult male, thirty-three inches long, stuffed, and

[1] Jour. Bost. Soc. Nat. Hist., I., 1834–1837, p. 521.

[2] J. B. Jackson, M. D., Anatomical Description of the Galapagos Tortoise. Read Feb. 1, 1837. Jour. Bost. Soc. Nat. Hist., I., 1837; pp. 443–464, Pl. X., XI.

"belongs to the Museum of Science and Arts, Edinburgh." According to Dr. Günther nothing is known of its history. *T. ephippium* very much resembles *T. abingdonii* not only in the shell, but also in the skull and the slender fore-limb, and it seems to me that it really represents this species. Some notes in Captain Basil Hall's Journal,[3] which were omitted by Dr. Günther, give a very strong support to this belief.

Captain Basil Hall visited the Galapagos Islands in January, 1822. On Abingdon Island, the only island visited, experiments were made with an invariable pendulum. Speaking of the tortoises, Captain Hall says: "We took some on board, which lived for many months, but none of them survived the cold weather off Cape Horn. I preserved one in a cask of spirits, *and it may now be seen in the Museum of the College at Edinburgh:* it is about the medium size." (Italics are mine.) The following measurements of a tortoise weighing 190 pounds are given.

	Inches.
"Length of upper shell,	43
Breadth of ditto,	44½
Length of belly shell,	29
Breadth of ditto,	26
Length of the head,	6½
Greatest breadth,	4½
Ditto depth,	3¾
Greatest extent of upper and lower mandible,	3¾
Distance of eye from nose,	1⅔
Length of neck,	31
Circumference about the middle of the neck,	9
From fore part of upper shell to the fore part of belly shell,	11½
From after part of upper shell to the after part of belly shell,	7
Length of fore-leg and thigh,	22½
Circumference above the foot,	8¾

[3] Captain Basil Hall, Extracts from a Journal written on the coasts of Chili, Peru, and Mexico, in the years 1820, 1821, 1822. Part II. London, 1840. (Orig. Ed., Edinburgh, 1824.)

	Inches.
Length of hind leg and thigh, . . .	24
Circumference above the foot, ...	16
Length of tail, ...	8½
Depth of upper shell when scooped out, . .	17
Width inside, ...	27
Number of pieces composing the disk, . .	13
Number of pieces in the margin, ...	24
When alive weighed, ...	190 lbs.
Quantity fit for use, ...	84 lbs."

Is it not probable that the specimen now in the Edinburgh Museum of Science and Arts is the one collected by Captain Hall in 1822, and therefore from Abingdon Island?

Thinking it possible that something about the history of *T. ephippium* could be found out, I wrote to the Director of the Edinburgh Museum of Science and Arts, in which the type is preserved, asking whether anything is known about this specimen. Dr. R. H. Traquair had the great kindness to examine the matter and wrote to me: "I have to say that I have had the records of the old College Museum searched for information as to the specimen of *Testudo ephippium* figured and described by Dr. Günther, and the only entry which we can find which can possibly have any reference to that specimen is one in the year 1822-23 of a 'Large Turtle from South Sea—Captain Basil Hall.' Now in those old days, when the Museum was under the charge of Professor Jamison, no marks were put upon the specimens by which they could be afterwards identified with entries in the register! Consequently we have no *absolute* certainty as to whether our *Testudo ephippium* is the specimen from the 'South Sea' presented by Captain Basil Hall or not."

From these notes and frcm a comparison of the descriptions of *T. ephippium* and *T. abingdonii*, I reach the conclusion that *T. ephippium* is the same species as *T. abingdonii*, and that the type specimen of the former is the one brought by Captain Hall from Abingdon Island. The name *T. ephippium* has the priority, but I think that the name *T. abingdonii* ought to be selected, as more significant.[4]

After excluding *T. ephippium* we have six species left inhabiting the Galapagos Islands :

1. *T. elephantopus* (Harlan) Günther.
2. *T. nigrita*, D. and B.
3. *T. vicina*, Günther.
4. *T. abingdonii*, Günther.
5. *T. microphyes*, Günther.
6. The specimen from Charles Island in the Museum of the Bos. Soc. Nat. Hist., called *T. elephantopus*, Harlan, by Jackson.

Through the great kindness of the Secretary of the Academy of Natural Sciences, in Philadelphia, I have received permission to examine the type specimen of Harlan. It was in a very bad condition. The skin of the neck was all decayed, and also different parts on the limbs. The best possible thing to do was to save everything of the skin that could be saved and prepare a skeleton of the specimen. Fortunately all parts of the skeleton were found with the exception of the hyoid bones and both femora.

The comparison of the skull of the type and the skull of the specimen from Charles Island showed at once that they belonged to two different species. A further comparison of the type of *T. elephantopus* with the description of the specimens in the British and other English Museums (by Dr. Günther) regarded as this species, led to the conclusion that Günther's *T. elephantopus* is a different species from the type.

The next question is, Is it possible that any of the other species

[4] Since the above was written, I had opportunity, through the kindness of Prof. Brown Goode, to examine a nearly complete specimen of *T. abingdonii* in the U. S. National Museum, which was collected by the steamer *Albatross* on Abingdon Island. It is an old male. This specimen is of great importance, since it contains the elements missing in the British Museum specimens. A comparison of these with the corresponding ones of *T. ephippium* leaves no doubt that *T. abingdonii* is not different from *T. ephippium*. I take the opportunity to express my best thanks to Mr. F. A. Lucas, of the U. S. National Museum, for many services offered in connection with the examination of these tortoises.

described by Dr. Günther is referable to the type specimen of *T. elephantopus* Harlan.[5]

According to these statements we have the following synonymy:

1. *Testudo elephantopus* Harlan = *T. vicina* Günther.
2. *Testudo spec. nov.* = *Testudo elephantopus* Jackson, non Harlan.
3. *Testudo spec. nov.* = *Testudo elephantopus* Günther, non Harlan.
4. *Testudo abingdonii* Günther = *T. ephippium* Günther.
5. *Testudo nigrita* D. and B.
6. *Testudo microphyes* Günther.

For the species from Charles Island, described by Jackson, and now in the Boston Museum of Natural History, I propose the name *Testudo galapagoensis;* for the species described by Günther as *T. elephantopus*, the name *Testudo güntheri*, in honor of Dr. A. Günther of the British Museum, to whom we owe much of our knowledge of the gigantic Land Tortoises.

I follow Dr. Günther in disusing the name *Testudo nigra* proposed by Quoy and Gaimard in 1824 for a young specimen, since it is impossible to decide at present which of the species proposed later is referable to this species. The exact locality of this specimen being unknown, I think it will always be impossible to settle the question.

The Fish Commission steamer *Albatross* brought about fifteen living specimens of tortoises from the Galapagos Islands, but unfortunately the exact localities were not known. Some of them were said to be from Duncan Island, from which no tortoises had been recorded.[6]

Land tortoises have been recorded from Hood Island by Delano, Porter, and Cookson, but no specimens have been examined.

[5] A number of specimens collected by the *Albatross* agree exactly with the type of *T. elephantopus* Harlan and the *T. vicina* of Günther.

[6] A party of the Italian steamer *Vettor Pisani* visited Duncan Island in 1885, "um Schild-Kröten zu fangen, konnte jedoch, obschon verschiedene die man bis auf 80 Pfundschätzts gesehen den war keine erbeuten," *Illustr. Zeitschrift für Länder. Und Völkerkunde Globus*, Vol. XLIX., No. 6, 1886, p. 93. It is not possible to decide whether these tortoises were land or sea tortoises.

What we know to-day is the following: The tortoise of Charles Island is with very little doubt extinct. The only authentic specimen brought from this island is now in the Boston Museum of Natural History, and is the type of *Testudo galapagoenis*. *T. abingdonii* (*ephippium*) the tortoises from Abingdon Island, seem to be very much reduced, perhaps extinct.

The tortoises on Albemarle are still numerous. The northern form is *T. microphyes*, the southern form *T. elephantopus* Harlan (*T. vicina* Günther). The localities of *T. güntheri* (*T. elephantopus* Günther) and *T. nigrita* D. and B. are not known; but, since tortoises have been recorded from Chatham, Indefatigable and James Islands, they belong to one of these; but the future must decide to which special island. Perhaps this question can still be decided, if the tortoises have not become entirely extinct on these islands, which I do not suspect.

Whether the tortoises said to be on Duncan Island belong to a new species, or one of the six known ones, is a question. The same is to be said of the tortoises inhabiting Hood Island. Nothing is known in regard to tortoises about Barrington, Burnloe and Tower Islands.

I fear that the history of the land tortoises of the Galapagos will never be solved; if it is to be, a scientific expedition must be sent out soon, with the object of making a full examination of each land of this group.

SOME OF THE OLDER ACCOUNTS OF THE LAND TORTOISES.

At the end of the seventeenth century the Galapagos Islands were frequently visited by buccaneers. Cowley, Wafer and especially Dampier have given accounts of these visits, and it was at this time that Cowley published a map of the islands. The first visit was in 1684 by Cowley, Cooke, Dampier and Edward Davis. They arrived the 31st of May. The following year Davis, Wafer, Knight and Harris were again there, and in 1687 Davis and Wafer made the third visit. Dampier was there at different times, and to him we owe the first account of the land-tortoises. "There is no place in the world," he says, "so much stored with Guanos and Land-Tortoises as these Isles. The first are fat, and of an extraordinary size, and exceedingly tame; and the Land-Tortoises so numerous that some hundred men may subsist on them for a considerable time, being very fat, and as pleasant food as a pullet; and of such bigness, that one of them weighs 150–200 pounds, and are from two feet to two feet six inches over the belly, whereas, in any other places, I never met with any above 30 pounds weight, though I have heard some say, that at St. Lawrence or Madagascar there are also some very large ones." They "are in shape like the first, [Hackatee=*Chrysemys ornata*, Gray] with long necks and small heads, only they are much bigger." "The oil saved from them was kept in jars, and used instead of butter to eat with dough-boys or dumplings." "We lay here feeding sometimes on land-turtle, sometimes on sea-turtle, there being plenty of either sort; but the land-turtle, as they exceed in sweetness, so do they in numbers; it is incredible to report how numerous they are."

In June, 1700, the French captain de Beauchesne visited the Islands, but nothing is said in the Journals of his voyage about the tortoises, so far as I know.

The first good account of the tortoises was given by Woodes Rogers, who was on the Islands in September, 1707.

"Some of the largest of the Land-Turtles," he says, "are about 100 pounds weight, and those of the sea upwards of 400. The Land-Turtles laid eggs on our deck [13th of September]. Our men brought some from the shore about the Bigness of a goose egg, white, with a large big shell, exactly round. The creatures are the ugliest in Nature, the shell not unlike the top of an old hackney-coach, as black as jet, and so is the outside skin, but shriveled and very rough. The legs and neck are very long, and about the bigness of a man's wrist; and they have club-feet, as big as one's fist, shaped much like those of an elephant, with five thick nails on the fore-foot and but four behind, and the head little, and visage small like snakes, and look very old and bleak. When at first surprised they shrink their neck, head and legs under their shell. Two of our men, with Lieutenant Stratton and the trumpeter of the *Duchess*, affirm they saw vast large ones of this sort, about four feet high. They mounted two men on the back of one of them, which, with its usual slow pace, carried them and never regarded the weight. They supposed this could not weigh less than 700 pounds. I do not affect giving Relations of strange creatures so frequently done by others; but when an uncommon creature falls in my way I cannot omit it. The Spaniards tell us, they know of none elsewhere in these Seas, but they are common in Brazil." [*T. tabulata* Wall.] Different islands were visited by Rogers. He continues, "I saw no sort of beast, but there are Guanos in abundance, and Land-Turtles almost on every island. It is strange how the latter got here, because they cannot come of themselves, and none of that sort are found on the main."

In 1720, Clipperton was for ten days on the island. Vancouver, who determined the position of some in 1795, did not go to land.

Colnet surveyed the Galapagos Islands in 1793, and published a survey of them. He says, p. 59: "The land tortoise was poor at this season, but made excellent broth. Their eggs are as large, and their shells as hard, as those of a goose, and form a perfect globe. Their nests are thrown up in a circular form, and never contain more than three eggs, which are heated by the sun, a hole being so contrived as to admit its rays through its daily course [!]. The shell is perfectly smooth, and when highly polished receives a beautiful and brilliant black."

One of the most accurate accounts of the tortoises has been given by Delano, who visited the Galapagos Islands at different times. He was a very good observer, and his notes must be considered as reliable.

"Delano went over all parts of the island and procured plenty of tortoises." On Charles Island "plenty of tortoises were to be obtained." Tortoises were also reported from James and Albemarle Islands. On pages 375-378 he gives a full account of these animals: "The terrapin, or, as it is sometimes called, the land tortoise, that is found here, is by far the largest, best, and most numerous of any place I have ever visited. Some of the largest weigh three or four hundred pounds, but their common size is between fifty and one hundred pounds. Their shape is somewhat similar to our small land tortoise, which is found upon the island, and is like it, high and round in the back.[7] They have a very long neck, which, together with their head, has a very disagreeable appearance, very much resembling a large serpent. I have seen them with necks between two and three feet long, and when they saw anything that was new to them, or met each other, they would raise their heads as high as they could, their necks being nearly vertical, and advance with their mouths wide open, appearing to be the most spiteful of any reptile whatever; sometimes two of them would come up to each other in that manner, so near as almost to touch, and stand in that position for two or three minutes, appearing so angry that their mouths, heads, and necks appeared to quiver with passion; when by the least touch of a stick against their necks or heads, they would sink back in an instant and draw their necks, heads and legs into their shells. This is the only quick motion I ever saw them perform. I was put in the same kind of fear that is felt at the sight or near approach of a snake at the first one I saw, which was very large. I was alone at the time, and he stretched himself as high as he could, opened his mouth, and advanced towards me. His body was raised more than a foot from the ground, his head turned forward in the manner of a snake in the act of biting, and raised two feet and a half above his body. I had a musket in my hand at the time, and when he advanced near enough to reach him with it, I held the muzzle out so that he hit his neck against it, at the touch of which he dropped himself upon the ground and instantly secured all his limbs within his shell. They are perfectly harmless, as much so as any animal I know of, notwithstanding their threatening appearance. They have no teeth, and of course cannot bite very hard. They take their food into their mouths by the assistance of the sharp edge of the upper and under jaw, which shut together one a little within the other, so as to nip grass, or any flowers, berries, or shrubbery, the only food they eat.

[7] *Terrapene carolina* L., the common box-tortoise.

"Those who have seen the elephant have seen the exact resemblance of the leg and foot of a terrapin. I have thought that I could discover some faint resemblance to that animal in sagacity. They are very prudent in taking care of themselves and their eggs, and in their manner of securing them in their nests; and I have observed on board my own ship, as well as on others, that they can easily be taught to go to any place on the deck which may be fixed for them to be constantly kept in. The method to effect this is by whipping them with a small line when they are out of place, and to take them up and carry them to the place arranged for them, which being repeated a few times will bring them into the practice of going themselves, by being whipped when they are out of their place. They can be taught to eat on board a ship as well as sheep, or a goat, and will live for a long time if there is proper food provided for them. This I always took care to do when in a place where I could procure it. The most suitable to take on board a ship is prickly pear-trees, the trunk of which is a soft, pithy substance, of a sweetish taste, and full of juice. Sometimes I procured grass for them. Either of these being strewed on the quarter-deck, the pear-tree being cut fine, would immediately entice them to come from all parts of the deck to it; and they would eat in their way as well as any domestic animal. I have known them live several months without food; but they always in that case grow lighter and their fat diminishes, as common sense teaches, notwithstanding some writers have asserted the contrary. If food will fatten animals, to go without it will make them lean.

"I carried at one time from James Island three hundred very good terrapins to the island of Massa Fuero, and there landed more than one half of them, after having them sixty days on board my ship. Half of the number landed died as soon as they took food. This was owing to their stomachs having got so weak and out of tone that they could not digest it. As soon as they eat any grass after landing they would froth at the mouth, and appeared to be in a state of insanity, and died in the course of a day or two. This satisfied me that they were in some degree like other animals, and only differed from them by being slower in their motions, and that it takes a longer time to produce an effect upon their system than upon that of other creatures. Those that survived the shock which was occasioned by this sudden transition from total abstinence to that of abundance, soon became tranquil, and appeared to be as healthy and as contented with the climate as when they were at their native place, and they would probably have lived as long had they not been killed for food. Their flesh, without exception, is of a sweet and pleasant a flavour as any that I ever ate. It was common to take out of one of them ten or twelve pounds of fat when they were opened, besides what was necessary to cook them with. This was as yellow as our best butter, and of a sweeter flavour than hog's lard. They are the slowest in their motions of any animal I ever saw except the sloth. They are remarkable for their strength; one of them would bear a man's weight on his back and walk with him. I have seen them at one or two other places only. One instance was those brought from Madagascar to the Isle of France, but they were far inferior in size, had longer legs, and were much more ugly in looks than those of the Galapagos Islands. I think I have likewise seen them at some of the Oriental Islands which I visited.

"I have been more particular in describing the terrapin than I otherwise should have been, had it not been for the many vague accounts given of it by some writers, and the incorrect statements made of the country in which it is to be found. The frequent political comparisons and allusions which have been made by our public papers and orators to this animal, may have led the people of this country into incorrect notions concerning them. It has been publicly said that terrapins are common to China, which I am confident is incorrect; for I have carried them to Canton at two different times, and every Chinese who came on board my ship was particularly curious in inspecting and asking questions about them, and not one, I am positive, had any knowledge of the animal before."

The most important of the other accounts is that given by Captain David Porter, who visited the Galapagos Islands, between 1812 and 1814 different times on the United States frigate *Essex*. He was the first one who noticed the difference of the tortoises on the different islands. He likewise published the first figure of a Galapagos tortoise.

On Hood's Island he obtained land tortoises in great numbers, p. 127. In another visit he could not procure more than fifty tortoises, and they small, but "of a quality far superior to those found on James Island" (p. 233). In regard to Charles Island he says, it "abounds with tortoises, which frequent the springs for the sake of the water, and upwards of thirty of them were turned on their backs by us, as they came down to drink, during the short time we remained there, which was not more than an hour and a half. But we were enabled to bring down only one, and he was selected more for his antiquated appearance than for his size or supposed excellence. His weight was exactly one hundred and ninety-seven pounds, but he was far from being considered a large size. Later, between four and five hundred were taken on board. They were brought the distance of from three to four miles, through thorns and over sharp rocks, yet it was no uncommon thing for them to make three and four trips a day, each with tortoises weighing from fifty to a hundred weight." "Although the parties in this employment (which were selected every day, to give all an opportunity of going on shore), indulged themselves in the most ample manner on tortoise meat (which for them was called Galapagos mutton), yet their relish for this food did not seem in the least abated, nor their exertions to get them on board in the least relaxed, for everyone appeared desirous of securing as large a stock of this provision as possible for the cruise" (p. 162).

On James Island the tortoises must have been very numerous. Two vessels captured by Porter near that Island, "had been in at James Island, and had supplied themselves abundantly with these extraordinary animals, the tortoises of the Galapagos, which properly deserve the name of the elephant tortoise. Many of them were of a size to weigh upwards of three hundred weight." "Numbers of them had been thrown overboard by the crews of the vessels before their capture, to clear them for action. A few days afterwards, at daylight in the morning, we were so fortunate as to find ourselves surrounded by about fifty of them, which were picked up and brought on board, as they had been lying in the same place where they had been thrown over, incapable of any exertion in that element, except that of stretching out their long necks." Two other English vessels captured later, "had been only a few days from James Island;" Porter "found on board them eight hundred tortoises of a very large size, and sufficient to furnish all the ships [with 333 men] with fresh provisions for one month." At another time Porter laid in a very large stock of tortoises from James Island. "Four boats were despatched every morning for this purpose, and returned at night, bringing with them from twenty to thirty each, averaging sixty pounds. In four days we had as many on board as would weigh about fourteen tons, which was as much as we could conveniently stow. They were piled up on the quarter-deck for a few days, with an awning spread over to shield them from the sun, which renders them very restless, in order that they might have time to discharge the contents of their stomachs; after which they were stowed away below, as you would stow any other provisions, and used as occasion required. No description of stock is so convenient for ships to take to sea as the tortoises of these islands. They require no provisions or water for a year, nor is any farther attention to them necessary, than that their shells should be preserved unbroken" (p. 214). "The most of those we took on board were found near a bay on the northeast part of the Island, about eighteen miles from the ship. Among the whole only three were male, which may be easily known by their great size, and from the length of their tails, which are much longer than those of the females. As the females were found in low sandy bottoms, and all without exception were full of eggs, of which generally from ten to fourteen were hard, it is presumable that they came down from the mountains for the express purpose of laying. This opinion seems strengthened by the circumstance of there being no male tortoises among them, the few we found having been taken a considerable distance up the mountains. One remarkable peculiarity in this animal is, that the blood is cold. I shall leave it to those better acquainted with natural history to investigate the cause of a circumstance so extraordinary, my business is to state facts, not to reason from them.

"The temperature of the air of the Galapagos Islands varies from 72° to 75°; that of the blood of the tortoise is always 62°" (p. 215).

No tortoises were taken by Porter on Albemarle, but he remarks (p. 142) that an English sailor, who had been landed there by his captain, existed near a year on land tortoises and guanos."

No landing was possible on Abingdon Island, but Porter had no doubt landing might have been effected elsewhere; and from the verdant appearance of the interior of the island he supposed that, like all others, it afforded tortoises.

On Chatham, where Porter stayed only a very short time, he did, not get any tortoises, but he "saw a few of their shells and bones; but they appeared to have been long dead." This remark relates only to these shells and bones he found, but not to the tortoises of Chatham in general.

Indefatigable Island, was surveyed by David T. Adams, the chaplain of the *Essex*, for the first time, and called Porter's Island. Adams informed Porter that land tortoises were in the greatest abundance, "of an enormous size, one of which measured five feet and a half long, four feet and a half wide, and three feet thick, and others were found by some of the seamen of larger size."

Porter has given the following general description of the Galapagos tortoises:

"Nothing, perhaps, can be more disagreeable or clumsy than they are in their external appearance. Their motion resembles strongly that of the elephant; their steps slow, regular and heavy, they carry their body about a foot from the ground, and their legs and feet bear no slight resemblance to the animal to which I have likened them; their neck is from eighteen inches to two feet in length, and very slender; their head is proportioned to it, and strongly resembles that of a serpent. But, hideous and disgusting as is their appearance, no animal can possibly afford a more wholesome, luscious, and delicate food than they do; the finest green-turtle is no more to compare to them in point of excellence than the coarsest beef is to the finest veal; and after once tasting the Galapagos tortoises, every other animal food fell greatly in our estimation. These animals are so fat as to require neither butter nor lard to cook them, and their fat does not possess that cloying quality, common to that of most other animals. When fried out, it furnishes an oil superior in taste to that of the olive. The meat of this animal is the easiest of digestion, and a quantity of it exceeding that of any other food, can be eaten without experiencing the slightest inconvenience. But what seems the most extraordinary in this animal, is the length of time that it can exist without food; for I have been well assured that they have been piled away among the casks in the hold of a ship, where they have been kept eighteen months, and when killed at the expiration of that time, were found to have suffered no diminution in fatness or excellence. They carry with them a constant supply of water, in a bag at the root of the neck, which contains about two gallons; and on testing that found in those we killed on board, it proved perfectly fresh and sweet. They are very restless when exposed to the light and heat of the sun, but will lie in the dark from one year's end to the other without moving. In the daytime, they appear remarkably quick-sighted and timid, drawing their head into their shell on the slightest motion of any object; but they are entirely destitute of hearing, as the loudest noise, even the firing of a gun, does not seem to alarm them in the slightest degree, and at night or in the dark they appear perfectly blind." In regard to the bag of water, Porter gives another statement (p. 100.) He partly ascended a hill on Charles Island, and on his way back he found a large tortoise. It was opened, "with the hope of finding some water to allay our thirst. But we were disappointed —says he—in only finding a few gills, of a disagreeable-tasted liquid." The tortoises taken on James Island had in their stomach or reservoir from one to two gallons, of a "taste by no means disagreeable." It seems therefore that this "water reservoir" is not always filled. It was in August when Porter found the tortoises on James Island full of eggs. We have seen above that Woodes Rogers relates, that the tortoises laid eggs on his ship in September. It seems therefore that the breeding time is in these two months. According to Porter the eggs "are perfectly round, white, and two and a half inches in diameter. They are far from being a delicacy when cooked, as they are dry, tasteless, and the yolk is little better than saw-dust in the mouth" (p. 216).

In regard to the difference of the tortoises from different Islands Porter makes the following remarks: "The shells of those of James Island are sometimes remarkably thin and easily broken, but more particularly so as they become advanced in age; when, whether owing to the injuries they receive from their repeated falls in ascending and descending the mountain, or from injuries received otherwise, or from the course of nature, their shells become very rough, and peel off in large scales, which renders them very thin and easily broken. Those of James Island appear to be a species entirely distinct from those of Hood's and Charles Islands. The form of the shell of the latter is elongated, turning up forward in the manner of a Spanish saddle, of a brown color and of considerable thickness, They are very disagreeable to the sight, but far superior to those of James Island in point of fatness, and their livers are considered the greatest delicacy. Those of James Island are round, plump, and black as ebony, some of them handsome to the eye, but their liver is black, hard when cooked, and the flesh altogether not so highly esteemed as the others" (pp. 214, 215). The tortoises of Hood's Island "were of a quality far superior to those found on James Island. They were similar in appearance to those of Charles Island, very fat and delicious" (p. 233).

After his cruise round the Galapagos Porter proceeded to the Marquesas Islands. On Madison Island he "distributed from his stock several young tortoises among the chiefs, and permitted a great many to escape into the bushes and among the grass" (Vol. II., p. 104.)

In 1825 Capt. Benjamin Morrell visited the Islands, having been there already in 1823 from the 3d of October to the 2d of December, during which time he took not less than about five thousand fur-seal skins. The tortoises, he says, "grow to even a greater size than that mentioned by Commodore Porter, as I have seen some that would weigh from six to eight hundred pounds. They are excellent food, and have no doubt saved the lives of thousands of seamen employed in the whale-fishing in those seas, both Americans and Englishmen. I have known whale-ships to take from six to nine hundred of the smallest size of these tortoises on board when about leaving the islands for their cruising grounds; thus providing themselves with provisions for six or eight months, and securing the men against the scurvy. I have had these animals on board my own vessels from five to six months without their once taking food or water; and on killing them I have found more than a quart of sweet fresh water in the resceptacle which nature has furnished them for that purpose, while their flesh was in as good condition as when I first took them on board. They have been known to live on board of some of our whale-ships for fourteen months under similar circumstances, without any apparent diminution of health or weight." On his first visit Morrell took one hundred tortoises on board. On his second visit, Feb. 10–12, a terrible eruption on Narborough Island was observed. Two hundred and ninety-four tortoises, averaging about twenty-five pounds each, were taken on board. Morrell does not state from which special island the tortoises were taken. During his third visit, Oct. 27 to Nov. 10, 1825, Indefatigable Island was visited, and one hundred and eighty-seven tortoises secured.

Up to this time the Galapagos Islands had not been inhabited. Only an Irishman, called Patrick Watkins, lived for some time in 1809 on Charles Island. Captain Porter has given an account of this first resident. But it was not until 1832 that Charles Island was really colonized. T. N. Reynolds, the secretary of Commodore John Downes, who visited the Galapagos Islands on the United States frigate *Potomac* in September, 1833, has given the history of this colonization. J. Vilamil, a native of Louisiana, of the United States, but for many years a resident of Guayaquil, had this enterprise in view as long ago as the year 1811. Political circumstances prevented his fulfilling his wish. In 1831 he petitioned the Government of Ecuador, and a charter in due form was granted, conceding the possession of the islands and authorizing the establishment of a colony. "In January, 1832, Colonel Hernandez, with only twelve colonists, was despatched to take formal possession of Charles Island, and in April and June, settlers of both sexes followed the first. Vilamil in person, accompanied by eighty colonists, arrived in October, and at once assumed his station as proprietor and governor of the island" (p. 469).

It is clear that the colonization of Charles Island was of the greatest influence on the fauna of the islands, especially on the tortoises. Buccaneers and whalers have done a good deal to reduce these animals, but the colony of 2300 people reduced the number of tortoises on Charles Island in a short time to such an extent that when three years later Darwin visited the island they were already obliged to go to other islands to procure tortoises. In 1832, when the *Potomac* visited Charles Island, tortoises were still abundant, for a great many were brought from the island to the ship by the crew (p. 547). The number of whale-ships reported at Charles Island from October 13th, 1832, to August 30th, 1833, was not less than thirty-one, according to Reynolds. If each of these whalers took only two hundred tortoises on board, in less than one year six thousand tortoises were taken from Charles Island alone. There is little doubt that about one hundred thousand tortoises were taken from the Galapagos Islands since their discovery.

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ON INHERITANCE IN EVOLUTION.

BY E. D. COPE.

THE hypothesis of evolution rests on the fact that the character possessed by one generation of animals and plants may be inherited by descendants. In the case of retardation, retrograde metamorphosis, or degeneracy, certain characters are lost by the failure to be inherited. In the case of stationary or persistent type, only the preëxistent characters are inherited. In the case of progressive evolution, characters which are acquired, or added to those already existing, are inherited, thus constituting acceleration.

It is a fact of ordinary observation on animals and men, that many and apparently most of the structural characteristics of one generation are inherited by its offspring. Not only is this the case, but the functioning of organs which depend on minute histological peculiarities is inherited. Such are points of mental and muscular idiosyncrasy; of weakness and strength of all or any of the viscera, and consequent tendencies to disease or vigor of special organs. Darwin has collected in his work on the Descent of Man, numerous instances of the inheritance of various tricks of muscular movement of the face, hands, and other parts of the body.

It is however claimed by Weismann and others, that such characteristics as are thus inherited are not " acquired " but are " congenital." And they appeal to various experiments on the breeding of mutilated animals as evidence of the truth of their position. It is undoubtedly true that mutilations and injuries are not as a general rule inherited. This is also one of the well-known facts of ordinary observation. Were this customary, there would not be at the present time a sound plant or animal on the earth for what individual of either kingdom has not had an ancestor mutilated at some or many periods of past times? But this is a proposition widely different from that which the paleontologist is called on to contemplate.

In the first place, no sharp and fast line can be drawn between "congenital" and "acquired" characters. It has not been shown that the former have not been acquired at an early period, and become by long use incorporated into the organism so as to constitute an essential part of it. It is highly probable that it is just this use which is the index of the value of a character,—which has rendered characters, at first feebly acquired, finally congenital in the fullest sense. The vast majority of mutilations are not useful, and are not generally frequently repeated in the history of a phylogenetic line, so that they are never sufficiently impressed on the organism to become congenital. It is evident that the kind of characters which have become such, are those which result from use in the fullest sense of the word; that is, by countless repetitions continued for immense periods of time. This is clearly the case with respect to the movements of animals which are necessary to their progress through the mediums in which they live; to the obtaining of their food, and to the propagation of their kind. These have been indefinitely repeated, and their mechanical effects on the hard supports of the body, as the skeleton, external and internal, and on the protoplasm whose contractions move the skeleton, were repeated by successive generations before they were inherited, and were by degrees incorporated into the growth-habit of the type, or became, in other words, congenital and inheritable. Such is the hypothesis of inheritance as affecting and effecting progressive evolution; and it is difficult to believe that it is not true. We see much of inheritance about us. The characters which are now inherited have not always existed, and they must have been acquired at some time or another.

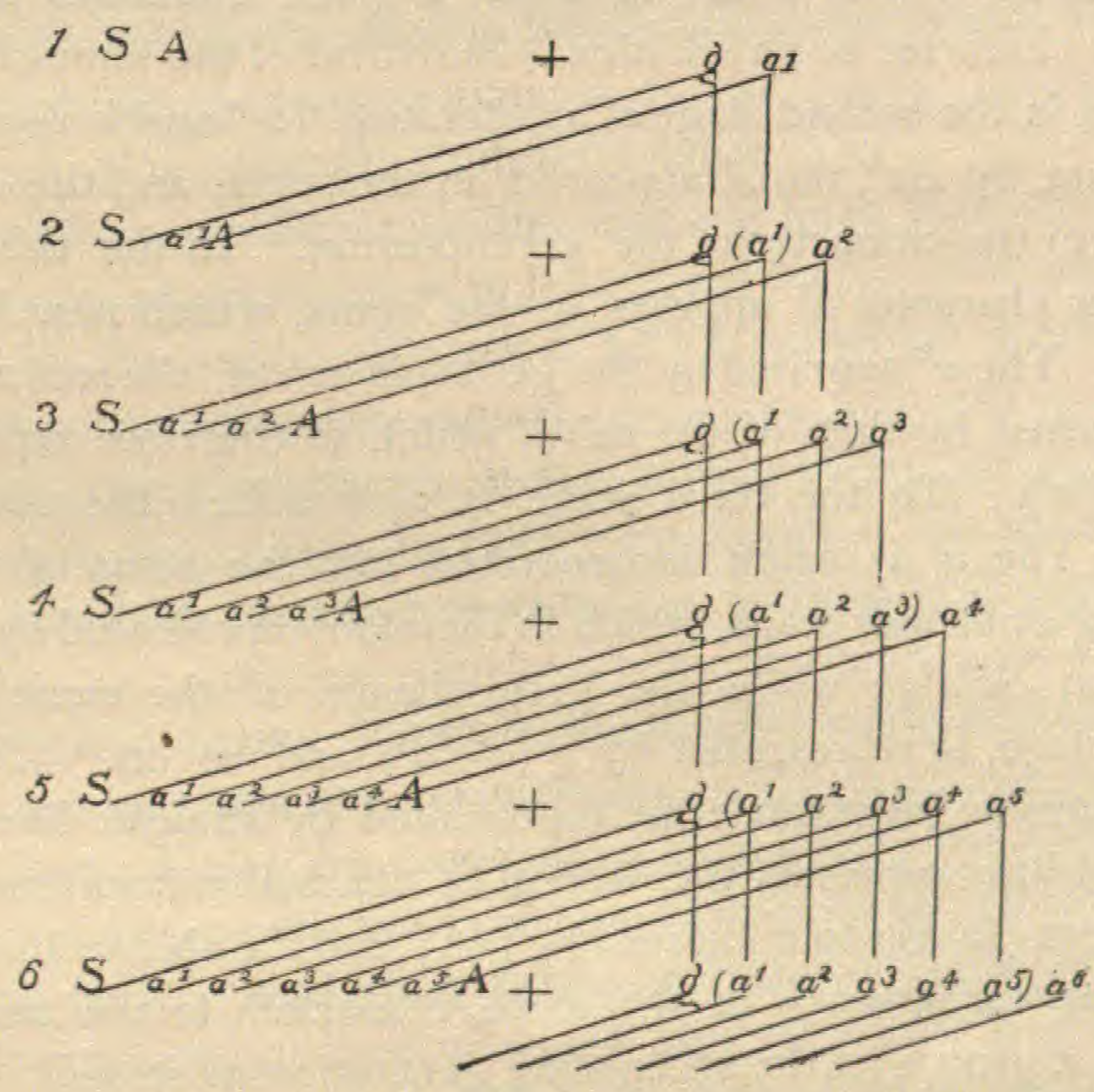
It has been shown by Brooks that bisexual reproduction, by doubling the sources of inheritance, doubles the opportunities for variation of characteristics in descent. This has led Weismann and others to trace all variation to this source. That this proposition is quite insufficient to explain the origin of variation is evident on slight consideration. The appeal to inheritance as a source of variation, no matter whether the inheritance be simple (unisexual) or complex (bisexual) explains nothing. The variations originated at a definite time and in a definite place, whether there be one sex or two, and the presence of the latter merely complicates the question and nothing more. And all characters small or great, whether "sports" or other, have had a definite physical cause.

The basis of the theory that acquired characters are not inherited is as follows: It is asserted by Weismann that the reproductive cells are separated from the primitive layers of the blastoderm at a very early period, and are set apart from those which develop into the other tissues and organs, so as to be uninfluenced by all the later changes undergone by them. In the female they develop into the ovarian cells, and in the male into the mother cells of the spermatozoöids. It is claimed that this isolation is such as to protect them from influences which affect organs and tissues which compose the rest of the body, so that changes which arise in the latter are not transmitted to the former.

Although we may see in the facts adduced by Weismann reasons for the conservatism of type possessed by the reproductive cells, there are various other facts, both of embryology and histology, which restrain us from attaching to the former the importance that the members of his school are accustomed to do. In the first place, since the reproductive cells are derived from the segmentation of the fertilized ovum, they partake of all the characters, whatever they may be, which both parents contribute to the latter, in common with all of the other cells so derived. Now, since the other or "somatic" cells develop the modifications which constitute evolution in their subsequent growth into organs, there is no reason why the reproductive cells which experienced similar influences should not develop similar characters, so soon as they also are prepared to grow into organs. That such influences are experienced by the germ cells is rendered the more probable by the fact that their appearance after segmentation is often not immediate. In some of the rodent mammalia they do not appear until the thirteenth day after the first appearance of the blastoderm. Furthermore the isolation of these cells is not complete after they appear. The continuity of the reticular structure (cytoplasm) of the cells has been repeatedly demonstrated, an arrangement which is essentially connected with their nutrition.

So long as nutrition of the germ-cells continues, the building of structure in which they become the chief agents must be for this reason also subject to the influences which are experienced by all the other cells of the body, under the strains and other stimuli derived from the interaction of the individual and its environment.

The relation of inherited and acquired characters in a series of generations may be graphically represented as follows: Let *S* represent the aggregate of character of the body (*soma*) of a given species in process of progressive evolution or acceleration. Let



g represent the aggregate of characters potential (or dynamically present) in the germ cells of the same individual. For the sake of simplification of the problem I consider here only one sex, and imagine the reproduction to be parthenogenetic. Let *A* represent the new character acquired by the *soma* under the appropriate stimulus, and let *a* represent the same characteristic as it is impressed on the germ plasma of the same individual at the same time, and in consequence of the same stimulus. The history of the acquisition and incorporation of newly acquired characters by the line of descent originating with the species *S*+*g*, may be represented as follows, for successive generations, which are numbered, 1, 2, 3, etc.

Under the appropreate stimulus the soma acquires A and the germ plasma the identical a^1 as the first stage. The character Aa^1 being only inheritable via the germ-plasma, it is represented by a^1 in the second stage or generation, where it appears as an addition to the characters of S and g, so that the soma of the second generation is represented by the expression Sa^1, and the germ plasma by $g\,(a^1)$; (on the supposition that $S\,A + ga^1$ represents the first of a line in which a given character appears). A new character or an additional increment of the same character, appears in the second stage of acceleration "2," and is represented as before, by Aa^2, the A appearing in the soma, and the a^2 being added to the character of the germ-plasma. In the third stage, the new character a^2 appears in the soma, which now becomes Sa^1a^2. The a^2 acquired by the germ-plasma of the second stage, is inherited by that of the third, which is therefore represented by $g(a^1a^2)$. To the third stage is now added the acquisition Aa^3. The a^3 is again incorporated into the soma of the succeeding or former stage, which is therefore represented by the expression $Sa^1a^2a^3$; while the germ-plasma of the same (fourth, "4,") stage, is represented by $g\,(a^1a^2a^3)$, and so on. The lines of immediate inheritance are represented by straight lines. The vertical lines represent the descent of characters from one type of the germ-plasma to a succeeding one; and the oblique lines represent the transmission of the same characters to the soma into which it grows, as the succeeding generation or stage.

The letters a^1, a^2, etc., expressive of characters acquired by the germ-plasma, are numbered for identification only. Should the influences derived from the ancestry of the other sex be added to the diagram its complexity would become inconvenient, and they are therefore omitted. It is to be also observed, that the enumeration of generations as immediately sucessive, as 1-2-3 etc., is to be understood as indicating succession only, and not any exact number of generations.

In the hypothesis of heredity above outlined, it is insisted that the effects of use and disuse are two-fold; viz.: the effect on the soma, and the effect on the germ-plasma. Those who sustain the view that acquired characters are inherited, must, I believe, understand it as thus stated. The character must be potentially acquired by the germ-plasma as well as actually by the soma. Those who insist that acquired characters are not inherited, forget that the character acquired by the soma is identical with that acquired by the germ-plasma, so that the character acquired by the former is inherited, but not directly. It is acquired contemporaneously by the germ-plasma, and inherited from it. There then is truth in the two apparently opposed positions, and they appear to me to be harmonized by the doctrine above laid down, which I call the Theory of Diplogenesis, in allusion to the double destination of the effects of use and disuse in inheritance.

From the preceding considerations we learn that a new character is not inherited unless it is acquired by the germ-plasma, as well as by the soma. Should it fail of the former it will not be inherited, although it may appear in the soma. It is also evident that the same character appears in the soma of later generations by virtue of its inheritance by their germ-plasma. Hence should it fail to appear in the adult soma of one generation, it might arise in a later one; and hence the possibility of atavism, and an alternation of generations. Intermittent stimulus might be followed by intermittent activity of growth energy. This would be especially apt to occur during the assumption of sexuality by animals and plants whose reproduction had been performed by cell-division or budding only. And such is the character of most types of alternate generations; a sexual type alternates with a non-sexual type. The advantages being on the side of sexual reproduction on account of its increased opportunity of variation, it has replaced the more primitive method by the process of natural selection.

The chief source from which acquired characters are introduced into the germ-plasma, and hence into the soma of the next generation, is probably the spermatozoöid; since it is endowed with a greater potential energy than the ovum. The latter furnishes nutritive material for the supply of the needs of growth. That the male is the chief source of variation is also indicated in the numerous cases when he is more active than the female; and hence more under the stimulus of use.

The manner in which influences which have affected the general structure are introduced into the germ cells remains the most difficult problem of biology. For its explanation we have nothing as yet but hypotheses. The one which has seemed to me to be the most reasonable belongs to the field of molecular physics, and it must be long before it is either proved or disproved. I have termed it a "dynamic theory," and it is in some respects similar to that subsequently proposed by Haeckel under the name of the "perigenesis of the plastidule." I have already referred to the phenomena of the building or growth of the added characters which constitute progressive evolution as evidence of the existence of a peculiar species of energy which I termed bathmism. This is to be explained as a mode of motion of the molecules of living protoplasm, by which the latter build tissue at particular points, and do not do so at other points. This action is most easily observed in the beginnings of growth, as in the segmentation of the oösperm, the formation of the blastodermic layers, of the gastrula, of the primitive groove, etc. In the meroblastic embryo the energy is evidently in excess at one part of the oösperm, and in defect at another. This is a simple example of the "location of growth force or bathmism." In all folding or invagination, there is excess of growth at the region which becomes the convex face of the fold; or a location or especial activity of bathmism at that point. All modifications of form can be thus traced to activity of this energy at particular points. A basis is thus laid for a more or less complex organism, and the channels of nutritive pabulum being once established, the location or distribution of the energy is assured in the directions in which they lead. Thus with the establishment of circulating channels nutrition is definitely guided to particular points. It is evident that on this hypothesis the bases of evolutionary change are laid in the embryonic tissues, where indeed bathmism displays its activity in producing the base forms on which all subsequent structure is moulded.

The building energy being thus understood to be a mode of molecular motion, we are not at liberty to suppose that its existence is dependent on the dimensions of the organic body which exhibits it. It is as characteristic of the organic unit or plastidule as the mode of motion which builds the crystal is of the simplest molecular aggregate from which the crystal arises. Bathmism has however no other resemblance to crystalloid cohesion. The latter is a simple energy which acts within geometrically related spaces, without regard to anything else but the present compulsion of superior weight energy. In bathmism we see the resultant of innumerable antecedent influences, which builds an organism constructed for adaptations to the varied and irregularly occurring contingencies which characterize the life of living beings. As this resultant is distinctive for every species, Bathmism must be regarded as a generic term, and the characteristic growth-energy of each species as distinct species of energy, which presents also diversities expressive of the peculiarities of individuals. If the doctrine of kinetogenesis be true, this energy has been been moulded by the interaction of the living being and its environment. It is the expression of the habitual movements of the organism which have become impressed on the reproductive elements. It is evident that these and the other organic units of which the organism is composed possess a memory which determines their destiny in the building of the embryo. This is indicated by the recapitulation of the phylogenetic history of its ancestors displayed in embryonic growth. This memory has perhaps the same molecular basis as the conscious memory, but for reasons unknown to us, consciousness does not preside over its activities. The energy which follows its guidance has become automatic, and it builds what it builds with the same regardlessness of immediate surroundings as that which is displayed by the crystallific growth energy. It is incapable of a new design. Consciousness is necessary for the origin of a design, since design cannot come into being without sensation and conscious memory. Hence we are lead to suppose that the designed handiwork displayed by bathmism had its origin in conscious states, and under the influence of the effort of the organism to adapt itself to its environment, internal and external. Not only does the conclusion seem reasonable, but it is supported by the well-known effects of mental states on various functions of the adult organism; such as the formation of ptomaines in the digestive tract, the depression and acceleration of the heart's action, the control of erectile tissues, etc.; to say nothing of ordinary muscular movements.

It is for such reasons that I have maintained that there would have been no evolution of animal types at least, if acquired characters were not inherited. Promiscuous variations there would have been, but it is certain that the probabilities are enormously against the persistence of any of them beyond one generation, should they not be inherited. That any succession of such variations could be profitable is also highly improbable, to say nothing of the improbability of their displaying the direct relation to use which we find in them in point of fact. The explanation of the appearance of such continued series of direct adaptations, such as has been demonstrated for instance in the phylogeny of the horse, is only explicable to my mind on the supposition of the inheritance of the direct effects of use, which use has been primarily directed by sensation. Without these factors evolution would have been suppressed at its inception, just as we see that it has been retrogressive or downward so soon as one or another of these factors has been withdrawn.

The time when the impressions of physical habits are conveyed to the reproductive elements has an important bearing on the question of inheritance. The life of an animal may be divided into three periods; those of embryonic life, of adolescence, and of maturity. During embryonic life impressions are exclusively somatic, and can be only obtained through or from parental stimulus and parental environment. Such will reach the embryo though nutrition, and through the direct mechanical contacts and strains of the environment. The environment of the oviparous forms is external to the parent; that of viviparous forms is the walls of the oviduct, uterus, etc., within the parent. Ryder has shown with much reason that the nature of the contact of the chorion with the walls of the oviducts or uterus has determined the shape of the placenta; and that the invagination of the embryo which resulted in the development of the amnion is a result of gravitation. While these facts have an important bearing on inheritance, they have but a collateral relation to evolution; since the embryo, whether in utero or in ovo, has little opportunity of experiencing the external influences which are only possible at later periods of life. It is during adolescence that the normal activities of maturity except reproduction, are first practiced, whether inherited or learned for the first time. The superior capacity of the adolescent stage for acquisition in all directions is well-known, and it is reasonable to suppose that since growth is not completed, changes in its details can be most readily introduced. It is to this period of life then that we must look for the effective influence of the factors of evolution in the acquisition of new characters of the soma. And if the nervous, muscular and other tissues react at this period most readily to external stimmuli, it is to be supposed that the developing reproductive cells possess the same characteristic, and record in their molecular movements the influences which are experienced by the entire body. Such influences on the reproductive cells, repeated millions of times from generation to generation, must produce a definite effect on them, in spite of the conservatism which their comparative isolation imposes on them. It is difficult to see how it can be otherwise in view of the evident mechanical origin of the characters which have succeeded each other as the steps of the evolution of vegetable and animal types.

The transmission of acquired characters is evidently principally accomplished during the adult period. While the influence on the soma is greatest during adolescence, the influence on the germ-plasma is greatest during maturity. Here habits formed during adolescence are practiced with especial energy and frequency. The influence on the constantly renewed germ-plasma is correspondingly greater, and transmission is of course more certain. Some characters seem to have been mainly acquired during maturity. Such is the permanent dentition of the higher Mammalia, which does not appear until or after maturity. In this case the influence of use on the germ-plasma must be more energetic than that on the soma. It is however not unlikely that the fundamental characters of mammalian dentition were laid during adolescence, since in the primitive types the temporary dentition was nearly wanting. The tritubercular molar was established at that time, and owes its present existence to inheritance. Only the sectorial and lophodont types have been added since the extensive development of the milk dentition in geologic time.

The preceding statements do not of course constitute an explanation of the exact manner in which a stimulus which effects say the contraction of a muscle, effects molecular movements of the nuclei of the reproductive cells. This is a question of organic molecular physics; a science which has made scarcely a beginning. That the transmission of such influence is primarily through the nervous system and secondarily through nutrition, may be safely assumed. That the modus operandi is similar to that which produces reflexes may be also reasonably supposed. How the records of these movements become reflexes, is concentrated in a reproductive cell, is a question to be solved only in a more advanced stage of knowledge of organic physics than we now possess.

Speculation in this direction takes the following forms. The energy or molecular movement must be transmitted to the germ-plasma through a material or molecular basis. This basis, it may be supposed, must be that which receives the mechanical impression which is to produce a corresponding modification of growth energy in the ovum or spermatozoöid; that is, in the case of a modified bone articulation, particles of matter must pass from the latter through the medium of the circulation to the reproductive cells. The alternative hypothesis is, that the nervous energy (neurism) which directs the active region to make or omit to make a given movement, the result of which is to be structural modification in the young, is impressed through nervous channels, on the germ-cells of either sex. In this case the transmission of particles of matter is not necessary, as material connection through the nervous threads already exists.

To the first of these points of view belong the pangenesis theory of Darwin, and the modified pangenesis of Brooks.[1] These

[1] The Law of Heredity, Baltimore, 1883, p. 80.

hypotheses present the difficulty that we must conceive of each particle or "gemmule" derived from a given part of the organism finding its way through the circulation to its exact place in the growing embryo; or otherwise, of transmitting its peculiar mode of motion to the correct molecules of the embryo, without error as to locality. The difficulties to be encountered in accomplishing such a feat seem to be insuperable. The transmission of a mode of motion organized in a central nervous system, is less inconceivable. This central system is the seat of a composition of incoming stimuli and of outgoing energies, the resultant of both combined constituting the active agency in the production of automatic adaptive or intelligent adaptive movements of any and all of the organs. It appears to me that we can more readily conceive of the transmission of a resultant form of energy of this kind to the germ-plasma than of material particles or gemmules. Such a theory is sustained by the known cases of the influence of maternal impressions on the growing fœtus. Going into greater detail we may compare the building of the embryo to the unfolding of a record or memory, which is stored in the central nervous organism of the parent, and impressed in greater or less part on the germ-plasma in the order in which it was stored. The basis of memory is reasonably supposed to be a molecular (or atomic) arrangement from which can issue only a definite corresponding mode of motion. That such an arrangement exists in the central nervous organism is demonstrated by automatic and reflex movements. That the entire record is not repeated in automatic and reflex acts, but only that part of it which was last acquired, may be regarded as due to the muscular and other systems concerned in it having performed it most recently, and having for a longer or shorter period omitted to perform the older movement, because the latest structures of the organs would render the performance of the old movements impossible. In other words, the physiological division of labor extends to memory at the basis. In the case of the germ-plasma no specialisation exists, so that the entire record may be repeated stage after stage, thus producing the succession of type-structures which embryology has made familiar to us. In the process of embryonic growth, one mode of motion would generate its successor in obedience to the molecular structural record first laid down in the ovum and spermatozoöid, and then combined and recomposed on the union of the two in the oöspore, or fertilized ovum.

Were all cells identical in characters, everyone would retain the structural record, or memory of its past physical history, as do the unicellular organisms. Evolution has however so modified most of the structural units of the organic body that none but the nervous and reproductive cells retain this record, in greater or less perfection. And the nervous cells have been specialized as the recipients of new impressions, and the excitors of definite corresponding movements in the cells of the remainder of the organism. The somatic cells retain only the record or memory of their special function. On the other hand, the reproductive cells, which most nearly resemble the independent unicellular organisms, retain first the impressions received during their primitive unicellular ancestral condition; and second, those which they have acquired through the organism of which they have been and are only a part. And the principal medium through which they can receive such impression is that system of cells called the nervous system, which has been specialized through use and natural selection to receive impressions from without, and to transmit them to such parts of the organism as are capable of receiving them. And the only other cells which can retain and record the entire record are the reproductive cells.

This is the logical result of the considerations which have occupied the preceding pages, and is the carrying out of the Bathmism theory of heredity, of which I have given hitherto only the bare outline.

Since Darwin, successive contributions have been made to the theory of heredity in its relation to evolution. In 1878 and 1871 the present writer advanced the dynamic hypothesis, but made no attempt to explain the mode of conveyance of dynamic impressions and modifications to the germ-cells. The theory of "perigenesis" proposed by Haeckel in 1873 is of the same character, and is deficient in the same way. The modified pangenesis theory of Brooks, published in 1883, attempts to supply the defect found in the previous conceptions, but does so by assuming with Darwin the intermediation of gemmules, a hypothesis to which objection has been made in the preceding pages. Brooks's theory also fails to admit the origin of variations through mechanical stresses, although he seeks for the origin of gemmules through the lack of equilibrium between the organization and its environment, which embraces that proposition in a less precise form. To Weismann we are indebted for the exposition of the separate origin and relative isolation of the germ-plasma, but no explanation of the origin and inheritance of new characters is offered. Ryder[2] has especially dwelt on the physiological division of labor seen in the tissues of the organism, and on the special function of the germ-plasma as the recipient of impressions through the processes of metabolism; but he does not go into greater detail.

ON VARIATION: WITH SPECIAL REFERENCE TO CERTAIN PALÆOZOIC GENERA.

BY PROF. JOSEPH F. JAMES.

THE question, "What are the limits of a species?" has been discussed for over two hundred years, and a satisfactory reply to it has not yet appeared. None of the numerous answers seem to meet all requirements. The conception of what a species really is has, too, been greatly modified since the publication of the "Origin of Species" by Darwin. It has been assumed by some of the more radical naturalists that species as entities are very rare, and that their boundaries are so indefinite that practically few exist. It is true that certain forms of animals and plants are distinct, or possess so few relatives that they seem to stand isolated. The Venus's Fly-trap among plants, and the Duck-bill among animals, seem to occupy positions which cut them off from all other plants or animals; but such cases are certainly exceptional. On the other hand, there are whole groups of

[2] AMERICAN NATURALIST, 1890, p. 85.

animals and plants where the lines between the various forms are so indefinite that they are practically absent. The testimony of both botanists and zoologists can be quoted in this regard. Lindley, though regarding species as "created by Nature herself, and remaining always the same" (Intro. to Botany, p. 307, 1832), yet states that "No absolute limits . . . . . . exist, by which groups of plants can be circumscribed. They pass into each other by insensible gradations, and every group has apparently some species which assumes in part the structure of some other group" (Vegetable Kingdom, p. 30).

Among zoologists Milne-Edwards says: "When zoology is only studied in systematic works it is often supposed that each class, each family, each genus, present to us boundaries precisely defined, and that there can be no uncertainty as to the place to be assigned, in a natural classification, to every animal the organization of which is sufficiently known. But when we study this science from Nature herself we are soon convinced of the contrary, and we sometimes see the transitions from one plan of structure to an entirely different scheme of organization take place by degrees so completely shaded one into the other, that it becomes very difficult to trace the line of demarcation between the groups thus connected" (*Amer. Sci. Nat.*, Sept., 1840,—quoted by Lindl., Veg. Kingd., p. 31).

Nature recognizes but one class in her domain. That class is composed of individuals, and the individuals are her units. So, too, they are the units of man's classification, and for his own convenience he groups them into what he calls species; the species he arranges in genera, and the genera are collected in families or orders. Such a classification is necessarily more or less arbitrary, however natural it may be considered; and it is essentially artificial, inasmuch as no such grouping exists in Nature.

Among the individuals there is always a greater or less amount of variation. Sir Morell Mackenzie tells us that the muscles that form the human larynx are not arranged alike in any two individuals; and that differences in physiognomy are probably due to variations in arrangements of the muscles which move the skin of the face (*Pop. Sci. Monthly*, December, 1889). Though the two Dromios as twins were as "like as two peas that grew in one pod," there are never two persons alike in all particulars. The fact of individual variation is especially insisted upon by Darwin, who, in fact, bases his theory of the origin of species upon their presence. In short, variation has been, and is, so generally acknowledged, that it seems almost superfluous to dwell upon it; but as it bears so strongly upon the facts to which I wish to call attention, I shall devote some space to its consideration.

It has been the fate of every naturalist who has given his time and attention to some special branch of natural science to become one of two things, or perhaps be one and then the other. He is either inclined to multiply species, or to suppress them and acknowledge only a few widely variable forms. Darwin has recorded his experience with stock breeders, and pigeon, duck, poultry and rabbit fanciers, and he states that all of these are fully convinced that each main breed is descended from a distinct species. He refers also to a treatise upon pears and apples, the author of which distinctly shows his disbelief that two varieties of apples could have originated from seeds produced by the same tree. He goes on to say: "The explanation, I think, is simple; from long continued study they are strongly impressed with the differences between the several races: and though they well know that each race varies slightly, for they win their prizes by selecting slight differences, yet they ignore all general arguments, and refuse to sum up in their minds slight differences accumulated during many successive generations."

The same idea is expressed later on where the remark is made: "When a young naturalist commences the study of a group of organisms quite unknown to him, he is at first much perplexed in determining what differences to consider as specific, and what as varietal; for he knows nothing of the amount and kind of variation to which the group is subject; and this shows, at least, how very generally there is some variation. But if he confines his attention to one class within one country he will soon make up his mind how to rank most of the doubtful forms. His general tendency will be to make many species, for he will become impressed . . . . . . with the amount of difference in the forms which he is continually studying; and he has little general knowledge of analogical variation in other groups and in other countries by which to correct his first impressions. As he extends the range of his observations he will meet with more cases of difficulty, for he will encounter a greater number of closely allied forms. But if his observation be widely extended he will in the end generally be able to make up his own mind; but he will succeed in this at the expense of admitting much variation,—and the truth of this admission will often be disputed by other naturalists. Where he comes to study allied forms brought from countries not now continuous, in which case he cannot hope to find intermediate links, he will be compelled to trust almost entirely to analogy, and his difficulties will rise to a climax."

It would be an impossibility, even were it desirable, to refer to all the recorded cases of variation among animals and plants. But it will be instructive to turn to some authorities in diffierent departments, and listen to what they have to say on this subject. Dr. Isaac Lea was well known as a describer of species, but he has put upon record his opinion of variation in the great genus Unio. It is well to note here that he attempted to divide the genus into different genera, but gave it up finally as impracticable and useless. In a paper read before the American Philosophical Society on November 2, 1827 (p. 260, as published in the "Transactions") he says:

"It has been doubtful with some concologists whether the species of the genus Unio are not the mere varieties of one species. To the naturalist, who has the opportunity of examining numerous specimens, the gradations are so interesting, and at the same time so perplexing, that he is lost in the maze of their changes, and he seeks almost in vain to draw a distinctive line between them; for even the tuberculated shells sometimes pass by almost insensible gradations into smooth ones."

In another paper read two years later (American Phil. Society, read March 6, 1829) he says: "The number of species [of Unio] adds greatly to the difficulty of distinguishing them, for they glide into each other so insensibly through their varieties that the most experienced are often at fault and perplexed with the difficulty of placing them properly in the most approved system." He further remarks upon the variableness of the features upon which the species of Unio are characterized. For example, the teeth vary in the same species from one angle to another; they are thick in one specimen and thin in another; corrugated in some and in some smooth. The color varies in the same species, both in the nacre and in the epidermis. In most specimens of *Unio gibbosus* the nacre is dark purple, but it is also sometimes white. In *Unio verrucosus* it is generally dark chocolate, but it also varies to white. Mr. Lea says he has an Anodonta from the Ohio with the nacre of one valve white and the other salmon color. In certain species of *Unio clavus* the epidermis is beautifully rayed, but other specimens have no rays at all. In *Unio æsopus* the epidermis is sometimes glossy yellow, and sometimes dark brown. This is also the case with *Unio cylindricus*. *Unio alatus* again varies from a beautifully rayed green to nearly black and rayless. The tuberculations and undulations vary. Specimens of *Unio lacrymosus*, normally with numerous tubercles, are sometimes nearly smooth. *Unio plicatus* may have a few or have numerous folds, or even be nearly smooth. "The *Unio cornutus* is furnished with three or four protuberances or horns in a row, passing from the backs direct to the basal margin; the varieties of *cornutus* have these 'horns' more depressed and more frequent, and thus pass into varieties with a mere furrow without any distinct elevation, and these gradations are almost innumerable." The beak varies in the same species, as does also the general outline of the shell; as, for example, in *Unio luteolus*, which varies from oblong "pea-shaped" to a shorter form, with a broad anterior basal projection. The muscular impressions on the interior vary, as does also the ligament. In short, there is no character so constant that it can be made the certain characteristic of any one species. (See Ibid, pp. 407–415.)

Still later (in 1870) Mr. Lea returns to the subject of variation, and again calls attention to the fading of one species into another, and the difficulty of drawing lines of separation with any definiteness. (Synopsis of Unionidæ, p. 11.)

Other branches of zoology show similar variations. Dr. Carpenter, speaking of the Foraminifera, says in the Introduction (quoted by Wallace in "Natural Selection," pp. 162, 163) that an immense number of specimens of different species had passed under the observation of himself and Messrs. Williamson, Parker and Rupert Jones, and the result of the observation is said to be that "the range of variation is so great among the Foraminifera as to include not merely those differential characters which have been usually accounted *specific*, but also those upon which the greater part of the *genera*, and even in some instances those of its *orders*," are founded.

Mr. Wallace also refers (p. 165) to the studies of Bates upon butterflies, stating that "during eleven years he accumulated vast materials, and carefully studied the variation and distribution of insects. Yet he has shown that many species of Lepidoptora, which before offered no special difficulties, are in reality most inextricably combined in a tangled web of affinities, leading by such gradual steps from the slightest and least stable variations, to fixed races and well-marked species, that it is very often impossible to draw those sharp dividing lines which it is supposed that a careful study and full materials will always enable us to do."

Swainson, writing in 1835, in his volume "On the Geography and Classification of Animals," in speaking of the features which characterize species (p. 277), says that in some genera of the Dynastidæ the horn-like protuberances which distinguish the male sex vary in their length in almost every individual,—so that in some they are very prominent, while in others they are more iike short tubercles." And again he says: "The spines upon the different rock-shells (Murex), and on the coronated volutes (Cymbiola, Sev.), vary in like manner,—some specimens having acute and prominent spines, while others are nearly smooth."

In still another group of animals, the sponges, great confusion exists. Prof. Alexander Agassiz ("Three Cruises of the Blake," Vol. II., p. 170) says that here "all our ordinary notions of individuality of colonies, or of species, are completely upset. It seems as if in the sponges we had a mass in which the different parts might be considered as organs capable in themselves of a cestain amount of independence, yet subject to a general subordination, so that, according to Haeckel and Schmidt, we are dealing neither with individuals nor colonies in the ordinary sense of the words.

"As Schmidt well says: 'From the variability of all the characters, our idea of an organism as a limited or centralized individual disappears in the sponges, and in place of an individual, or a colony, we find an organic mass, differentiated into organs, while the body, which feeds itself and propagates, is neither an individual nor a colony.'"

We turn again for a few moments to the "Origin of Species" to show the recognized variability in a genus of plants. Darwin refers in considerable detail to the work of De Candolle upon the oaks of the whole world, pointing out his wealth of material, and the great care he took in the discrimination of species. He mentions that in this work De Candolle notes the many points of structure which vary, and "specifies above a dozen characters which may be found varying even on the same branch, sometimes according to age and development, sometimes without any assignable reason." Though not regarded as of specific value, they are yet such as often enter into specific descriptions. The rank of species is given in this case only to forms which differ in "characters never varying on the same tree, and never found connected by intermediate states." De Candolle remarks: "They are mistaken who repeat that the greater part of our species are clearly limited, and that doubtful species are in a feeble minority. This seems to be true so long as a genus was imperfectly known, and its species were founded upon a few specimens,—that is to say, were provisional. Just as we come to know them better, intermediate forms flow in, and doubts as to specific forms augment." He goes on to say, adds Darwin, "that it is the best-known species which present the greatest number of spontaneous varieties and sub-varieties. Thus *Quercus robur* has twenty-eight varieties, all of which excepting six are clustered round three sub-species." The forms connecting these are rare, and if they were to become extinct, "the three sub-species would hold exactly the same relation to each other as do the four or five provisionally admitted species which closely surround the typical *Quercus robur*. Finally De Candolle admits that out of the three hundred species which will be enumerated in his Prodromus as belonging to the oak family, at least two-thirds are provisional species that are not known strictly to fulfill the definition above given of a true species."

Of our own botanists, the late Dr. Asa Gray was one of the most conservative. But he could not but recognize the wonderful variableness of certain genera, and he has left upon record his opinion of two of them (Proc. of the Amer. Academy, Vol. XVII., p. 163). He says: "Aster and Solidago in North America, like Hieracium in Europe, are among the larger and are doubtless the most intractible genera of the great order to which they belong. In these two genera, along with much uncertainty in the limitation of species as they occur in Nature, there is an added difficulty growing out of the fact that many of the earlier ones were founded upon cultivated plants, some of which had already been long in the gardens, where they have undergone such changes that it has not been easy, and in several cases not yet possible, to identify them with wild originals. Late flowering Compositæ, and Asters especially, are apt to alter their appearance under cultivation in European gardens. For some the season of growth is not long enough to assure normal and complete development, and upon many the difference in climate and exposure seems to tell in unusual measure upon the ramification, inflorescence and involucral braets, which afford principal and comparatively stable characters to the species as we find them in their native haunts. I am not very confident of the success of my prolonged endeavors to put these genera into proper order, and to fix the nomenclature of the older species; and in certain groups absolute and practical definition of the species by written characters or descriptions is beyond my powers. But no one has ever seen so many of the type specimens of the species as I have, nor given more time to the systematic study of these genera."

I have myself noticed the variation presented by two reputed species of rock cress (Cardamine), or, as it is usually called, Dentaria. Some years ago I collected at Lookout Mountain Tennessee, *Cardamine laciniata* and *C. multifida*. In the first of these the segments of the leaves are frequently quite broad, sometimes half an inch, while in typical forms of the latter the segments are filiform. But I found there a series so perfectly graduated that the two extremes were connected by every intermediate form. In view of this graduated passage of one into the other, no one will dispute the justness of classing one as a variety of the other. The variety grows in dry soil, while the type form is more common in damp, shady places, and this difference of habitat may account for the differences in the leaves.

I have quoted freely thus far from writers on zoology and upon botany in order to show the general recognition of the fact of variation among the different classes of living forms. The references could be multiplied to an indefinite extent, for scarcely a student but has recognized the fact. The remarks already made must make it apparent to all that variation is the rule and not the exception. The question arises, noting the fact of variation among living classes, Are we not justified in extending the same idea to extinct groups? If variation is a fact in living forms, was it not likewise prevalent among those long since extinct? Nay, may we not go further and ask, Was it not more prevalent during the earlier periods of the earth's history than it is at present?

It is certainly a little remarkable that however much variation may be acknowledged in the living world, its presence among fossil forms has been largely overlooked. Whether it be the lack of extensive enough suites of specimens, or their very abundance, we can scarcely say. Most probably it is the former, combined, too, with the frequently fragmentary nature of the material. Palæontologists generally do not seem to have taken sufficiently into account the great variability of species; and with undue haste have rushed into print with new names that eventually add to the synonomy of an already overburdened science. Not that all are thus hasty, but too many are; and we can congratulate the cautious few who hesitate before attaching their names to species which soon appear only in the italicized form.

All geologists are aware that instances are not uncommon where species and even genera have been founded upon individual bones or teeth of animals which subsequent discoveries have shown to belong to a single species. It is also probable that among fossil plants species have been made from pieces of stems, or from leaves, which more abundant material will show to be portions of but one. Species are not unknown that have been made upon the single arm of a single starfish in an unperfect state of preservation; upon a fragment of a coral; the compressed or distorted body of a crinoid; the obscure internal cast of a bivalve; or the head, tail, or spine of a crustacean. So far has the passion for genus and species making been carried, that inorganic markings, "a single row of tracks," mud splashes, wave marks, and rill marks have been described: to say nothing of the scores of mollusk trails, worm trails, or worm burrows that have so long done duty as Algæ. We are glad to see, in some quarters at least, a reaction from this excessive species making, though in other quarters the name coining still goes on.

Perhaps one cause of the excessive multiplication of species in palæontology is the refusal for so many years to recognize the fact that the same species may have existed in two distinct areas, or throughout two distinct epochs. As among certain botanists and zoologists the presence of the same species in two widely separated countries was, and is, considered sufficient cause to make two species, so the occurrence of identically the same forms, as far as our specimens can tell us, in two geologic horizons, or in two distinct localities, is considered *prima facia* evidence that we are dealing with two distinct species. Even in one of the latest monographs published by the U. S. Geological Survey (Vol. XIV.) we observe an inorganic marking (as it appears to us), masquerading under the name of a sea-weed; and under a new name, too, because its brother rill mark existed some geological ages prior to its own oncoming formations. So, too, we see species of corals, of shells, of cephalopods, of crustaceans and others bearing distinct names because one lived in the Cincinnati, and another lived in the Trenton period; or because one lived in the ocean that covered New York, and the other that of Iowa.

We strongly suspect that a considerable amount of hesitation still exists among palæontologists against the acceptance of the idea of a former wide extension of species, both in time and in area. But it would appear that many are beginning to realize that variability must have existed in the past as well as at present; and that many species may have lived through several of the hard and fast periods into which geologists have divided geologic time. We have, for example, the testimony of Prof. James Hall, who (*American Geologist*, Feb., 1890, p. 122), in remarks made before the Geological Society of America, refers to the great variability of Spirifera and its allies. So, too, the large genus Orthis shows great variation in some of the species, as does also Endoceras. Mr. Matthew has recognized great variability in certain species of Paradoxides, and Mr. C. D. Wolcott has noted a remarkable series of variations in *Plenellus gilberti*, especially in the features of the head (Bulletin U. S. Geol. Sur., No. 30, pp. 173–180). These variations he considers to be the result of the retention, by some individuals, of certain embryonic features which are lost by the generality of the specimens after they attain a certain definite size.

There has developed, of late, a tendency to split some of the earlier and larger Palæozoic groups up into numerous genera, which are separated by few definite characters. It is especially prevalent among the lower orders, the corals and polyzoa, though the tendency is not confined here. Among many of the earlier forms it is extremely difficult to decide on any limitations to genera. If we take external characters as a guide, one set of writers say, "Those are of no value: use the internal structure." But when we turn to this, another set tell us, "Those features are utterly worthless: use the external form." Examination proves that certain species having a similar outward form have a different external structure; and certain others with quite diverse aspects have a like internal structure. The fact seems to be that in many of these early forms generic characters are not settled. The structure has not become stable enough to present definite features, and so many of the attempts to formulate definitions for genera are set at naught. Let us turn our attention now to some of these groups, prefacing the examination by a reference to the mode and condition of preservation of one of them in particular, the corals.

The exposure of Lower Silurian rocks at Cincinnati is noted for the excellent preservation of its fossils and for their great abundance. Especially is it noted for the great number of individuals of brachiopods and corals. The rocks which now make up the formation were most likely deposited upon a ridge in the bottom of the ocean, previously formed by the contraction of the earth's crust. A warm current of water sweeping over this brought quantities of food, and enabled the animal forms to increase and multiply. Gradual growth, assisted, probably, by elevatory forces, must at times have brought the rocks up to or near the surface of the water, subsequent sinking allowing additional matter to be deposited. There seems little reason to doubt that these rocks were deposited in shallow water, and under conditions which brought them at times even above its surface.

As already stated, the corals are among the most abundant forms. They occur at certain localities literally in thousands, and where the shale has crumbled through weathering, they cover the ground so one can gather them up by the handful. Attention was first directed to these corals by a scientific man about 1870, and since then they have been the special study of a number of palæontologists.[1] First one and then another undertook their study, until now a rather thorough knowledge of the group is the result. At first the few described species were referred to the genus Chætetes. Later investigations caused them to be placed in the genus Monticulipora, and a special family was established for them, for which reason they have frequently been called the "Monticuliporoids." At first this single genus Monticulipora, like Chætetes, was enough. Then it was divided into five sub-genera, this classification being based largely on internal structure. Next we find it divided into twenty or more distinct genera, a host of species described, and the whole removed from the corals to the polyzoa. Since the first sub-division the work

[1] Consult the writings, especially, of U. P. James, Prof. H. A. Nicholson, G. R. Vine, and E. O. Ulrich.

has been continued, and new genera and species have been proposed, until the group has assumed such vast proportions, and contains such a mixture of forms, that it has become almost unmanageable. As an illustration of this fact it is observed that in a late work (North American Palæontology, by S. A. Miller), of the genera containing species that have been, and are still by some, referred to the Monticuliporoids, twelve are placed with the Cœlenterata, and nineteen with the Polyzoa.

The family as a whole is really a natural one, but it is also very diversified. It contains species which are massive, frondose, discoid or free, parasitic, and ramose. The division into the numerous genera has been based mainly upon internal structure. This, like the external form, is variable, and the one frequently bears no relation to the other; so that a massive form may have the interior of a ramose species, or a discoid be like a parasitic species. In reading the endeavors to divide the group up into families, genera, and species, we are struck by the enormous difficulty encountered. This cannot be better illustrated than by an extract from a lately published paper (Micropalæontology of Canada, Part II.), changing the language so as to make it less envolved, but not altering in the least the sense of the author. In this paper it is is said:

"The genus Diplotrypa, as now understood, embraces at least three small but well-marked groups of species, indicating relations to widely different families. The typical section bears a resemblance to true species of Monotrypa that may amount to affinity. Monotrypa comprises two very different sections, some being true Amplexipordæ with relations to Leptotrypa, while the typical section presents no very great affinity with any family.

"Batostoma, which has given no little trouble to place, is more intimately related to the typical sections of both Diplotrypa and Monotrypa than any of the others. The obvious relationship between the three groups suggests the erection of a new family, Diplotrypa being the type. By establishing this new family three troublesome genera are satisfactorily placed. But with this happy result comes another less fortunate, viz., are construction of Diplotrypa and Monotrypa. Thus the second section of Diplotrypa approaches Prasopora, and ought perhaps to go with the Monticuliporidæ. This disposition, however, necessitates the adoption of one of two courses,—either a new genus would have be established, or the species would have to go under Prasopora."

Here we have an acknowledgment from one of the most industrious makers of new genera and species, of their great indefiniteness in this group, and of the difficulty of establishing limitations. It is exactly what should be expected. Believing in the evolution of many forms from one or a few primitive ones, we should be prepared to find in early geologic times genera and species beginning to differentiate. The Monticuliporoido first appear, as far as now known, in the chazy rocks of Canada, two species having been described in 1859, while a third has been lately recorded. In the Trenton period there is a sudden increase in the number of species, forty-four having received distinct names, while in the next period, that in which the Cincinnati rocks were deposited, no less than one hundred and eighteen names have been given to the different forms. It is not at all improbable that many of these are synonyms, but there can be no doubt about there being a great increase in the number of species during Cincinnati time. So,—too, there were introduced two new types of growth the massive and the frondescent, while there was at the same time a great increase in the the parasitic forms. In the Niagara period came a reduction in the number of species of true Monticulipora, and definite differentiation into genera began. The forms are nearly all ramose; the parasitic forms seem to have disappeared and true polyzoa, like Paleschara, to have taken their place. The Fistulipora-like forms assume predominance, and Monticulipora proper dies out. This is seen in the great increase of species referred to Callopora and Trematopora, both synonyms or very close allies of Fistulipora. This genus again is related to Chætetes, which in its turn is allied to the Favositidæ; while *this* family, represented by two species in the Lower Silurian, becomes wonderfully abundant in the Upper Silurian age.

In another group of corals, the Cyathophyllidæ, but three genera are found in rocks of Lower Silurian age, each containing only a few species. But in the rocks of a later age, notably the Niagara, came an astonishing increase in numbers, and this continued up to Devonian time.

With the genus Orthoceras there is a condition of affairs approaching Monticulipora. Here is a straight, chambered shell, possessing constant and similar characters in most of the species; existing in extraordinary abundance at many different horizons; appearing first in the Calciferous, and increasing suddenly in numbers in the Trenton period; progressing, as it were, by leaps; occurring sparingly in one formation and abundantly in the next; and finally dying out altogether in the Permian. As many as 354 species have been named and described from America by authors, though the number of really good species will fall considerably below this.

In this genus, too, there have been two methods of procedure. In the one case a reduction of certain so-called genera to the rank of sub-genera or of synonyms; and in the other a great multiplication of genera. Professor Hall, for example, following Barrande, gives seven-teen synonyms for Orthoceras, and besides recognizes three sub-genera. Professor Hyatt, on the other hand, has restored many names discarded by Barrande and Hall, and has even increased their number. He recognizes eighteen distinct genera. These are separated upon the external markings of the shell, upon the coudition of the septa, the appearance of the siphon, and the form of the aperture. These straight forms may represent the embryonic stages and ancestral types of the Nautiloid and Ammonitic forms, which in later geologic times became the predominant types. It is not the purpose here to discuss the validity of the many genera adopted by Professor Hyatt, but it does not appear philosophical to establish genera upon embryonic characters, especially among early Palæozoic types. The period cannot be regarded but as a formative one; the structurual features of many classes had scarcely attained sufficient stability to be constant; individual variation must have been wider than at present; and with our known imperfection of material, to attempt to separate into species even, to say nothing of erecting into genera, many of the fossils from the older formations, is often a hazardous task. These remarks apply not to Orthoceras alone, but to Monticulipora, to Orthis, and to other large genera of early geologic time.

One other genus will be referred to here. This is Fenestella. Professor Hall has probably studied this group as thoroughly as any one in this country. In his report as State Geologist of New York for 1882, he discusses the different genera which have been at times proposed for Fenestelloid forms of polyzoa; and, after quoting the descriptions of thirteen of these, he remarks (p. 8) that "after an examination of hundreds of specimens, offering a wide range of variation, I am convinced that the genera mentioned above have only a sub-generic value, and should only be included in the comprehensive genus Fenestella." He then proceeds to show by a series of illustrations the failure of all the characters upon which the genera had been founded. He concludes no generic character can be drawn from the the celluliferous character of the dissepiments; that the anastomosing of the branches is too indefinite to be a valid character; that the number of ranges of all apertures is too inconstant, for often in this regard the features of several genera are found in one example; and, finally, that the presence of a ridge or keel upon the branches is in many cases not even a good specific character. He then formulates a generic description of Fenestella broad enough to include the various forms.

In a later publication (Report of the State Geologist of New York for 1884, Professor Hall returns to this subject, and gives short descriptions of seventeen sub-genera, recognizing the fact, however, that the boundaries of many of these are very indefinite, and that several may eventually have to be united under one. Fenestella is mainly an Upper Silurian genus, and it is evidently in the same formative condition as Monticulipora in the Lower Silurian.

Does it not seem probable, then, that the disappearance from a certain horizen of a genus previously abundant, is the result of the differentiation of characters? If, for example, the very abundant genus Monticulipora of the Cincinnati rocks is present in greatly diminished numbers in the Niagara period, but is represented there by numerous species of closely allied genera, it would seem a proof that that the old and large genus was becoming extinct by the fixation of various structural types foreshadowed in it in a general way. May it not be for this reason, and not because of any sudden catastrophe, that the formerly abundant genus disappeared? In the three prominent genera of trilobites which characterize the three divisions of the Cambrian rocks, there is an example of the entire disappearance of one genus before the appearance of the next. Between the two earlier ones (Olenellus and Paradoxides) is an intermediate genus or sub-genus (Mesonacis) possessing features of both, while the presence of a connecting link (Olenoides) between the second and third genera (Paradoxides and Dikellocephalus) is also probable. Then the extinction of number one (Olenellus) will be in reality the birth of number two (Paradoxides); and the dying out of that form be the beginning of the life of number three (Dikellocephalus). Finally, may not this last genus find its representative in number four (Asaphus), which characterizes rocks still higher in the geologic column?

These are suggestions, not assertions. But at the same time we believe it to be really true that large genera of the earlier geologic periods contain in themselves the elements which, later on in the life of the world, become well-defined generic characters. Present only in a rudimentary form at one period, well-marked and distinctive characters appear at a later one.

March 20, 1890.

EDITORIAL.

EDITORS, E. D. COPE AND J. S. KINGSLEY.

THE University of Pennsylvania has undertaken to sustain original scientific research in a more comprehensive and thorough way than heretofore. In biology, the biological school permits of opportunites in this direction, of which especial advantage is being taken in the departments of embryology and botany, and with valuable results. The department of psychophysics is also in active operation, and is under able management. More recently a department of archeology and paleontology has been established, and considerable space for the exhibition of the objects of research of the department have been provided in the rear library building. Valuable collections will soon be placed in these exhibition halls, selected from the best private collections in Philadelphia, and other collections are now being acquired by the University. The progress made in this direction is gratifying to the friends of Natural Science, and to the friends of the University, and is one of the many indications of vigorous vitality which this, the oldest University in the United States, now exhibits. It is to be hoped that these important departures will be well sustained from the material side, as they are sure to be on the part of the numerous able men who have been employed conduct their work.

—THE numbers of the AMERICAN NATURALIST for 1889 were issued at the following dates: January, March 1st, 1889; February, May 31st; March, June 28th; April, August 15th; May, September 28th; June, December 1st; July, November 18th; August, January 5th, 1890; September, February 4th; October, March 13th; November, May 10th; December, July 19th. The delays in the issues as above recorded were entirely involuntary on the part of the proprietor and editors, and they owe their publication to the enterprise of the present publishers, whose connection with the NATURALIST commenced nominally with the year 1890. It was also owing to the failure of the former publishers to submit proof to the editors, that one hundred pages are skipped between the numbers for March and April, and the paging is duplicated in the numbers for February and March.

General Notes.

MINERALOGY AND PETROGRAPHY.[1]

Petrographical News.—An interesting paper on the origin of the hornblende schists and granulites of the Lizard, by McMahon,[2] contains some new ideas with regards to these rocks. The author thinks that the banded hornblende schists were originally volcanic ashes, along the sedimentation planes of which water flowed, dissolving substances in some places and depositing them at others. The hornblende crystals in certain places attracted to themselves new hornblende material and thus produced a dark band. The banding of such schists is thus supposed to be due to segregation. Their composition is essentially hornblende, plagioclase, and malacotite. The granulites are plagioclase, mica, quartz rocks containing a few other unimportant constituents. They are markedly banded with dark and light bands, the great differences in the composition of which are accounted for on the supposition that the rocks were originally diorites cut by granite veins, and that afterwards they were changed as above outlined.——Another valuable paper upon a kindred subject is that by Callahan[3] upon the production of gneiss and schists by the shearing of eruptive rocks. The diorites of the Malvern Hills have undergone a structural change along shearing zones without changes in their mineralogical composition. The hornblende of these rocks is fractured. It breaks into little grains, and diminishes in quantity, until in the zone of greatest shearing it is entirely replaced by epidote, chlorite and biotite. The plagioclase also decreases as the schistisity becomes more marked, and gives rise to muscovite. At the same time secondary quartz and new feldspar are generated. In some instances the final stage of the alteration is a rock composed of quartz, some feldspar and a little biotite. The alteration of the biotite and chlorite into muscovite, the production of garnets and zoisite, probably from chlorite, the change of almenite into sphene, and the formation of actinolite, hematite and calcite are discussed, and the description of many thin sections of rocks are given. It is shown that infiltration occurs along the shearing zones, and takes part in the

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] *Quart. Jour. Geol. Soc.*, Aug., 1889, p. 519.

[3] *Quart. Jour. Geol. Soc.*, Aug., 1889, p. 475.

formation of the new minerals.——Johnston-Lavis [4] gives a description of an interesting trachyte from the Bay of Naples. It is of a light gray color, and consists of sanidine crystals, fractured and strained by pressure, hornblende, in broken, irregular, yellowish green grains, small masses of the same substances mixed with grains of pyroxene, and with these producing an apparent crystal of hornblende having an aggregate polarization, and a third variety of the same mineral in dark bluish green rods, also composed of an aggregation of grains. This last variety of hornblende, together with microlites of sanidine, make up the groundmass. The peculiarity of the rock is the great variety and beauty of the minerals implanted on the walls of the vesicles so abundant in it. These in the order of their age are: little crystals of sanidine, needles of amphibole, a crystallized manganese pyroxene, bunches of hair-like chocolate crystals that may be rutile or a titanium breislakite, pseudo-hexagonal, colorless, limpid crystals of sodalite, small hexagonal crystals of a mineral resembling microsommite, and orange scalenohedra of calcite.——Miss Raisin [5] gives an account of the perlitic and spherulitic felsites of the Lleyn in Wales. These are devitrified lava flows, containing concretionary nodules, and other forms produced by secretion. The larger spherulites are developed in certain layers. They appear to be the most durable portions of the rock, since the pressure that modified the matrix in which they lie has not affected them in the slightest degree. Some of the nodules are undoubtedly concretionary, and others are produced by the filling of vesicles. A few conclusions deduced from the facts observed relate to the mode of formation of spherulites and lithophysæ in rhyolites and andesites.——Hutchings [6] has discovered an ottrelite schist in Tintagel, North Cornwall. The rock is a hard, lustrous state, composed of sericite, ottrelite and ilmenite. The ottrelite is in small flakes, frequently intergrown with sericite. Its pleochroism is A=yellowish green, B=blue, C=greenish yellow, and it is filled with inclusions of rutile. This latter mineral is also abundantly scattered through the rest of the rock. An interesting association of ilmenite and rutile is mentioned, but the manner of their combination could not be determined.——McMahon[7] explains the polysynthetic structure of porphyritic quartz crystals in a felsite from near Delhi, India, by supposing the crystals to have formed at depths, and then to have been corroded by the magma after the rock reached

[4] *Geological Magazine*, Feb., 1889, p. 74.

[5] *Quart. Jour. Geol. Soc.*, May, 1890, p 247.

[6] *Geol. Magazine*, May, 1889, p. 214.

[7] *Micro. Magazine*, May, 1888, p 10.

the surface of the ground. Under these changed conditions the quartz became plastic, and was about to remelt when solidification resulted. Mr. Worth[8] uses the term Elvan to designate rocks that have been found by the cooling of a magma with the composition of granite under conditions intermediate between those that yielded plutonic rocks and those that gave rise to surface rocks. He calls attention to the many different structures possessed by these elvans even in the same dyke. ——Miss Raisin[9] declares that the greenstone-schists near Redlap, S. Devon, Eng., are crushed diabases, in which secondary changes have taken place. The article denies the correctness of certain conclusions with regard to the character of these rocks, as drawn by Mr. Somervail,[10] who thinks them chlorite schists.——Mr. Goodchild[11] does not believe that the paste of limestones is the result of the breaking down of shells. He ascribes it to chemical precipitation, due to the reaction of decomposing organic matter upon the sulphate of calcium so abundant in sea water. Berwerth[12] declares that the rock from Pizzo Lunghino described by himself and von Tellenberg as jade, is a granular aggregate of vesuvianite and sahlite, of which the latter is the younger.

Mineralogical News.—*Crystallographic.*—Traube[13] has discovered seventeen new forms in *cinnabar* from the barite veins cutting hornstones near Mt. Avala in Servia. Four of these are trigonal pyramids $\frac{1}{10}R2$, $\frac{1}{3}R2$, $\frac{7}{9}R2$ and $\frac{5}{4}R2$, and the others are rhombohedra—$\frac{1}{15}R$, $\frac{1}{12}R$, $\frac{1}{7}R$, $\frac{1}{5}R$ $\frac{5}{14}R$, $\frac{3}{10}R$, $\frac{5}{9}R$, $\frac{10}{19}R$, $\frac{13}{9}R$, $\frac{5}{8}R$, $\frac{9}{5}R$, $\frac{7}{2}R$, and 16 R. The plane 6P2 which has been reported as occurring in the mineral, is found by more accurate measurements to be 4P2, so that up to this time 74 forms have been detected in cinnabar. The *calomel* that covers quartz and cinnabar crystals in this vein was also carefully examined by Traube.——On *tantalite* from Pisek, Bohemia, Urba[14] finds the new planes $6P_{\bar{6}}$, $3P_{\bar{3}}$, $\frac{3}{2}P\bar{\frac{3}{2}}$, $P\breve{\frac{4}{3}}$, $P_{\breve{3}}$. Good crystals of the rare mineral *parisite* (Medici-Spada's *musite*) from New Granada afford an opportunity for more complete measurements of this mineral than have heretofore been possible. Its habit is short hexagonal or columnar, with an axial ratio $a:c = 1:3.36\ 46$. Its specific gravity is 4.364.——In

[8] *Quart. Jour. Geol. Soc.*, Aug., 1889, p. 398.

[9] *Geol. Mag.*, June, 1889, p. 265.

[10] Devonshire Transactions for 1888, p. 215.

[11] *Geological Magazine*, Feb., 1890, p. 73.

[12] Ann. K. K. Naturhis. Hofmus. Wien, 1889, p. 87.

[13] *Zeits f. Kryst.*, XV., p. 563.

[14] *Zeits. f. Kryst.*, XV., p. 194.

an article on the *magnetite* of the alps Brugnatelle [15] describes crystals of this mineral from Traversella in Piedmont, Wildkreuzjoch in the Pfitschthal and Monte Mulatto and Scalotta in the Fassathal. The crystals are remarkable for their wealth of forms, of which $\frac{3}{2}O\frac{3}{2}$, $\frac{5}{3}O\frac{5}{3}$, $5O5$, $3O$, $\infty O5$, $\frac{5}{3}O\frac{5}{4}$ and $\frac{13}{9}O\frac{3}{11}$ are new to the species, and the last of these new to the system. The plane $3O\frac{3}{2}$ occurring with O and ∞O in crystals from Traversella is thought to have been developed by etching after the formation of the crystals. Natural etched figures on the ∞O faces of Rothenkcpf crystals are described in detail.——Tetrahedrally shaped crystals of *stronticenite*[16] from the phonolite of the Kaiserstuhl are hemimorphic in the direction of their *C* axes, and contain ∞P, $\infty P\breve{\infty}$ and $P\breve{\infty}$. When two or more of these hemimorphic crystals are twinned they produce forms resembling aragonite twins.—Complicated crystals of *fluorite*, with numerous vicinal planes, are mentioned by Hintze[17] as associated with the scheelite from Kiessberge in the Riesengrund, Germany.——*General.*—In his notes on some minerals from the Lizard, Eng., Mr. Teall [18] describes briefly some interesting ones. A chrome *diopside* forms with labradorite and olivine a rock mass at Coverak, Cornwall. The diopside has a green color when viewed microscopically, but is colorless in thin section. It has a diallagic parting, an extinction of 40°, and a specific gravity of 3.2. Analysis of this, of a pale *hornblende* from a gabbro-schist at Pen Voose, and of *malacolite* from the gabbro of Karakelews are given.

	SiO_2	Al_2O_3	Fe_2O_3	Cr_2O_3	FeO	MnO	CaO	MgO	Ign.
Chromic diopside	49.9	6.2	1.7	.6	3.9	.4	20.4	16.1	.9
Hornblende	48.8	10.6	1.7	tr	4.7		12.2	18.6	1.8
Malacolite	52.8	2.8	1.8				25.2	16.6	.5

Anthophyllite, from a reaction rim between olivine and feldspar at the contact of gabbro and serpentine, was separated, and its composition was found to be:

SiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	Ign
50.8	3.6	tr	2.7	6.8	1.2	26.1	.2		5.8

A new find of *corundum*, associated with andalusite, cyanite, chloritoid and mica, is reported by Genth [19] from near Stuart, Patrick Co., Va. The rock in which the minerals occur appears to be a garnetifer-

[15] *Zeits. f. Kryst.*, XIV., p. 237.

[16] Becken kamp. *Zeits. f. Kryst.*, XIV., p. 67.

[17] *Zeits. f. Kryst.*, XIV., p. 74.

[18] *Min. Magazine*, Oct., 1888, p. 116.

[19] *Min. Magazine*, Oct., 1888, p. 116.

ous and staurolitic gneiss. The andalusite is often an alterative product of the corundum. Cyanite, rhætzite and margarite pseudomorphs of *andalusite* are quite common in the rock.—Von Eterlein[20] describes a new occurrence of calcite in the Floitenthal, Tyrol. The crystals are implanted in a granitic muscovite gneiss. Those containing the basal plane have this face marked by three systems of striations, running parallel to the three edges oR, $\wedge$, R. They are thought to be due to etching. A bed of *sulphur* in the volcanic island Saba in the W. Indies contains crystals of this substance, very rich in crystal planes. Twenty-three forms have been detected upon them by Molengraff,[21] and of these four are new, viz. $3P\breve{\infty}$, 2P, 3P and $P\breve{3}$. Two crystals of *neochrysolite* from the 1631 lava stream of Vesuvius, the one with a tabular habit, and the other columnar, have been carefully measured by Scacchi,[22] who regards the mineral as very similar in all its properties to fayalite.—Analyses of *dufrenite*[23] from Cornwall correspond to the formula $3Fe_2O_3.FeO.2P_2O_5.6H_2O$, and not to $2Fe_2O_3$, P_2O_5, $3H_2O$ as is usually supposed. *Warrenite*[24] is the name proposed for the sulph-antimonate described by Eakins some time ago.

Miscellaneous.—Hutchings[25] records the discovery of a little crystal of *willemite* in a slag obtained during the fusion of lead dross. The slag contains 1½ per cent. of lead, and from 12–15 per cent. of ZnO, and it consists of fayalite, zinc, spinel and magnetite, with but a trace of amorphous base. A second run of the same furnace yielded no willemite. The slag in this case contained 5 per cent. of lead, and was in large part glassy, and in it were idiomorphic crystals of fayalite. The observations are interesting, also showing the effects produced in the structure of the cooled magma by the slight differences in the percentage of lead. Crystals of *cuprite* and *cerussite* are described by Fletcher[26] as resulting from the slow alteration of old Roman coins buried at Chester, England. The crystals line the cavities between adjacent coins, and are supposed to be due to the action of circulating alkaline waters on the metals in them.

[20] *Zeits. für Kryst.*, XIV., p. 280.

[21] *Zeits. für Kryst.*, XIV., p. 43.

[22] *Zeits. für Kryst.*, XIV., p. 293.

[23] Kinch: *Miner. Magazine*, Oct., 1888, p. 112.

[24] *Amer. Jour. Sci.*, Jan., 1890. p. 75.

[25] *Geol. Mag.*, Jan., 1890. p. 31.

[26] *Miner. Magazine*, Dec., 1887. p. 87.

BOTANY.

A New Genus of Algæ.—George Murray has recently described a curious algæ collected by Professor Moseley, the naturalist of the "Challenger expedition," on the coast of Japan. It has hitherto been considered to be a species of Cladophoro, and was described by Dickie under the name of *C. coacta.* (*Jour. Linn. Soc., Botany,* Vol. XV., p. 451). It now turns out to belong to a new genus, to which the name of Boodlea has been given. It is a net-like plant, consisting of a mass of cylindical cells, joining each other with a great deal of irregularity, so as to form a network when viewed in *any section.* The four ends of the branches are provided with curious "tenacula," and it is by these that they are joined into the complex network above mentioned.

The systematic position of Boodlea is considered by Murray to be between the jointed genus algæ (Cladophoræ, and the like) and the Siphoniæ.

The Collecting and Study of Willows.—Under this title Dr. F. Buchanan White writes as follows in the March *Journal of Botany.*

"In collecting willows it is of the utmost importance to guard against admixture of specimens. The bushes should not only be marked, but a note of their situation taken. A good method of marking is to cut Roman numerals on the the bark, but, since this is troublesome with the higher numbers, the same numbers can be repeated when the localities are distinct. To avoid confusion in the vasculum, the collector should provide himself with slips of paper (3 or 4 inches long), with a slit cut in each. On these the number of the bush and indications of its situation are written, and then the specimens thrust through the slit and placed in the vasculum. On reaching home, the number and other particulars of each bush must be entered in the note-book, and the permanent or note-book number (Arabic figures) placed opposite it. Then by means of small pieces of paper attach to each specimen its permanent number. In this way all risk of mixing specimens is reduced to a minimum. The permanent numbers of course must not—unlike the tree-marks—be used for more than one bush.

Having attached to each example its number, any particulars which can be seen more readily in the fresh than in the dried plant may be entered in the note-book. These should include the color of the leaves, twigs, stigmas, and anthers; the nature of the filaments—

whether free or more or less combined—and pubescence, if any, on them; shape of the nectary; style of the venation of the leaves, whether raised or impressed, etc. The specimens should be very carefully dried, and subjected to as much pressure as will keep the leaves from wrinkling, but not so much as to crush the catkins altogether. The leaves should be so arranged that the underside of some of them—both the old, or lower, and the younger, or upper—be shown.

The periods of growth when specimens should be taken is important. Male catkins should not be too old, but should be in full flower, and some with the pollen shed, so as to show the color of the empty anthers. Female catkins should neither be too young nor too old, and should illustrate the condition of the fully-developed stigmas. When it is possible, specimens *in fruit* should also be obtained, but not too old, as burst capsules are comparatively useless.

The leaves should not be taken till they have arrived at maturity, and not, as a general rule, before the middle of August. Young leaf-specimens are sometimes useful as supplementary examples. It is important, in taking leaf-specimens, to secure side-branches as well as shoots, since the character of the leaves on these is often different.

In collecting willows every bush should be examined, not only when in flower, but when in leaf, and, if there is the least doubt about the species, specimens taken. Where more than one species grows together, a sharp look-out should be kept for hybrids, but hybrid forms occasionally occur at some distance from either of their parents. This may happen by the transmission of the seeds by wind or water, or by the parent bush, cross-fertilized by insect-agency, having died out. In looking for hybrids it must be remembered that frequently they do not show exactly intermediate characters, but often bear a close resemblance to one or other of the parent species. Such forms can be detected only by careful study, and an intimate acquaintance with specific characters."

ZOOLOGY.

The Fauna of the Mississippi Bottoms.—The Illinois State Laboratory of Natural History is engaged in a study of the aquatic animals of the state. A contribution to a knowledge of these is given by Prof. H. Garman in a recent publication from the laboratory.[1] When the region was studied the river was high, and hence many forms were lacking which might have been found at low water. An astonishing feature was the great rarity of Batrachia. There was an interesting commingling of lake and river fishes in the sloughs. Garman thinks some of the Unionidæ act as scavengers. Notes are given on the various forms of vertebrates and invertebrates collected by the survey, but some groups are scarcely touched upon, while forms as prominent as the Crustacea are not mentioned in the Report.

Neomenoidea.—Hansen has had abundant material for the study of these interesting molluscs and recognises[2] three species of Neomenia and six of Proneomenia, *P. filiformis* being new. Hubrecht's definition of the latter genus must be modified, for Hansen finds in two species a well developed penis on either side. The same forms show no well developed filiform branchiæ as in Neomenia, but in the "anal cavity" are well developed epithelial folds which are regarded as functional gills and the anal cavity of Hubrecht is called a branchial cavity. Hansen further describes the various organs in both genera mentioned above and also in Chætoderma. In Proneomenia as in Chætoderma the eggs pass through the pericardium, passing thence by a canal on either side into which the vitellaria empty. The blood in the living animals is red, but it was not settled whether the color belongs to the round or oval nucleated corpuscles or to the serum.

The Classification of the Lamellibranchs.—Dr. W. H. Dall[3] has attacked this perennial problem from the characters afforded by the hinge. In many respects he is in accordance with Neumayr.[4] In short he recognises three types of hinge, although these may intergrade. The most archaic, the lack of teeth in the hinge is made to characterize

[1] Preliminary Report on the animals of the waters of the Mississippi Bottoms, near Quincy, Ill., 1889.

[2] Bergens Museums Aarsberetning for 1888 [1889.]

[3] *Am. Jour. Sci. & Arts*, XXXVIII., Dec., 1889.

[4] Stz. k. Akad. Wiss, Wien., Math. Nat., Cl. I., Bd. 88. 1883.

the order Anomalodesmacea containing the sub-orders Solenomyacea, Anatinacea, Myacea, Eusiphonacea, and Adesmacea. The prionodont type has the hinge with teeth transverse to the long axis of the shell and is characteristic of the order Prionodesmacea with the sub-orders Nuculacea, Arcacea, Naiadacea, Trigonacea, Mytilacea, Pectinacea, Anomiacea, Ostracea. A pure orthodont type of hinge hardly exists. In this the hinge should be longitudinally plicate. Usually however it is combined with the prionodont type. This mixed condition finds exemplification in the order Teleodesmacea embracing the sub-orders Tellinacea, Solenacea, Mactracea, Carditacea, Cardiacea, Chamacea (? Rudistes), Trinacreacea, (?) Leptonacea, Lucinacea, (?) Isocardiacea, Veneracea. A classification of this sort is convenient, but it seems to the present writer no more satisfactory than its predecessors, based as it is on the characters of a single structure. Adequate reasons for the substitution of the Goldfussian name Pelecypoda for the more familiar Lamellibranchiata and Acephala are not apparent, although Dr. Dall is in good company in this respect.

A Remarkable Crustacean.—Dr. G. H. Flower describes [5] under the name *Petrarca bathyactidis*, a parasitic crustacean found in the abyssal anthozoan, *Bathyactis symmetrica*. The animal is nearly spherical, 1.5 to 1.8 mm in diameter, and has much of the general structure of a Lepas without the peduncle. The penis is bent foward under the thorax, the legs are reduced, and the mantle is without calcareous plates. The appendages consist of a pair of preoral antennæ, a pair of weak mandibles lying in an oral cone, and six pairs of postoral (thoracic) appendages which are not biramose. The alimentary canal consists of three median cæcal portions (there being no anus) and the paired hepatopancreas. The nervous system is extremely reduced and is not divided into ganglia. The annual is hermaphroditic. No sense organs were recognised. Petrarca is regarded as closely allied to Laura and Synagoga, and all are placed in the group Ascothoracida. This group is regarded in many respects as intermediate between the Ostracoda and the Cirripedia, Petrarca leaving the main stem later than its associates.

Anatomy of Polyxenus.—Heathcote has studied [6] some points in the structure of this interesting Myriapod. The account of the external genitalia given by Latzel is confirmed. Two Malpighian tubes occur bound to the rectum by a common membrane. The nerve

[5] *Quarterly Jour. Micros-Sci.*, XXX., 1889.

[6] *Quart. Jour. Micros. Sci.*, XXX., 1889.

cord is more like that of Chilopods than that of any other Chilognath; the eye has a lens approximating that of Scutigera, the hypodermis cells forming a sort of diaphragm, and the crystalline cone cells being arranged in groups. Heathcote concludes that Polyxenus has preserved traces in its anatomy of descent from the common ancestor of both Chilopods and Chilognaths, "such ancestor being related to the Archipolipoda" [*sic.*] He also regards the Myriapods as having a Peripatus-like rather than a Thysanuran ancestor.

The Position of the Cæcilians.—Dr. P. Sarasin gives[7] a brief résumé of the work done by himself and his brother upon the development of *Ichthyophis glutinosus*. The embryos pass through stages which are clearly to be regarded as Perennibranchiate, and Derotreme stages, Sarasin fully recognizing the similarity between the embryos of Amphiuma and Ichthyophis first pointed out by Ryder. In short the result is that the Cæcilians are to be regarded not as a distinct Batrachian order, but in reality as apodous Urodeles. Although the development of the Perennibranchiate will show the affinities of the Batrachia better, the Sarasins recognise Ganoid relationships in the fact that the young Cæcilian has a spiral valve, while in the ear a condition of the ductus endolymphaticus is transitory which is permanent in the Ganoids. On the other hand Reptilian affinities are recognised in the large yolked egg, in the great ossification and extensive articulation of the skull, the condition of the brain, the two aortic arches, a Jacobson's organ of the Reptilian type. The Stegocephali are regarded as highly important in the line of phylogeny.

The Dolphins.—Mr. F. W. True has recently reviewed the Dolphins of the world.[8] He has studied not only the collections of the United States but also those of the chief museums of England, Paris, Leyden and Louvain. The result is, that many forms previously regarded as distinct are merged in synonymy, and for the whole world but sixty-two species are recognized, arranged in the genera Sotalia, Steno, Tursiops, Delphinus, Prodelphinus, Tursio, Lagenorhynchus, Sagmatias, Feresa, Cephalorhynchus, Neomeris, Phocæna, Orcella, Grampus, Globiocephalus, Pseudorca, Orca, Delphinapterus, and Monodon. The genus Pontoporia is not regarded as belonging to the family Delphinidæ. The whole work is accompanied by two keys, one based upon external, the other upon cranial characters. The North American species recognized are as follows:—*Sotalia tucuxi* (? Florida),

[7] *Verhandl. anat. Gesellsch. a. d. 3 Versamml.*, 1889.

[8] Bulletin U. S. Nat. Mus. No. 36. 1889.

Tursiops tursio, T. gillii, Delphinus delphis, Prodelphinus euphrosyne, P. plagiodon, P. longirostris, Tursio borealis, Lagenorhynchus acutus, L. albirostris, L. obliquidens, L. thicolea, Phocæna communis, Ph. dallii, Grampus griseus, Globiocephalus melas, G. brachypterus, G. scammoni, Delphinapterus leucas, and *Monodon monoceraus.* Probably the above list will be extended, as these forms are largely cosmopolitan in their distribution.

The Relationship of the Genus Dirochelys.—This tortoise was for the first time described by Latreille, from manuscript notes and drawings of Bosc, under the name of *Testudo reticularia;* the year after, Daudin described it as *T. reticulata.* Agassiz established the genus Dirochelys for the tortoise, but he did not give any characters. He placed it in a sub-family of the Emydinidæ under the name of Dirochelyoidæ (Agass., Cont. N. H. U. S., p 441). Boulenger (Cat. Tort., p. 75) considers it a species of Chrysemys, and places it between *Chr. dorsalia* Ag. and *Chr. troostii* Holb.

For a long time I knew only shells of this species. They at once proved the generic distinction from Chrysemys. The neurals were broader than long, a condition never found in Chrysemys; besides, the rib-heads were enormously long, very much like those in Chelydra and *Emys blandingii* Holb.

It was only a short time ago that I could examine the skull of a specimen in the Smithsonian Institution through the kindness of Dr. L. Stejneger and Mr. F. A. Lucas.

The skull resembles very much that of *E. blandingii.* It has the same lower jaw, the same long postorbital part of the head, and the alveolar surface without median ridge. The interorbital space is still narrower, than in *E. blandingii,* forming less than one-half the diameter of the orbit. A comparison between *Emys orbicularis* L.; *Emys blandingii* Holb., and *Dirochelys reticularia* Latr., shows that all three belong to different genera, and that Dirochelys is very much nearer to *E. blandingii* than to *E. europæa.*

I give now the generic characters of these three forms.

Emys Dum.

Frontals excluded from orbit; plastron united to carapace by ligament, and more or less distinctly divided in the adult into two lobes between hyo- and hypoplastra; entoplastron intersected by the humero-pectoral suture. Rib-heads short as in Clemmys.

Type, *Emys orbicularia,* L.

Emydoidea, Gray (name only.)

Frontals not excluded from orbit; plastron united to carapace by ligament, and more or less distinctly divided in the adult into two lobes between hyo- and hypoplastra; entoplastron not intersected by the humero-pectoral suture. Rib-heads very long, as in Chelydra.

Type, *Emydoidea blandingii*, Holb. Deirochelys Ag. (name only.)

Dirochelys Ag.

Frontals not excluded from orbit; plastron united to carapace by suture, not divided into movable lobes; entoplastron not intersected by the humero-pectoral suture. Rib-heads very long, as in Chelydra.

Type: *Dirochelys reticularia*, Latr. Clemmys is in the same relation to Emys, as Dirochelys to Emydoidea.

It is clear that Emys has developed from Clemmys and Emydoidea from Dirochelys; the ligamentous connection between plastron and carapace is secondary.—*G. Baur.*

Habitat of Xantusia riversiana Cope.—The locality from whence the specimen came that Prof. E. D. Cope described has not hitherto been recorded; and I now add that information. It was found upon San Nicolas Island, the westward island of the Santa Barbara group California. I have recently received some examples of this lizard from Catalina Island, a larger island of the same group. The lizards contrast in size as do the islands, the larger lizards from the larger island.—J. J. RIVERS, *University of California, April* 24th, *1890.*

Zoological News.—General.—Students who wish to understand the present stage of the study of cell division and its relations to impregnation, heredity, etc., will find an admirable résumé by Waldeyer translated in the *Quarterly Journal of Microscopical Science* for July and December, 1889. It being itself a summary, no abstract can do it justice.

Cœlenterata.—In the Bergens Museums *Aarsberetning* for 1888 [1889], Dr. D. C. Danielssen gives an anatomical description of *Cerianthus borealis*, which he recognizes as destinct from *C. lloydii.*

Fisher[9] states that in Cerianthus the number of tentacles is always odd, the unpaired tentacles being on the ventral side.

Echinoderms.—In a list of invertebrates of the Western fiords of Norway[10] Grieg describes and figures as new *Cucumaria mosterensis.*

[9] Bull. Zool. Soc. France, XIV.

[10] *Bergens Museums Aarsberet.* for 1888 [1889.]

In connection with the recent paper by Fewkes in these pages upon the boring of sea urchins, the reader is refered to an article by G. John[11] in which it is maintained that the teeth form the chief boring apparaatus, aided to a slight extent by the spines.

As has long been suspected the saccular diverticula of the starfish are not hepatic, but pancreatic in their function. Griffith and Johnstone[12] have studied them chemically, and find that the secretion is closely similar to that of the vertebrate pancreas.

Vertebrates.—Grieg[13] gives a detailed description of *Lagenorhynchus albirostris*, with a plate, a copy of a photograph.

Dr. Shufeldt gives a review of the work done in the Anatomy of birds during the years 1888–89.[14] The American workers are few, F. A. Lucas and Dr. Shufeldt being the only ones mentioned.

ENTOMOLOGY.[1]

Myrmecophilous Insects.—Herr E. Wassmann continues his interesting investigations on the life of myrmecophilous beetles and their relations to the ants. He distinguishes: (1) true guests which are cared for and fed by the ants (Atemeles, Somechusa, Claviger); (2) forms which are tolerated but are not treated with special friendliness, and which feed on dead ants or rotting vegetable material (Dinarda, Hæterius, Formicoxenus, etc.); (3) ant-eating species, pursued as enemies, or only tolerated as a matter of necessity (Myrmedonia, *Quedius brevis*, etc.), to which may be added parasites like Phora. The three sets are not rigidly separable.

Atemeles and Somechusa have taken on some of the habits of their hosts, and are more adopted than other myrmecophilous insects. The best known species of Atemeles (*A. paradoxus* and *A. marginatus*) are found most frequently in the nests of Myrmica, more rarely in those of Formica and others. On the contrary, *A. pubicollis* seems to be more frequent in Formica nests. The species of Atemeles are lively animals,

[11] *Archiv für Naturgesch.*, lv.

[12] Proc. Roy. Soc. Edinburgh, XV.

[13] *Bergens Museums Aarsberetning* for 1888 [1889.]

[14] *Jour. Comp. Med. and Veterinary Archives*, 1890.

[1] This department is edited by Clarence M. Weed, Agricultural Experiment Station, Columbus, O.

constantly moving their feelers, and experimenting with everything. If one be attacked by a hostile ant, it first seeks to pacify its antagonist by antennary caresses, but if this is unavailing it emits a strong odor which appears to narcotize the ant. Wassmann describes how the ants feed the Atemeles, and are caressed and licked for their care; how one Atemeles feeds another, or even as a rarity one of the hosts. Yet the beetles feed independently on sweet things, dead insects, and even the unprotected young of the ants. The guests are licked and cleaned by the hosts, as well as *vice versâ;* but the beetles are in reality quite dependent upon the ants.

As to Somechusa, it is represented in Central Europe by a single species, *S. strumosa,* which is almost always found with *Formica sanguinea,* though occasionally with other forms. This beetle is much larger, plumper, and more helpless than Atemeles; its odor is different and very like formic acid; its relations to the hosts are more passive, yet it can feed independently, for instance, on the larvæ and pupæ of the ants.

The other guests are rather pests than pets. They almost all live on animal food, are often protected simply by prestige or by their odor. The minute Oligota, *Homalota talpa*, Myrmecoxenus, Monotoma, Histeridæ, the small guest-ant Formicoxenus in the nests of *Formica rufa*, etc., appear to escape unnoticed.

On a change of abode, the myrmecophilus insects follow their guests, or, as in the case of Somechusa and Atemeles, they are taken with them by force. While the ants themselves are well known to be very exclusive, the guests can be shifted from nest to nest or even from species to species. As Wassmann says, the guests seem to have "international relations."

In commenting upon the above facts, Prof. Emery regards it as certain that the semi-domesticated, and in one sense parasitic, forms like Atemeles and Somechusa, are descended from thievish forms. They retain some of the original traits, just as dogs and cats do in their recently acquired tamed state.—*Journal Royal Microscopical Society.*

A New Harvest-Spider.—In a lot of material collected in Warren county, Ohio, during the summer of 1889, I find a single female specimen of an undescribed species of *Oligolophus*, a genus of Phalangiinæ of which we have as yet recorded for the North American fauna but a single representative—*O. pictus* (Wood). This latter differs greatly from the one under consideration, for which the specific name

PLATE XLII.

Fig. 1.

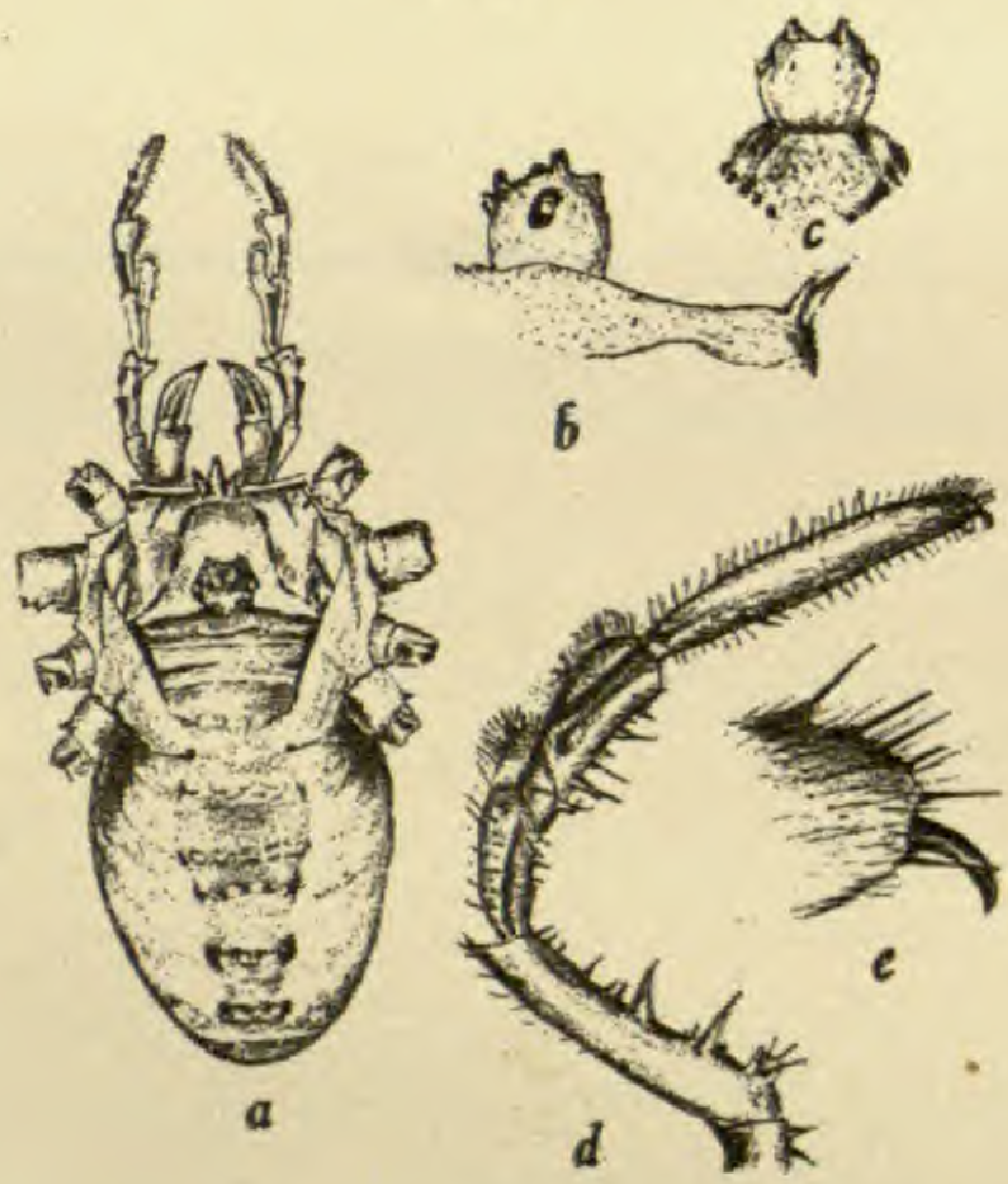


Fig. 2.

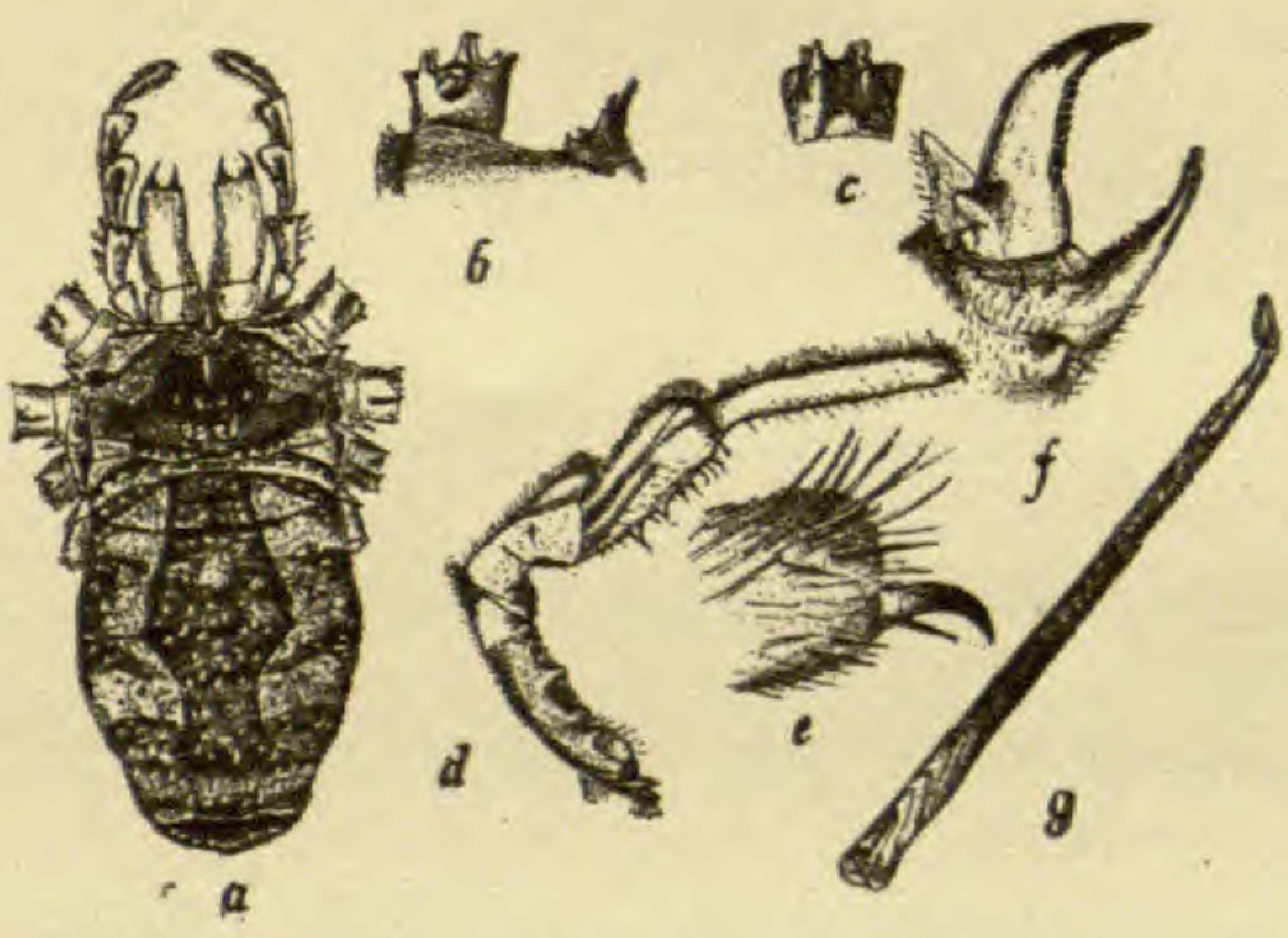


Fig. 3.

Oligolophus ohioensis and O. pictus.

ohioensis is proposed, both in general appearance and structural details, as will be seen by comparing Fig. 2 of Plate——, which represents the structural characters of the new species, with Fig. 3 of the same plate, representing the structural details of *O. pictus*. The description is as follows:

Oligolophus ohioensis, n. sp. Plate, Fig. 1 and 2.

FEMALE.

Body 6 mm. long; 3.5 mm. wide. Legs: I., 8 mm.; II., 20 mm.; III., 15 mm.; IV., 10 mm.

Dorsum of a peculiar glossy gray, very different from that of any other harvest-spider I have seen. Central marking indistinct, shown mostly by stripes at outer margins: beginning at anterior lateral angles of cephalothorax two faint blackish stripes run obliquely back and toward the middle to the anterior border of the abdomen (forming a truncate V) and then run parallel to each other two-thirds of the distance to the posterior extremity, although they are nearly obsolete on the anterior third of the abdomen. Dorsum of cephalothorax free from tubercles except on margins, but having many minute brownish granules. Dorsum of abdomen with numerous very minute pits scattered over its entire surface; and an indistinct transverse row of small whitish tubercles, tipped with very minute dark spines, on each segment. Division between the cephalothorax and abdomen almost obsolete, and segmentation of anterior abdominal segments wholly so. Anterior margin of cephalothorax nearly straight; lateral angles slightly produced, each having a small black spine; three prominent, acute, grayish tubercles on middle of anterior margin, each tipped with a minute black spine, the middle one being twice as large as those on the side, and also slightly in front of them. Eye eminence prominent, constricted at base; grayish, except a dark spot about each eye; canaliculate, and having on each carina a row of four prominent conical, grayish tubercles, each terminating in a minute black spine; eyes small. Mandibles light brown, claws tipped with black; dorsal surface of second joint furnished short black hairs. Palpi mottled: ventral surface of femur with numerous white, elongate-conical tubercles, each tipped with a prominent black spine; dorsal surface furnished with numerous black spinose hairs, many of which are tipped with white. Patella short, with its inner lateral distal angle much prolonged (almost equalling the patella in length), the whole inner lateral surface being thickly set with strong spines, which are black tipped with white; a few smaller spines on its dorsal surface.

Tibia slightly longer than patella, its inner lateral distal angle slightly prolonged, and its inner lateral surface provided with spines like those on the patella; its dorsal and lateral surfaces also having smaller and sparser spines, and its ventral surface being provided with a few whitish conical tubercles tipped with black spines. Tarsus furnished with many rows of rather long, black, stiff hairs; and having two very small black tubercles at the base of the well-developed claw. Ventrum light gray, hispid. Legs very short, robust, pinkish: coxæ light gray with a slight pink tinge, provided with rather long stiff black hairs, on elevated whitish bases; trochanters tuberculate, light gray with a pink tinge; remaining joints pinkish, all except tarse having longitudinal rows of small black spines.

The pink legs, prolonged patella, and light gray color at once distinguish this species from *O. pictus*. CLARENCE M. WEED.

EXPLANATION OF PLATE.

FIG. 1. *Oligolophus ohioensis*, n. sp. Female. Natural size.

FIG. 2. Structural details of same magnified. *a*, Body; *b*, Eye eminence, side view; *c*, Eye eminence, front view; *d*, Palpus, side view; *e*, Claw of palpus.

FIG. 3. *Oligolophus pictus* (Wood). Male. Structural details magnified. *a*, Body; *b*, Eye eminence, side view; *c*, Eye eminence, front view; *d*, Palpus, side view; *e*, Claw of palpus; *f*, Claws of mandibles, side view; *g*, Genital organ.

Entomology in Illinois.—Two more volumes have lately been added to the valuable series of the Reports of the State Entomologists of Illinois. These are the Fifteenth and Sixteenth Reports, the first covering the years 1885 and 1886, and the latter 1887 and 1888. The late appearance of these volumes is due to a series of mishaps to which publications dependent on State printers are always liable, but which in this case have been peculiarly unfortunate; although Professor Forbes has gotten over the difficulty to a large extent, by the publication of the more important articles in bulletin form. These include the articles concerning arsenical poisons for the Codling Moth, and the life history of the Hessian fly of the Fifteenth Report, and the Studies on the Chinch Bug of the Sixteenth. Among the discussions now first published, the more important occur in the Sixteenth Report, and include the following subjects: The Corn Bill Bugs; The Meadow Maggots or Leather-Jackets; Notes on Cutworms; The Burrowing Web Worm; and an elaborate Economic Bibliography of the Chinch Bug, embracing the years 1785 to 1888, and covering 122 printed pages.

This report is illustrated by six magnificent Heliotype plates, made from drawings by Mrs. A. M. Westergren. Ten species of *Sphenophorus* and nine species of cut-worms are figured. It is needless to say that the character of these reports renders them indispensable to every working entomologist.—*C. M. W.*

Observations on the Plum Curculio.—In a paper read before the Iowa Academy of Sciences, and reported in the proceedings, Prof. C. P. Gillette concludes that the Plum Curculio is not wholly or even largely double-brooded, at Ames, Iowa. The following observations are recorded: Egg-laying began about May 25th, and practically ceased by the last of June. Eggs began to be deposited in considerable numbers about July 20th. Unhatched eggs were found constantly from July 22d to August 22d. The number of eggs laid after July 20th on trees, where counts were made, was over one-fifth as great as the number laid before that date. The beetles reared from early-stung plums began appearing in the breeding cages as early as July 22d. Beetles were seen pairing July 22d. The eggs of late punctures hatch as well as any, and the larvæ develop in the plums.

The Corn Root Louse.—In the fifteenth report of the State Entomologist of Illinois, Professor Forbes reports that the winter history of this species has been made out for the first time. "The eggs are collected from the ground in autumn by the common brown ant, *Lasius alienus*. Early in the spring, before corn is planted, the young lice, as they hatch, are placed on the roots of 'pigeon grass' (*Setaria*), smartweed (*Polygonum*), and possibly some other weeeds, and are reared there until the field is planted to corn—if this be done—when they attack the corn-roots, or the subterranean part of the stem. If the field is planted to some other crop, the young lice mature on the grass-roots, and produce a second brood, many of which acquire wings about the middle of May, and then disperse. Later they seem to abandon the grasses entirely." In the sixteenth report of the same series, Professor Forbes speaks of this root louse as *Aphis maidis?* Fitch. The interrogation point apparently indicates a doubt in the author's mind as to the identity of the root and aerial forms of the Aphis infesting corn,—an identity which has been heretofore assumed by nearly all writers upon the subject, with very little reason for so doing.

The conclusions above quoted, which rest upon positive observations made in the field through several seasons, are entirely different from those reached by Mr. F. M. Webster, from observations largely of a negative character, and recorded in the report of the United States Department of Agriculture for 1887 (p. 149), as follows: "These observations led me to conclude that the corn plant louse does not live over winter in the fields, nor are the eggs deposited about the corn in the fall, but that they are deposited about the roots of some other plant, most likely one of the grasses."

Our Injurious Ægerians.—In a paper with this title, recently read before the Columbus (Ohio) Horticultural Society, Professor D. S. Kellicott made the following introductory remarks, which are worthy of a wider circulation than they received in the journal of the Society in which the paper has been published in connection with the accompanying plate.

There is perhaps no family of Lepidoptera possessing more points of interest to the student than the Ægeridæ. It is separated from families placed next to it by hard and fast lines. The Sphingidæ, or hawk-moths, on one hand, are large, thick-bodied moths flying at twilight; their larvæ are foliage feeders, having a characteristic acute caudal horn on the last ring; whilst the Ægerians are all numbered among the small moths; their bodies are slender; they fly only by day, often in the brightest sunshine, in which many of them delight; their larvæ, so far as known, are borers; the caudal horn is absent, and in consequence of their mining habits their color is not variegated as is the case of larvæ of Sphinges. On the other hand, the family is as clearly distinct from the Thyridæ and Zygenidæ.

The unusual interest in the group then begins on account of its trenchant character; it is continued in view of the great beauty of the species, and beauty ought not to be ignored—it is not, even by the traditionally bloodless specialists; again, their natural history is full of suggestions, especially the remarkable protective mimicry exhibited by all or nearly all species. Moreover, many of the larvæ are harmful to farm and garden products, or to ornamental shrubs and trees; a few are real pests.

The ægerian moths are charming objects. Their graceful, delicate forms and rich coloration are scarcely surpassed by any of nature's countless objects of fine beauty. Steel-blue, red, orange, and golden are prevailing colors; several of these, always harmoniously blended, often constitute the ornamentation as well as the protection of a single individual.

Their close resemblance to insects of very different colors was observed long before the significance of protective mimicry was understood. Nowhere among insects may be found better examples of this principle than in this group. The majority mimic bees and wasps, particularly the latter. We all know, and most insect-destroying animals know, that wasps hold out strong and pointed inducements for being left alone; surely the wide-spread knowledge of their armament, and their disposition to use it, prevents many rash attacks, and secures them practical immunity from a host of enemies. Now, the defenceless ægerians have, in some way, come to so closely resemble these batteries of potential energy and poison, that the practiced eye of the collector is often deceived; in consequence, these delicate moths, incapable of offense or defense except by flight, are allowed to pass without the destructive attention accorded to most conspicuous Lepidoptera by entomologically inclined birds and others.

This mimicry is more than a superficial resemblance; it is deeper and more substantial. Let us specify: first, the long, narrow wings, which are so often more or less hyaline and veined, are close imitations of those of the Hymenoptera; again, the steel-blue wings and bodies recall well-known wasps; third, the transversely marked or ringed bodies of many afford another mark of resemblance; fourth, when captured or disturbed, their sounds and attitudes are striking imitations of those of wasps; fifth, they fly about and rest on flowers in a manner quite similar to bees; and sixth, when captured some species at least give off the characteristic odor of the hornet.

It is scarcely possible that all these particulars are mere accidental coincidences, or that they are due to a common ancestry. It seems more rational to believe that the protection thus afforded gave direction to natural selection in the evolution of the present forms.

It was remarked above that ægerian larvæ are universally borers. But in the choice of food-plants there is the widest diversity; some bore through and devour solid woods as do the larvæ of the cossids; some prefer the pith of woody stems; others are found in the superficial woody layers; still others corrode the roots of plants, both woody and herbaceous, or herbaceous stems. These differences in taste, and the consequent variety of habits, suggest the interesting question of the duration of their larval period. The wood-boring larvæ of several species of Lepidoptera are known to require several years to reach maturity. For example: in June, 1885, I placed eggs of *Cossus robiniæ* in wounds made in the bark of an unaffected common locust; the caterpillars hatching therefrom were seen to bore beneath the bark, and in June, 1888, at least one imago issued from the same place. I have strong evidence that *Hepialus argenteomaculatus* also lives three years in the stems of *Alnus incana* and unmistakable proof that the ægerian which bores the pine tree has a similar period.

The number of North American species known to science has been remarkably increased of late. Of the one hundred and forty species, more or less. Mr. Henry Edwards has described a large majority during the last decade. Other species were made known by Harris, Walker, Westwood, Grote, and other well known specialists. The life history of comparatively few of these species is known. Dr. Harris, who did so much as a pioneer of American entomology, especially for its practical or economic application, published the first accounts of the natural history of these beautiful and destructive forms. Since his publications the details in the life of several others have been made known.

EXPLANATION OF PLATE XLIII.

The drawings from which the engravings were made were prepared by Miss Freda Detmers, of the Division of Entomology and Botany of the Ohio Agricultural Experiment Station. All the figures are twice natural size.

Fig. 1. Peach Tree Borer, *Sannina exitiosa*, male.
Fig. 2. Peach Tree Borer, *Sannina exitiosa*, female.
Fig. 3. Pear Tree Borer, *Ægeria pyri*, male.
Fig. 4. Imported Currant Borer, *Ægeria tipuliformis*, male.
Fig. 5. Maple Tree Borer, *Ægeria acerni*, female.
Fig. 6. *Ægeria lustrans*, male.
Fig. 7. Plum Tree Borer, *Ægeria pictipes*, male.

Entomological News.—Mr. Wm. H. Ashmead is engaged upon a monograph of the Braconidæ of North America, which he hopes to complete before starting on a proposed trip to Europe. In a recent letter he states that he has recognized in the material on hand all the Försterian genera of the subfamily *Microgastrinæ*, and has three distinct species of the genus *Mirax*. . . . Mr. E. A. Schwarz has distributed his recent address as president of the Entomological Society of Washington. It is entitled "On the Coleoptera common to North America and other Countries." "The simultaneous occurrence of identical species in regions separated by wide stretches of ocean, or other great natural boundaries, can only be explained, 1st, by *Natural Dispersion;* or, 2d, by the *Agency of Man.* The author further divides the subject by including under the first heading "*a*, The circumpolar fauna; *b*, Species not belonging to the circumpolar fauna, probably of intratropical origin, which have spread into the temperate zone; *c*, Migratory species;" and under the second heading including "*d*, Intentional introductions; *e*, Non-intentional introductions; and *f*, Non-intentional importations. . . . A number of interesting entomological papers have lately been published in the Proceedings of the Iowa Academy of Sciences, by Professors Herbert Osborn and C. P. Gillette. . . . Professor A. J. Cook has published in a recent Bulletin of the Michigan Experiment Station an excellent discussion of insecticides. . . . Professor L. A. Forbes and his assistants have been engaged for some time in a study of the Aquatic life of Illinois; and the first of a series of papers upon the subject has lately been distributed from the Illinois State Laboratory of Natural History. It is a descriptive catalogue of the animals of the Mississippi Bottoms near Quincy, Illinois, by Prof. H. Garman, formerly of the Laboratory force, but now entomologist of the Kentucky Experiment Station.

Parasitic Castration of Typlocybæ.[1]—M. A. Giard gives an account of his observations on the parasitic castration of Typlocybe by the hymenopterous larva *Aphelopus melaleucus*, and the dipterous larva *Ateleneura spuria*. Like their hosts these insects have two generations in a year. The researches of Mr. James Edwards show that what, in a previous note, M. Giard called *T. rosæ* L. should be distinguished into *T. hippocastani* J. Edw. and *T. douglasi* J. Edw. Aphelopus usually attacks the former and Atelenevra the latter. Parasitism by Aphelopus generally causes the ovipositor to be much reduced, and incapable of penetration, but Ateleneura seems to have much less influence. The penis, on parasitic castration, undergoes considerable reductions, and the specific character is greatly modified.—*Journal Royal Microscopical Society*.

SCIENTIFIC NEWS.

The Hayden gold medal for the advancement of geology, which is the gift of the widow of the late Prof. P. V. Hayden, has just been awarded by a committee of the Academy of Natural Sciences to Jas. Hall of Albany, N. Y. The Hayden medal fund amounts to $2,500, and from the interest a medal valued at $130 is to be presented annually to the person who has done the most during the year for the science which was Prof. Hayden's specialty. The award is in the hands of the Academy of Natural Sciences, and the committee consists of Profs. Frazer, Lesley, and Heilprin.

[1] Comptes Rendus, c. IX. (1889), pp. 708–710.

The Tokio Zoological Society has begun the publication of the *Zoological Magazine*, a popular journal in the Japanese language. We understand that it is not the intention to publish in it original contributions to science, but rather popular résumés of scientific work.

The annual report of the Essex Institute at Salem, Mass., makes a good showing. The library has been increased by 11,397 volumes and pamphlets, while the regular income amounts to $4,288 ; of which over $1,000 was expended for printing.

With the October number *The Microscope* has a change of publisher and editor. It is now in the editorial charge of Dr. Alfred C. Stokes, of Trenton, N. J., while "The Microscope Publishing Company," of 145 North Greene Street, Trenton, N. J., has charge of its business affairs.

A party under Professor Angelo Heilprin, recently left for Mexico to explore the volcanic belt stretching across the lowlands from the Gulf to the Pacific Coast. The expedition is sent out under the auspices of the Academy of Natural Sciences, of Philadelphia.

Dr. William Patten has been appointed Professor of Biology in the University of North Dakota, at Grand Forks, North Dakota.

Wassili Uljanin, the well-known embryologist, died at Warsaw, February 5th, in his 49th year.

Philip Stöhr, formerly of Würzburg, has been called to the professorship of anatomy at the University of Zurich.

Dr. Drasch, privat-docent in Leipzig, has been called to the University of Graz, as professor extraordinary of histology and embryology.

Dr. J. Worm-Müller, professor of physiology in the University of Christiania, died of pneumonia, January 11th, aged 54.

Dr. F. G. Gade is demonstrator of microscopy in the University of Christiania.

PLATE XLIII.

Aegerian Moths.

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